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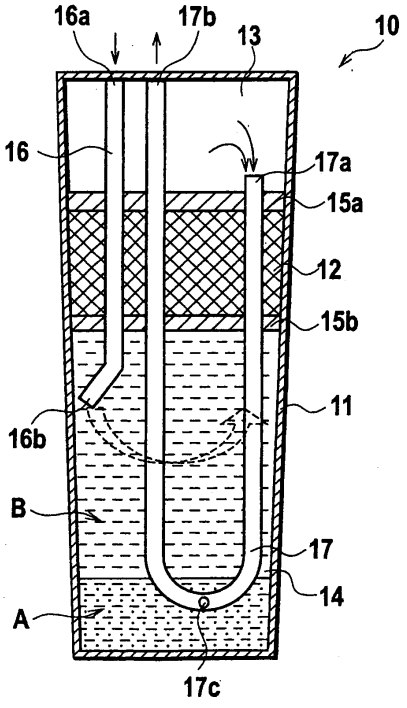
(54) ACCUMULATOR

(57) In an accumulator for use in a refrigerating cycle of a vehicle air conditioner or the like, to prevent a refrigerant liquid sucked inside returning to a compressor.

A desiccant layer 12 is provided above the middle of a tank 11 to divide the main body into upper and lower chambers 13 and 14. A gas-liquid mixed refrigerant sucked into the lower chamber is subjected to gas-liquid separation in the desiccant layer 12, and only the refrigerant gas is transferred to the upper chamber 13 while the refrigerant liquid and the like are accumulated in the lower chamber 14. An outlet port 16b of the refrigerant suction tube 16, through which the refrigerant is sucked into the main body, is opened within the lower chamber 14, and an inlet port 17a of a refrigerant/oil discharge tube 17, through which refrigerant gas obtained by the gas-liquid separation in the desiccant layer 12 is discharged, is opened within the upper chamber 13. The desiccant layer 12 separates the outlet port 16b of the refrigerant suction tube 16 from the inlet port 17a of the refrigerant/oil discharge tube 17, so that the refrigerant liquid sucked through the refrigerant suction tube 16 is not directly sucked into the inlet port 17a of the refrigerant/oil tube 17.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a structure of an accumulator for use in a refrigerating cycle of a vehicle air-conditioner or the like.

Background Art

[0002] Heretofore, in a refrigerating cycle of a vehicle air-conditioner, an accumulator is disposed on a side of a compressor to which a refrigerant returns. Herein, the compressor compresses the refrigerant. In a cooling dedicated cycle of a general vehicle including an engine as a driving source, such an accumulator is an essential part to store redundant refrigerant due to variations in load during the cooling operation. In a heating and cooling cycle of a vehicle which does not include a heat source such as a fuel cell vehicle or an electrical vehicle, in addition to such a function of storing redundant refrigerant, the accumulator has a function of separating the refrigerant returning to the compressor into liquid and gas and allowing only refrigerant gas to be sucked into the compressor, thus preventing damage of the compressor due to liquid or wet compression.

[0003] FIG. 3 is a schematic cross-sectional view showing a conventional example of a general accumulator. This accumulator 100 is connected to a path reaching a compressor from a not-shown internal heat exchanger and includes a refrigerant suction tube 102 and a substantially U-shaped refrigerant discharge tube 103 within a substantially cylindrical tank 101. The refrigerant suction tube 102 is connected to an inlet refrigerant pipe which is connected to the not-shown internal heat exchanger, and a gas-liquid mixed refrigerant is flown through the refrigerant suction tube 102 into the tank 101. The refrigerant discharge tube 103 is connected to an outlet refrigerant pipe which is connected to the not-shown compressor and discharges the refrigerant gas obtained by gas-liquid separation. In a tank upper part of the refrigerant discharge tube 103, a refrigerant return opening 103a through which the refrigerant gas is sucked is formed, and, in a bent part of the substantially U shape thereof, an oil return port 103b is formed, through which oil contained in a refrigerant liquid is returned.

