(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 293 471 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
14.03.2018 Bulletin 2018/11

(51) Int Cl.:
F25B 43/00 *(2006.01)*

(21) Application number: **17182729.8**

(22) Date of filing: **24.07.2017**

(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
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **17.08.2016 JP 2016159880**

(71) Applicant: **Fujikoki Corporation**
Tokyo 158-0082 (JP)

(72) Inventor: **HOSOKAWA, Kouji**
Setagaya-ku, Tokyo 158-0082 (JP)

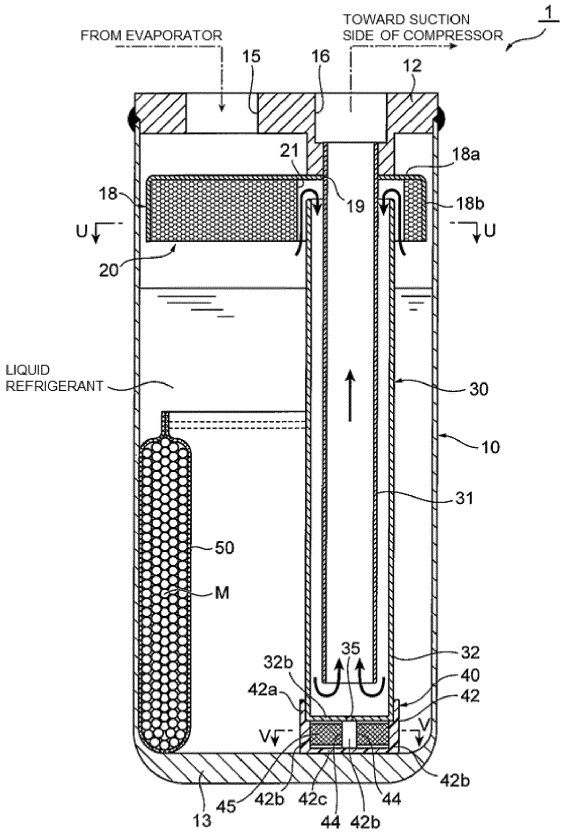
(74) Representative: **Schweiger, Martin**
Schweiger & Partners
Intellectual Property Law Firm
Elsenheimer Strasse 1
80687 München (DE)

(54) ACCUMULATOR

(57) [Object] To provide an accumulator capable of effectively suppressing a shock sound accompanied by bumping during a start-up of a compressor without causing complexity, high cost, large size, and the like.

[Solving Means] In order to reduce a shock applied to a gas-liquid separator 18 in the event of bumping, a rear surface of the gas-liquid separator 18 is provided with a shock absorbing member 20 formed of a porous body or an elastic body.

FIG. 1



EP 3 293 471 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an accumulator (a gas-liquid separator) which is used in a heat pump type refrigeration cycle (hereinafter, referred to as a heat pump system) such as a car air conditioner, a room air conditioner, and a freezer.

BACKGROUND ART

[0002] Generally, a heat pump system 200 constituting a car air conditioner or the like includes an accumulator 250 in addition to a compressor 210, an outdoor heat exchanger 220, an indoor heat exchanger 230, an expansion valve 260, a four-way switching valve 240, and the like as illustrated in Figs. 11 (A) and 11 (B).

[0003] In such a system 200, a cooling operation and a heating operation (flow paths) are switched by the four-way switching valve 240. In the cooling operation, a refrigerant is circulated according to a cycle illustrated in Fig. 11 (A). At this time, the outdoor heat exchanger 220 serves as a condenser and the indoor heat exchanger 230 serves as an evaporator. Meanwhile, in the heating operation, a refrigerant is circulated according to a cycle illustrated in Fig. 11 (B). At this time, the outdoor heat exchanger 220 serves as an evaporator and the indoor heat exchanger 230 serves as a condenser. In any operation, a low-temperature and low-pressure gas-liquid-phase refrigerant is introduced from the evaporator (the indoor heat exchanger 230 or the outdoor heat exchanger 220) to the accumulator 250 via the four-way switching valve 240.

[0004] As the accumulator 250, as disclosed in, for example, Patent Document 1 and the like, there is known an accumulator including: a bottomed cylindrical tank of which an upper surface opening is air-tightly blocked by a lid member provided with an inflow port and an outflow port, a cap-shaped or inverted thin bowl shaped gas-liquid separator which has a diameter smaller than the inner diameter of the tank, an outflow pipe which is suspended while an upper end portion is connected to the outflow port and has a double pipe structure including an inner pipe and an outer pipe, a strainer which is provided in the vicinity of a bottom portion of (the outer pipe of) the outflow pipe and captures and removes a foreign material contained in a liquid-phase refrigerant and oil (refrigeration oil) mixed with the liquid-phase refrigerant, and the like.

[0005] The refrigerant which is introduced into the accumulator 250 collides with the gas-liquid separator to be diffused radially and is separated into a liquid-phase refrigerant and a gas-phase refrigerant. Here, the liquid-phase refrigerant (including oil) flows down along the inner peripheral surface of the tank to be accumulated in the lower portion of the tank. Then, the gas-phase refrigerant moves down in a space (a gas-phase refrigerant lower flow path) formed between the inner pipe and the outer pipe of the outflow pipe, moves up in a space inside the inner pipe, and is sucked to the suction side of the compressor 210 to be circulated.

[0006] Further, the oil which is accumulated in the lower side of the tank along with the liquid-phase refrigerant moves toward the bottom portion of the tank due to a difference in specific gravity or property with respect to the liquid-phase refrigerant, is sucked to the gas-phase refrigerant sucked to the suction side of the compressor via the outflow pipe, and is returned to the suction side of the compressor along with the gas-phase refrigerant while passing through (the mesh filter of) the strainer, the oil return hole formed in the bottom portion of the outflow pipe (the outer pipe), and the space inside the inner pipe of the outflow pipe to be circulated (see Patent Documents 2 and 3).

[0007] Incidentally, the liquid-phase refrigerant including oil is accumulated at the lower side of the tank of the accumulator when the operation of the system (the compressor) is stopped. However, when oil which is not compatible with the refrigerant and has a smaller specific gravity than the refrigerant is used, two layers, that is, an upper oil layer and a lower liquid-phase refrigerant layer are formed due to a difference in specific gravity and viscosity between the liquid-phase refrigerant and the oil.

[0008] In such a two-layer separation state, the pressure inside the tank suddenly decreases when the system (the compressor) is started. For this reason, a problem arises in that the liquid-phase refrigerant is boiled suddenly and fiercely (hereinafter, referred to as bumping) and thus a large shock sound is generated.

[0009] As a cause of the bumping and the accompanying shock sound, even when the pressure inside the tank (the suction side of the compressor) during the start-up of the compressor, the oil layer serves as a lid of the refrigerant layer (so that bumping does not occur in the oil layer) to a certain time point and thus the generation of the bumping is suppressed. However, when a difference in pressure between the upper side (the gas-phase refrigerant) of the oil layer and the lower side (the liquid-phase refrigerant) thereof becomes a predetermined pressure or more, the liquid-phase refrigerant is explosively boiled at one time (also refer to Patent Document 2 having a description of the bumping of the compressor).

[0010] Further, there is a case where the oil and the liquid-phase refrigerant may not have the two-layer separation state as described above during the stop of the compressor, that is, the oil and the liquid-phase refrigerant may be mixed with each other even when the compressor is stopped. Alternatively, there is a case where the oil which is not compatible with the refrigerant and has a larger specific gravity than the refrigerant may be used so that the liquid-phase refrigerant layer is formed at the upper side and the oil layer is formed at the lower side. Even in this case, the bumping explosively boiling the liquid-phase refrigerant and the accompanying shock sound may occur depending on a difference in condition

such as a type and a property of the refrigerant or the oil.

[0011] As one countermeasure for suppressing the bumping and the accompanying shock sound, Patent Document 2 proposes a structure in which a stirring blade is provided in a rotation shaft (a crank shaft) of a compressor using a reciprocating engine as a drive source and the stirring blade is rotated during the start-up of the compressor to mix the oil layer portion and discharge the liquid-phase refrigerant to the upper side of the oil.

[0012] Further, Patent Document 3 is devised for a main purpose of reliably mixing the oil inside (the tank of) the accumulator and the liquid-phase refrigerant which are in the two-layer separation state. Here, a part of the gas-phase refrigerant discharged from the compressor is blown from the bottom portion of the tank into the liquid-phase refrigerant via a bypass flow path with an on-off valve to perform the above-described mixing operation.

CITATION LIST

PATENT DOCUMENT

[0013]

Patent Document 1: JP 2014-70869 A
Patent Document 2: JP 2001-248923 A
Patent Document 3: JP 2004-263995 A

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0014] As described above, although the inventors have found that the bumping and the accompanying shock sound can be suppressed to a certain degree by mixing the liquid-phase portion including the oil and the liquid-phase refrigerant inside the tank during the start-up of the compressor. However, in the technologies proposed by the related arts, the shock sound accompanied by the bumping cannot be sufficiently removed. Further, in the technologies proposed by the related arts, the stirring means (the stirring blade, the drive source for rotating the stirring blade, the bypass flow path with the on-off valve, and the like) are additionally needed. As a result, a problem arises in that the accumulator (and the heat pump system including the same) becomes complex and increases in cost and size.

[0015] The invention has been made in view of such circumstances and an object of the invention is to provide an accumulator capable of effectively suppressing a shock sound accompanied by bumping during a start-up of a compressor without causing complexity, high cost, large size, and the like.

MEANS FOR SOLVING PROBLEM

[0016] In order to attain the above-described object, an accumulator according to the invention basically includes: a tank which is provided with an inflow port and an outflow port; an outflow pipe of which one end side is connected to the outflow port and the other end side is opened inside the tank; and a cap-shaped or inverted thin bowl shaped gas-liquid separator which is fixed and disposed below the inflow port to cover the other end side opening, in which a rear surface of the gas-liquid separator is provided with a shock absorbing member formed of a porous body or an elastic body in order to reduce a shock applied to the gas-liquid separator in the event of bumping.

