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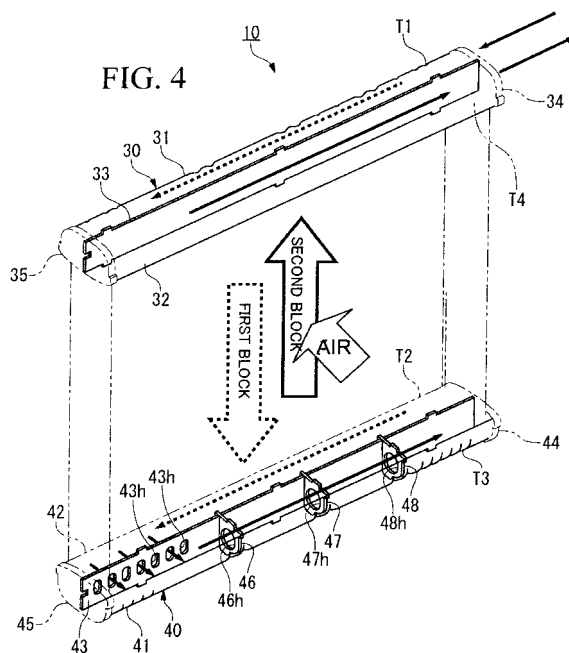
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(54) **HEAT EXCHANGER**

(57) A heat exchanger 10 includes a first block and a second block. The first block includes a first tank T1 having a refrigerant inlet through which the refrigerant flows in, a plurality of first tubes 21 into which the refrigerant having flowed into the first tank T1 is distributed and flows therein, and a second tank T2 in which the refrigerant flowing in the first tubes 21 merges. The second block includes a third tank T3 into which the refrigerant having merged in the second tank T2 flows therein, a plurality of second tubes 22 into which the refrigerant having flowed into the third tank T3 is distributed and flows, and a fourth tank T4 in which the refrigerant flowing in the second tube merges, and having a refrigerant outlet through which the merged refrigerant flows out. A refrigerant passage 43h through which the refrigerant flows from the second tank T2 into the third tank T3 is locally placed on the opposite side of the refrigerant inlet.



Description

Technical Field

[0001] The present invention relates to a heat exchanger, and more particularly to a heat exchanger suitably used in an evaporator in a refrigeration cycle for an air conditioner mounted in an automobile.

Background Art

[0002] A known heat exchanger that constitutes an evaporator (or condenser) used in a refrigeration cycle includes a core in which a plurality of tubes and a plurality of fins alternately stacked, and a tank to which ends of the tubes are connected. A refrigerant is introduced into the heat exchanger from an inlet header provided in the tank, passes through the tubes while performing heat exchange with air using heat transferred to the core, and then is discharged to the outside from an outlet header provided in the tank.

[0003] An evaporator mounted in an automobile is required to have high performance and also be small and lightweight as described later.

[0004] Generally, performance Q of an evaporator is represented by $Q = K \cdot A \cdot (T_a - T_r)$, where K is a overall heat transmission coefficient, A is a heat transmission area, T_a is an air temperature, and T_r is a refrigerant temperature. Since the refrigerant temperature T_r is lower with lower pressure loss of a refrigerant in an evaporator, it is important to minimize pressure loss of the refrigerant in the evaporator in order to increase the evaporator performance Q (increase $(T_a - T_r)$).

[0005] Also, a circulation amount Gr [kg/s] of a refrigerant flowing in a refrigeration cycle during operation is generally the same throughout a refrigerant channel. Also in the evaporator, the circulation amount Gr of the refrigerant is the same throughout the refrigerant channel. In the evaporator, the refrigerant is gradually vaporized while performing heat exchange with air. The refrigerant on a side closer to an outlet is gasified, has lower density, and has higher flow rate. Thus, pressure loss of the refrigerant is relatively higher on the side closer to the outlet.

[0006] From the above, it is demanded to reduce pressure loss of the refrigerant, particularly, reduce pressure loss of the refrigerant on the side closer to the outlet in order to increase the evaporator performance Q .

[0007] Meanwhile, an evaporator used in an automobile generally has a multi-flow structure in which a refrigerant is distributed from one tank to a plurality of tubes, and thus distribution of the refrigerant (particularly, a liquid component that influences cooling performance) needs to be uniform. If the refrigerant distribution is non-uniform, a heat transmission area A of a part with a few liquid component is small (cannot be effectively used), thereby reducing performance Q .