[0004] In the aforementioned structure, the gas-liquid mixed refrigerant discharged from the not-shown internal heat exchanger is flown through the refrigerant suction tube 102 into the tank 101, and the refrigerant liquid is accumulated in the bottom of the tank 101. The refrigerant gas is sucked through the refrigerant return opening 103a of the refrigerant discharge tube 103 and fed to the not-shown compressor through the refrigerant discharge tube 103. The oil contained in the refrigerant liquid accumulated in the bottom of the tank 101 is sucked through the oil return port 103b formed in the refrigerant discharge tube 103 and fed to the compressor together with the refrigerant gas.

[0005] As a conventional art related to this type of accumulator, an accumulator is proposed in which the tank is partitioned by a desiccant unit into upper and lower chambers. The upper chamber is divided by a separator wall into a chamber on the refrigerant inlet side and a chamber on the refrigerant outlet side, and the separator wall includes a number of ventilation holes (see Patent Literature 1).

[0006] Patent Literature 1: Japanese Patent Laid-open Publication No. 10-232071

Disclosure of the Invention

Problems to be Solved by the Invention

[0007] In the accumulator 100 of the conventional example shown in FIG. 3, the gas-liquidmixed refrigerant sucked through the refrigerant suction tube 102 sometimes enters the refrigerant discharge tube 103 through the refrigerant return opening 103a as indicated by a solid arrow. Moreover, the gas-liquid mixed refrigerant flown into the tank strikes the surface of the accumulated liquid and ruffles the surface thereof, and accordingly, the refrigerant liquid in the surface sometimes reaches the refrigerant return opening 103a and enters the refrigerant discharge tube 103. In the accumulator 100 of the conventional example shown in FIG. 3, the refrigerant liquid is sent to the compressor in such a manner, and the compressor could be damaged by liquid or wet compression.

[0008] In the accumulator proposed by Japanese Patent Laid-open Publication No. 10-232071, the refrigerant liquid flown into the chamber on the refrigerant inlet side passes through the desiccant unit and is accumulated in a lower chamber, and the refrigerant liquid does not ruffle the surface of the accumulated liquid. However, a lot of ventilation holes are formed in the separator wall separating the chambers on the refrigerant inlet and outlet sides, and it is thought that a part of the refrigerant liquid flown into the chamber on the refrigerant inlet side could enter the opposite chamber on the refrigerant outlet side through these ventilation holes and sent to the compressor. Accordingly, in such an accumulator, the refrigerant liquid returning to the compressor is not prevented.

[0009] An object of the present invention is to provide an accumulator capable of preventing the refrigerant liquid sucked inside returning to the compressor.

Means for Solving the Problems

[0010] To achieve the aforementioned object, an accumulator according to the present invention includes: a main body; and a desiccant layer which is provided above a middle of the main body to divide the main body into upper and lower chambers. A gas-liquid mixed refrigerant sucked into the lower chamber is subjected to gas-liquid separation in the desiccant layer, and only the refrigerant gas is transferred to the upper chamber. Moreover, an

outlet port of a refrigerant suction tube through which the refrigerant is sucked into the body is opened within the lower chamber, and an inlet port of a refrigerant discharge tube through which the refrigerant gas obtained by the gas-liquid separation in the desiccant layer is discharged out of the main body is opened within the upper chamber.

[0011] In the accumulator according to the present invention, the outlet port of the refrigerant suction tube is opened obliquely downward along a side surface of the main body.

[0012] In the accumulator according to the present invention, the refrigerant discharge tube is bent in a substantially U-shape and has an outlet port opened outside of the upper chamber 13, and the refrigerant discharge tube includes an oil return hole through which oil accumulated together with the refrigerant liquid is sucked, the oil return hole being formed in a bent part positioned in a bottom of the lower chamber.

[0013] In the accumulator according to the present invention, the desiccant layer is filled with desiccant particles inside and fixed by perforated metals which are provided above and below the same and include a plurality of ventilation holes to bring the upper and lower chambers in communication with each other and transfer only the refrigerant gas.

[0014] The accumulator according to the present invention further includes an oil separation layer which is provided in the lower chamber and separates the refrigerant liquid from the oil for accumulation, in which the oil separation layer is composed of a fiber or porous material.