[0017] The porous body is preferably formed of a foam material or a massive fiber material.

[0018] In a preferred embodiment, the shock absorbing member is provided along the rear surface of the gas-liquid separator.

[0019] In another preferred embodiment, the outflow pipe has a double pipe structure including an inner pipe connected to the outflow port and suspended inside the tank and an outer pipe disposed on an outer periphery of the inner pipe and the shock absorbing member is provided with an insertion hole through which the outflow pipe passes.

[0020] In another preferred embodiment, the shock absorbing member is provided with a communication space which communicates the other end side opening with a lower space in relation to the gas-liquid separator inside the tank.

[0021] In another preferred embodiment, the shock absorbing member is further provided on an inner peripheral surface of the tank.

EFFECT OF THE INVENTION

[0022] In the accumulator according to the invention, the rear surface of the gas-liquid separator is provided with the shock absorbing member formed of the porous body or the elastic body and in the event of bumping, a part of the liquid-phase refrigerant boiled inside the tank intrudes to the inside (that is, a small hole formed in the porous body) of the porous body provided on the rear surface of the gas-liquid separator or the elastic body provided on the rear surface of the gas-liquid separator is compressed and deformed by a part of the liquid-phase refrigerant boiled inside the tank. For that reason, since a shock applied to the gas-liquid separator in accordance with the bumping is reduced and the vibration of the gas-liquid separator is suppressed, it is possible to effectively suppress the shock sound caused by the bumping during the start-up of the compressor.

[0023] In this case, since the porous body or the elastic body which is manufactured cheaply and simply may be basically disposed on the rear surface of the gas-liquid separator, it is possible to simplify the configuration of the accumulator compared to a case where a stirring blade corresponding to stirring means, a drive source for rotating the stirring blade, a bypass flow path with an on-

off valve, and the like are used as in the related art. As a result, it is possible to realize a decrease in cost and size.

BRIEF DESCRIPTION OF DRAWINGS

[0024]

Fig. 1 is a longitudinal sectional view illustrating a first embodiment of an accumulator according to the invention;
Fig. 2 is a cross-sectional view taken along an arrow U-U of Fig. 1;
Fig. 3 is a cross-sectional view taken along an arrow V-V of Fig. 1;
Fig. 4 is a main enlarged longitudinal sectional view illustrating a main part in the event of bumping of the accumulator illustrated in Fig. 1;
Fig. 5 is a longitudinal sectional view illustrating a second embodiment of the accumulator according to the invention;
Fig. 6 is a main enlarged longitudinal sectional view illustrating a main part in the event of bumping in the accumulator illustrated in Fig. 5;
Fig. 7 is a partially cutaway front view illustrating a modified example of the first embodiment;
Fig. 8 is a cross-sectional view taken along an arrow W-W of Fig. 7;
Fig. 9 is a cross-sectional view taken along an arrow X-X of Fig. 7;
Fig. 10 is a partially cutaway front view illustrating a modified example of the second embodiment; and
Figs. 11 (A) and 11 (B) show an example of a heat pump system, where Fig. 11 (A) is a schematic configuration diagram illustrating a refrigerant flow (cycle) in a cooling operation and Fig. 11 (B) is a schematic configuration diagram illustrating a refrigerant flow (cycle) in a heating operation.

MODE(S) FOR CARRYING OUT THE INVENTION

[0025] Hereinafter, embodiments of the invention will be described with reference to the drawings.

[First Embodiment]

[0026] Fig. 1 is a longitudinal sectional view illustrating a first embodiment of an accumulator according to the invention, Fig. 2 is a cross-sectional view taken along an arrow U-U of Fig. 1, and Fig. 3 is a cross-sectional view taken along an arrow V-V of Fig. 1. Additionally, a plate rib 36 (to be described later) of an outflow pipe 30 is not illustrated in Fig. 1.

[0027] As illustrated in Figs. 11 (A) and 11 (B), the accumulator 1 of the first embodiment is used as an accumulator 250 of a heat pump system 200 constituting, for example, a car air conditioner of an electric vehicle and includes a bottomed cylindrical tank 10 which is formed of metal such as stainless steel or aluminum alloy. Here, an opening of an upper surface of the tank 10 is air-tightly blocked by a metallic lid member 12. For example, as illustrated in the drawings, the accumulator 1 of the embodiment is disposed in a vertical direction, that is, a direction in which the lid member 12 is directed to the upside (the ceiling side) and a bottom portion 13 of the tank 10 is directed to the downside (the ground side).

[0028] An inflow port 15 and a stepped outflow port 16 are provided in parallel in the lid member 12, a cap-shaped or inverted thin bowl shaped gas-liquid separator 18 which is slightly smaller than the inner diameter of the tank 10 is disposed below the lid member 12, and an upper end portion of the outflow pipe 30 is connected to a lower portion of the outflow port 16.

[0029] The outflow pipe 30 is formed as a double pipe structure including an inner pipe 31 which has an upper end portion connected to the lower portion of the outflow port 16 by crimping or press-inserting, is suspended inside the tank 10 via a guide hole 19 provided in a ceiling portion 18a of the gas-liquid separator 18, and is formed of, for example, metal and a bottomed outer pipe 32 which is disposed at the outer periphery of the inner pipe 31 and is formed of, for example, synthetic resin.

[0030] Here, at least one of the inner pipe 31 and the outer pipe 32 may be provided with a rib for ensuring a predetermined gap therebetween. In the example illustrated in the drawings, as understood with reference to Fig. 2, three plate ribs 36 are provided at the outside of the inner pipe 31 (the lower portion of the gas-liquid separator 18) to protrude outward in the radial direction at the same angular interval in the longitudinal direction (the vertical direction) and the outer pipe 32 is externally fitted and fixed to the outer peripheries of three plate ribs 36.

[0031] Further, the inner pipe 31, the outer pipe 32, and the plate rib 36 may be integrally formed by extruding using synthetic resin, aluminum, or the like. That is, the double pipe structure may be formed as an integrally molded product using an aluminum extruded material or the like.

[0032] The lower end portion of the outer pipe 32 is fitted into an inner peripheral step attached upper portion 42a of a casing 42 of a strainer 40 to be described later. The lower end of the inner pipe 31 is positioned slightly above a bottom portion 32b of the outer pipe 32 and the upper end of the outer pipe 32 is positioned slightly below the lid member 12. An oil return hole 35 is formed at the center of the bottom portion 32b of the outer pipe 32. The hole diameter of the oil return hole 35 is set to, for example, about 1 mm.

[0033] The gas-liquid separator 18 is formed of metal such as stainless steel or aluminum alloy and is fixed and disposed at the lower side of the inflow port 15 to cover an opening (an opening near the other end of the outflow pipe 30) between the inner pipe 31 of the outflow pipe 30 and (the upper end portion of) the outer pipe 32. The gas-liquid separator 18 includes a disk-shaped ceiling portion 18a which is provided with the guide hole 19 for

inserting the upper end portion of (the inner pipe 31 of) the outflow pipe 30 therethrough and is disposed to face the inflow port 15 and a cylindrical peripheral wall portion 18b which extends downward from the outer periphery of the ceiling portion 18a.

[0034] At the time in which the gas-liquid separator 18 and the inner pipe 31 are assembled to the lid member 12, the upper end portion of the inner pipe 31 (an upper portion in relation to the portion provided with the plate rib 36) passes through the guide hole 19 provided in the gas-liquid separator 18 and is fixed to the outflow port 16 from below by press-inserting or expanding pipe. Accordingly, the gas-liquid separator 18 is held and fixed to be sandwiched between the plate rib 36 of the inner pipe 31 and the lower end surface of the lid member 12.

[0035] Additionally, a flange portion which is compressed and bent by bulge forming or the like may be provided in the vicinity of the upper end of the inner pipe 31 to hold and fix the gas-liquid separator 18 while sandwiching the gas-liquid separator between the flange portion and the lower end surface of the lid member 12.

[0036] The strainer 40 is fixed while being placed on bottom portion 13 of the tank 10 and includes a bottomed cylindrical casing 42 which is formed of synthetic resin and a cylindrical mesh filter 45 which is integrated with the casing 42 by insert-molding or the like as understood with reference to Fig. 3. The mesh filter 45 is formed by, for example, a wire mesh or a mesh material formed of synthetic resin.

[0037] The casing 42 of the strainer 40 includes an inner peripheral step attached upper portion 42a into which the lower end portion of the outer pipe 32 is fitted and fixed, a bottom plate portion 42c, and four columnar portions 42b which are uprightly formed at the outer periphery of the bottom plate portion 42c at the same angular interval and connect the upper portion 42a. The outer periphery of the bottom plate portion 42c is provided with an annular connection band and the upper and lower end portions of the mesh filter 45 are fixed to the connection band and the lower portion of the upper portion 42a. Additionally, the mesh filter 45 may be integrated by insert-molding when the casing 42 is molded. That is, four windows 44 each having a rectangular shape is defined among four columnar portions 42b and the mesh filter 45 is stretched in the portions of the windows 44. Additionally, four columnar portions 42b may have slopes for die cutting, but four columnar portions 42b have the substantially same width in the radial direction. Further, a method of providing the mesh filter 45 in the casing 42 is not limited to the above-described method.

[0038] Inside the tank 10, a bag 50 which encloses a drying agent M and has a height substantially corresponding to the half of the tank 10 is placed on the bottom portion 13 along the inner periphery of the tank 10 in order to absorb and remove moisture in a refrigerant. The bag 50 is formed by a cloth such as a felt having air permeability and water permeability and a required shape maintaining property and a granular drying agent M is substantially fully filled therein.

