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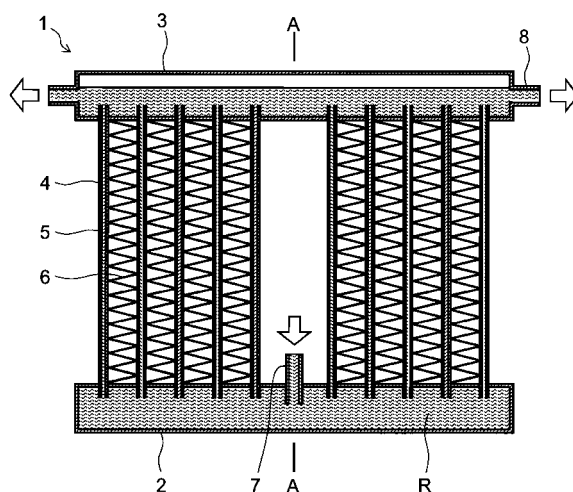
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(54) **HEAT EXCHANGER**

(57) A parallel flow type heat exchanger (1) in which flow rates of refrigerant are equalized for respective flat tubes (4). The heat exchanger (1) comprises a lower header pipe (2) becoming the refrigerant inflow side, an upper header pipe (3) becoming the refrigerant outflow side, and a plurality of vertical flat tubes (4) arranged at a predetermined pitch, between both the header pipes (2, 3), and each having a vertical refrigerant passage (5) provided therein and communicating with the inside of

both the header pipes. An inlet pipe (7) for making the refrigerant (R) flow into the lower header pipe (2) is arranged between a pair of flat tubes (4) out of a plurality of flat tubes (4), spaced apart from an outlet pipe (8) for making the refrigerant flow out from the upper header pipe (3) and connected with the lower header pipe (2) from the above. The outlet pipes (8) are provided at the both ends of the upper header pipe (3), and the inlet pipe (7) is arranged between the pair of flat tubes (4) located in the center of the lower header pipe (2).

FIG.1



Description

Technical Field

[0001] The present invention relates to a parallel-flow-type heat exchanger for use in air conditioning or refrigeration apparatuses.

Background Art

[0002] A parallel-flow-type heat exchanger having a plurality of flat tubes arranged vertically between an upper header pipe and a lower header pipe, with refrigerant passages formed inside the flat tubes so as to communicate with the insides of the two header pipes, is widely used in car air conditioners and the like. Examples thereof are seen in Patent Documents 1 and 2.

[0003] In the parallel-flow-type heat exchanger, leveling of flow rates of refrigerant among the flat tubes holds the key to improved heat exchanging performance. Parallel-flow-type heat exchangers disclosed in Patent Documents 1 and 2 achieve the leveling of the flow rates of refrigerant in the flat tubes in the following manners.

[0004] In a heat exchanger disclosed in Patent Document 1, one end of each of heat exchanger tubes (flat tubes) that is inserted into a refrigerant inflow vessel (a lower header pipe) to be connected thereto is formed to be tilted with respect to a direction in which refrigerant flows. This helps eliminate negative effects associated with a heat-exchanging-tube-insertion-amount error, and as a result, liquid refrigerant is equally distributed to flow into the heat exchanger tubes. Or, one end of each of heat exchanger tubes that is to be inserted into the refrigerant inflow vessel is bent in a horizontal direction and is horizontally inserted into the refrigerant inflow vessel to be connected thereto. This helps eliminate an error of an amount of insertion of the heat exchanger tubes into liquid refrigerant, and as a result, the liquid refrigerant is equally distributed to flow into the heat exchanger tubes.

[0005] In a heat exchanger disclosed in Patent Document 2, a collective heat-exchange medium circulation port is formed at a center of one of two header pipes, and divided heat-exchange medium circulation ports are formed at both ends of the other one of the two header pipes; thus are achieved conditions necessary for achieving appropriate distribution of the heat-exchange medium.

Patent Document 1: Japan Patent No. 3133897

Patent Document 2: JP-U-H06-14782

Disclosure of the Invention

Problems to be Solved by the Invention

[0006] Fig. 14 is a schematic vertical sectional view showing an outline of the structure of a conventional parallel-flow-type heat exchanger. A heat exchanger 1 is formed of horizontal lower and upper header pipes 2 and

3, respectively, that are arranged parallel in an up/down direction at an interval from each other, and a plurality of flat tubes 4 arranged vertically with a predetermined pitch between the lower and upper header pipes 2 and 3. The flat tubes 4 are elongate members formed by extrusion of a metal with high thermal conductivity, such as aluminum, and has, vertically formed inside them, refrigerant passages 5 for circulation of refrigerant R. Each of the refrigerant passages 5 allows insides of the lower and upper header pipes 2 and 3 to communicate with each other.

[0007] The flat tubes 4 are fixed to the lower and upper header pipes 2 and 3 by welding. Between the flat tubes 4, corrugated fins 6 are arranged, and they are also fixed to the flat tubes 4 by welding. Like the flat tubes 4, the lower and upper header pipes 2 and 3 and the corrugated fins 6 are formed of a metal with high thermal conductivity (for example, aluminum).

[0008] The lower header pipe 2 is located at a refrigerant inflow side, and an inlet pipe 7 is connected to one end thereof. The upper header pipe 3 is located at a refrigerant outflow side, and an outlet pipe 8 is connected to one end thereof. The inlet pipe 7 and the outlet pipe 8 are arranged concentrically with the lower header pipe 2 and the upper header pipes 3, respectively, and the refrigerant flows into the lower header pipe 2 in a horizontal direction and flows out of the upper header pipe 3 in a horizontal direction.

[0009] As in the example of Patent Document 1, the inlet and outlet pipes 7 and 8 are positioned diagonal to each other. When the refrigerant R in liquid state is made to flow in through the inlet pipe 7, a level of liquid refrigerant R inside the lower header pipe 2 has a tendency that it arises toward a dead-end portion at a right end of the lower header pipe 2, and flow rates of the refrigerant R in the flat tubes 4 are proportional to the level of the refrigerant R inside the lower header pipe 2. As a result, the flow rates of refrigerant in the flat tubes 4 are not leveled.

[0010] A known means for leveling the flow rates of refrigerant in the flat tubes 4 is to provide a horizontal partition plate 9 inside the lower header pipe 2 as shown in Fig. 15, but this is not an ultimate solution.

[0011] In the case where, as in the structure of the heat exchanger disclosed in Patent Document 2 shown in Fig. 16, the inlet pipe 7 is connected to a center of the lower header pipe 2 from below and the horizontal outlet pipes 8 are connected to both ends of the upper header pipe 3, a portion of refrigerant R that flows into the flat tubes 4 that are located at a center portion of flat tube row and close to the inlet pipe 7 maintains upward kinetic energy with which it flows into the lower header pipe 2, and thus a large amount of refrigerant R flows into each of the flat tubes 4 located at the flat tube row center. However, a portion of the refrigerant R that reaches other flat tubes 4 located away from the flat tube row center does not have such an upward kinetic energy, and thus only a small amount of refrigerant R flows into each of the other

flat tubes 4 located away from the flat tube row center. Thus, it is very difficult to level the flow rates of refrigerant in the flat tubes 4. Also, since the inlet pipe 7 projects downward from a lower side of the lower header pipe 2, the heat exchanger 1 needs to be held high enough for the inlet pipe 7 not to hit a member (such as a bottom plate of a housing in which the heat exchanger 1 is housed) that is located below the heat exchanger 1, and as a result, a larger setting space is necessary.

[0012] The present invention has been made in view of the above described problems, and an object of the present invention is to provide a parallel-flow-type heat exchanger in which flow rates of refrigerant in flat tubes are leveled by a new approach that is different from conventional ones.

Means for Solving the Problem

[0013] To achieve the above object, according to the present invention, a heat exchanger includes: a lower header pipe that is located at a refrigerant inflow side; an upper header pipe that is located at a refrigerant outflow side; and a plurality of flat tubes that are vertically arranged between the lower header pipe and the upper header pipe, and each of which has a refrigerant passage formed inside thereof so as to communicate with an inside of the lower header pipe and an inside of the upper header pipe. Here, an inlet pipe for allowing refrigerant to flow into the lower header pipe is arranged between a pair of adjacent flat tubes that are located away from an outlet pipe for allowing the refrigerant to flow out of the upper header pipe, and the inlet pipe is connected to the lower header pipe from a higher level than a lower header pipe center.

[0014] According to this structure, with the inlet pipe and the outlet pipe arranged apart from each other in a conventional way, the inlet pipe is connected to the lower header pipe from a higher level than the lower header pipe center. Consequently, the refrigerant is reflected upward inside the lower header pipe, and as a result, kinetic energy of the refrigerant is converted into pressure, and this pressure is distributed all over inside the lower header pipe. This prevents a portion of the refrigerant having kinetic energy along an inflow direction thereof from flowing mostly into specific flat tubes, and as a result, the flow rates of refrigerant in the flat tubes 4 are leveled.

[0015] In the heat exchanger structured as described above, it is preferable that the inlet pipe extend, between the pair of adjacent flat tubes, to a vicinity of the upper header pipe.