Effects of the Invention

[0015] According to the aforementioned constitution, the outlet port of the refrigerant suction tube is opened within the lower chamber, and the inlet port of the refrigerant discharge tube is opened within the upper chamber which is separated from the lower chamber by the desiccant layer. Accordingly, the refrigerant liquid sucked through the refrigerant suction tube is not directly sucked into the inlet port of the refrigerant discharge tube. Moreover, even if the refrigerant liquid ruffles the inside of the lower chamber, the refrigerant liquid does not reach the inlet port of the refrigerant discharge tube. The refrigerant liquid is therefore not sucked into the compressor, and the damage of the compressor due to liquid or wet compression can be prevented.

[0016] Furthermore, the outlet port of the refrigerant suction tube is opened obliquely downward along the side surface of the main body. Accordingly, the refrigerant liquid and oil flown into the lower chamber are discharged along the side surface of the main body and flows in a circular motion toward the center. At this time, the oil with a high specific gravity is deposited in a lower part by centrifugation while the refrigerant liquid with a specific gravity lower than that of the oil is deposited in an upper part. Accordingly, the oil can be easily separated from the refrigerant liquid and can be surely returned to the compressor.

[0017] Still furthermore, the oil return hole is formed in the bent part positioned in the bottom of the lower chamber. Moreover, the refrigerant liquid and the oil sucked through the refrigerant suction tube into the lower chamber flow into the center of the lower chamber in a circular motion, and the oil with a high specific gravity is deposited in lower part by centrifugation while the refrigerant liquid with a low specific gravity is deposited in upper part. Accordingly, the oil deposited in the lower part of the lower chamber can be sucked through the oil return hole.

[0018] Still furthermore, the desiccant layer is fixed by the perforated metals provided above and below the same. Accordingly, the desiccant layer can be easily positioned while the gas ventilation between the upper and lower chambers is maintained.

[0019] Still furthermore, the oil separation layer is provided in the lower chamber. Accordingly, the refrigerant liquid and oil can be easily separated, and the oil can be surely returned to the compressor. In addition, the liquid surface at the interface between the liquid refrigerant and oil can be stabilized.

Brief Description of Drawings

[0020]

FIG. 1 is a schematic cross-sectional view of an accumulator according to a first embodiment.
FIG. 2 is a schematic cross-sectional view of an accumulator according to a second embodiment.
FIG. 3 is a schematic cross-sectional view of a conventional example of a general accumulator.

Explanation of Reference Numerals

[0021]

10, 20,	ACCUMULATOR
11,	TANK
12,	DESICCANT LAYER
13,	UPPER CHAMBER
14,	LOWER CHAMBER
15a, 15b, 15c,	PERFORATED METAL
16, 19,	REFRIGERANT SUCTION TUBE
16a, 19a,	INLET PORT (REFRIGERANT SUCTION TUBE)
16b, 19b,	OUTLET PORT (REFRIGERANT SUCTION TUBE)
17,	REFRIGERANT/OIL DISCHARGE TUBE
17a,	INLET PORT (REFRIGERANT/OIL DISCHARGE TUBE)
17b,	OUTLET PORT (REFRIGERANT/OIL DISCHARGE TUBE)
17c,	OIL RETURN HOLE
18,	OIL SEPARATION LAYER

Best Mode for Carrying out the Invention

[0022] Hereinafter, a description is given of embodiments of an accumulator according to the invention. In the following description, a gas-liquid mixed refrigerant is properly abbreviated to a refrigerant.

<First Embodiment>

[0023] FIG. 1 is a schematic cross-sectional view of an accumulator according to a first embodiment. An accumulator 10 of this embodiment includes a substantially cylindrical tank 11 as a main body and a desiccant layer 12 above the middle of the main body. This desiccant layer 12 divides the inside of the main body into upper and lower spaces. The upper space is partitioned as an upper chamber 13 in which refrigerant gas flows, and the lower space is partitioned as a lower chamber 14 in which refrigerant liquid and oil are accumulated.

[0024] The desiccant layer 12 is filled with particles of a desiccant inside and has functions of gas-liquid separation and moisture adsorption. This desiccant layer 12 is fixed at a predetermined position by perforated metals 15a and 15b arranged above and below the same. Each of these perforated metals 15a and 15b is formed into a circle in a plan view and includes a plurality of not-shown ventilation holes in the surface. The upper and lower chambers 13 and 14 communicate with each other through the desiccant layer 12. The desiccant layer 12 sandwiched by the perforated metals 15a and 15b transmits only refrigerant gas.