[0039] In the accumulator 1 with such a configuration, as in the related art, a low-temperature and low-pressure gas-liquid-phase refrigerant is introduced from an evaporator into the tank 10 via the inflow port 15, the introduced refrigerant collides with (the ceiling portion 18a of) the gas-liquid separator 18 to be diffused radially, and is separated into a liquid-phase refrigerant and a gas-phase refrigerant. Then, the liquid-phase refrigerant (including oil) flows down along the inner peripheral surface of the tank 10 to be accumulated in the lower space of the tank 10 and the gas-phase refrigerant is sucked to the suction side of the compressor 210 via a space (a gas-phase refrigerant lower flow path) formed between the inner pipe 31 and the outer pipe 32 of the outflow pipe 30 and the inner space of the inner pipe 31 to be circulated.

[0040] Further, the oil which is accumulated in the lower space of the tank 10 along with the liquid-phase refrigerant moves toward the bottom portion 13 of the tank 10 due to a difference in specific gravity or property with respect to the liquid-phase refrigerant, is sucked to the gas-phase refrigerant which is sucked to the suction side of the compressor via the outflow pipe 30, and is returned to the suction side of the compressor along with the gas-phase refrigerant passing through the mesh filter 45 of the strainer 40, the oil return hole 35, and the inner space of the inner pipe 31 to be circulated. When passing through the mesh filter 45, a foreign material such as sludge is captured and the foreign material is removed from the circulating refrigerant (including the oil).

[0041] In addition to the above-described configuration, in the accumulator 1 of the embodiment, a shock absorbing member 20 that is formed of a porous body is provided on a rear surface (a surface near the liquid-phase refrigerant accumulated inside the tank 10) of the gas-liquid separator 18 in order to reduce a shock applied to the gas-liquid separator 18 in accordance with the bumping.

[0042] The shock absorbing member 20 (the porous body) is provided with an insertion hole 21 through which the outflow pipe 30 passes, has an outer diameter which is substantially the same as the diameter of (the peripheral wall portion 18b of) the gas-liquid separator 18, and is fixed to the rear surface of the gas-liquid separator 18 by adhering or crimping in a state where the upper surface contacts (the lower surface of) the ceiling portion 18a of the gas-liquid separator 18 and the outer peripheral surface contacts (the inner peripheral surface of) the peripheral wall portion 18b of the gas-liquid separator 18. Here, the outflow pipe 30 is inserted into the insertion hole 21 with a predetermined gap and the insertion hole 21 is formed as a communication space which communicates the lower space of the gas-liquid separator 18 inside the tank 10 with the opening (the other end side opening of the outflow pipe 30) formed between the inner pipe 31 and (the upper end portion of) the outer pipe 32 of the outflow pipe 30.

[0043] The shock absorbing member 20 (the porous

body) is formed of, for example, a foam material like resin such as rubber or metal such as aluminum or a massive fibrous material like resin such as a felt, metal such as steel wool, or glass wool.

[0044] As described above, in the accumulator 1 of the embodiment, the rear surface of the gas-liquid separator 18 is provided with the shock absorbing member 20 formed of a porous body and in the event of bumping, a part of the liquid-phase refrigerant boiled inside the tank 10 intrudes to the inside (that is, a small hole formed in the porous body) of the porous body (the shock absorbing member 20) provided in the rear surface of the gas-liquid separator 18 (see Fig. 4). For that reason, since a shock applied to the gas-liquid separator 18 in accordance with the bumping is reduced and the vibration of the gas-liquid separator 18 is suppressed, it is possible to effectively suppress a shock sound caused by the bumping during a start-up of the compressor.

[0045] In this case, since the porous body which is manufactured cheaply and simply may be basically disposed on the rear surface of the gas-liquid separator 18, it is possible to simplify the configuration of the accumulator compared to a case where a stirring blade corresponding to stirring means, a drive source for rotating the stirring blade, a bypass flow path with an on-off valve, and the like are used as in the related art. As a result, it is possible to realize a decrease in cost and size.

[Second Embodiment]

[0046] Fig. 5 is a longitudinal sectional view illustrating a second embodiment of the accumulator according to the invention. Also in Fig. 5, the plate rib 36 of the outflow pipe 30 is not illustrated similarly to Fig. 1.

[0047] An accumulator 2 of the second embodiment has the same configuration as that of the accumulator 1 of the first embodiment except for the configuration of the shock absorbing member 20. Additionally, common reference numerals are given to corresponding parts of the accumulator 1 of the first embodiment in Fig. 5 illustrating the accumulator 2 of the second embodiment. That is, in the accumulator 1 of the first embodiment, the shock absorbing member 20 provided in the rear surface of the gas-liquid separator 18 is formed of a porous body in order to reduce a shock applied to the gas-liquid separator 18 in accordance with bumping, but in the accumulator 2 of the second embodiment, the shock absorbing member 60 is formed of an elastic body.

[0048] That is, the rear surface of the gas-liquid separator 18 of the accumulator 2 of the second embodiment is provided with the shock absorbing member 60 that is formed of an elastic body, has an inverted concave cross-section, and is provided with an insertion hole 61 through which (the inner pipe 31 of) the outflow pipe 30 passes. Here, the shock absorbing member is disposed along the rear surface (specifically, the lower surface of the ceiling portion 18a and the inner peripheral surface of the peripheral wall portion 18b) of the gas-liquid separator 18. The shock absorbing member 60 (the elastic body) is formed of, for example, resin such as rubber and is fixed to the rear surface of the gas-liquid separator 18 by baking or the like. Here, a concave portion 62 in the shock absorbing member 60 (the elastic body) is formed as a communication space which communicates the lower space of the gas-liquid separator 18 inside the tank 10 with the opening (the other end side opening of the outflow pipe 30) formed between the inner pipe 31 and (the upper end portion of) the outer pipe 32 of the outflow pipe 30.

[0049] In the accumulator 2 of the second embodiment with such a configuration, the rear surface of the gas-liquid separator 18 is provided with the shock absorbing member 60 formed of the elastic body and in the event of bumping, the elastic body provided on the rear surface of the gas-liquid separator 18 is compressed and deformed by a part of the liquid-phase refrigerant boiled inside the tank 10 (see Fig. 6). For that reason, since a shock applied to the gas-liquid separator 18 in accordance with the bumping is reduced and the vibration of the gas-liquid separator 18 is suppressed, it is possible to obtain the substantially same operation and effect as those of the accumulator 1 of the first embodiment.

[Modified Example of First and Second Embodiments]

[0050] In the first and second embodiments, countermeasures for suppressing (the magnitude of) the shock sound in accordance with bumping has been described. However, in the countermeasures of the first and second embodiments, it is proved that (the magnitude of) the shock sound in accordance with the bumping is more effectively suppressed by employing various countermeasures described in Japanese Patent Application No. 2015-231052 proposed by the inventor (bumping and countermeasures for suppressing the generation of the shock sound in accordance with the bumping).

[0051] Figs. 7 and 10 illustrate an example (Fig. 7 illustrates a modified example of the first embodiment and Fig. 10 illustrates a modified example of the second embodiment).

[0052] In an accumulator 1A illustrated in Fig. 7 and an accumulator 2A illustrated in Fig. 10, (the inner surface) of the bottom portion 13 of the bottomed cylindrical tank 10 is provided with a plurality of (in the example illustrated in the drawings, seven) annular protrusions 13a which are formed concentrically by pressing or cutting and serve as a start point of boiling (bubble generation) (particularly, see Fig. 8).

[0053] Further, the outer pipe 32 constituting the outflow pipe 30 is provided with a knurled portion 37 having a plurality of protrusions formed on the outer periphery thereof by knurling and serves as a start point of boiling. In this example, the knurled portion 37 is provided from the lower end portion to the upper end portion of the outer pipe 32 (in the vertical direction).

[0054] A front end of the protrusion of the knurled por-

tion 37 of the outer pipe 32 or the protrusion 13a of the inner surface of the bottom portion 13 of the tank 10 is formed sharply in order to promote the boiling.

[0055] Further, a cloth 90 such as a felt or a mesh-shaped flexible or resilient plate-shaped body is wound or externally fitted to cover the entire area of the upper portion of the strainer 40 in the outer periphery of (the knurled portion 37 of) the outer pipe 32. Additionally, a foam material may be used instead of the cloth 90 and as the foam material, commercially available synthetic resin, rubber, ceramic, or the like can be used.

[0056] Further, in the accumulator 1 of the first embodiment and the accumulator 2 of the second embodiment, the bag 50 enclosing the drying agent M is removed and the cloth 90 such as a felt is provided with a pipe extrapolation portion 92 which is externally fitted and fixed to the outer periphery of (the knurled portion 37 of) the outer pipe 32 and a cylindrical drying agent storage portion 95 of which upper and lower sides are blocked and which stores the drying agent M for removing a moisture in the refrigerant.

[0057] The drying agent storage portion 95 is provided in the vertical direction (the axis direction of the outer pipe 32) at the outside near the inflow port 15 in the outer pipe 32 (particularly, see Fig. 9). Here, the drying agent storage portion 95 is provided from the upper end portion to the lower end portion of the pipe extrapolation portion 92 (in other words, from the upper portion of the strainer 40 in the outer pipe 32 to the upper end portion) and the upper portion thereof protrudes upward in relation to the maximum liquid level height of the liquid-phase portion (the liquid-phase refrigerant and the oil) accumulated inside the tank 10 during the stop of the compressor 210.

[0058] Additionally, the hole diameter of the insertion hole 21 of the shock absorbing member 20 illustrated in Fig. 7 is larger by the amount of the drying agent storage portion 95.

[0059] The pipe extrapolation portion 92 of the cloth 90 is provided with a plurality of slits (gaps) 90s (which are provided totally at six positions including three positions provided at the substantially same interval in the vertical direction and positions at the front and rear sides of the drawing in the example illustrated in the drawings to extend in the horizontal direction).

