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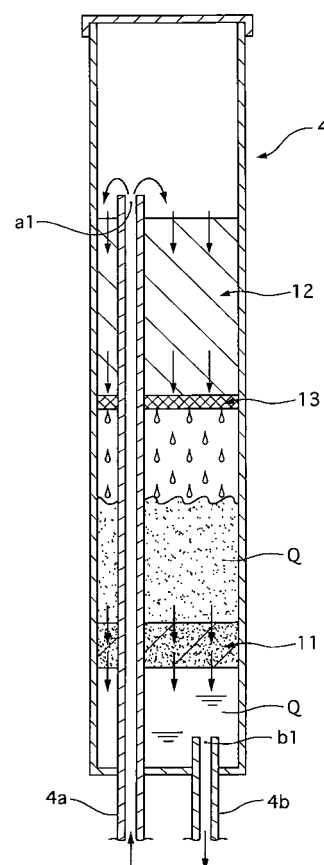
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(54) **LIQUID TANK STRUCTURE FOR HEAT EXCHANGER**

(57) In a liquid tank structure of a heat exchanger, a liquid tank 4 is attached to a heat exchanger having a heat exchanger core defining a condensation part AC and an under cooling part BC, and a pair of headers 1 and 2 each having an inlet part R1, R2 connected with the condensation part AC and an outlet part R3, R4. The condensed refrigerant from the inlet part R2 flows in the liquid tank 4 through an inlet port 1a of an inlet-port side connecting pipe 4a connected with the inlet part R2 of one header 2 of the pair of header. The condensed refrigerant Q accumulated in a bottom portion of the liquid tank 4 is discharged to the outlet part R3 through an outlet port b1 of an outlet-port side connecting pipe 4b connected with the outlet part R3 at a position under an inlet port a1. A sloshing suppression member 11, for suppressing a sloshing of the condensed refrigerant Q accumulated in the bottom portion of the liquid tank 4, has a passing-through ability of the condensed refrigerant and is provided in an inner space of the liquid tank 4 between the inlet port a1 and the outlet port b1.

FIG. 4



Description

[TECHNICAL FIELD]

[0001] The present invention relates to a liquid tank structure of a heat exchanger which is mounted on a motor vehicles and the like.

[BACKGROUND OF THE INVENTION]

[0002] Conventional liquid tank structures of heat exchangers are disclosed in Japanese Patents Laid-open No. (Tokkaihei) 11 - 316064 and No. 2000 - 46444. In these liquid tank structures, a heat exchange core, which includes a condensation part and an under cooling part, is provided with a pair of headers which fluidically connects the condensing part and the under cooling part. One of the headers is defined into an inlet part and an outlet part, where the inlet part is provided with an inlet port to be fluidically connected with the condensing part, and the outlet part is provided with an outlet port to be fluidically connected with the under cooling part. The other of the headers is defined into an inlet part and an outlet part, where the inlet part is fluidically connected with the under cooling part, being provided with an inlet side connecting pipe which is fluidically connected with an outlet port of a liquid tank, and an outlet part is fluidically connected with the condensation part, being provided with an outlet side connecting pipe which is fluidically connected with an inlet port of the liquid tank.

Incidentally, the liquid tank is constructed so that it separates gas and liquid of condensed refrigerant, which enters through the inlet port provided on an upper portion inside of the liquid tank, to move in an upward direction and a downward direction, respectively, so as to discharge the condensed refrigerant which is accumulated on a lower portion thereof to the under cooling part through the outlet port.

[DISCLOSURE OF THE INVENTION]

[PROBLEM(S) TO BE SOLVED BY THE INVENTION]

[0003] In the conventional liquid tank structures of the heat exchangers, as shown in FIG. 10, the inlet portion 101 of the condensed refrigerant is located at a position higher than that of the outlet portion 102 in order to separates its gas and liquid, which causes the condensed refrigerant to course into an inner space of the liquid tank through the inlet portion 101. This hard fall of the condensed refrigerant disturbs a liquid surface of the condensed refrigerant 130 which is accumulated in a bottom portion of the liquid tank 100. This causes a problem in that the condensed refrigerant 100, which is accumulated in the bottom portion of the liquid tank 100, is discharged to the under cooling part in a white turbidity state where the condensed refrigerant 103 contains the gas because the gas and the liquid thereof are remixed up due to the

hard fall.

[0004] As a result, as shown in FIG. 5, in an examination to determine the optimum charge quantity of the refrigerant, there is tendency that a large charge quantity of refrigerant is needed in order to obtain an under cooling rate, as shown y a solid line LC2 relative to an optimum line LC1 indicated by a broken line, where a horizontal axis indicates an enclosed capacity of the refrigerant and a vertical axis indicates an under cooling rate. Accordingly, in the conventional liquid tank structure, there is a problem in that the enclosed capacity of the refrigerant increases too much, thereby increasing a consumption amount of the refrigerant which causes environmental problems in recent years.

[0005] The present invention is made in order to solve the above described problem, and its object is to provide a liquid tank of a heat exchanger which can decrease a charge quantity of refrigerant by preventing the refrigerant from being sent to an under cooling part in a state where condensed refrigerant is unsufficiently separated into a gas and a liquid, due to a disturbance of a liquid surface of the condensed refrigerant.

[MEANS FOR SOLVING THE PROBLEMS]

[0006] A liquid tank structure of a heat exchanger according to the present invention is attached to a heat exchanger which has a heat exchange core which is divided into a condensation part and an under cooling part, and a pair of headers each having an inlet part fluidically connected with the condensation part and an outlet part fluidically connected with the under cooling part, to separate condensed refrigerant into a gas and a liquid. The liquid tank structure includes: an inlet-port side connecting pipe fluidically connected with the inlet part of one header of the pair of headers, the inlet-port side connecting portion being formed with an inlet port for flowing the condensed refrigerant into an inner space of a liquid tank; through the inlet part; an outlet-port side connecting pipe fluidically connected with the outlet part of the one header, the outlet-port side connecting pipe being formed with an outlet port under the inlet port so that the condensed refrigerant which is accumulated in a bottom portion of the liquid tank can be discharged to the outlet part; and a sloshing suppression member arranged in the liquid tank between the inlet port and the outlet port, the sloshing suppression member allowing the condensed refrigerant to pass through the sloshing suppression member and suppressing a sloshing of the condensed refrigerant which is accumulated in the bottom portion of the liquid tank.

[EFFECT OF THE INVENTION]

[0007] In the liquid tank structure of the invention, the sloshing suppression member is arranged in the inner space of the liquid tank between the inlet port and the outlet port for suppressing the condensed refrigerate ac-

accumulated in the bottom portion of the liquid tank. Therefore, even when the condensed refrigerate which causes through the inlet part falls on the condensed refrigerate accumulated in the bottom portion of the liquid tank to disturb a liquid surface, the liquid surface is calmed down while and after the condensed refrigerant passes through the sloshing suppression member with the passing-through ability, and consequently its gas and its liquid are more surely separated from each other, only the condensed refrigerate is sent to the under cooling part through the outlet part.