[0008] Currently, if a width of an evaporator is reduced

in view of a demand for size reduction for mounting in an automobile, a refrigerant passage in the evaporator is reduced to increase pressure loss of a refrigerant, thereby reducing evaporator performance. Thus, an evaporator is proposed in which the number of partitions of a refrigerant circuit is reduced in the evaporator to reduce pressure loss of a refrigerant (Patent Document 1).

[0009] FIG. 9 shows a heat exchanger 100 disclosed in Patent Document 1. The heat exchanger 100 includes a group of tubes 105 in two or more rows constituted by a plurality of heat exchange tubes (hereinafter referred to as tubes) 104 between an refrigerant flow-in/out side tank 102 and a refrigerant turn-side tank 103. An inside of a refrigerant inlet header chamber 106 in the refrigerant flow-in/out side tank 102 is partitioned into two spaces 106a and 106b in a height direction by a dividing resistance plate 107. The tubes 104 are connected to the refrigerant flow-in/out side tank 102 so as to face the first space 106a. One refrigerant passing hole 108 is formed in a middle in a length direction of the dividing resistance plate 107. The refrigerant having flowed into the first space 106a of the refrigerant inlet header chamber 106 in the refrigerant flow-in/out side tank 102 flows through the refrigerant passing hole 108 into the second space 106b, flows through the tubes 104 into the refrigerant turn-side tank 103. Then, the refrigerant changes its flow direction and flows through the tubes 104 into a refrigerant outlet header chamber 109 in the refrigerant flow-in/out side tank 102.

[0010] In the heat exchanger 100 in Patent Document 1, the refrigerant is fed into the second space 106b of the refrigerant inlet header chamber 106 in the refrigerant flow-in/out side tank 102, flows through one refrigerant passing hole 108 in the dividing resistance plate 107 into the first space 106a, and is divided from the first space 106a into all the tubes 104 communicating with the refrigerant inlet header chamber 106. Since only one refrigerant passing hole 108 is formed in the dividing resistance plate 107, the refrigerant gradually flows from the second space 106b into the first space 106a, reaches the entire first space 106a, and flows into all the tubes 104. Thus, a ratio between a gas component and a liquid component in a refrigerant in the heat exchange tubes connected to the refrigerant inlet header chamber in the refrigerant flow-in/out side tank, that is, refrigerant distribution is made uniform, thereby increasing heat exchange performance of the heat exchanger.

Citation List

Patent Document

[0011]

Patent Document 1: Japanese Patent Laid-Open No. 2005-43040

Summary of Invention

Problems to be Solved by the Invention

[0012] However, in the heat exchanger 100, a refrigerant circuit includes two blocks (a first block on a refrigerant inlet side and a second block on a refrigerant outlet side). In both the first block and the second block, the refrigerant is equally distributed to all the tubes, and the ratio between the gas component and the liquid component in each tube tends to be non-uniform. This tendency is particularly noticeable in the second block on the outlet side in which vaporization of the refrigerant proceeds to increase the ratio of the gas component. Thus, in Patent Document 1, a dividing auxiliary resistance plate 110 that vertically partitions the refrigerant outlet header chamber 109 is provided.

[0013] In Patent Document 1, the refrigerant circuit includes the two blocks in order to reduce pressure loss, but the dividing auxiliary resistance plate 110 is provided in the refrigerant outlet header chamber 109 in which most of the refrigerant is gasified for uniform refrigerant distribution. Thus, pressure loss is eventually increased, and a sufficient effect of reducing pressure loss cannot be obtained in terms of increasing performance Q.

[0014] The present invention is achieved in view of such technical problems, and has an object to provide a heat exchanger that reduces pressure loss and can provide uniform refrigerant distribution in a second block.

Solution to the Problems

[0015] A heat exchanger of the present invention is configured so that a refrigerant successively passes through a first block and a second block and flows out of the second block.