[0060] In the accumulator 1A illustrated in Fig. 7 and the accumulator 2A illustrated in Fig. 10, it is possible to obtain the substantially same operation and effect as those of the accumulator 1 of the first embodiment and the accumulator 2 of the second embodiment. Also, the protrusion (the protrusion of the knurled portion 37 of the outer pipe 32 or the protrusion 13a of the upper surface of the bottom portion 13 of the tank 10) serving as a start point of the boiling (bubble generation) is provided in a portion immersed into the liquid-phase portion (the liquid-phase refrigerant and the oil) accumulated inside the tank 10 of the accumulators 1 A and 2A. Thus, the protrusion becomes a start point (a trigger) when the liquid-phase refrigerant is boiled to evaporate during the start-up of the compressor 210. Accordingly, the liquid-phase refrigerant is gradually boiled (to be smaller than that of bumping) in accordance with a decrease in pressure of the tank 10 before the bumping and the shock sound caused by the bumping. That is, since a boiling which is smaller than that of the bumping is promoted by the protrusion before a current pressure reaches a predetermined pressure at which the bumping accompanying the shock sound occurs and the liquid-phase refrigerant is gently boiled, it is possible to effectively suppress the generation of the bumping and the shock sound during the start-up of the compressor 210.

[0061] In this case, since only the tank 10 or (the outer pipe 32 of) the outflow pipe 30 provided with the protrusion may be provided cheaply and simply by pressing, cutting, or knurling, it is possible to simplify the configuration of the accumulator compared to a case where a stirring blade corresponding to stirring means, a drive source for rotating the stirring blade, a bypass flow path with an on-off valve, and the like are used as in the related art. As a result, it is possible to realize a decrease in cost and size.

[0062] Further, since the refrigerant contacting the protrusion (the protrusion of the knurled portion 37 of the outer pipe 32) provided in the outer pipe 32 becomes sparse due to the cloth 90 (or the foam material) externally fitted or wound on the outer periphery of the outer pipe 32 constituting the outflow pipe 30 so that a pressure decreases, the protrusion formed in the outer pipe 32 becomes a start point (a trigger) when the liquid-phase refrigerant is boiled to evaporate during the start-up of the compressor 210. Accordingly, bubbles gradually come out, that is, the liquid-phase refrigerant gradually evaporates. For that reason, the boiling of the liquid-phase refrigerant is gently performed. As a result, it is possible to more effectively suppress the bumping in which the liquid-phase refrigerant is explosively boiled at one time and the shock sound according to the bumping.

[0063] In this case, since the cloth 90 (or the foam material) may be wound or externally fitted to the outer periphery of the outer pipe 32 by a simple configuration, there is no need to worry complexity, high cost, large size, and the like as in the above-described conventional countermeasures. As a result, it is extremely excellent in cost effectiveness.

[0064] Further, since the slit (the gap) 90s formed in (the pipe extrapolation portion 92 of) the cloth 90 becomes a trigger of the boiling of the refrigerant and the generated bubbles easily come to the outside via the outer pipe 32 and the cloth 90, this configuration becomes more effective.

[0065] Further, since the cloth 90 such as a felt has air permeability and water permeability, the drying agent storage portion 95 serves as a bag when the drying agent storage portion 95 storing the drying agent M for absorbing and removing a moisture in the refrigerant is provided in the cloth 90 such as a felt in addition to the pipe extrapolation portion 92 as in the example. Accordingly,

there is no need to separately prepare the bag storing the drying agent M or fixing means (a binding band or the like). As a result, it is possible to further improve cost effectiveness.

[0066] Further, when the upper portion of the drying agent storage portion 95 is positioned above the maximum liquid level height, it is possible to more reliably suppress the generation of the bumping and the shock sound according to the bumping during the start-up of the compressor 210.

[0067] Additionally, the detailed structures and the operations and effects of the modified examples illustrated in Figs. 7 to 9 and Fig. 10 are also referred to Japanese Patent Application No. 2015-231052.

[0068] Additionally, although not illustrated in the drawings, the shock absorbing member may be provided in the inner peripheral surface (the entire surface or a part thereof) of the tank 10 (the lid member 12 blocking the upper surface opening of the tank 10 or the cylindrical portion of the tank 10) along with the rear surface of the gas-liquid separator 18. In that case, it is needless to mention that the shock absorbing member can be fixed to the inner periphery of the tank 10 by the same method as those of the first and second embodiments.

[0069] Further, in the first and second embodiments, the outflow pipe having the double pipe structure with the inner pipe and the outer pipe has been employed, but it is needless to mention that the invention can be also applied to an accumulator including, for example, a U-shaped outflow pipe of which one end side is connected to an outflow port and the other end side opening is positioned in the vicinity of a lower surface of a gas-liquid separator.

EXPLANATIONS OF LETTERS OR NUMERALS

[0070]

1	accumulator (first embodiment)
1A	accumulator (modified example of first embodiment)
2	accumulator (second embodiment)
2A	accumulator (modified example of second embodiment)
10	tank
12	lid member
13	bottom portion of tank
13a	protrusion of bottom portion of tank
15	inflow port
16	outflow port
18	gas-liquid separator
18a	ceiling portion
18b	peripheral wall portion
19	guide hole
20	shock absorbing member (porous body)
21	insertion hole
30	outflow pipe
31	inner pipe
32	outer pipe
35	oil return hole
36	plate rib
37	knurled portion
40	strainer
50	bag
60	shock absorbing member (elastic body)
61	insertion hole
62	concave portion
90	cloth
90s	slit
92	pipe extrapolation portion
95	drying agent storage portion
M	drying agent

Claims

1. An accumulator comprising:

a tank which is provided with an inflow port and an outflow port;
an outflow pipe of which one end side is connected to the outflow port and the other end side is opened inside the tank; and
a cap-shaped or inverted thin bowl shaped gas-liquid separator which is fixed and disposed below the inflow port to cover the other end side opening,
wherein a rear surface of the gas-liquid separator is provided with a shock absorbing member formed of a porous body or an elastic body in order to reduce a shock applied to the gas-liquid separator in the event of bumping.

2. The accumulator according to claim 1,
wherein the porous body is formed of a foam material or a massive fiber material.

3. The accumulator according to claim 1 or 2,
wherein the shock absorbing member is provided along the rear surface of the gas-liquid separator.

4. The accumulator according to any one of claims 1 to 3,
wherein the outflow pipe has a double pipe structure including an inner pipe connected to the outflow port and suspended inside the tank and an outer pipe disposed on an outer periphery of the inner pipe, and
wherein the shock absorbing member is provided with an insertion hole through which the outflow pipe passes.

5. The accumulator according to any one of claims 1 to 4,
wherein the shock absorbing member is provided with a communication space which communicates the other end side opening with a lower space in

relation to the gas-liquid separator inside the tank.

6. The accumulator according to any one of claims 1 to 5,
wherein the shock absorbing member is further provided on an inner peripheral surface of the tank.

FIG. 1

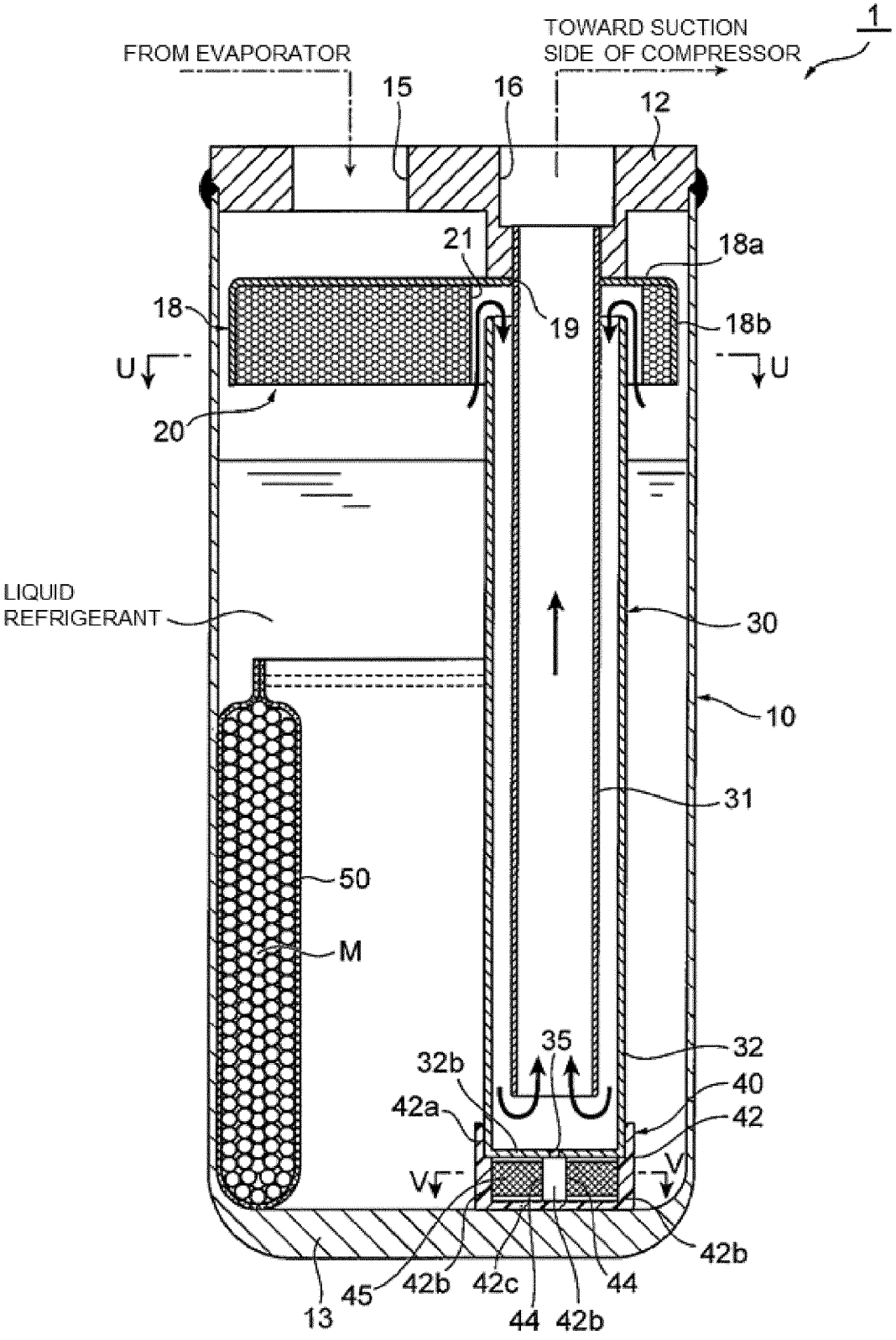

1
FROM EVAPORATOR
TOWARD SUCTION SIDE OF COMPRESSOR
15
16
12
21
18a
18
19
18b
U
U
20
LIQUID REFRIGERANT
30
10
31
50
M
35
32
32b
40
42a
42
V
V
42b
13
45
42b
42c
44
44
42b