[0008] Therefore, the liquid tank structure of the invention can prevent the condensed refrigerant from being sent to the under cooling part in a state where its gas and its liquid are unsufficiently separated from each other, due to a disturbance of the liquid surface of the condensed refrigerate in the liquid tank, and thereby it can obtain the effect in decreasing a necessary amount of the refrigerant.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0009]

FIG. 1 is an entire front view showing a condenser to which a liquid tank structure of a heat exchanger, of a first embodiment according to the present invention, is applied;

FIG. 2 is an enlarged cross sectional view showing a connector portion of the liquid tank structure of the heat exchanger of the first embodiment shown in FIG. 1;

FIG. 3 is an enlarged cross sectional view showing a connector of the liquid tank structure of the heat exchanger of the first embodiment shown in FIG. 1;

FIG. 4 is an enlarged cross sectional view showing a liquid tank which corresponds to a main part of the liquid tank structure of the heat exchanger of the first embodiment shown in FIG. 1;

FIG. 5 is a characteristic diagram showing relationships between refrigerant enclosed capacity and under cooling rate, which are comparatively indicated by an optimally set line and a conventional structure's line;

FIG. 6 is a cross sectional view showing a liquid tank as a main part of a liquid tank structure of a heat exchanger to which a connector, of a second embodiment of the present invention, is applied;

FIG. 7 is a cross sectional view showing a liquid tank as a main part of a liquid tank structure of a heat exchanger to which a connector, of a third embodiment of the present invention, is applied;

FIG. 8 is a cross sectional view showing a liquid tank as a main part of a liquid tank structure of a heat exchanger to which a connector, of a fourth embodiment of the present invention, is applied; and

FIG. 9 is a cross sectional view showing a conventional liquid tank structure of a heat exchanger.

[DESCRIPTION OF REFERENCE NUMBER]

[0010]

R1	first room
R2	second room
R3	third room
R4	fourth room
1	header
2	header
3	condenser core (core of heat exchanger)
3a	tube
3b	fin
4	liquid tank
4a	inlet-port side connecting pipe
4b	outlet-port side connecting pipe
5	partition part
6	partition part
7	bracket
8	connecting pipe
9a	reinforcement
9b	reinforcement
10a	inlet port
10b	outlet port
10c	fixing hole
11	sloshing suppression member
12	drying agent
13	filter
a1	opening portion (inlet port)
b1	opening portion (outlet port)

[BEST MODE FOR CARRYING OUT THE INVENTION]

[0011] Hereinafter, embodiments according to the present invention will be described with reference to the accompanying drawings.

[FIRST EMBODIMENT]

[0012] Hereinafter, a liquid tank structure of a heat exchanger of a first embodiment according to the present invention will be described.

Incidentally, the liquid tank structure of the heat exchanger of the first embodiment is applied to a liquid tank which is mounted on a motor vehicle. Herein, a condenser corresponds to the heat exchanger of the present invention.

[0013] First, an entire structure of the heat exchanger with the liquid tank structure of the first embodiment will be described.

As shown in FIG 1, the liquid tank structure of the heat

exchanger of the first embodiment has a pair of headers 1 and 2, a condenser core 3 and a liquid tank 4.

[0014] The condenser core 3 is constructed by a plurality of tubes 3a and a plurality fins 3b, which are piled alternately to each other, and it is arranged between the pair of headers 1 and 2. The headers 1 and 2 are arranged at a right side and a left side, respectively, and their detail structure will later be described. Both end portions of each tube 3a are inserted into and fixed to the corresponding headers 1 and 2, respectively. Incidentally, the condenser core 3 corresponds to a heat exchanger core of the present invention.

[0015] The headers 1 and 2 are formed like a circular cylinder, and each of their inner spaces are divided by partition parts 5 and 6, which are indicated by dotted lines in FIG. 1, to form a first room R1 to a fourth room R4.

[0016] The first room R1 of the header 1 and the second room R2 of the header 2 are fluidically connected with a condensation part AC which are an upper portion of the condenser, and the third room R3 of the header 2 and the fourth room R4 of the header 1 are fluidically connected with an under cooling part BC which is a lower portion of the condenser.

[0017] In addition, the headers 1 and 2 are connected with each other by a pair of upper reinforcement 9a and lower reinforcement 9b, between their upper portions and between their lower portions.

Further, the upper portion of the header 1 is provided with a connector 10, which will later be described.

[0018] As shown in FIG. 2 and FIG. 3, the connector 10 is made of aluminum to entirely form like a rectangular shape. It is provided with an inlet port 10a formed to penetrate like a straight duct, an outlet port 10b formed to penetrate like a bent shape like a letter L, and a fixing hole 10c for fixing a not-shown motor-vehicle side connector.

[0019] In addition, the inlet port 10a of the connector 10 is fluidically communicated with the first room R1 of the header 1, while the outlet port 10b thereof is fluidically communicated with the fourth room R4 of the header 1 through the connecting pipe 8. Herein, the first room R1 of the header 1 corresponds to an inlet part of the present invention, and the fourth room R4 of the header 1 corresponds to an outlet part of the present invention.

[0020] Further, the connector 10 is fixed to the header 1 by brazing in a state where an end portion of its fit-in portion 10e forming the inlet port 10a therein is inserted into and fixed into a through hole 1a formed in the header 1.

[0021] On the other hand, as shown in FIG. 1, the liquid tank 4 is fixed to the header 2 through a bracket 7, where an inlet-port side connecting pipe 4a is fluidically connected between the liquid tank 4 and a bottom side of the second room R2 of the header 2, and an outlet-port side connecting pipe 4b is fluidically connected between the liquid tank 4 and an upper side of the third room R3 of the header 2. Herein, the second room R2 of the header 2 corresponds to the inlet part of the present invention,

and the third room R3 of the header 2 corresponds to the outlet part of the present invention.

[0022] As shown in FIG. 4, the liquid tank 4 is formed like a long circular cylinder in a vertical direction and along the header 2. A bottom portion thereof is fluidically connected with the inlet-port side connecting pipe 4a and the outlet-port side connecting pipe 4b.

[0023] The inlet-port side connecting pipe 4a, which is fluidically connected with the second room R2 of the header 2, is inserted into an inner space of the liquid tank 4 deeply in an upper direction so that its opening formed at a top portion of the connecting pipe 4a opens into the inner space of the liquid tank 4 near a top end portion of the liquid tank 4. On the other hand, the outlet-port side connecting pipe 4b, which is fluidically connected with the third room R3 of the header 2, opens into the inner space near a bottom portion of the liquid tank 4.

[0024] In addition, in the liquid tank 4, between an opening a1 of the inlet-port side connecting pipe 4a and the outlet-port side connecting pipe 4b, there is provided a sloshing suppression member 11, which has a passing-through ability of the refrigerant, for suppressing a sloshing of condensed refrigerant Q accumulated in the bottom portion of the liquid tank 4.

Further, in this embodiment, the sloshing suppression member 11 is installed at a position slightly upper than the opening portion b1 of the outlet-port side connecting pipe 4b so that the condensed refrigerant Q can normally be accumulated over and above the opening b1. Incidentally, the opening portion a1 of the inlet-port side connecting pipe 4a corresponds to an inlet port of the present invention, and the opening portion b1 of the outlet-port side connecting pipe 4b corresponds to an outlet port of the present invention.