[0016] With this structure, the inlet pipe itself can serve to perform heat exchange, and this helps improve heat exchange efficiency.

[0017] In the heat exchanger structured as described above, it is preferable that a wind shield be provided between the pair of adjacent flat tubes between which the inlet pipe is located.

[0018] With this structure, air is prevented from flowing

through a space between the pair of adjacent flat tubes disposed with an interval wide enough to accommodate the inlet pipe, and this reduces an amount of air that idly flows through the heat exchanger without exchanging heat with the flat tubes, and as a result, heat exchange efficiency is improved.

[0019] In the heat exchanger structured as described above, it is preferable that, between the pair of adjacent flat tubes between which the inlet pipe is disposed, a heat conductive plate be provided for transmission of heat to and from the pair of adjacent flat tubes.

[0020] With this structure, heat can be exchanged between the heat conductive plate and air that flows through the space between the pair of adjacent flat tubes disposed with an interval wide enough to accommodate the inlet pipe, and this helps improve heat exchange efficiency.

[0021] In the heat exchanger structured as described above, it is preferable that the outlet pipe be provided at each end of the upper header pipe, and that the inlet pipe be located between a pair of adjacent flat tubes disposed at a center of the lower header pipe.

[0022] With this structure, refrigerant flows in via the inlet pipe and hits a center part of an inner surface of the lower header pipe from above, and this makes it easy for the refrigerant to be divided into right and left flows of refrigerant, and as a result, equal amounts of refrigerant flows into the flat tubes arranged on right and left sides of the inlet pipe.

Advantages of the Invention

[0023] According to the present invention, by connecting an inlet pipe disposed apart from an outlet pipe to a lower header pipe from a higher level than a lower header pipe center, a portion of refrigerant having kinetic energy along an inflow direction thereof is prevented from flowing mostly into specific flat tubes, and as a result, flow rates of refrigerant in the flat tubes are leveled.

Brief Description of Drawings

[0024]

[Fig. 1] A schematic vertical sectional view showing an outline of the structure of a heat exchanger of a first embodiment of the present invention.

[Fig. 2] A sectional view taken along line A-A in Fig. 1.

[Fig. 3] A schematic vertical sectional view showing an outline of the structure of a heat exchanger of a modification of the first embodiment.

[Fig. 4] A sectional view taken along line B-B in Fig. 3.

[Fig. 5] A graph of the results of simulations conducted to study effects of the connection angle of an inlet pipe on average flow rates in flat tubes.

[Fig. 6] Sectional views showing the lower header pipes used in the simulations (a) to (e) shown in Fig. 5.

[Fig. 7] A schematic vertical sectional view showing an outline of the structure of a heat exchanger of a second embodiment of the invention.

[Fig. 8] A sectional view taken along line C-C in Fig. 7.

[Fig. 9] A schematic vertical sectional view showing an outline of the structure of a heat exchanger of a third embodiment of the invention.

[Fig. 10] A sectional view taken along line D-D in Fig. 9.

[Fig. 11] A schematic vertical sectional view showing an outline of the structure of a heat exchanger of a fourth embodiment of the invention.

[Fig. 12] A sectional view taken along line E-E in Fig. 11.

[Fig. 13] A schematic vertical sectional view showing an outline of the structure of a heat exchanger of a fifth embodiment of the invention.

[Fig. 14] A schematic vertical sectional view showing an outline of the structure of a conventional heat exchanger.

[Fig. 15] A schematic vertical sectional view showing an outline of the structure of another conventional heat exchanger.

[Fig. 16] A schematic vertical sectional view showing an outline of the structure of a still another conventional heat exchanger.

List of Reference Symbols

[0025]

- 1 heat exchanger
- 2 lower header pipe
- 3 upper header pipe
- 4 flat tubes
- 5 refrigerant passages
- 6 corrugated fins
- 7 inlet pipe
- 8 outlet pipe
- 9 partition plate
- 10 wind shield
- 11 heat conductive plate

Best Mode for Carrying Out the Invention

[0026] Hereinafter, a description will be given of a first embodiment of the present invention with reference to Figs. 1 and 2. Since a structure of the first embodiment shares a lot in common with the conventional structure shown in Fig. 16, members and parts which are the same as those in FIG. 16 are given the same reference signs, and overlapping description thereof will be omitted. The first embodiment is distinctive from the conventional structure shown in Fig. 16 in disposition of an inlet pipe 7. The inlet pipe 7 is disposed in a position that is away from outlet pipes 8. The outlet pipes 8 are provided at both ends of an upper header pipe 3, and thus a central part of a lower header pipe 2 is the position that is away

from the outlet pipes 8. The structure of the first embodiment is so far the same as the structure shown in Fig. 16; however, in the present invention, the inlet pipe 7 is connected to the lower header pipe 2 not from below but from above. And, in order to prevent interference between the inlet pipe 7 and flat tubes 4, only a space between a pair of adjacent flat tubes 4 that are located in a center part of the lower header pipe 2 in a horizontal direction is made wider than spaces between other pairs of adjacent flat tubes, and the inlet pipe 7 is disposed in the wider space. On both the right and left sides of the inlet pipe 7, a same number of flat tubes 4 are arranged at regular intervals (with a predetermined pitch).

[0027] In a heat exchanger 1 of the first embodiment, refrigerant R in liquid state flows in via the inlet pipe 7 and is then reflected by an upward-facing inner surface of the lower header pipe 2, as a result of which kinetic energy of the refrigerant R is converted into pressure, and this pressure is distributed all over inside the lower header pipe 2. This prevents refrigerant having kinetic energy along an inflow direction thereof from flowing mostly into specific flat tubes 4, and as a result, flow rates of refrigerant in the flat tubes 4 are leveled.

[0028] Also, since the inlet pipe 7 does not project from a bottom of the lower header pipe 2, other members can be placed close to a bottom of the heat exchanger 1, and this makes it possible to make an apparatus incorporating the heat exchanger 1 compact.

[0029] Also, since the outlet pipes 8 are provided one at each end of the upper header pipe 3, and the inlet pipe 7 is disposed between the pair of adjacent flat tubes 4 that are located at a center of the lower header pipe 2, the refrigerant R flows in via the inlet pipe 7, and then hits a center part of an inner surface of the lower header pipe 2 from above, and this makes it easy for the refrigerant R to be divided into right and left flows, and as a result, equal amounts of refrigerant R flows into the flat tubes arranged on both the right and left sides of the inlet pipe 7.

[0030] The inlet pipe 7 does not need to be connected to the lower header pipe 2 from right above. As indicated by an imaginary line in Fig. 2, the inlet pipe 7 may be connected to the lower header pipe 2 at an angle in a plane that is perpendicular to an axis line of the lower header pipe 2, as long as the inlet pipe 7 is connected to the lower header pipe 2 from a higher level than a lower header pipe center (that is, in a direction above a horizontal line indicated in Fig. 2 by line segment H-H, which passes a center axis of the lower header pipe 2 in section).

[0031] As described above, according to the present invention, it is possible to achieve leveling of the flow rates of refrigerant in flat tubes while making compact a space necessary for setting a parallel-flow type heat exchanger.

[0032] A modification of the first embodiment is shown in Figs. 3 and 4. In this modification, a horizontal partition plate 9 that reaches both ends inside the lower header

pipe 2 is inserted therein substantially at a height of a center thereof. As a result, even if the refrigerant R is separated into liquid and gas phases inside the lower header pipe 2, a boundary surface between the liquid and gas phases is positioned high, and thus inflow of the refrigerant R in liquid phase into the flat tubes 4 is not hindered.

[0033] Another modification as described below is also possible. That is, instead of arranging the same number of flat tubes 4 on both of the right and left sides of the inlet pipe 7 at regular intervals, the flat tubes 4 are arranged such that lengths of the intervals among them are not uniform. Incidentally, it is preferable that the arrangement of the ununiform intervals be symmetrical with respect to the inlet pipe 7.

[0034] Fig. 5 shows a graph of the results of simulations conducted to study the effect of the connection angle of the inlet pipe on average flow rates in flat tubes. In the simulations, fourteen flat tubes were arranged on each of the right and left sides of an inlet pipe. The simulations were conducted for five patterns different from one another in whether or not a partition plate was provided and/or in connection angle. Fig. 6 shows sectional views of the lower header tubes in the patterns (a) to (e). Incidentally, the connection angle is considered to be 0° (zero degrees) when the inlet pipe is parallel with the flat tubes (vertical state), and it is considered to be 90° (ninety degrees) when the inlet pipe forms a right angle with the flat tubes (horizontal state).

[0035] The graph shown in Fig. 5 suggests the following tendencies. That is, in the patterns (c), (d), and (e), where no partition plate is provided, in the flat tubes positioned in a vicinity of the inlet pipe (tube positions 13 to 16), average flow rates inside the tubes increase as the connection angle of the inlet pipe increases. In other flat tubes positioned away from the inlet pipe 7 (tube positions 5 to 10, 19 to 24), average flow rates inside the tubes decrease as the connection angle of the inlet pipe increases. The average flow rates in all the flat tubes should ideally be equal, and in this regard, the pattern (d), where the connection angle of the inlet pipe is 30° (thirty degrees), can be said to be the best.