FIG. 2

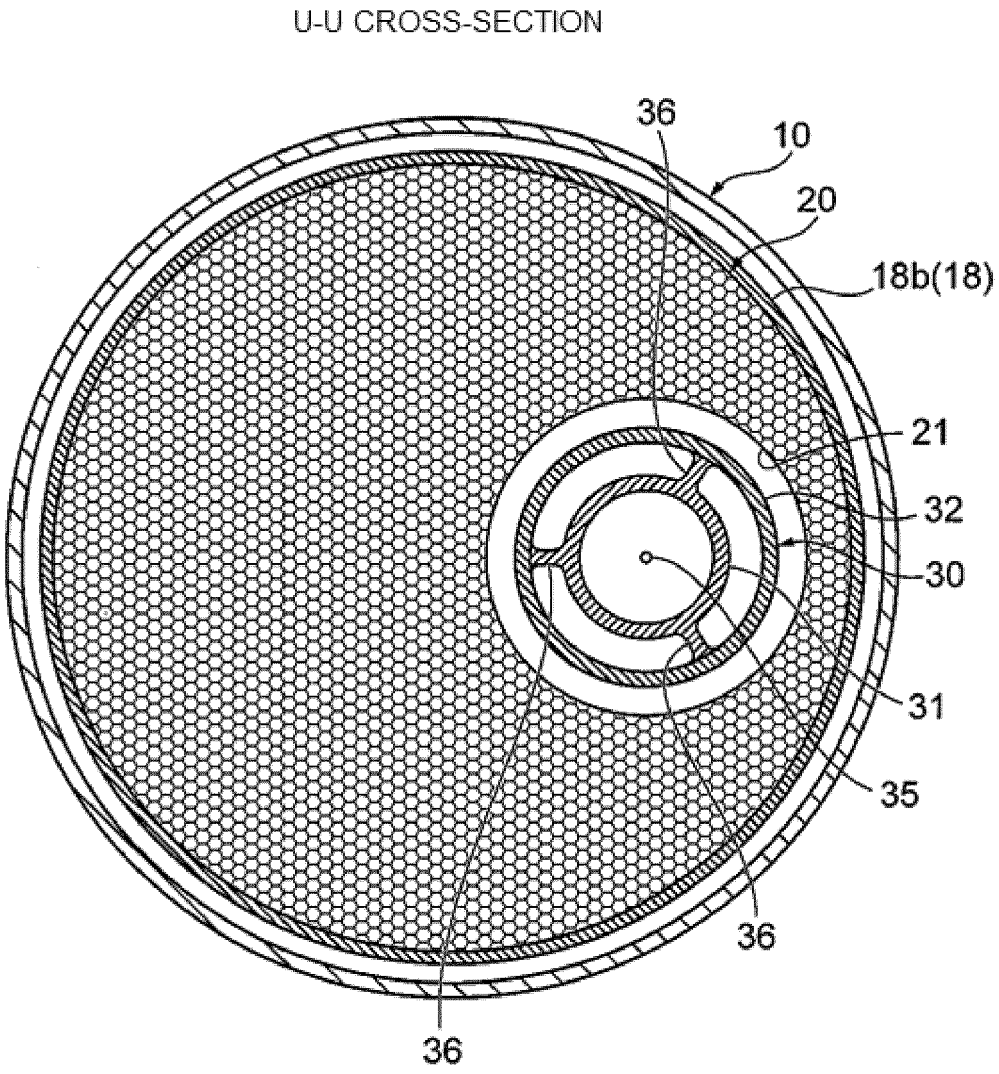


FIG. 3

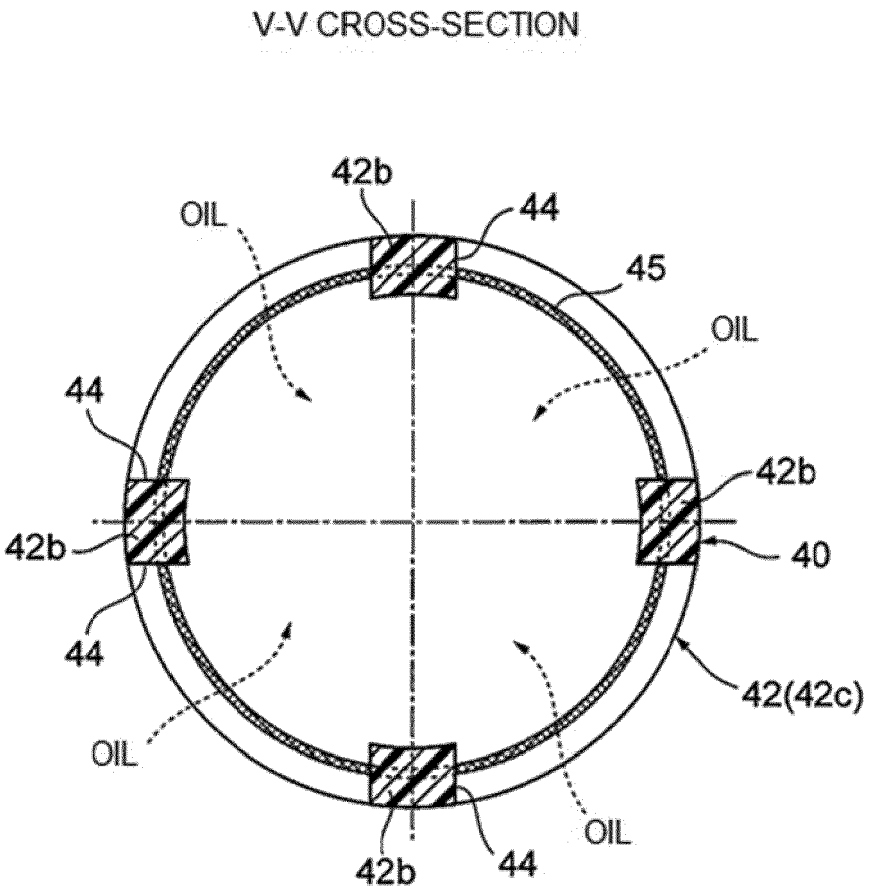

V-V CROSS-SECTION
42b
OIL
44
45
OIL
44
42b
42b
40
44
42(42c)
OIL
OIL
42b
44

FIG. 4

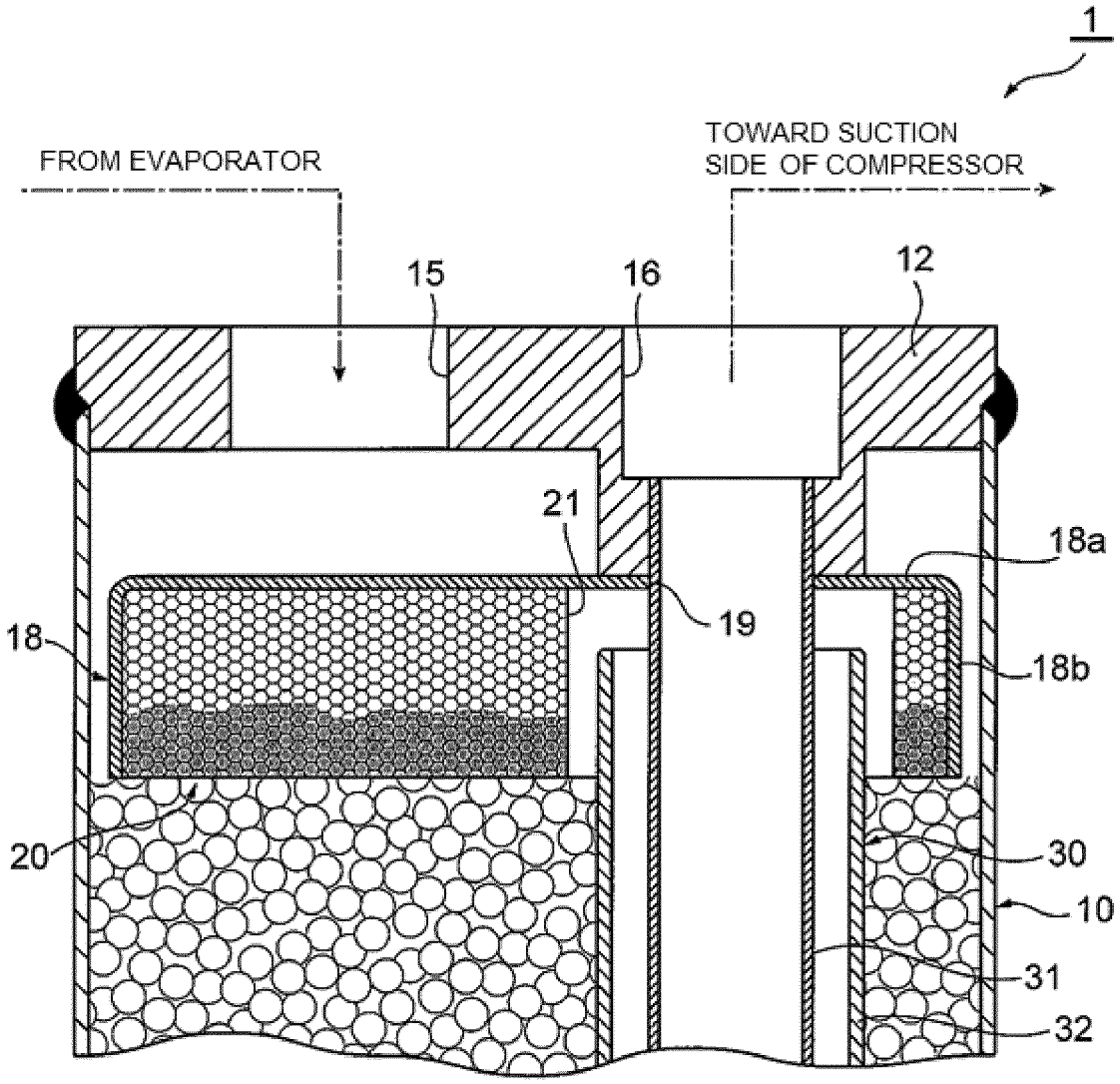

1
FROM EVAPORATOR
TOWARD SUCTION SIDE OF COMPRESSOR
15
16
12
21
18a
19
18
18b
20
30
10
31
32

FIG. 5

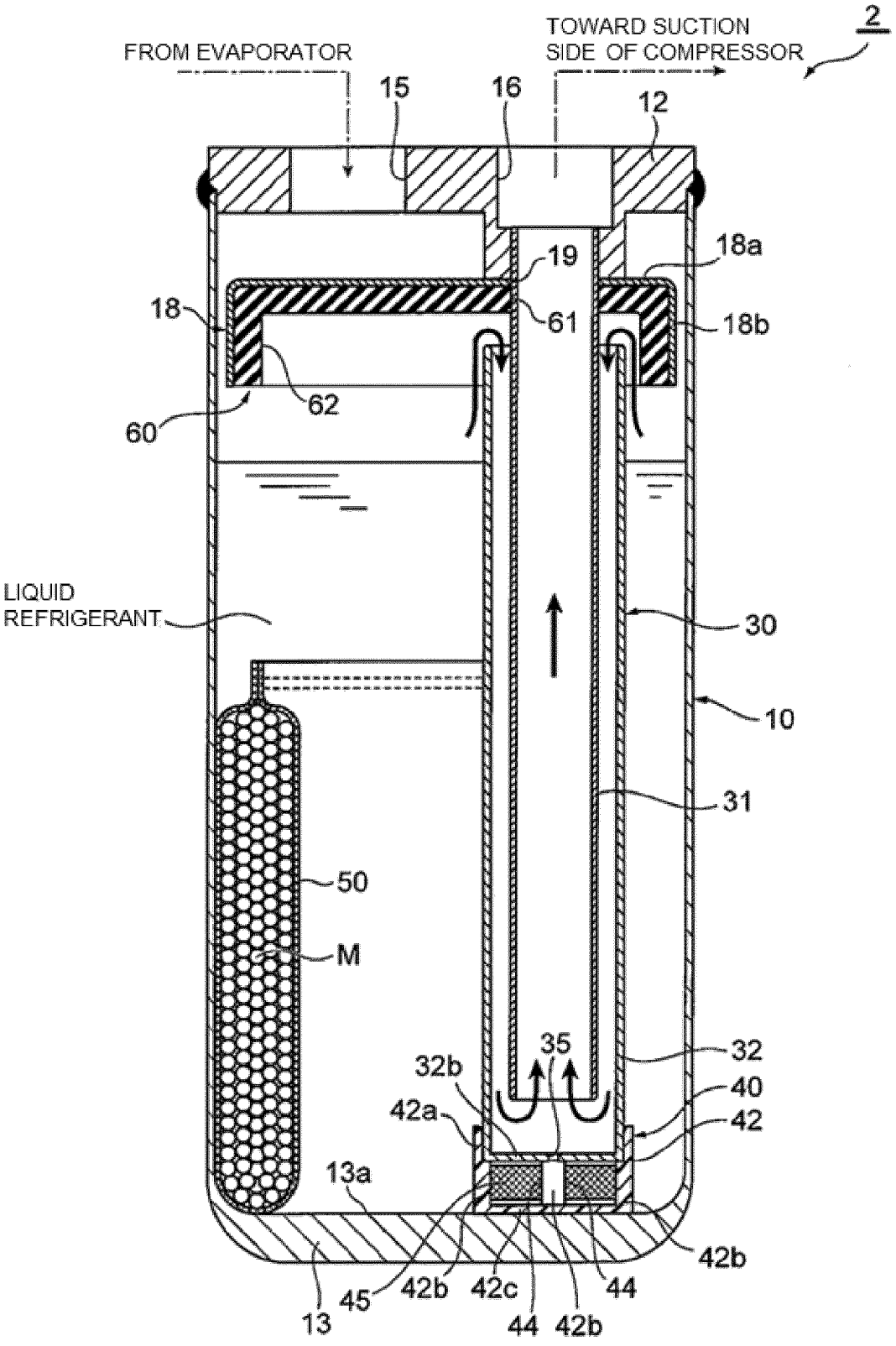

FROM EVAPORATOR
TOWARD SUCTION SIDE OF COMPRESSOR
2
15
16
12
18a
19
18
61
18b
62
60
LIQUID REFRIGERANT
30
10
31
50
M
35
32
32b
40
42a
42
13a
42b
45
42b
42c
44
44
42b
13