[0025] In addition, the sloshing suppression member 11 is constructed by a solid cylinder that allows the condensed refrigerant Q to flow through the sloshing suppression member 11 from its upper side to its lower side, such as a felt member having a predetermined thickness in the vertical direction, a laminate body of multiple fine meshes and a scrubber-like member formed by intertwining metal wires.

Further, in the inner space of the liquid tank 4, there provided a desiccating agent 12 and a filter above the sloshing suppression member 11.

[0026] Next, the operation of the liquid tank structure of the first embodiment will be described.

[0027] Since the liquid tank structure of the first embodiment is constructed as described above, the refrigerant, which enters the first room R1 of the header 1 through the inlet port 10a of the connector 10 at a temperature of approximately 80°C as indicated by broken lined arrows X in FIG. 2, changes its heat through the fins 3b to be condensed between the refrigerant and wind forcibly sent by a motor fan or wind generated when the motor vehicle is running, while the refrigerant flows through the tubes 3a connecting the first room R1 and the second room R2. Then the refrigerant flows into the

second room R2 of the header 2. Incidentally, the tubes 3a connecting the first room R1 and the second room R2 correspond to a condensation part AC of the present invention.

[0028] Then, the refrigerant in the second room R2 of the header 2 enters the upper portion of the liquid tank 4 through the inlet-port side connecting pipe 4a, where it is gas-liquid separated. After its separation, the refrigerant flows into the third room 3 of the header 2 through the outlet-port side connecting pipe 4b.

[0029] Then, the refrigerant in the third room R3 of the header 2 changes its heat through the fins 3b down to a temperature of approximately 40°C between the refrigerant and the wind generated by the fan or the wind generated when the vehicle running, while it flows through the tubes 3a connecting the third room R3 and the forth room R4. After cooling, the refrigerant enters the forth room R4 of the header 1. Incidentally, the tubes 3a connecting the third room R3 and the fourth room R4 corresponds to an under cooling part BC of the present invention.

[0030] Then, the refrigerant is discharged from the connecting pipe 8 to a not-shown expansion valve through the outlet port 10b of the connector 10 as indicated by a broken lined arrow Y in FIG. 2.

[0031] Next, the operation and the effect of the sloshing suppression member 11 that is arranged in the inner space of the liquid tank 4 will be described.

The condensed refrigerant, which flows into the liquid tank 4 through the inlet-port side connecting pipe 4a at the upper portion of the liquid tank 4, flows through the desiccating agent 12, the filter 13 and the sloshing suppression member 11 in these order, falling downward, and is accumulated in the bottom portion of the liquid tank 4 in a state where its gas and its liquid are separated from each other. Then, the refrigerant flows to the under cooling part BC through the outlet-port side connecting pipe 4b and the third room R3 of the header 2.

[0032] The condensed refrigerant, which courses into the liquid tank through the inlet-port side connecting pipe 4a, is slowed down by passing through desiccating agent 12, the filter 13, and then the sloshing suppression member 11 at downward thereof, thereby the sloshing, due to the falling condensed refrigerant, of the surface of the condensed refrigerant which is accumulated in the bottom portion of the liquid tank 4 being suppressed. Therefore, the gas and the liquid thereof can surely be separated, and only the condensed refrigerant Q is sent to the under cooling part BC from the outlet-port side connecting pipe 4b through the third room R3 of the header 2. Thus, the sloshing suppression member 11 is has a solid cross section, and accordingly it can absorb the sloshing of the liquid surface generated due to falling of the condensed refrigerant Q.

[0033] Therefore, the condensed refrigerant is prevented from being sent to the under cooling part BC in a state where the gas and the liquid thereof are unsufficiently separated from each other because of the slosh-

ing of the liquid surface of the condensed refrigerant in the liquid tank 4.

[0034] Consequently, in a test to determining an optimum enclosed capacity D of the refrigerant, the enclosed capacity D can be set to be a necessity minimum amount, namely within a range meeting a condition $D_1 < D < D_2$, according to an optimum line indicated by a dot line in FIG. 5. Obviously, the enclosed capacity can be set within the range of D1 to D3, while its range can be set to enlarge according to a specification of the condenser, relative to a range (D2 to D3 of the conventional liquid tank structure.

[0035] Next, the other embodiments according to the present invention will be described. In these embodiments, descriptions of parts or portions different from those of FIG. 1 will be made, these parts and portions similar to the first embodiment being omitted in the drawings or being illustrated with the same reference number, and their descriptions being omitted.

[SECOND EMBODIMENT]

[0036] In a liquid tank structure of a heat exchanger of a second embodiment, as shown in an enlarged cross section view of a main part of a liquid tank of FIG. 6, the second embodiment is different from the first embodiment in that a sloshing suppression member 11 is arranged in a bottom portion of the liquid tank 4, and also in that the sloshing suppression member 11 is directly connected with an opening portion b 1 formed on an end portion of an outlet-port side connecting pipe 4b. The other parts and portions of the second embodiment is constructed similarly to those of the first embodiment.

[0037] This means that, in the liquid tank structure of the second embodiment, falling condensed refrigerant passes through the sloshing suppression member 11, and then it is directly sent to an under cooling part BC through the outlet-port side connecting pipe 4b and the third room R3 of a header 2.

Accordingly, the liquid tank structure of the second embodiment can obtain the effects similar to those of the first embodiment.

[THIRD EMBODIMENT]

[0038] In a liquid tank structure of a third embodiment, it is different from the first and second embodiments in that a sloshing suppression member 11 is partially arranged in a state where the sloshing suppression member 11 covers an opening portion of an outlet-port side connecting pipe 4b while it does not cover all are of a bottom portion of a liquid tank. The other parts and portions of the third embodiment are constructed similarly to those of the first embodiment.

[0039] This means that, in the liquid tank structure of the third embodiment, falling condensed refrigerant passes through the sloshing suppression member 11, and then it is directly sent to an under cooling part BC

through the outlet-port side connecting pipe 4b and the third room R3 of a header 2. Accordingly, the liquid tank structure of the third embodiment can also obtain the effects similar to those of the second embodiment.

[FOURTH EMBODIMENT]

[0040] In the above-described liquid tank structures of the first to third embodiments, they are constructed so that condensed refrigerant Q can accumulate above a sloshing suppression member 11, while in a liquid tank structure of a fourth embodiment, the sloshing suppression member 11 is set to be at an installation position and have a passing-through ability of the condensed refrigerant so that the condensed refrigerant falls directly on an upper surface of the sloshing suppression member 11 and it does not accumulate thereon.

[0041] In the liquid tank structure of the fourth embodiment, the sloshing of a liquid surface of the condensed refrigerant accumulated under the sloshing suppression member 11 is suppressed, and then it is separated into a gas and a liquid, where only the condensed refrigerant is sent to an under cooling part BC through an outlet-port side connecting pipe 4b and a third room R3 of a header 2. As a result, the liquid tank structure of the fourth embodiment can also obtain the effects similar to those of the first embodiment.