[0036] A second embodiment is shown in Figs. 7 and 8. The second embodiment is obtained by modifying the first embodiment as follows. That is, in the second embodiment, an inlet pipe 7 extends to a vicinity of an upper header pipe 3 in a space between a pair of adjacent flat tubes 4 flanking the inlet pipe 7. This allows the inlet pipe 7 to exchange heat with air that passes thereby, and as a result, the heat exchanger 1 can perform heat exchange with higher efficiency.

[0037] A third embodiment is shown in Figs. 9 and 10. The third embodiment is obtained by modifying the first embodiment as follows. That is, in the third embodiment, a wind shield 10 is provided between a pair of adjacent flat tubes 4 flanking the inlet pipe 7. The wind shield 10 shown in the figures is a rectangular flat plate with its four corners rounded and its four sides shaved off in order to

prevent the fitting from being hindered by overbuilt welding between the flat tubes 4 and the lower header pipe 2 or the upper header pipe 3, or by irregularity in contours of the flat tubes 4. It is preferable that the wind shield 10 be formed of a same material as, for example, the flat tubes 4, and that the wind shield 10 be fixed by welding.

[0038] The provision of the wind shield plate 10 prevents air from passing through a space between the pair of adjacent flat tubes 4 disposed with an interval wide enough to accommodate the inlet pipe 7. In this case, it is only at gaps along the flat tubes 4 formed by shaving off the wind shield 10 that air is allowed to pass through the space between the pair of adjacent flat tubes 4 disposed with an interval wide enough to accommodate the inlet pipe 7, and thus only a very limited amount of air flows through the space. As a result, the amount of air that flows idly through the heat exchanger 1 without exchanging heat with the flat tubes 4 is reduced, and thus heat exchange efficiency is improved. Incidentally, such gaps as those formed by shaving off the wind shield 10 are not necessarily indispensable, and instead, the space between the pair of adjacent flat tubes 4 disposed with an interval wide enough to accommodate the inlet pipe 7 may be completely blocked by the wind shield 10.

[0039] The shielding plate 10 may have a horizontal section of an arch shape that is convex to windward. This allows wind to flow smoothly along a surface of the wind shield 10, and thus air-flow resistance is reduced. As a result, heat exchange efficiency is improved.

[0040] A fourth embodiment is shown in Figs. 11 and 12. The fourth embodiment is obtained by modifying the first embodiment as follows. That is, in the fourth embodiment, a heat conductive plate 11 is provided between a pair of adjacent flat tubes 4 flanking an inlet pipe 7 such that the heat conductive plate 11 exchanges heat with the pair of adjacent flat tubes 4. The heat conductive plate 11 shown in the figure is formed of wide corrugated fins.

[0041] The provision of the heat conductive plate 11, which can exchange heat with air passing through the space between the pair of adjacent flat tubes 4 disposed with an interval wide enough to accommodate the inlet pipe 7, helps improve heat exchange efficiency.

[0042] The fifth embodiment is shown in Fig. 13. In the fifth embodiment, only a right end of an upper header pipe 3 is provided with an outlet pipe 8. An inlet pipe 7 is disposed in a position apart from the outlet pipe 8, that is, between a pair of adjacent flat tubes 4 located close to a left end of a lower header pipe 2. The inlet pipe 7 extends to a vicinity of the upper header pipe 3.

[0043] In a heat exchanger 1 of the fifth embodiment, too, refrigerant R in liquid state flows in via the inlet pipe 7, and is then reflected by an upward-facing inner surface of the lower header pipe 2, as a result of which kinetic energy of the refrigerant R is converted into pressure, and this pressure is distributed all over inside the lower header pipe 2. This prevents refrigerant having kinetic energy along an inflow direction thereof from flowing

mostly into specific flat tubes 4, and as a result, flow rates of refrigerant in the flat tubes 4 are leveled.

[0044] Also, since the inlet pipe 7 does not project from the bottom of the lower header pipe 2, other members can be placed close to the bottom of the heat exchanger 1, and this makes it possible to make an apparatus incorporating the heat exchanger 1 compact.

[0045] The descriptions have been given above of the embodiments of the present invention, but the embodiments are not meant to limit the scope of the present invention, and the present invention may be practiced with various modifications without departing from the scope of the present invention. For example, the third embodiment may be combined with the second embodiment. That is, the structure may be such that the inlet pipe 7 extends to a vicinity of the upper header pipe 3 between a pair of adjacent flat tubes 4 flanking the inlet pipe 7, and the wind shield 10 is provided between the pair of adjacent flat tubes 4. Combination of the second embodiment and the fourth embodiment (heat conductive plate) is also possible. And the present invention can be practiced with any combination of the embodiments as long as a structure resulting from the combination is not contradictory in nature.

Industrial Applicability

[0046] The present invention can be widely applied to parallel-flow type heat exchangers.

Claims

1. A heat exchanger comprising:

a lower header pipe that is located at a refrigerant inflow side;
 an upper header pipe that is located at a refrigerant outflow side; and
 a plurality of flat tubes that are vertically arranged between the lower header pipe and the upper header pipe, and each of which has a refrigerant passage formed inside thereof so as to communicate with an inside of the lower header pipe and an inside of the upper header pipe,

wherein

an inlet pipe for allowing refrigerant to flow into the lower header pipe is arranged between a pair of adjacent flat tubes that are located away from an outlet pipe for allowing the refrigerant to flow out of the upper header pipe, and
 the inlet pipe is connected to the lower header pipe from a higher level than a lower header pipe center.

2. The heat exchanger of claim 1, wherein the inlet pipe extends, between the pair of adjacent flat tubes, to a vicinity of the upper header pipe.

3. The heat exchanger of claim 1, wherein a wind shield is provided between the pair of adjacent flat tubes between which the inlet pipe is disposed.

4. The heat exchanger of claim 1, wherein between the pair of adjacent flat tubes between which the inlet pipe is disposed, a heat conductive plate is provided for transmission of heat to and from the pair of adjacent flat tubes.

5. The heat exchanger of any one of claims 1 to 4, wherein the outlet pipe is provided at each end of the upper header pipe, and the inlet pipe is disposed between a pair of adjacent flat tubes located at a center of the lower header pipe.