FIG. 6

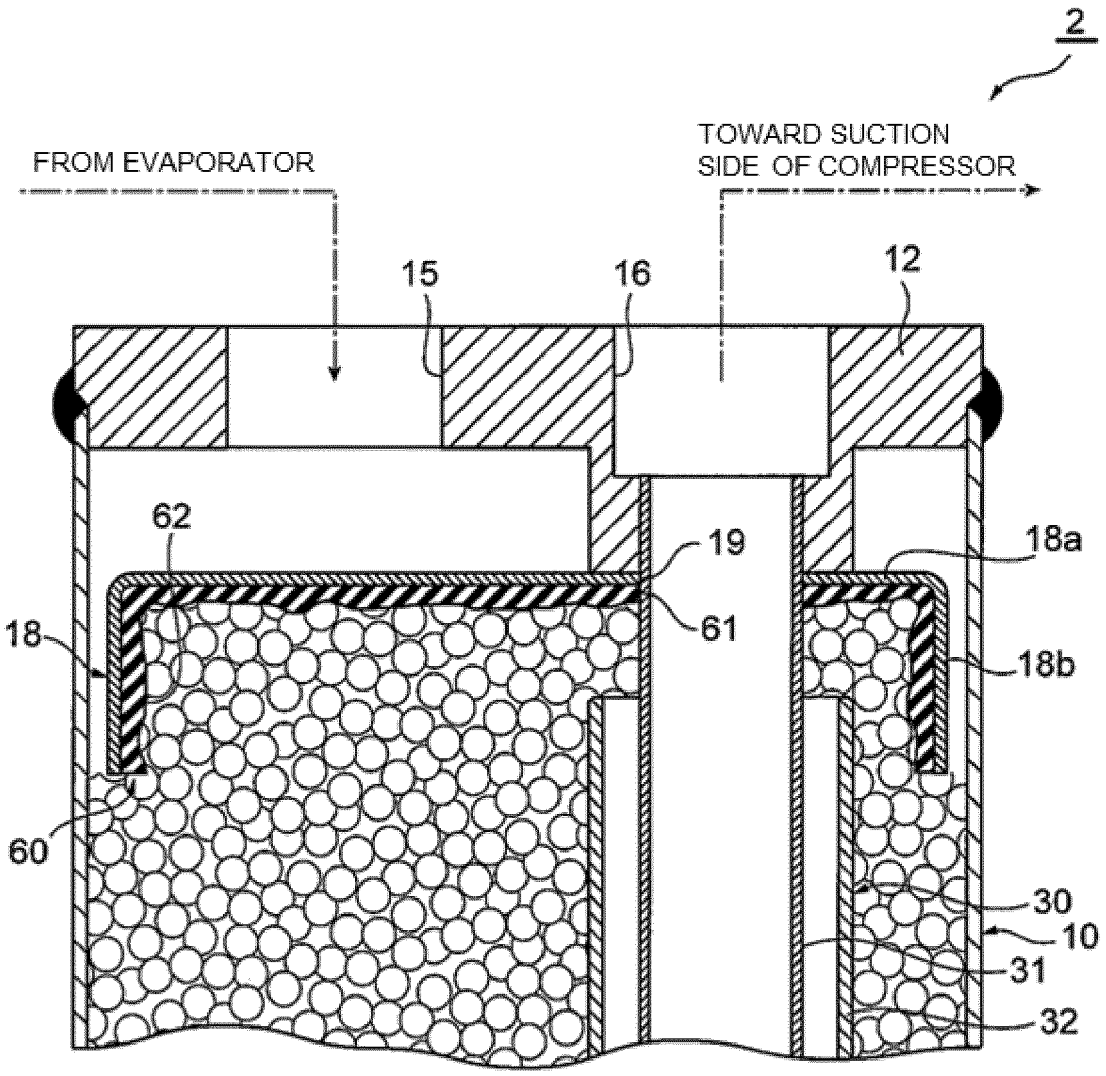

2
FROM EVAPORATOR
TOWARD SUCTION SIDE OF COMPRESSOR
15
16
12
62
19
18a
61
18
18b
60
30
10
31
32

FIG. 7

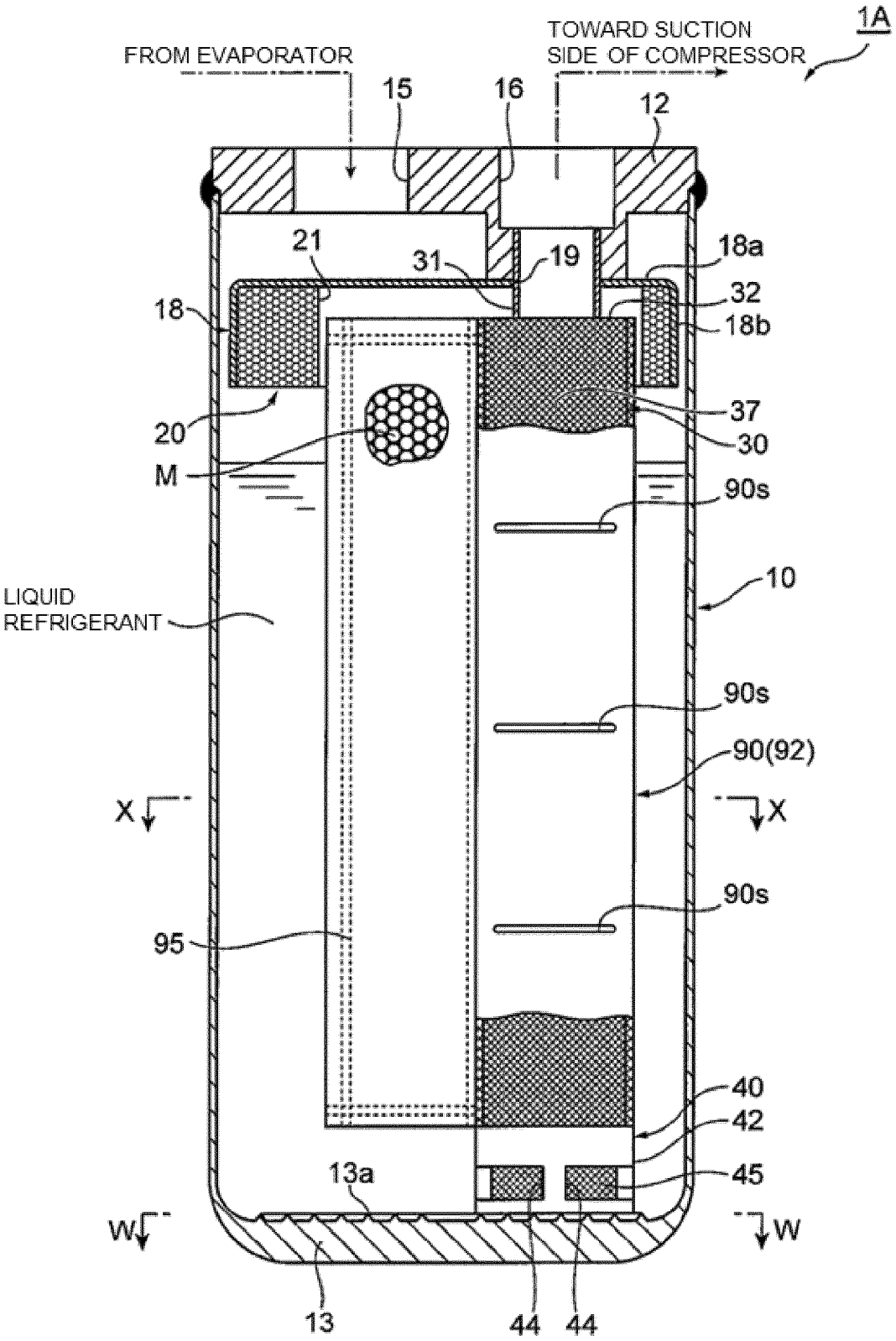

1A
FROM EVAPORATOR
TOWARD SUCTION SIDE OF COMPRESSOR
15
16
12
21
31
19
18a
32
18b
18
20
37
30
M
90s
LIQUID REFRIGERANT
10
90s
90(92)
X
X
90s
95
40
42
13a
45
W
W
13
44
44