[FIFTH EMBODIMENT]

[0042] Although the condensed refrigerant falls on the condensed refrigerant Q accumulated on the upper surface of the sloshing suppression member 11 in the first to third embodiments, in the liquid tank structure of the fifth embodiment, as shown in FIG. 9, an inlet-port side connecting pipe 4a is connected with a lower side wall of a liquid tank so that condensed refrigerant discharged from the connecting pipe 4a can flow into the condensed refrigerant Q accumulated on an upper surface of a sloshing suppression member 11 in a horizontal surface direction. In addition, an out-let side connecting pipe 4a is also connected with the lower side wall at a position under the inlet-port side connecting pipe 4a, heading in the horizontal surface direction. Incidentally, a filter 13 is removed, while the other parts and portions are constructed similarly to those of the first embodiment.

[0043] In the liquid tank structure of the fifth embodiment, the condensed refrigerant does not directly flow downward through the inlet-port side connecting pipe 4a, and it enters the condensed refrigerant Q, which is accumulated on the upper surface of the sloshing suppression member 11, heading substantially in the horizontal surface direction. Therefore, the sloshing of the liquid surface of the condensed refrigerant Q is suppressed relative to that in a case where the condensed refrigerant falls on the upper surface of the accumulated condensed refrigerant Q. In addition, the accumulated condensed refrigerant is surely separated into a gas and a liquid

when it passes through the sloshing suppression member 11, and then it is accumulated under the sloshing suppression member 11. The accumulated condensed refrigerant Q is sent to an under cooling part BC through the outlet-port side connecting pipe 4b and a third room R3 of a header 2.

As a result, the liquid tank structure of the fifth embodiment can also obtain the effects similar to those of the first embodiment.

[0044] While the embodiments have been described above, the invention is not limited to the above described embodiments, its modifications and its design changes are contained in the invention as long as they depart from the subject matter of the invention.

In the liquid tank structures of the above described first to fifth embodiments, they have only one path having a flow (a flow in an one-way direction) of the condensed refrigerant Q in the condensation part AC of the condenser core 3, while they may have a plurality of paths (at least one round trip flow).

In addition, the heat exchanger is not limited to the condenser, and the liquid tank structure of the invention may be adapted for others except motor vehicles.

[Industrial APPLICABILITY]

[0045] The invention can be adapted for a liquid tank necessary for separating condensed refrigerant into a gas and a liquid between an inlet port and an outlet port of a liquid tank of a heat exchanger for a motor vehicle and the like.

Claims

1. A liquid tank structure of a heat exchanger attached to a heat exchanger which has a heat exchange core which is divided into a condensation part and an under cooling part, and a pair of headers each having an inlet part fluidically connected with the condensation part and an outlet part fluidically connected with the under cooling part, to separate condensed refrigerant into a gas and a liquid, the liquid tank structure comprising:

an inlet-port side connecting pipe fluidically connected with the inlet part of one header of the pair of headers, the inlet-port side connecting portion being formed with an inlet port for flowing the condensed refrigerant into an inner space of a liquid tank; through the inlet part;
an outlet-port side connecting pipe fluidically connected with the outlet part of the one header, the outlet-port side connecting pipe being formed with an outlet port under the inlet port so that the condensed refrigerant which is accumulated in a bottom portion of the liquid tank can be discharged to the outlet part; and

a sloshing suppression member arranged in the liquid tank between the inlet port and the outlet port, the sloshing suppression member allowing the condensed refrigerant to pass through the sloshing suppression member and suppressing a sloshing of the condensed refrigerant which is accumulated in the bottom portion of the liquid tank. 5

2. The liquid tank structure of the heat exchanger according to claim 1, wherein the sloshing suppression member is solid and has a passing-through ability of the condensed refrigerant. 10
3. The liquid tank structure of the heat exchanger according to claim 1 or claim 2, wherein the sloshing suppression member is one of a felt member, a laminate body of multiple fine meshes and a scrubber-like member formed by intertwining metal wires 15 20
4. The liquid tank structure of the heat exchanger according to any one of claim 1 to claim 3, wherein the sloshing suppression member extends to a position under the outlet port to cover at least the outlet port of the outlet-port side connecting pipe and to be capable of accumulating the condensed refrigerant at least at an upper side of the sloshing suppression member. 25 30
5. The liquid tank structure of the heat exchanger according to any one of claim 1 to claim 3, wherein the sloshing suppression member is located at a position over the outlet port to be capable of accumulating the condensed refrigerant on an upper side and a lower side of the sloshing suppression member in the bottom portion. 35
6. The liquid tank structure of the heat exchanger according to any one of claim 1 to claim 6, wherein the inlet port flows the condensed refrigerant in a horizontal surface direction into an inner portion of the inner space which is at an upper side of the sloshing suppression member 40 45
7. The liquid tank structure of the heat exchanger according to any one of claim 1 to claim 3, wherein the sloshing suppression member is located at a position over the outlet port to be capable of accumulating the condensed refrigerant only at a position under the sloshing suppression member. 50