[0025] In the tank 11, a refrigerant suction tube 16, through which the gas-liquid mixed refrigerant is sucked into the tank 11, is provided substantially vertically so as to penetrate the desiccant layer 12 and perforated metals 15a and 15b. An inlet port 16a of the refrigerant suction tube 16 is opened to the outside from the upper part of the upper chamber 13 and is coupled to a refrigerant pipe connected to a not-shown internal heat exchanger. An outlet port 16b of the refrigerant suction tube 16 is opened in the lower chamber 14. The outlet port 16b is opened obliquely downward along the side surface of the tank 11. Accordingly, refrigerant liquid and oil contained in the refrigerant discharged from the outlet port 16b of the refrigerant suction tube 16 are discharged along the side surface of the tank 11 to flow toward the center in a circular motion as shown by a thick dashed arrow.

[0026] The tank 11 includes a refrigerant/oil discharge tube 17, through which the refrigerant gas obtained by gas-liquid separation of the desiccant layer 12 is discharged out of the tank 11. The refrigerant/oil discharge tube 17 is bent in a substantially U shape. An inlet port 17a thereof is opened within the upper chamber 13, and an outlet port 17b thereof is opened to the outside of the upper chamber 13 and coupled to a refrigerant pipe connected to a not-shown compressor. In the bent part of the refrigerant/oil discharge tube 17 positioned in the bottom of the lower chamber 14, an oil return hole 17c is formed, through which oil accumulated together with the refrigerant liquid is sucked.

[0027] In the accumulator 10 constituted as described above, the gas-liquid mixed refrigerant fed from the not-shown internal heat exchanger is sucked from the not-shown refrigerant pipe through the refrigerant suction tube 16 to the lower chamber 14. The refrigerant liquid and oil contained in the sucked gas-liquid mixed refrigerant are discharged along the side surface of the tank 11 and flow toward the center in a circular motion to be accumulated in the lower chamber 14. The refrigerant gas passes through the not-shown ventilation holes formed in the perforated metal 15b and the desiccant layer 12 and has moisture removed here. The refrigerant gas further passes through the upper perforated metal 15a and flows into the upper chamber 13.

[0028] The sucked gas-liquid mixed refrigerant is subjected to gas-liquid separation, and the refrigerant liquid and oil are accumulated in the lower chamber 14 while the refrigerant gas is flown into the upper chamber 13. The refrigerant gas flown into the upper chamber 13 is sucked from the inlet port 17a of the refrigerant/oil discharge tube 17 as shown by solid arrows and discharged to the refrigerant pipe connected to the not-shown compressor together with the oil.

[0029] On the other hand, the refrigerant liquid and oil sucked from the refrigerant liquid suction tube 16 to the lower chamber 14 flow toward the center of the lower chamber 14 in a circular motion. At this time, the oil with a high specific gravity is deposited in lower part (an area A) by centrifugation while the refrigerant liquid with a low specific gravity is deposited in upper part (an area B). The oil deposited in the lower part of the lower chamber 14 is sucked through the oil return hole 17c of the refrigerant/oil discharge tube 17 and discharged to the refrigerant pipe connected to the not-shown compressor together with the refrigerant gas.

[0030] In the accumulator 10 of the aforementioned first embodiment, the outlet port 16b of the refrigerant suction tube 16 is opened within the lower chamber 14, and the inlet port 17a of the refrigerant/oil discharge tube 17 is opened within the upper chamber 13 with the desiccant layer 12 interposed therebetween. Accordingly, the refrigerant liquid sucked through the refrigerant suction tube 16 is not directly sucked into the inlet port 17a of the refrigerant/oil discharge tube 17. Moreover, even if the refrigerant liquid flown into the chamber 13 ruffles the inside of the lower chamber 13, the refrigerant liquid does not reach the inlet port 17a of the refrigerant/oil discharge tube 17. Accordingly, the refrigerant liquid is not sucked into the compressor, and the damage of the compressor due to liquid and wet compression can be prevented.