[0016] In the heat exchanger of the present invention, the first block includes a first tank having a refrigerant inlet through which the refrigerant flows in, a plurality of first tubes into which the refrigerant having flowed into the first tank is distributed and flows therein, and a second tank in which the refrigerant flowing in the first tubes merges. In the heat exchanger of the present invention, the second block includes a third tank into which the refrigerant having merged in the second tank flows, a plurality of second tubes into which the refrigerant having flowed into the third tank is distributed and flows therein, and a fourth tank in which the refrigerant flowing in the second tube merges, and having a refrigerant outlet through which the merged refrigerant flows out.

[0017] In the heat exchanger of the present invention, a refrigerant passage through which the refrigerant flows from the second tank into the third tank is locally placed on the side opposite to the refrigerant inlet.

[0018] In the heat exchanger of the present invention, non-uniform refrigerant distribution that occurs in the first block is eliminated in the second block in such a manner that the refrigerant passage through which the refrigerant

flows from the second tank into the third tank, that is, from the first block into the second block is locally placed on the side opposite to the refrigerant inlet (hereinafter referred to as a counter-inlet side). Thus, without special resistance means provided in the fourth tank (corresponding to the refrigerant outlet header chamber 109 in Patent Document 1) in which most of the refrigerant is gasified, refrigerant distribution in the second block is made uniform to improve heat exchange performance of the heat exchanger.

[0019] In the heat exchanger of the present invention, it is preferable that the first block and the second block are placed in parallel with each other, the first tank and the fourth tank are placed on a vertically upper side, and the second tank and the third tank are placed on a vertically lower side.

[0020] According to the heat exchanger, the refrigerant is guided vertically downward from the first tank to the second tank, and the refrigerant is guided vertically upward from the third tank to the fourth tank. As such, the refrigerant flows from the second tank toward the third tank on the lower side, that is, from the counter-inlet side toward an inlet side, thereby enabling a liquid component to easily flow to an inlet side of the third tank, and providing uniform distribution of a gas component and the liquid component in the second block (second tubes).

[0021] In the heat exchanger of the present invention, it is preferable that the refrigerant passage through which the refrigerant flows from the second tank into the third tank is formed by providing a plurality of holes in a partition member provided between the second tank and the third tank. This can facilitate mixing of the gas component and the liquid component, and improve uniformity of refrigerant distribution in the second block (second tubes).

[0022] In the heat exchanger of the present invention, it is preferable that the third tank includes at least one resistor against the refrigerant therein, and the resistor is placed on a rear side of the refrigerant passage in a flow direction of the refrigerant. With such a resistor, a distribution amount of the liquid component in the refrigerant flowing in the third tank is particularly made uniform in the third tank. In the third tank, the liquid component is under vaporization, and pressure loss can be reduced even with the resistor in the third tank.

[0023] The third tank may include a plurality of resistors. In this case, it is preferable that the third tank includes a first resistor, and a second resistor placed on a rear side of the first resistor in the flow direction of the refrigerant, and an opening rate of the second resistor is equal to or lower than an opening rate of the first resistor. This is because gradually reducing a liquid component amount toward the refrigerant inlet side is preferable in more uniformly distributing the gas component and the liquid component.

[0024] In the heat exchanger of the present invention, it is preferable that a refrigerant channel area in the fourth tank that constitutes the second block is larger than a refrigerant channel area in the first tank that constitutes

the first block.

[0025] Similarly, it is preferable that a refrigerant channel area in the third tank that constitutes the second block is larger than a refrigerant channel area in the second tank that constitutes the first block.

[0026] This can reduce pressure loss in the second block in which the ratio of the gas component is higher than in the first block without changing an external size of the heat exchanger. From the same intention, it is preferable that a refrigerant channel area of the second tube that constitutes the second block is larger than a refrigerant channel area of the first tube that constitutes the first block.

Advantageous Effects of Invention

[0027] According to the present invention, non-uniform refrigerant distribution that occurs in the first block is eliminated in such a manner that the refrigerant passage through which the refrigerant flows from the second tank into the third tank, that is, from the first block into the second block is locally placed on the counter-inlet side. Thus, without special resistance means provided in the fourth tank (corresponding to the refrigerant outlet header chamber 109 in Patent Document 1) in which most of the refrigerant is gasified, refrigerant distribution in the second block is made uniform to improve heat exchange performance of the heat exchanger.

Brief Description of Drawings

[0028]

[FIG. 1] FIG. 1 is a perspective view showing a heat exchanger according to this embodiment.

[FIG. 2] FIG. 2 is an exploded perspective view of the heat exchanger according to this embodiment.