FIG. 8

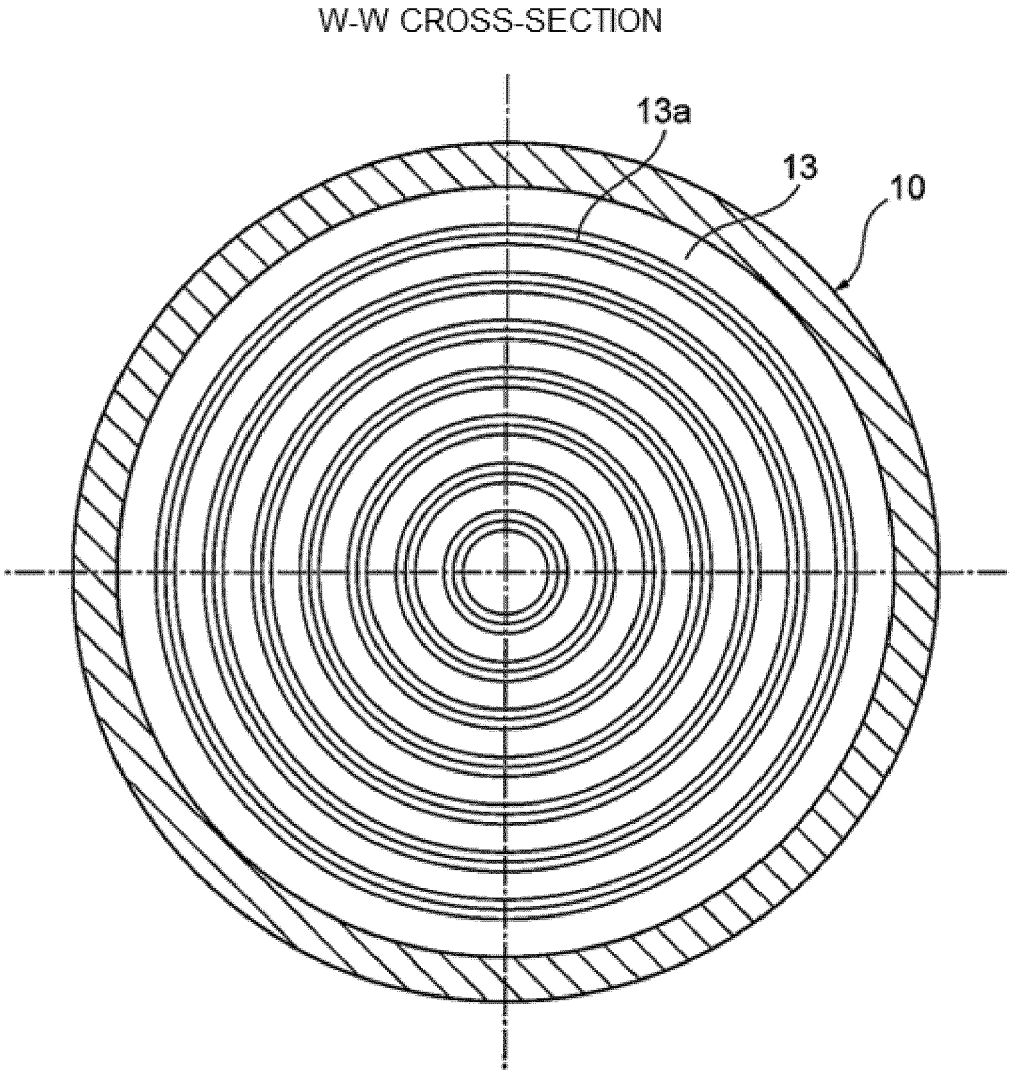


FIG. 9

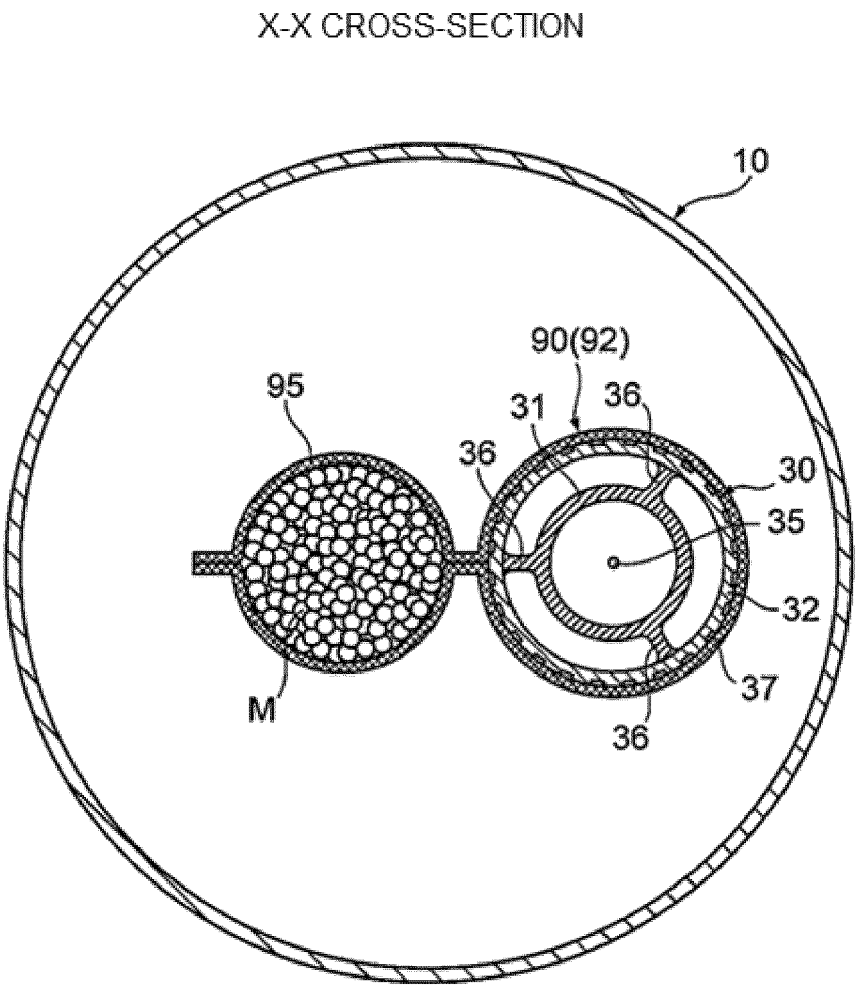


FIG. 10

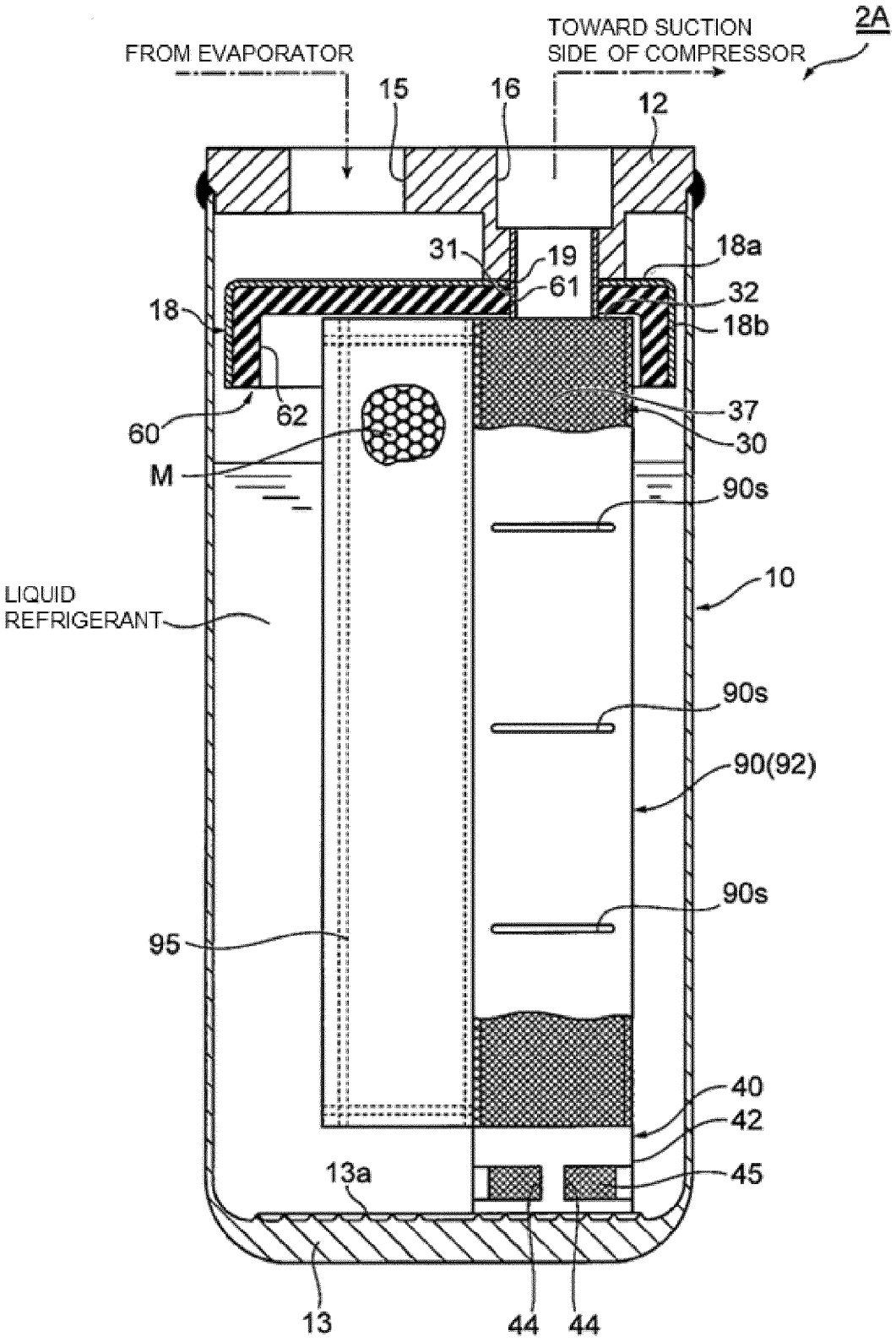

FROM EVAPORATOR
TOWARD SUCTION SIDE OF COMPRESSOR
2A
15
16
12
31
19
61
18a
32
18b
18
62
60
37
30
M
90s
LIQUID REFRIGERANT
10
90s
90(92)
90s
95
40
42
45
13a
13
44
44

FIG. 11A

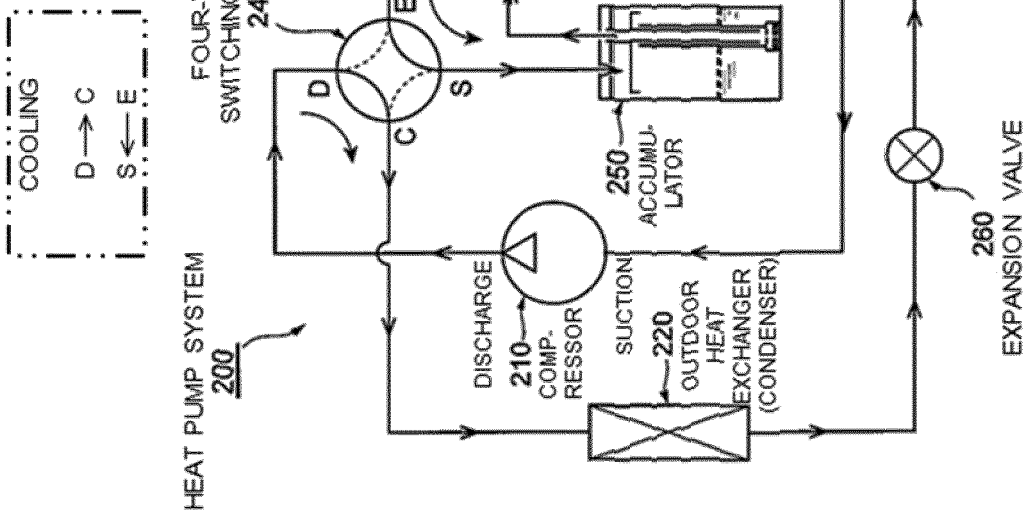
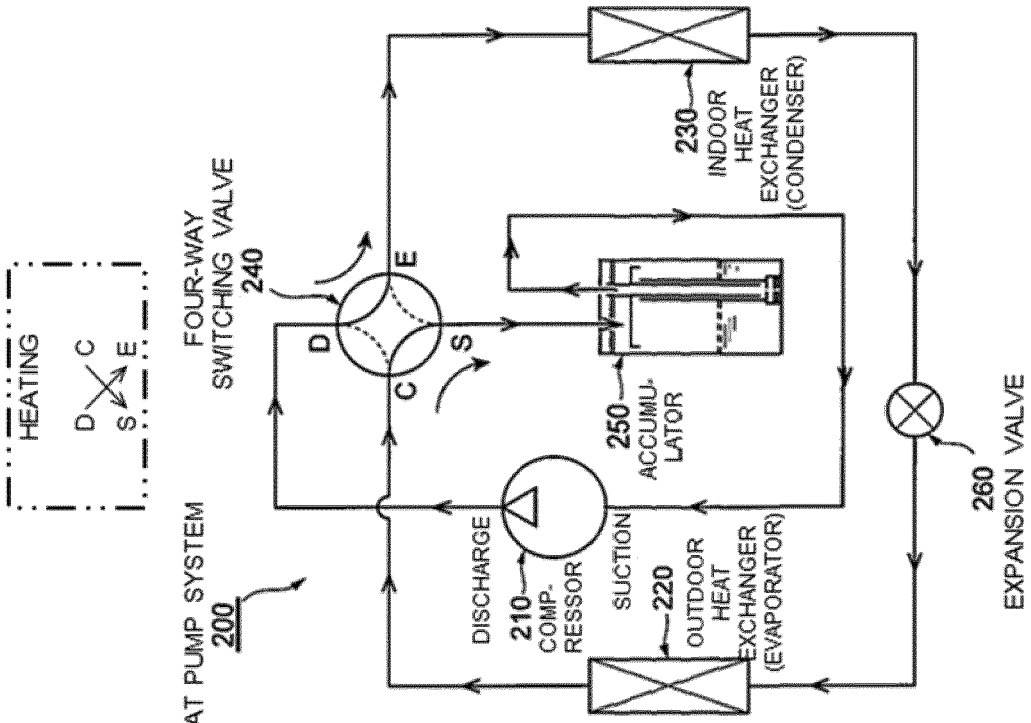


FIG. 11B



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 18 2729

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 896 914 A1 (DENSO CORP [JP]) 22 July 2015 (2015-07-22) * paragraphs [0016] - [0048]; figure 5 *	1-6	INV. F25B43/00

TECHNICAL FIELDS SEARCHED (IPC)

F25B
B60H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 January 2018	Ritter, Christoph

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 18 2729

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-01-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2896914 A1	22-07-2015	CN 104603555 A	06-05-2015
		EP 2896914 A1	22-07-2015
		JP 5849909 B2	03-02-2016
		JP 2014052139 A	20-03-2014
		US 2015231549 A1	20-08-2015
		WO 2014038127 A1	13-03-2014

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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 2014070869 A **[0013]**
- JP 2001248923 A **[0013]**
- JP 2004263995 A **[0013]**
- JP 2015231052 A **[0050] [0067]**