FIG.1

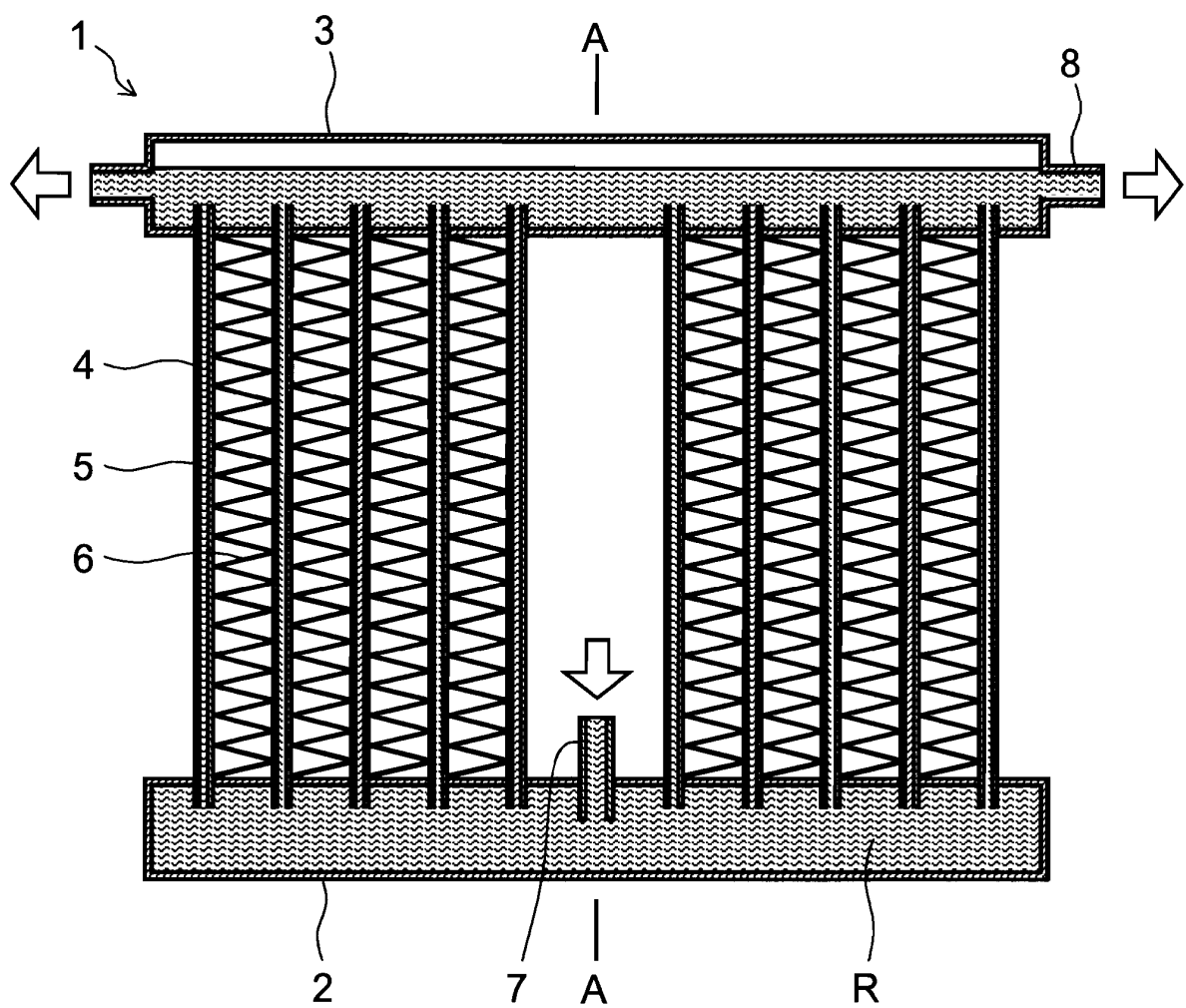


FIG.2

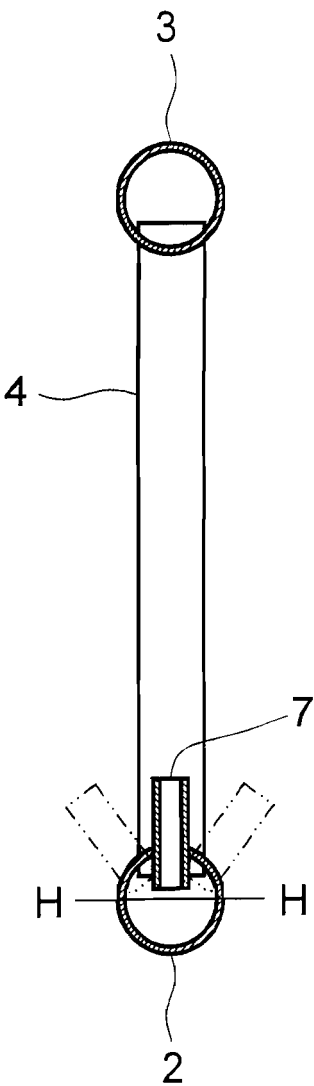


FIG.3

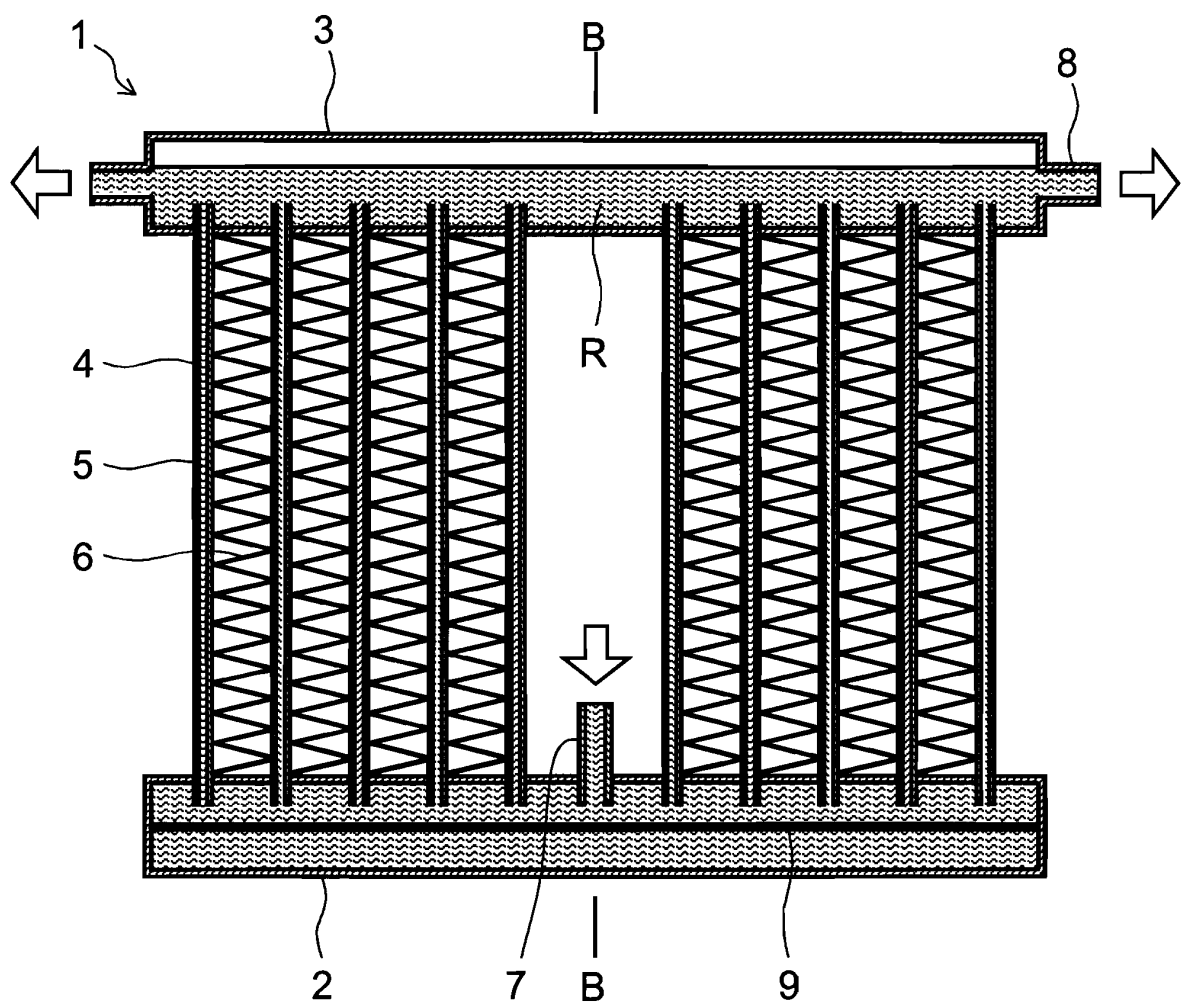


FIG.4

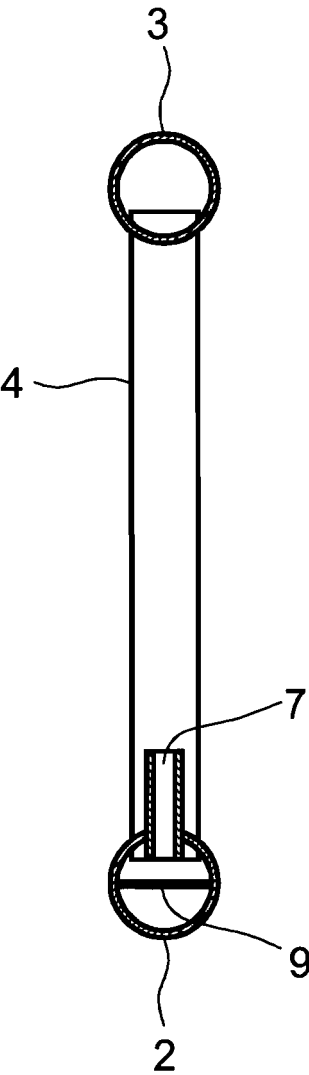


FIG.5

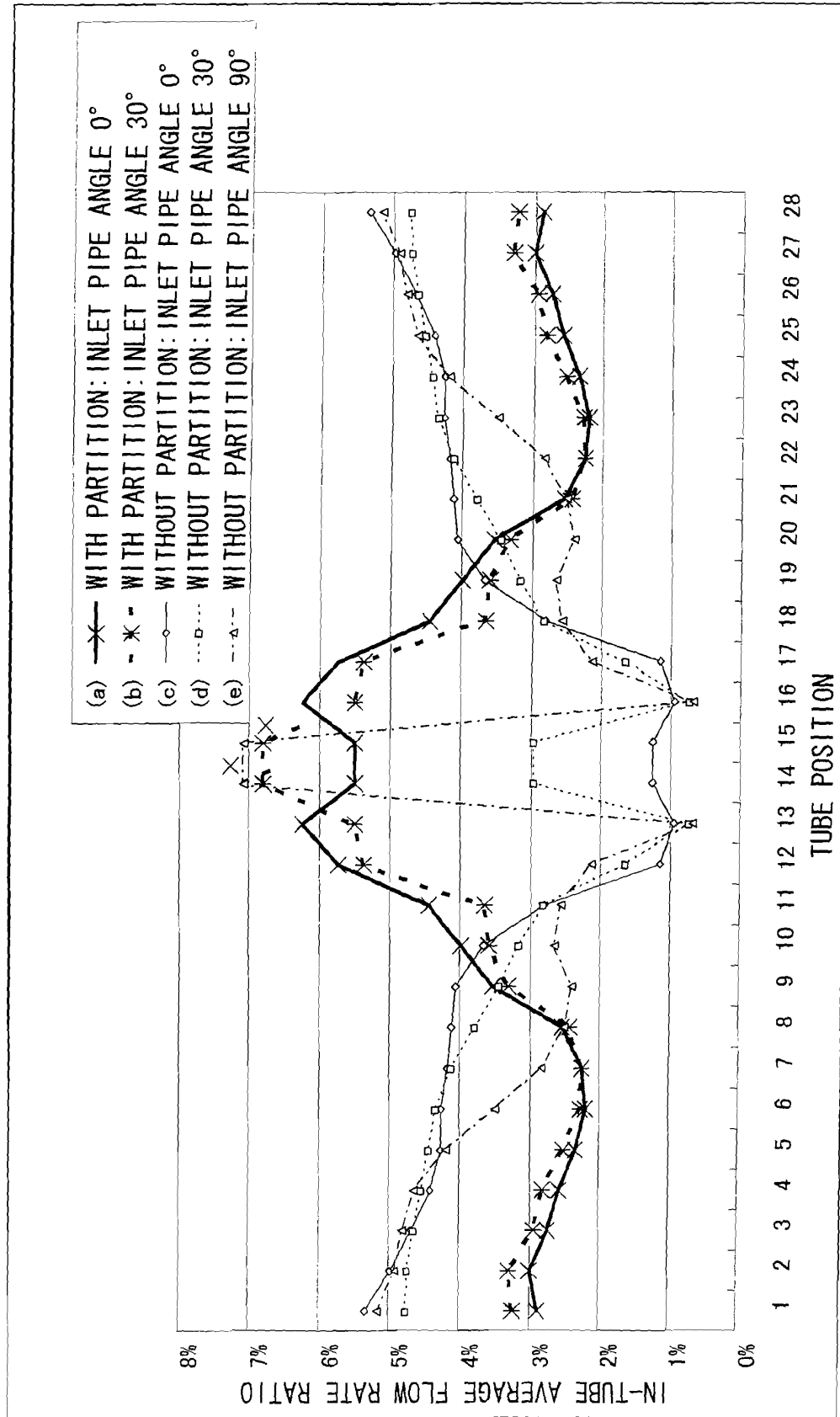


FIG.6A

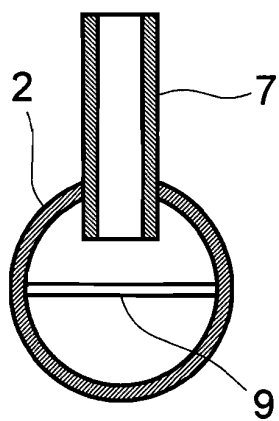


FIG.6B

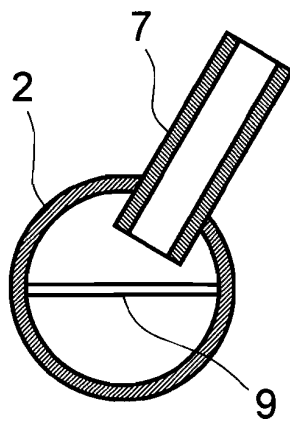


FIG.6C

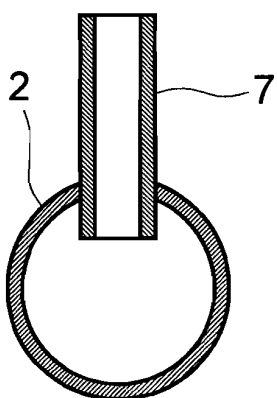


FIG.6D

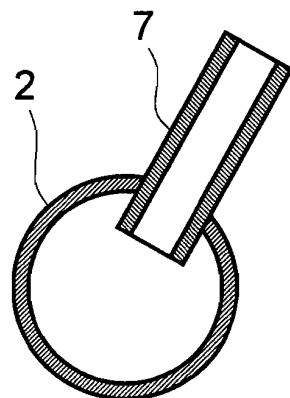


FIG.6E

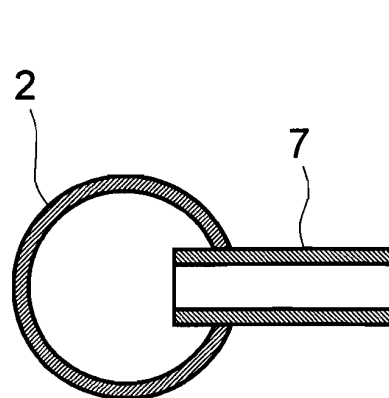


FIG.7

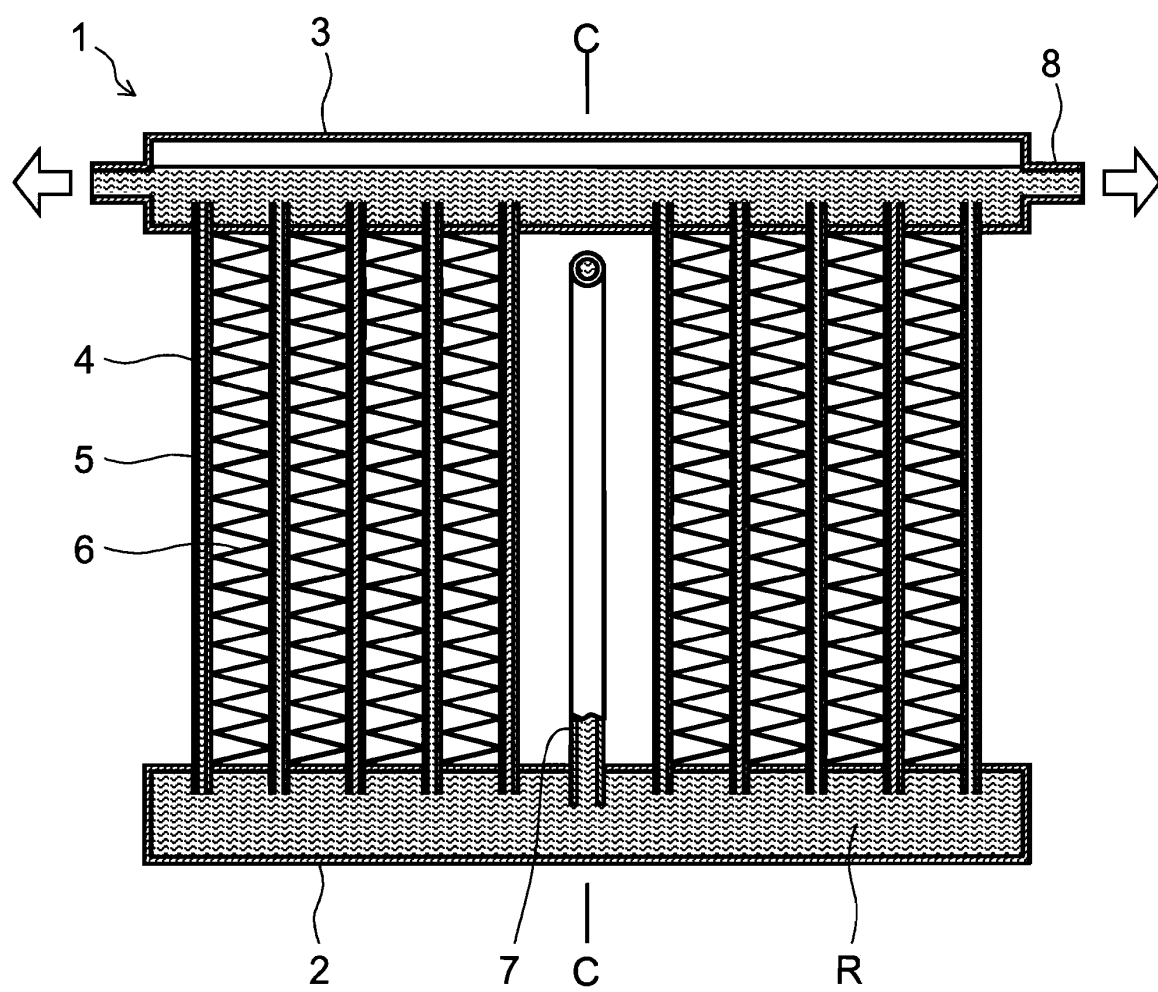