[FIG. 3] FIG. 3A is a front view of the heat exchanger according to this embodiment, and FIGS. 3B to 3D are sectional views taken along the arrowed lines A-A, B-B, and C-C in FIG. 3A.

[FIG. 4] FIG. 4 shows a refrigerant channel in the heat exchanger according to this embodiment.

[FIG. 5] FIGS. 5A and 5B schematically show a state where a refrigerant (liquid component) flows in the heat exchanger according to this embodiment, FIG. 5A shows a first block of the heat exchanger, and FIG. 5B shows a second block of the heat exchanger.

[FIG. 6] FIGS. 6A and 6B schematically show a state where a refrigerant (liquid component) flows in another heat exchanger according to this embodiment, FIG. 6A shows a first block of the heat exchanger, and FIG. 6B shows a second block of the heat exchanger.

[FIG. 7] FIGS. 7A and 7B schematically show a state where a refrigerant (liquid component) flows in a heat exchanger of a comparative example, FIG. 7A shows a first block of the heat exchanger, and FIG. 7B

shows a second block of the heat exchanger.

[FIG. 8] FIG. 8 is a sectional view of a tank in the heat exchanger according to this embodiment.

[FIG. 9] FIG. 9 is a perspective view showing a heat exchanger disclosed in Patent Document 1.

Description of Embodiments

[0029] Now, an embodiment of the present invention will be described in detail. A heat exchanger 10 according to this embodiment is suitably used in an evaporator in a refrigeration cycle for an air conditioner mounted in an automobile.

15 <General configuration of heat exchanger 10>

[0030] As shown in FIGS. 1 to 4, the heat exchanger 10 includes a core 20 in which a plurality of first tubes 21 and second tubes 22 through which a refrigerant flows, and a plurality of fins 23 are alternately stacked, an upper tank 30 to which one end (upper end in the drawings) of each of the first tubes 21 and the second tubes 22 is connected, and a lower tank 40 to which the other end (lower end in the drawings) of each of the first tubes 21 and the second tubes 22 is connected. The heat exchanger 10 performs heat exchange of the refrigerant using heat transferred to the core 20.

<Configuration of core 20>

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[0031] The first tubes 21 and the second tubes 22 are made of copper, a copper alloy, aluminum, or an aluminum alloy, and are members produced by extrusion molding or roll molding of a plate material and having a hollow portion and a rectangular section. In the heat exchanger 10, the first tubes 21 and the second tubes 22 are arranged in two rows in a width direction (Y direction in FIG. 2). The upper ends of the first tubes 21 and the second tubes 22 are connected to the upper tank 30, and the lower ends of the first tubes 21 and the second tubes 22 are connected to the lower tank 40. Thus, the upper tank 30, the first tubes 21, the second tubes 22, and the lower tank 40 are communicated with each other to allow passage of the refrigerant. This connection is generally performed by brazing. The sectional shape of the first tube(s) 21 and the second tube(s) 22 is not limited to the rectangular shape, but may be a circular shape or other shapes.

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[0032] The fin 23 is made of the same material as that of the first tube 21 and the second tube 22. In this embodiment, a corrugated fin molded by roll molding is used, but not limited to this, a plate fin may be used.

[0033] In the core 20, the first and second tubes 21, 22, and the fins 23 are alternately stacked in a longitudinal direction (X direction in FIG. 2) of the heat exchanger 10, and the both ends are sealed by side plates 24. The side plate 24 functions as a reinforcing member of the core 20, and the both ends in a longitudinal direction thereof

are supported by the upper tank 30 and the lower tank 40.

<Configuration of upper tank 30>

[0034] The upper tank 30 mainly includes a tank plate 31 and an end plate 32, and is assembled so that openings of the plates face each other. In the upper tank 30, an upper partition plate 33 is provided along a longitudinal direction. The upper partition plate 33 partitions an inside of the upper tank 30 at a middle in a width direction. One of partitioned sides constitutes a first tank T1, and the other constitutes a fourth tank T4. The first tube 21 is connected to a lower surface of the first tank T1, and the second tube 22 is connected to a lower surface of the fourth tank T4. Since the upper partition plate 33 is provided between the first tank T1 and the fourth tank T4, the refrigerant is not directly moved between the tanks T1 and T4.