[0031] In the first embodiment, moreover, the outlet port 16b of the refrigerant suction tube 16 is opened obliquely downward along the side surface of the tank 11. Accordingly, the refrigerant liquid and oil flown into the lower chamber 14 are discharged along the side surface

of the tank 11 and flown toward the center in a circular motion. At this time, the oil with a high specific gravity is deposited in the lower part while the refrigerant liquid with a specific gravity lower than that of the oil is deposited in the upper part. Accordingly, even when the oil is compatible with the refrigerant of carbon dioxide, the oil can be easily separated from the refrigerant liquid and can be surely returned to the compressor. The present invention thus has an effect on the case of using oil compatible with carbon dioxide refrigerant.

[0032] Furthermore, the desiccant layer 12 is provided above the middle of the main body, so that it is allowed to make enough space in the lower chamber 14 for the accumulated refrigerant liquid. Accordingly, it is possible to accumulate redundant refrigerant due to variations in load during cooling operation in a sufficient space.

[0033] The refrigerant gas warmed during operation of the refrigerating system is sucked by the accumulator 10, and the refrigerant liquid accumulated in the lower chamber 14 is exposed to heat of the refrigerant gas to be gasified. The gasified refrigerant passes through the desiccant layer 12 and is discharged through the refrigerant/oil discharge tube 17.

[0034] Moreover, the desiccant layer 12 is fixed by the perforated metals 15a and 15b provided above and below the same. Accordingly, the desiccant layer 12 can be easily positioned with ventilation maintained between the upper and lower chambers 13 and 14.

<Second Embodiment>

[0035] FIG. 2 is a schematic cross-sectional view of an accumulator according to a second embodiment. The second embodiment is described below with parts equivalent to those of the first embodiment given the same numerals.

[0036] The accumulator 20 of this embodiment includes an oil separation layer 18 in order to separately store the refrigerant liquid and oil. The oil separation layer 18 is supported in the substantially middle of the lower chamber 14 by a perforated metal 15c. The oil separation layer 18 is composed of a fiber material such as a felt material or a porous material such as sponge and has a function of separating oil from refrigerant liquid. The refrigerant liquid thus passes through the oil separation layer 18 (and the perforated metal 15c) to be accumulated in upper part of the lower chamber 14, and the oil is separated by the oil separation layer 18 and accumulated in lower part of the lower chamber 14.

[0037] A refrigerant suction tube 19 is provided substantially vertically so as to penetrate the desiccant layer 12 and perforated metals 15a and 15b. The inlet port 19a of the refrigerant suction tube 19 is opened to the outside form the upper part of the upper chamber 13 and is coupled to the refrigerant pipe connected to the not-shown internal heat exchanger. An outlet port 19b thereof is opened within the lower chamber 14.

[0038] In the constitution of the second embodiment, the refrigerant liquid sucked through the refrigerant suction tube 19 is not directly sucked into the inlet port 17a of the refrigerant/oil discharge tube 17. Moreover, even if the refrigerant liquid flown into the lower chamber 14 ruffles the inside of the lower chamber 14, the refrigerant liquid does not reach the inlet port 17a of the refrigerant/oil discharge tube 17. Accordingly, the refrigerant liquid is not sucked into the compressor, and the damage of the compressor due to the liquid or wet compression can be prevented.

[0039] In the second embodiment, furthermore, the oil separation layer 18 supported by the perforated metal 15c is provided in the substantially middle of the lower chamber 14. Even if the amount of refrigerant liquid and oil is too small to cause centrifugation unlike the first embodiment, accordingly, the refrigerant and oil can be more easily separated, and the oil can be surely returned to the compressor. In addition, the liquid surface at the interface between the refrigerant liquid and oil can be stabilized.

[0040] Furthermore, in addition to the aforementioned effects, the part of the constitution of the second embodiment similar to that of the first embodiment can provide similar effects.

Industrial Applicability

[0041] The present invention can be applied to not only refrigerating cycles of air conditioners for vehicles but also refrigerating cycles of a wide range of air conditioners.