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FIG. 1

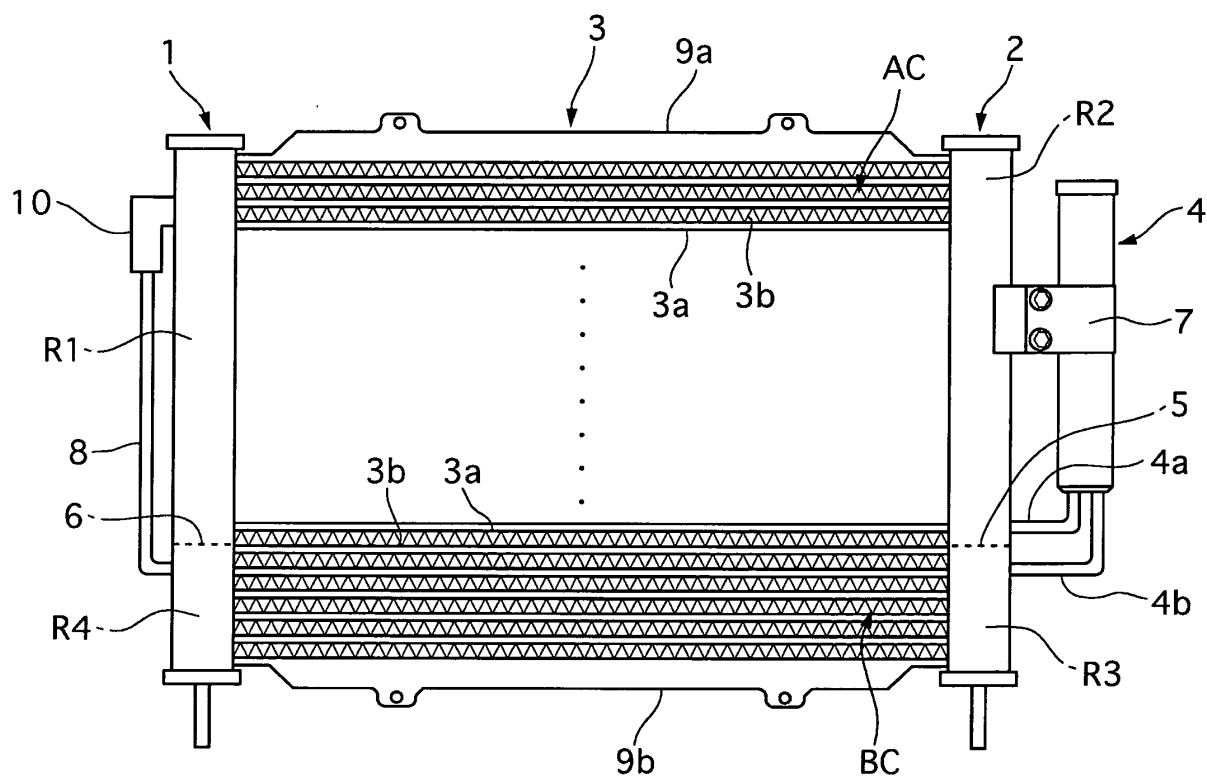


FIG. 2

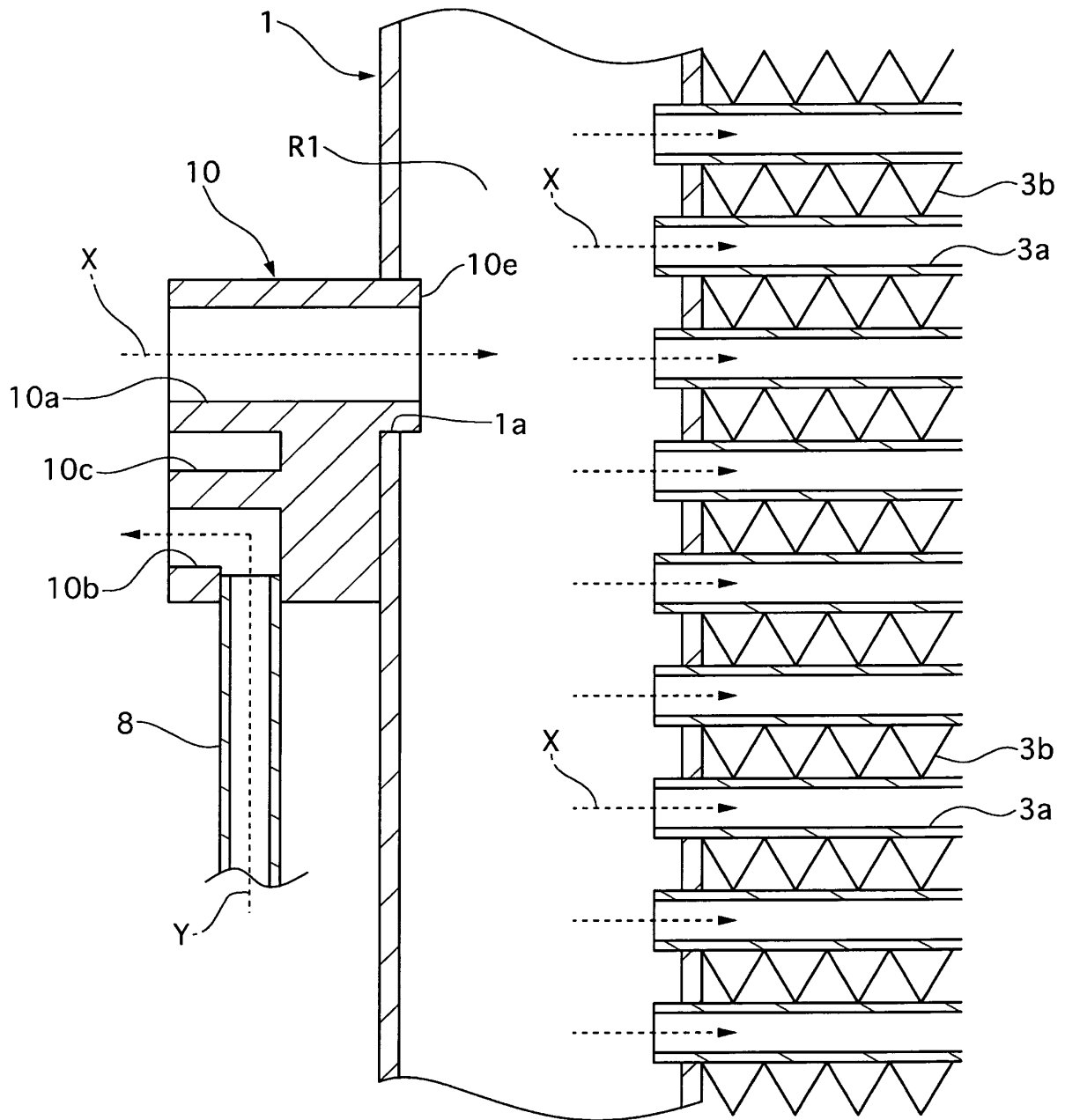


FIG. 3

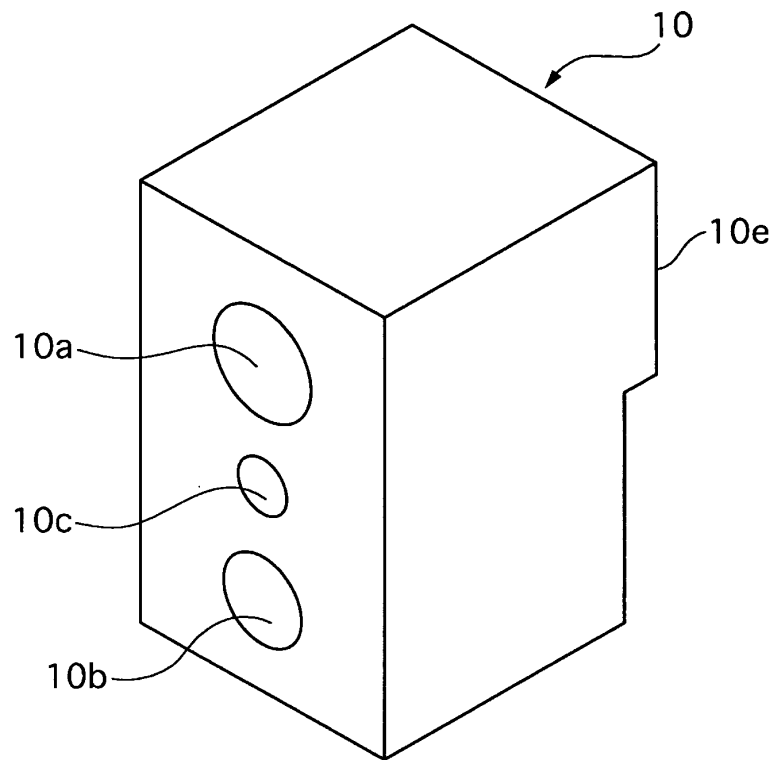


FIG. 5

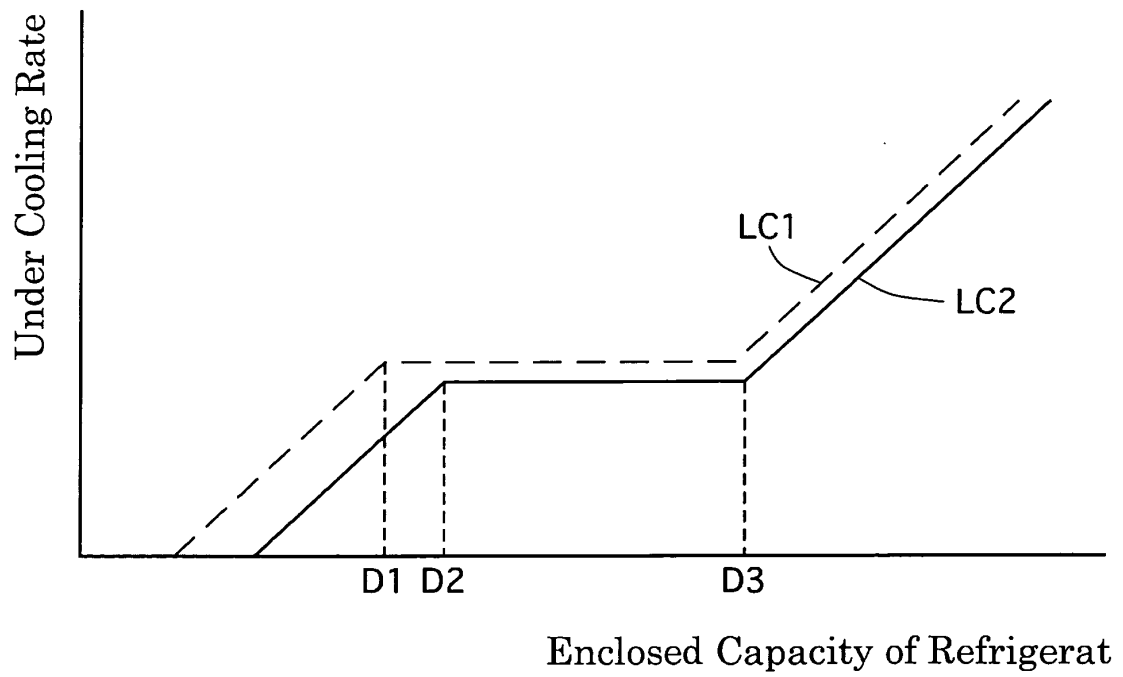


FIG. 4

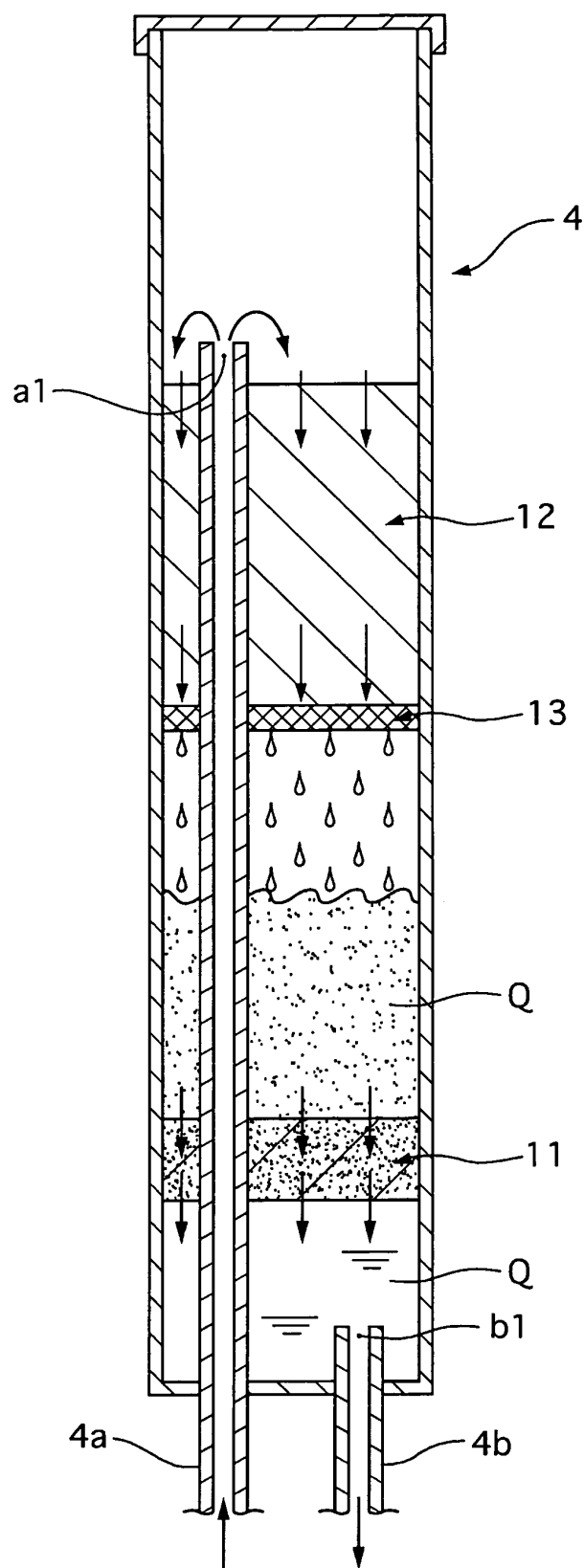


FIG. 6

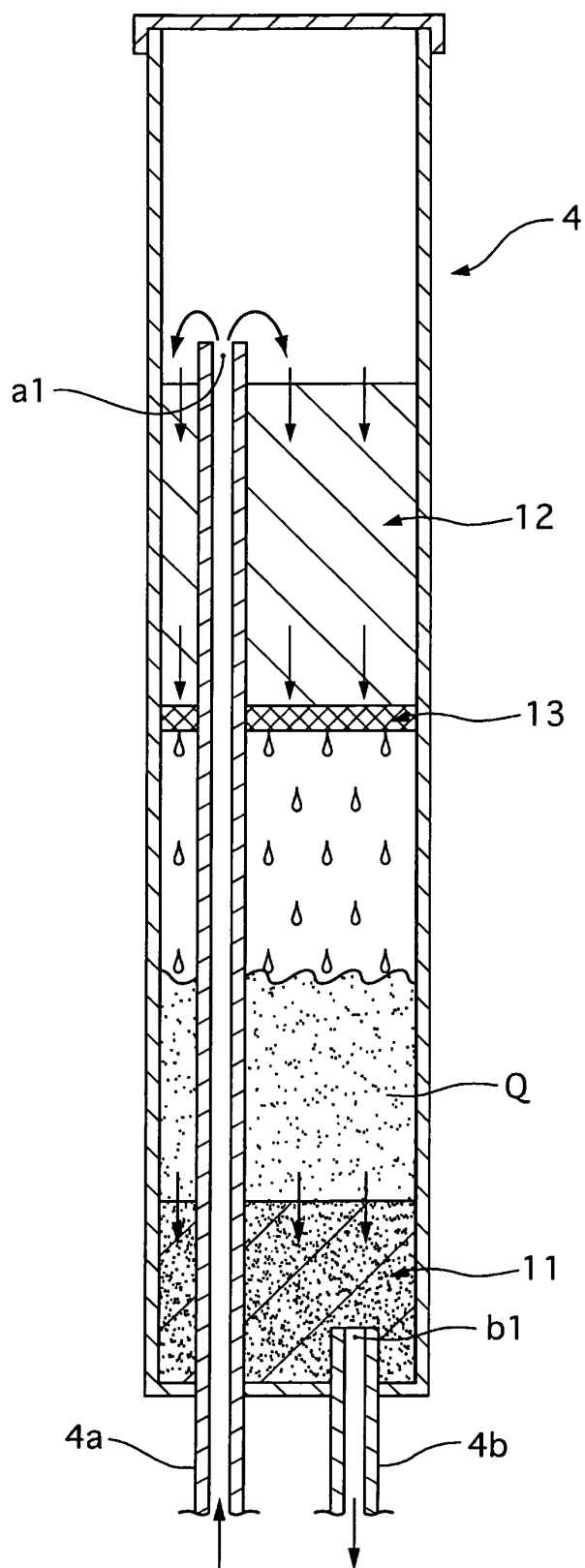


FIG. 7

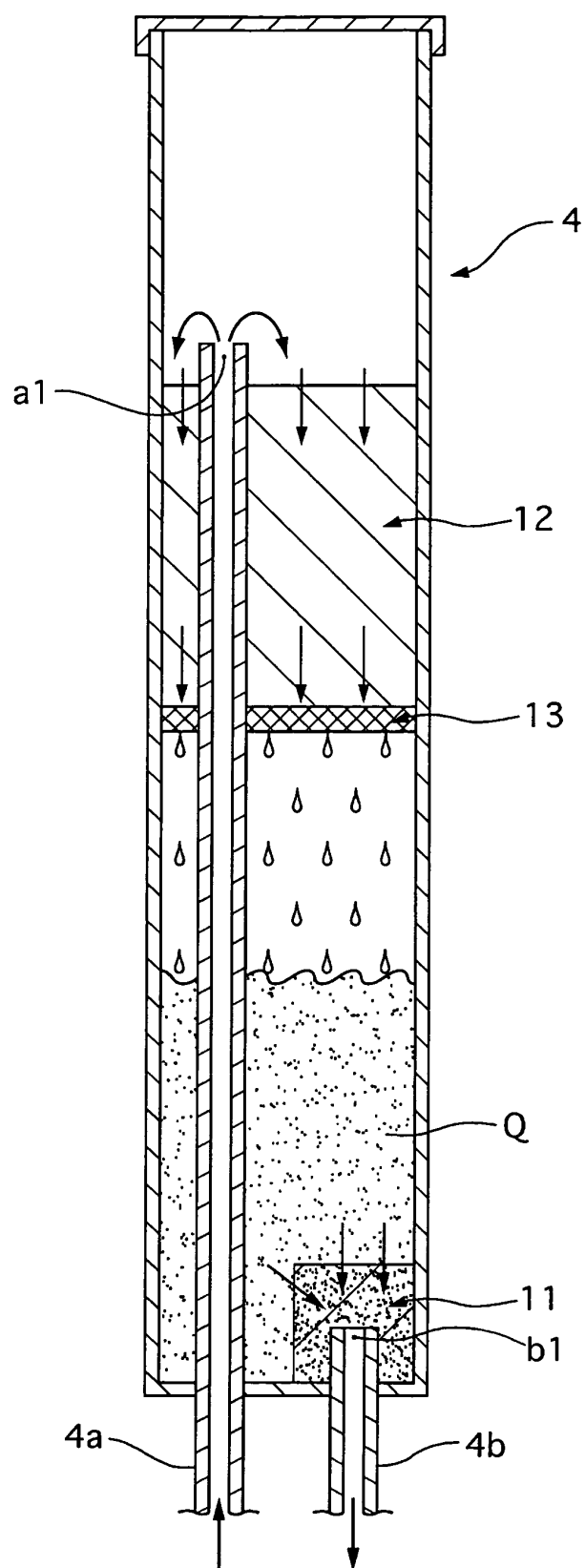