[0035] A cap 34 is provided on one end side in the longitudinal direction of the upper tank 30. The cap 34 has a refrigerant inflow hole h_{in} and a refrigerant outflow hole h_{ex} . A cap 35 is provided on the other end side in the longitudinal direction of the upper tank 30. The cap 35 seals the other end in the longitudinal direction of the upper tank 30.

<Configuration of lower tank 40>

[0036] The lower tank 40 mainly includes a tank plate 41 and an end plate 42, and is assembled so that openings of the plates face each other. In the lower tank 40, a lower partition plate 43 is provided along a longitudinal direction. The lower partition plate 43 partitions an inside of the lower tank 40 at a middle in a width direction. One of partitioned sides constitutes a second tank T2, and the other constitutes a third tank T3. The first tube 21 is connected to an upper surface of the second tank T2, and the second tube 22 is connected to an upper surface of the third tank T3.

[0037] The lower partition plate 43 has refrigerant passages 43h passing therethrough in a thickness direction. The plurality of (seven in this example) refrigerant passages 43h are locally provided on one end side in a longitudinal direction of the lower partition plate 43. The refrigerant passages 43h are placed on the opposite side of the refrigerant inflow hole h_{in} that is a refrigerant inlet in the longitudinal direction of the heat exchanger 10.

[0038] In the lower tank 40, the lower partition plate 43 is provided between the second tank T2 and the third tank T3, but the refrigerant flows from the second tank T2 into the third tank T3 through the plurality of refrigerant passages 43h locally placed on the opposite side of the refrigerant inlet (hereinafter referred to as a counter-inlet side). The refrigerant passages 43h are preferably provided within a range of 20% or less of the entire length of the lower partition plate 43. Increasing a flow rate of the refrigerant having passed through the refrigerant passages 43h is effective for uniformly mixing the gas com-

ponent and the liquid component in the refrigerant. In FIG. 2, the refrigerant passages 43h are constituted by a plurality of circular holes, but may be one or more wide refrigerant passages having a longer diameter in the longitudinal direction of the lower partition plate 43. However, in order to uniformly mix the gas component and the liquid component, it is preferable to provide the plurality of refrigerant passages 43h having a small diameter as in this embodiment.

[0039] In the lower tank 40, distribution adjusting plates (resistors) 46, 47 and 48 are provided in the third tank T3. The distribution adjusting plates 46, 47 and 48 are placed in this order from the counter-inlet side at a predetermined interval. The distribution adjusting plates 46, 47 and 48 have through holes 46h, 47h and 48h, respectively, through which the refrigerant passes. The refrigerant having flowed through the refrigerant passages 43h into the third tank T3 successively passes through the through holes 46h, 47h and 48h and flows downward with the distribution adjusting plates 46, 47 and 48 as the resistors. Without the distribution adjusting plates 46, 47 and 48 in the third tank T3, the liquid component in the refrigerant tends to flow to a downstream side, and the gas component tends to stay in an upstream side. When the liquid component is uneven in the longitudinal direction to provide non-uniform refrigerant distribution, sufficient vaporization performance cannot be obtained. Thus, the distribution adjusting plates 46, 47 and 48 are particularly used as the resistors for the liquid component, and thus the liquid component and the gas component in the refrigerant are distributed as equally as possible over upstream and downstream regions of the third tank T3.

[0040] The distribution adjusting plates 46, 47 and 48 function as the resistors and thus cause pressure loss of the refrigerant. However, the distribution adjusting plates 46, 47 and 48 are provided in the third tank T3 in which most of the liquid component is under vaporization, and thus the pressure loss can be minimized. In this embodiment, the three distribution adjusting plates 46, 47 and 48 are provided, but one distribution adjusting plate may be provided.

[0041] The distribution adjusting plate 46 (first distribution adjusting plate from an upstream end, "first resistor") provided for the above-described purpose is preferably provided in a position relatively close to the upstream end of the third tank T3. As a specific index, the distribution adjusting plate 46 is provided within a range of 30% or less of the entire length of the lower partition plate 43 from the upstream end.