FIG.8

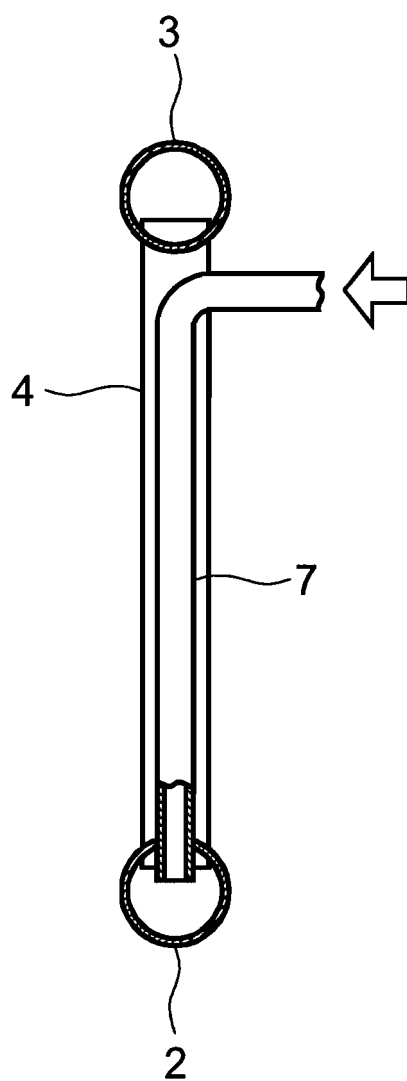


FIG.9

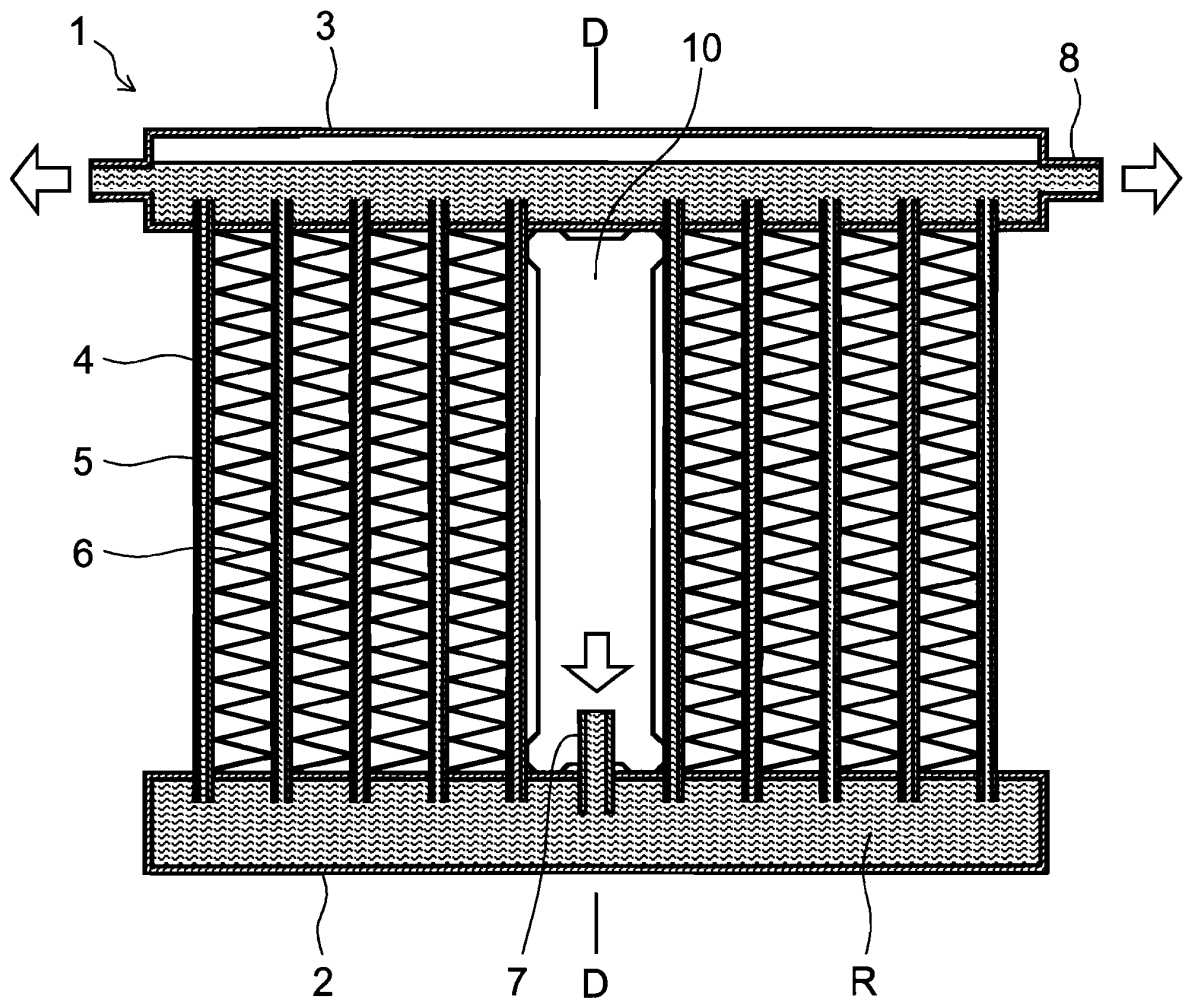


FIG.10

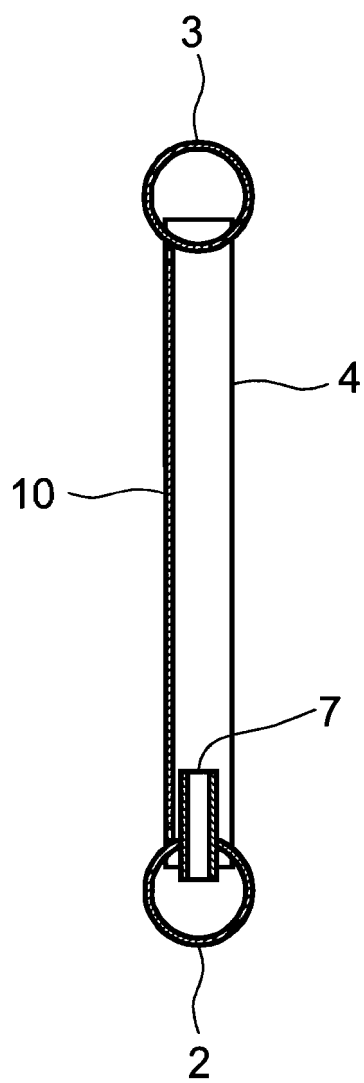


FIG.11

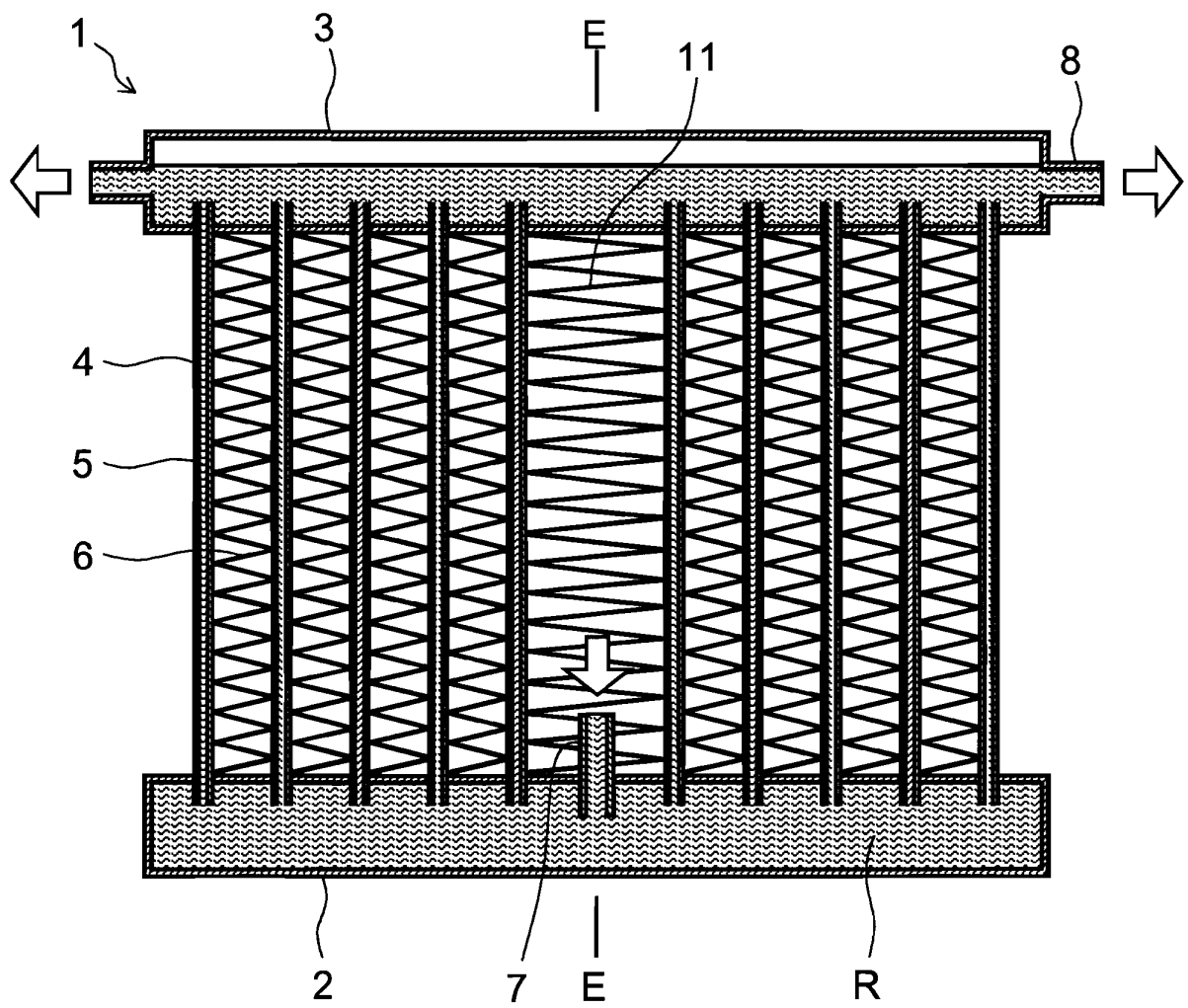


FIG.12

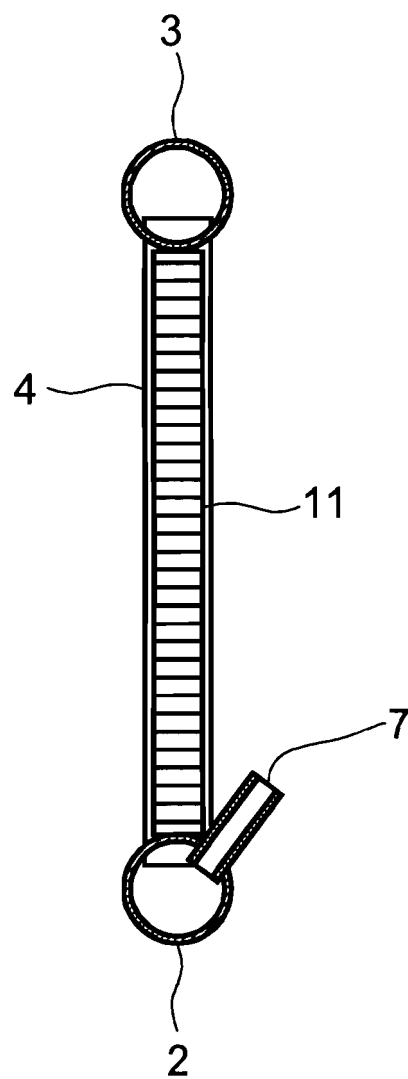


FIG.13

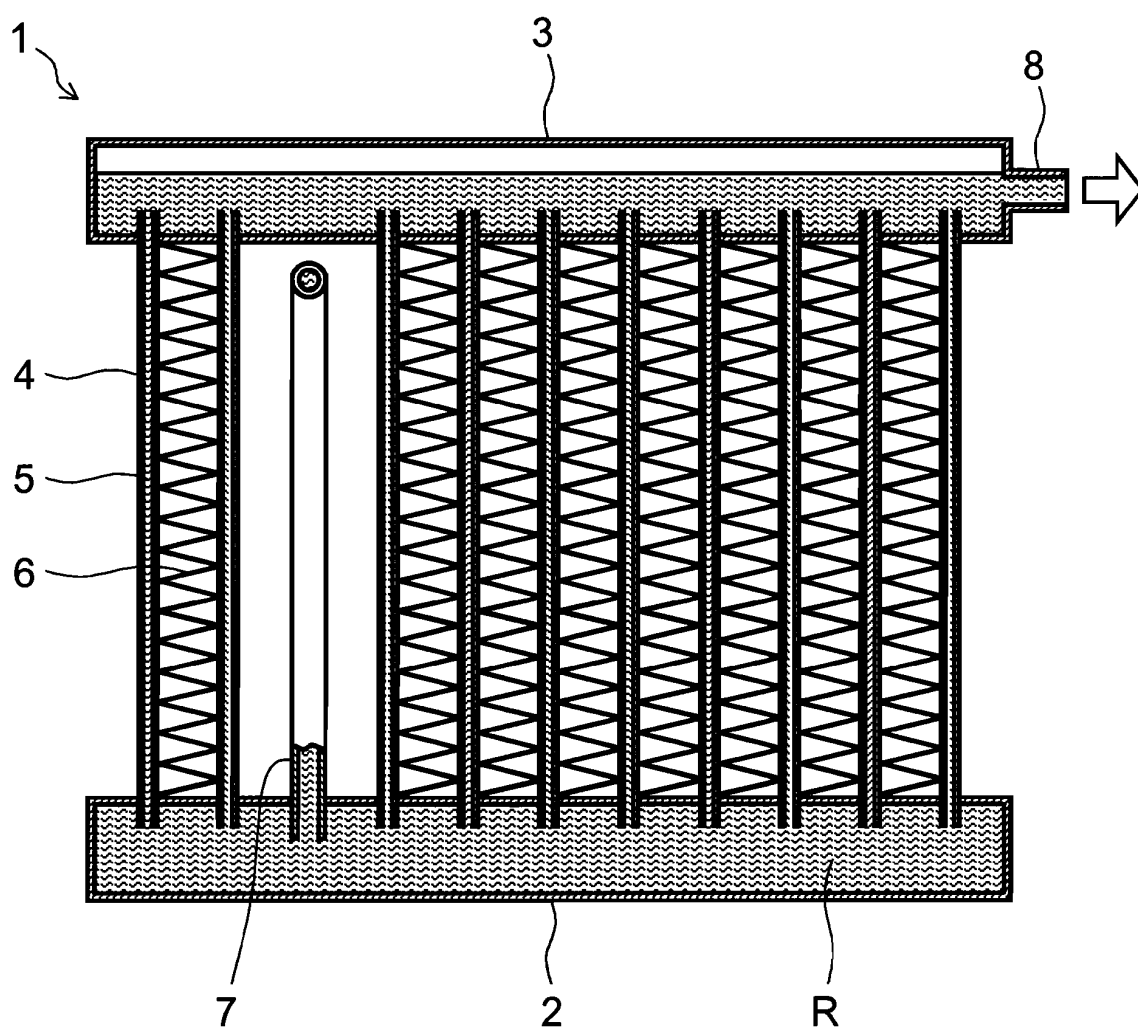


FIG.14

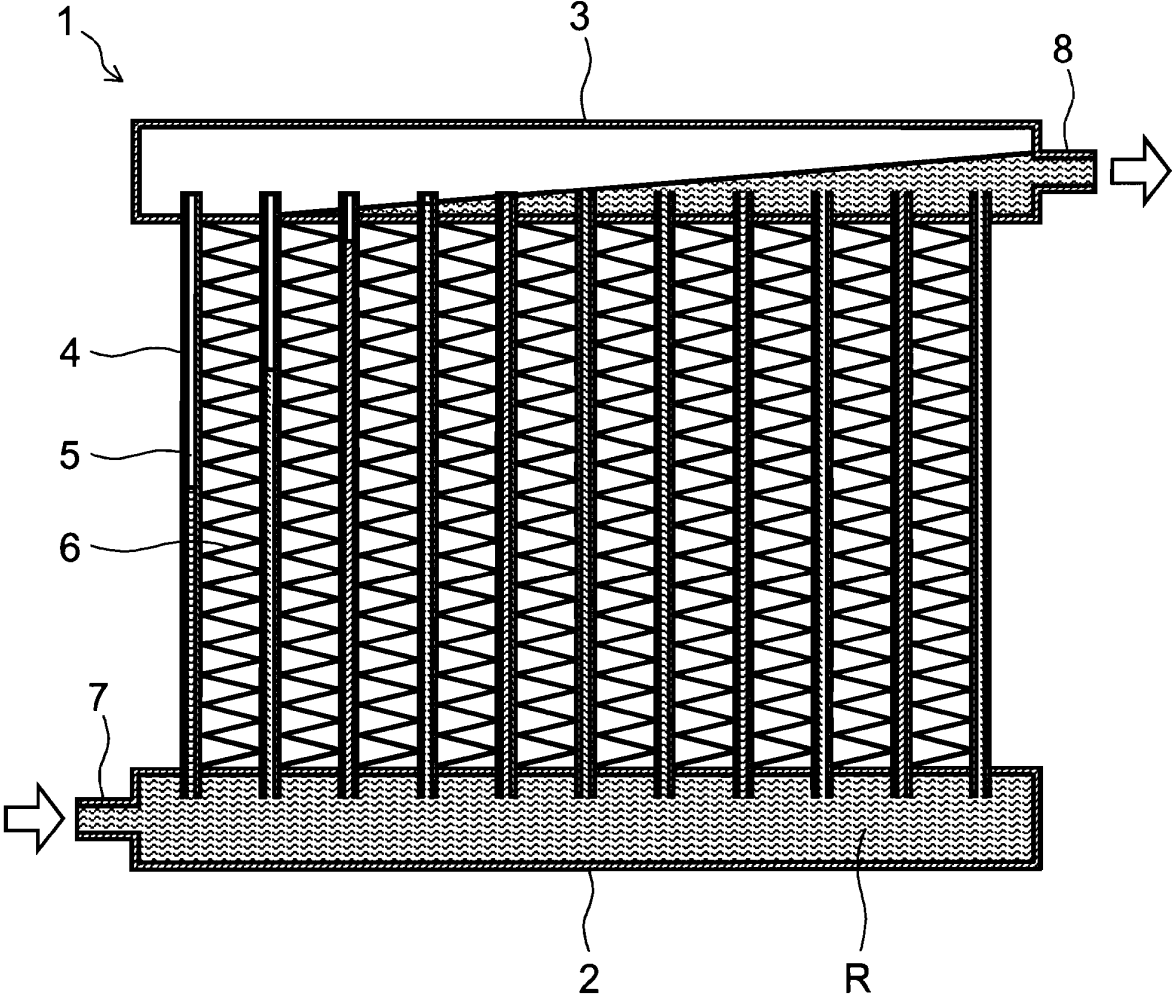


FIG.15

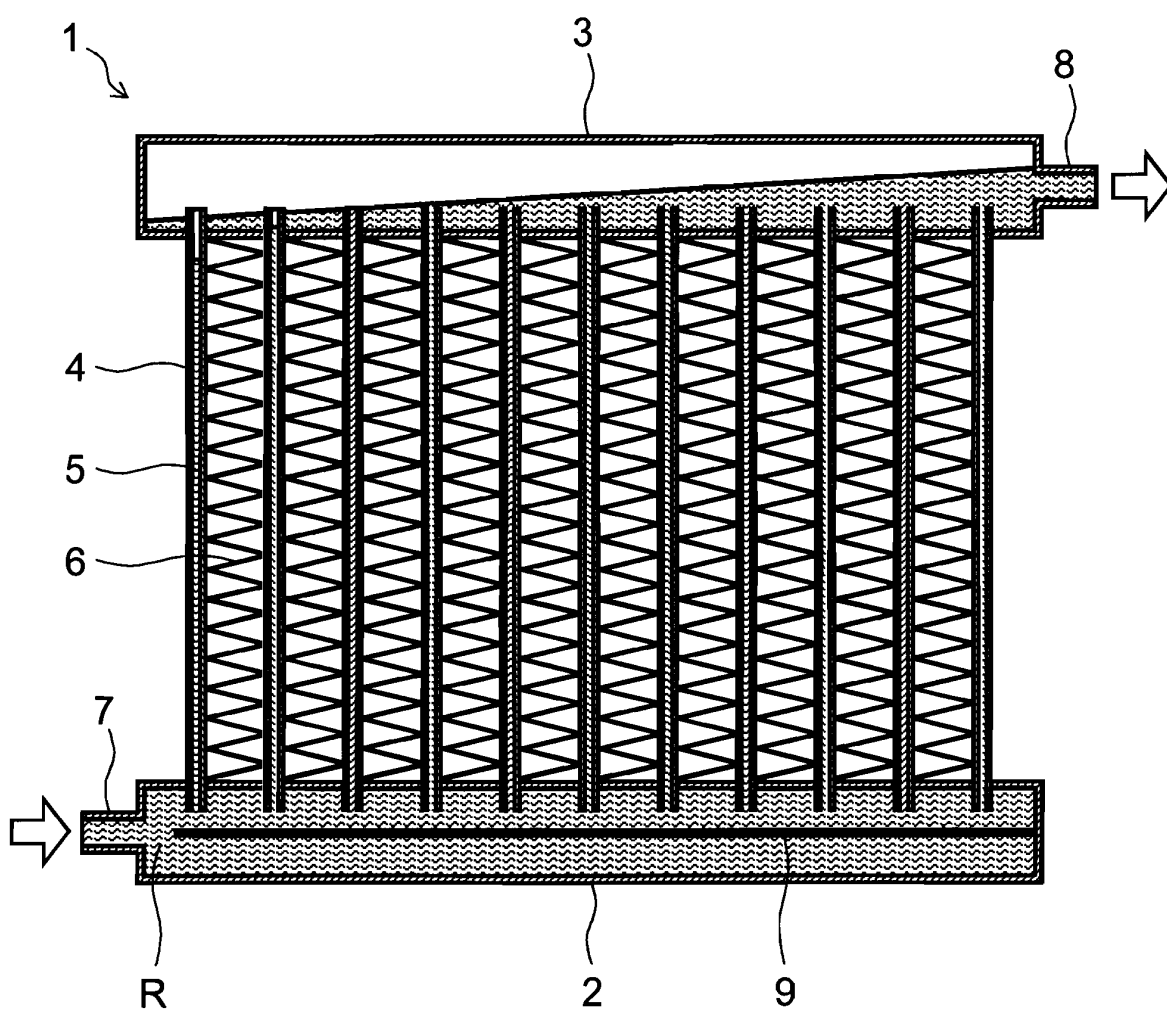
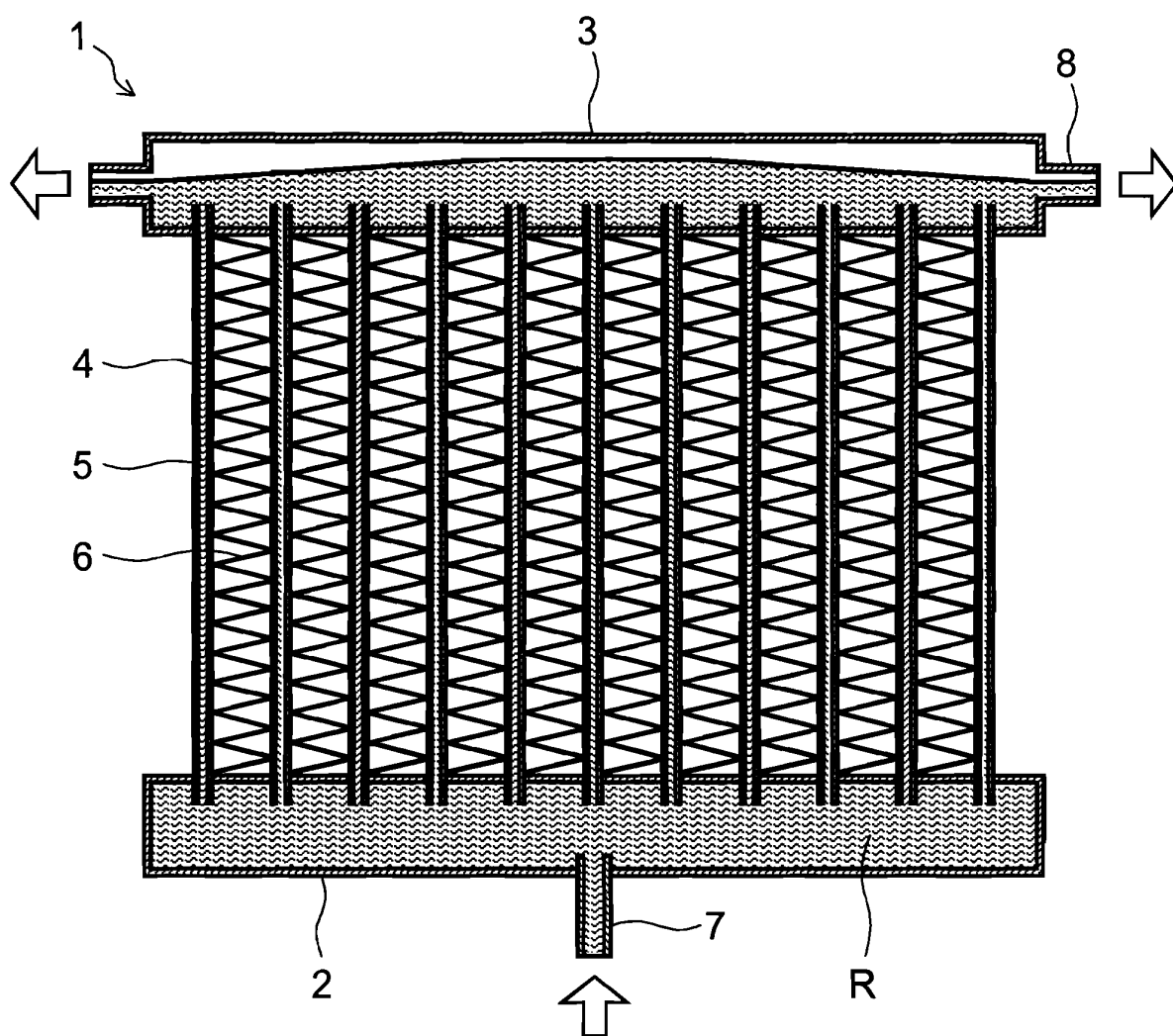


FIG.16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/066165

A. CLASSIFICATION OF SUBJECT MATTER