FIG. 8

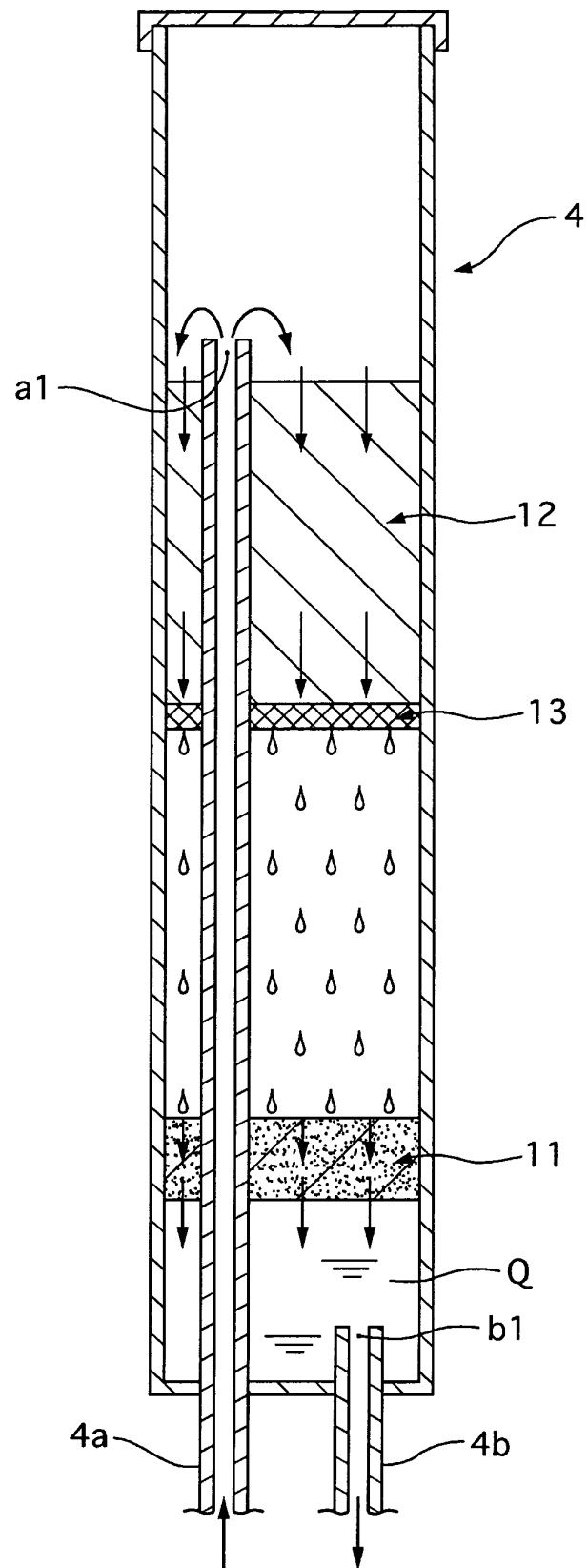


FIG. 9

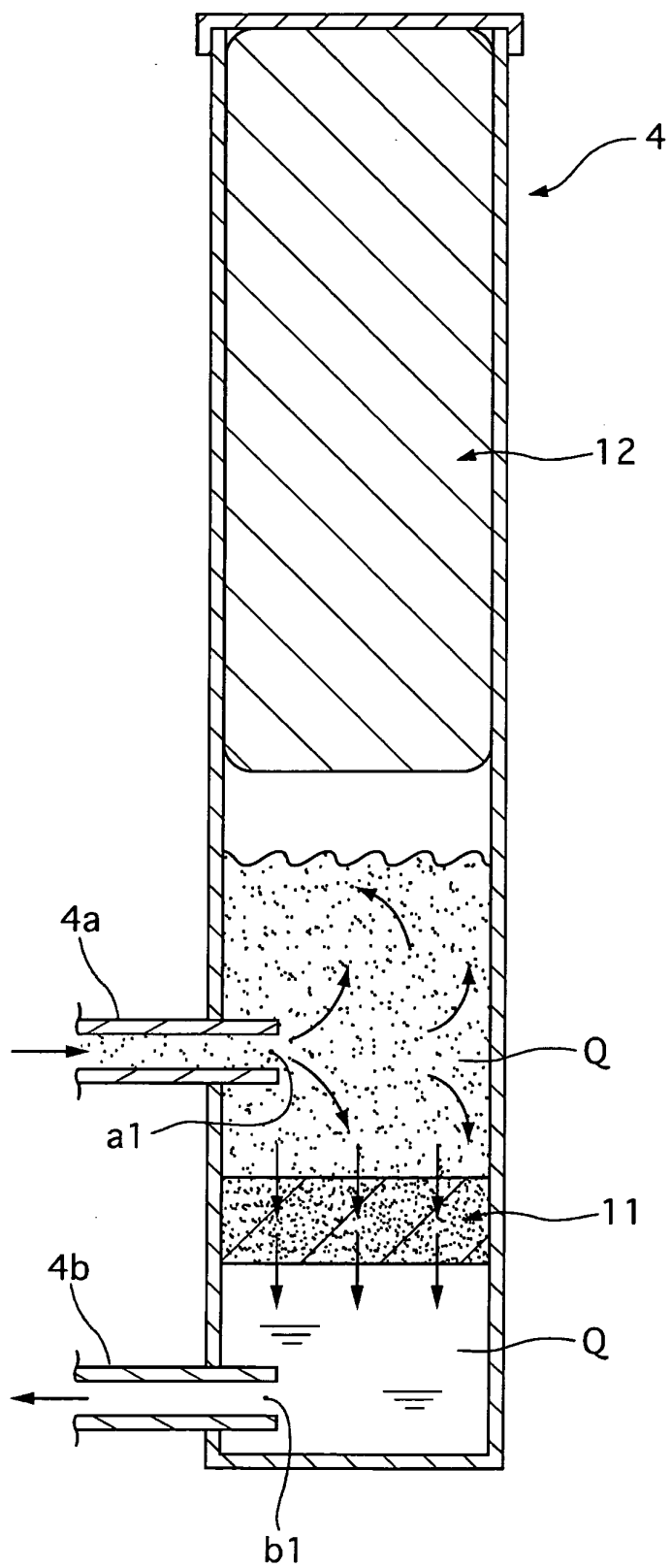
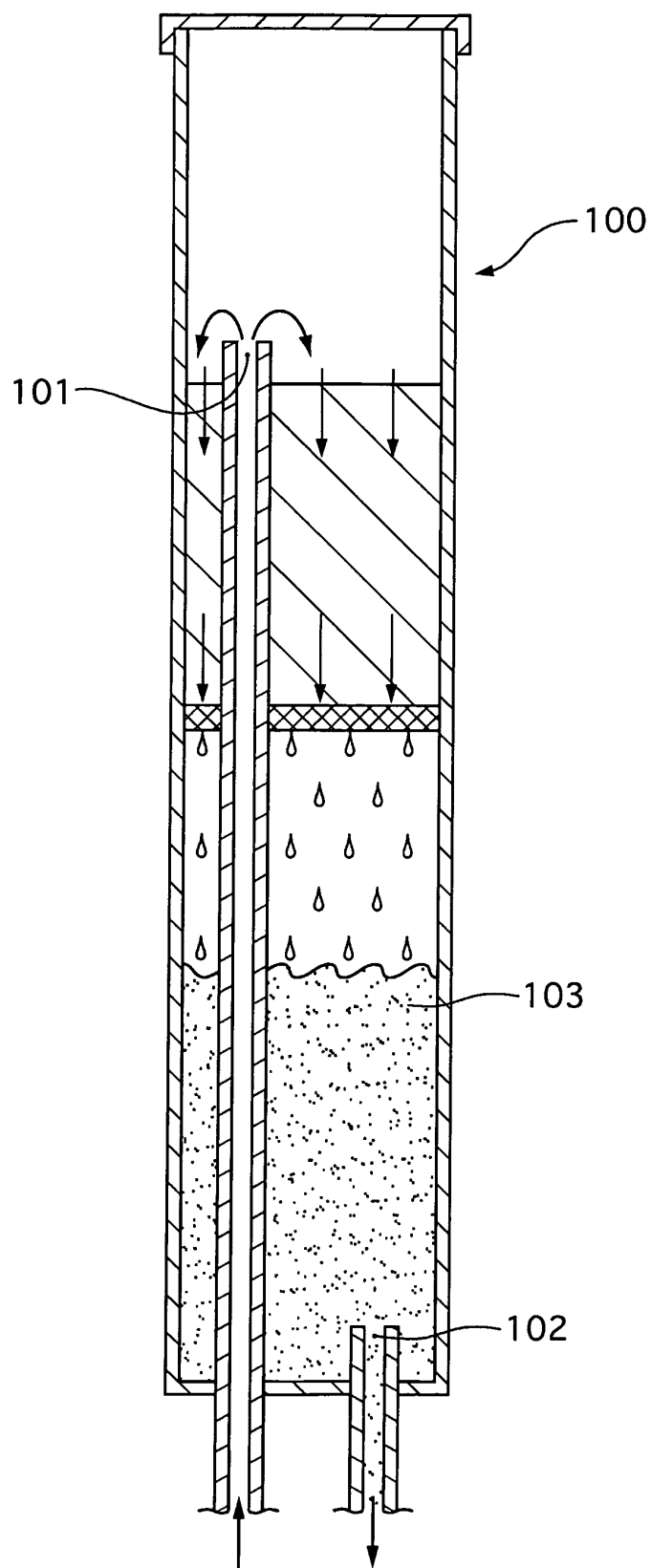


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/322460

A. CLASSIFICATION OF SUBJECT MATTER F25B43/00(2006.01) i, F25B39/04(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, F25B39/04		
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 1996-2006 Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006		
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.
X Y A	JP 2002-90007 A (Showa Denko Kabushiki Kaisha), 27 March, 2002 (27.03.02), Par. Nos. [0029] to [0033]; Fig. 6 (Family: none)	1-3, 5 6 4
X Y	JP 2002-54862 A (Showa Denko Kabushiki Kaisha), 20 February, 2002 (20.02.02), Full text; Figs. 1 to 3 (Family: none)	1, 7 6
Y	JP 10-47811 A (Mitsubishi Heavy Industries, Ltd.), 20 February, 1998 (20.02.98), Par. Nos. [0027] to [0029]; Fig. 3 (Family: none)	6
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Date of the actual completion of the international search 24 November, 2006 (24.11.06)		Date of mailing of the international search report 05 December, 2006 (05.12.06)
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