Claims

1. An accumulator comprising:

a main body; and
a desiccant layer (12) which is provided above a middle of the main body to divide the main body into upper and lower chambers (13, 14); wherein
a gas-liquid mixed refrigerant sucked into the lower chamber (14) is subjected to gas-liquid separation in the desiccant layer (12),
only the refrigerant gas is transferred to the upper chamber (13),
an outlet port (16b) of a refrigerant suction tube (16) through which the refrigerant is sucked into the body is opened within the lower chamber (14); and
an inlet port (17a) of a refrigerant discharge tube (17) through which the refrigerant gas obtained by the gas-liquid separation in the desiccant layer (12) is discharged out of the main body is opened within the upper chamber (13).

2. The accumulator according to claim 1, wherein

the outlet port (16b) of the refrigerant suction tube (16) is opened obliquely downward along a side surface of the main body.

3. The accumulator according to claim 1 or 2, wherein the refrigerant discharge tube (17) is bent in a substantially U-shape and has an outlet port (17b) opened outside of the upper chamber 13, and
the refrigerant discharge tube (17) includes an oil return hole (17c) through which oil accumulated together with the refrigerant liquid is sucked, the oil return hole being formed in a bent part positioned in a bottom of the lower chamber (14).

4. The accumulator according to any one of claims 1 to 3, wherein the desiccant layer (12) is filled with desiccant particles inside and fixed by perforated metals (15a, 15b) which are provided above and below the same and include a plurality of ventilation holes to bring the upper and lower chambers (13, 14) in communication with each other and transfer only the refrigerant gas.

5. The accumulator according to any one of claims 1, 3, and 4, further comprising:

an oil separation layer (18) which is provided in the lower chamber (14) and separates the refrigerant liquid from the oil for accumulation, wherein
the oil separation layer (18) is composed of a fiber or porous material.