[0042] An opening rate of the through holes 46h, 47h and 48h provided in the distribution adjusting plates 46, 47 and 48 is preferably within a range of 15% to 30%. This is because the liquid component and the gas component can be equally distributed over the upstream and downstream regions without increasing pressure loss of the refrigerant more than necessary. The opening rate herein refers to a ratio of each of the through holes 46h,

47h and 48h to an area (sectional area) of a refrigerant channel in the third tank T3.

[0043] when a plurality of distribution adjusting plates 46, 47 and 48 are provided, opening rates of through holes 47h and 48h in the second and thereafter distribution adjusting plate 47 (second resistor) and distribution adjusting plate 48 (second resistor) from an upstream end are preferably equal to or lower than opening rates of through holes 47h and 48h on an adjacent upstream side. This is because the opening rate is reduced in a position closer to the downstream side to retain, on the upstream side, the liquid component that tends to flow to the downstream side.

[0044] A cap 44 is provided on one end side in the longitudinal direction of the lower tank 40. The cap 44 seals one end side in the longitudinal direction of the lower tank 40. A cap 45 is provided on the other end side in the longitudinal direction of the lower tank 40. The cap 45 seals the other end side in the longitudinal direction of the lower tank 40.

<Flow of refrigerant>

[0045] The flow of the refrigerant in the heat exchanger 10 configured as described above will be described. In the heat exchanger 10, the refrigerant channel is constituted by the first block and the second block, and the refrigerant flows in the heat exchanger 10 in order of the first block and the second block. The first block includes the first tank T1, the first tube 21, and the second tank T2, and the second block includes the third tank T3, the second tube 22, and the fourth tank T4.

[0046] When the heat exchanger 10 is used as the evaporator of the refrigeration cycle, the refrigerant having brought into a gas-liquid two-phase state by an expansion valve placed on the upstream side with respect to the heat exchanger 10 flows through the refrigerant inflow hole h_{in} (refrigerant inlet) into the first tank T1.

[0047] The refrigerant having flowed into the first tank T1 flows vertically downward in the first tube 21 and reaches the second tank T2. During flowing in the first tube 21, the refrigerant is subjected to heat exchange with air passing through the core 20 with the liquid component being vaporized.

[0048] In the refrigerant flowing vertically downward in the first tube 21, the ratio between the gas component and the liquid component varies in the longitudinal direction of the heat exchanger 10. This is schematically shown in FIG. 7A. In FIG. 7A, the ratio of the liquid component in the refrigerant is shown by arrows. The ratio of the liquid component is higher in the first tube 21 on the side closer to the refrigerant inlet. Since the liquid component has higher resistance to an inner wall of the first tank T1 than the gas component, the liquid component is hard to flow in a position farther from the refrigerant inlet.

[0049] The refrigerant having flowed into the second tank T2 flows through the refrigerant passage 43h into

the third tank T3. Since the refrigerant passages 43h are locally provided on the counter-inlet side of the lower partition plate 43, the refrigerant having flowed in the first tube 21 in a position closer to the counter-inlet side among the first tubes 21 first flows through the refrigerant passages 43h into the third tank T3. The refrigerant having flowed into the third tank T3 flows vertically upward in the second tube 22 and reaches the fourth tank T4. During flowing in the second tube 22, the refrigerant is subjected to heat exchange with air passing through the core 20 while the liquid component is vaporized. The refrigerant with the liquid component being vaporized during flowing through the heat exchanger 10 flows through the fourth tank T4, and is discharged from the refrigerant flow-out hole h_{ex} toward a compressor placed on the downstream side.

[0050] If the refrigerant passages 43h are formed over the entire region in the longitudinal direction of the second tank T2 (or the third tank T3), the ratio of the liquid component of the refrigerant flowing vertically upward in the second tube 22 (second block) is higher in the second tube 22 on the side closer to the refrigerant inlet as shown in FIG. 7B because the state of the first tube 21 (first block) is taken over. This state is shown by dash-single-dot lines in FIG. 5B.

[0051] On the other hand, in the heat exchanger 10, the refrigerant passages 43h are locally provided on the counter-inlet side of the lower partition plate 43, and thus the refrigerant having flowed in the first tube 21 in the position closer to the counter-inlet side among the first tubes 21 first flows through the refrigerant passages 43h into the third tank T3. Thus, in the second block, as shown by solid lines in FIG. 5B, non-uniform distribution of the gas component and the liquid component in the longitudinal direction that has occurred in the first block (FIGS. 5A and 7A) is eliminated. The dash-single-dot lines in FIG. 5B indicate the ratio of the liquid component when the refrigerant passages 43h are formed over the entire region in the longitudinal direction of the third tank T3.