F28F9/02(2006.01) i, F25B39/02(2006.01) i, F28D1/053(2006.01) i, F28F9/22(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)

F28F9/02, F25B39/02, F28D1/053, F28F9/22

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 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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 A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 109927/1991(Laid-open No. 14782/1994) (Nippon Light Metal Co., Ltd.), 25 February, 1994 (25.02.94), Fig. 1 (Family: none)	1, 4, 5 2, 3
Y A	JP 6-273088 A (Zexel Corp.), 30 September, 1994 (30.09.94), Figs. 1, 2 (Family: none)	1, 4, 5 2, 3

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

* Special categories of cited documents:

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

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
21 October, 2008 (21.10.08)Date of mailing of the international search report
04 November, 2008 (04.11.08)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/066165

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 3-79994 A (Nippondenso Co., Ltd.), 04 April, 1991 (04.04.91), Figs. 1 to 5 (Family: none)	1, 4, 5 2, 3
A	JP 2006-138559 A (Calsonic Kansei Corp.), 01 June, 2006 (01.06.06), Figs. 1 to 5 (Family: none)	1-5
A	JP 2004-77032 A (Zexel Valeo Climate Control Corp.), 11 March, 2004 (11.03.04), Fig. 4 (Family: none)	1-5
A	US 4484622 A (The Garrett Corp.), 27 November, 1984 (27.11.84), Figs. 1 to 3 (Family: none)	1-5
A	JP 63-14093 A (Nippondenso Co., Ltd.), 21 January, 1988 (21.01.88), Figs. 1 to 6 (Family: none)	1-5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3133897 B [0005]
- JP H0614782 U [0005]