FIG. 1

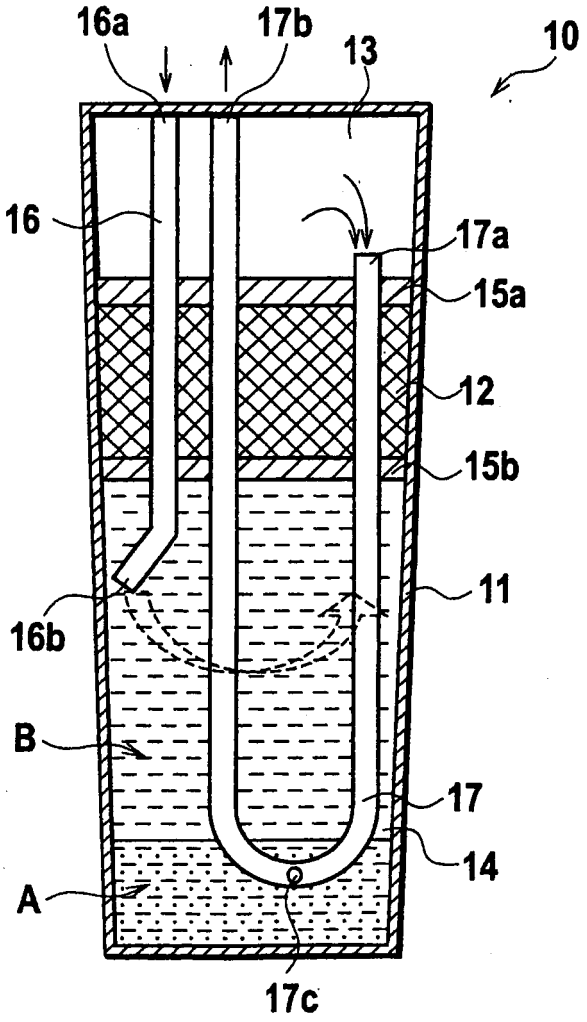


FIG. 2

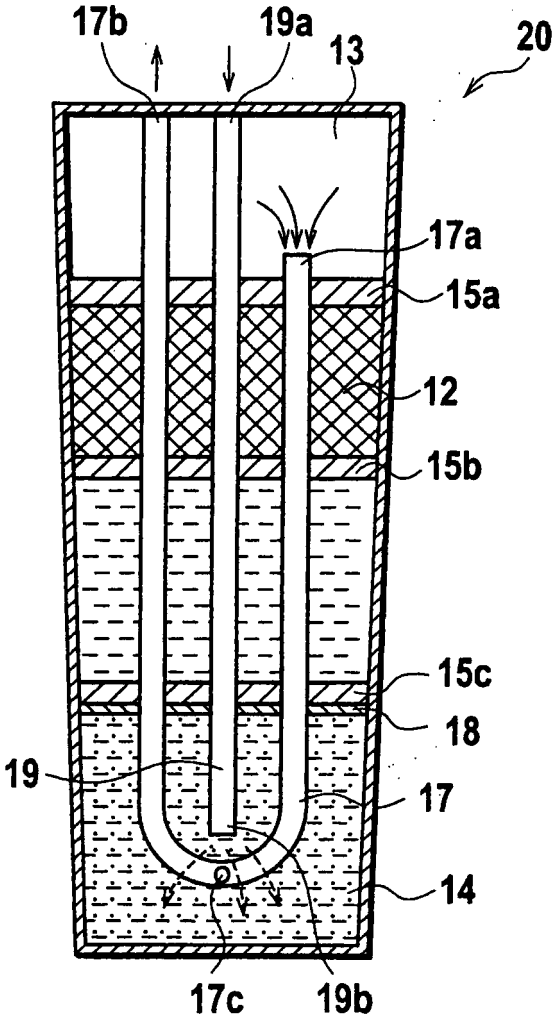
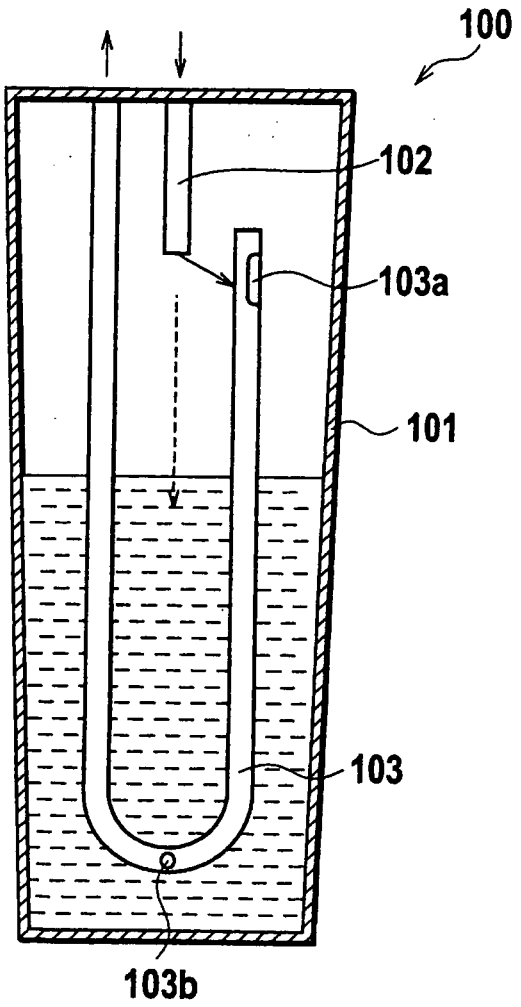


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/325587

A. CLASSIFICATION OF SUBJECT MATTER
F25B43/00(2006.01)i, *F25B43/02*(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)
F25B43/00, F25B43/02

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 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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 11-201588 A (Matsushita Refrigeration Co.), 30 July, 1999 (30.07.99), Par. Nos. [0066] to [0075]; Fig. 4 (Family: none)	1-4
Y	JP 2000-356439 A (Denso Corp.), 26 December, 2000 (26.12.00), Par. Nos. [0055] to [0059]; Fig. 7 (Family: none)	1-4
A	JP 11-14201 A (Matsushita Refrigeration Co.), 22 January, 1999 (22.01.99), Full text; Figs. 1 to 3 (Family: none)	5

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

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Date of the actual completion of the international search	Date of mailing of the international search report
18 January, 2007 (18.01.07)	30 January, 2007 (30.01.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/325587

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001-12827 A (Bosch Automotive Systems Corp.), 19 January, 2001 (19.01.01), Full text; Figs. 1 to 3 (Family: none)	1-5

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 10232071 A **[0006] [0008]**