[0052] In the above embodiment, the example in which the refrigerant inlet and the refrigerant outlet are provided on the same side of the upper tank 30 has been described. However, as shown in FIGS. 6A and 6B, the same applies to a heat exchanger in which a refrigerant outlet is provided on the opposite side of the refrigerant inlet.

[0053] The embodiment of the present invention has been described, but further, the configurations described in the embodiment may be chosen or changed to other configurations without departing from the gist of the present invention.

[0054] For example, as shown in FIGS. 8A and 8B, the position and shape of the upper partition plate 33 may be adjusted so that the refrigerant channel area of the fourth tank T4 is larger than the refrigerant channel area of the first tank T1. Similarly, the position and shape of the lower partition plate 43 may be adjusted so that the refrigerant channel area of the third tank T3 is larger than

the refrigerant channel area of the second tank T2. This can reduce pressure loss in the third tank T3 and the fourth tank T4 in which the ratio of the gas component is higher than in the first tank T1 and the second tank T2 without changing the external size of the heat exchanger 10. Further, as shown in FIG. 8C, a width (refrigerant channel area) of the second tube 22 that constitutes the second block may be larger than a width (refrigerant channel area) of the first tube 21 that constitutes the first block. This can reduce pressure loss of the refrigerant in the second block in which the ratio of the gas component is higher than in the first block without changing the external size of the heat exchanger 10.

Reference Signs List

[0055]

10 ... heat exchanger
 20 ... core, 21 ... first tube, 22 ... second tube, 23 ... fin
 30 ... upper tank, 33 ... upper partition plate
 40 ... lower tank, 43 ... lower partition plate, 43h ... refrigerant passage
 46, 47, 48 ... distribution adjusting plate, 46h, 47h, 48h ... through hole
 T1 ... first tank, T2 ... second tank, T3 ... third tank, T4 ... fourth tank

Claims

1. A heat exchanger in which a refrigerant successively passes through a first block and a second block and flows out of the second block, wherein the first block includes a first tank having a refrigerant inlet through which the refrigerant flows in, a plurality of first tubes into which the refrigerant having flowed into the first tank is distributed and flows therein, and a second tank in which the refrigerant flowing in the first tubes merges, the second block includes a third tank into which the refrigerant having merged in the second tank flows, a plurality of second tubes into which the refrigerant having flowed into the third tank is distributed and flows therein, and a fourth tank in which the refrigerant flowing in the second tube merges, and having a refrigerant outlet through which the merged refrigerant flows out, and a refrigerant passage through which the refrigerant flows from the second tank into the third tank is locally placed on the opposite side of the refrigerant inlet.
2. The heat exchanger according to claim 1, wherein the first block and the second block are placed in parallel with each other, the first tank and the fourth tank are placed on a vertically upper side, and

the second tank and the third tank are placed on a vertically lower side.

3. The heat exchanger according to claim 1 or 2, wherein the refrigerant passage through which the refrigerant flows from the second tank into the third tank is formed by providing a plurality of holes in a partition member provided between the second tank and the third tank.
4. The heat exchanger according to claim 1, wherein the third tank includes at least one resistor against the refrigerant, and the resistor is placed on a rear side of the refrigerant passage in a flow direction of the refrigerant.
5. The heat exchanger according to claim 4, wherein the third tank includes a plurality of the resistors.
6. The heat exchanger according to claim 5, wherein the third tank includes a first resistor, and a second resistor placed on a rear side of the first resistor in the flow direction of the refrigerant, and an opening rate of the second resistor is equal to or lower than an opening rate of the first resistor.
7. The heat exchanger according to claim 2, wherein a refrigerant channel area in the fourth tank that constitutes the second block is larger than a refrigerant channel area in the first tank that constitutes the first block.
8. The heat exchanger according to claim 2, wherein a refrigerant channel area in the third tank that constitutes the second block is larger than a refrigerant channel area in the second tank that constitutes the first block.
9. The heat exchanger according to claim 1, wherein a refrigerant channel area of the second tube that constitutes the second block is larger than a refrigerant channel area of the first tube that constitutes the first block.

FIG. 1

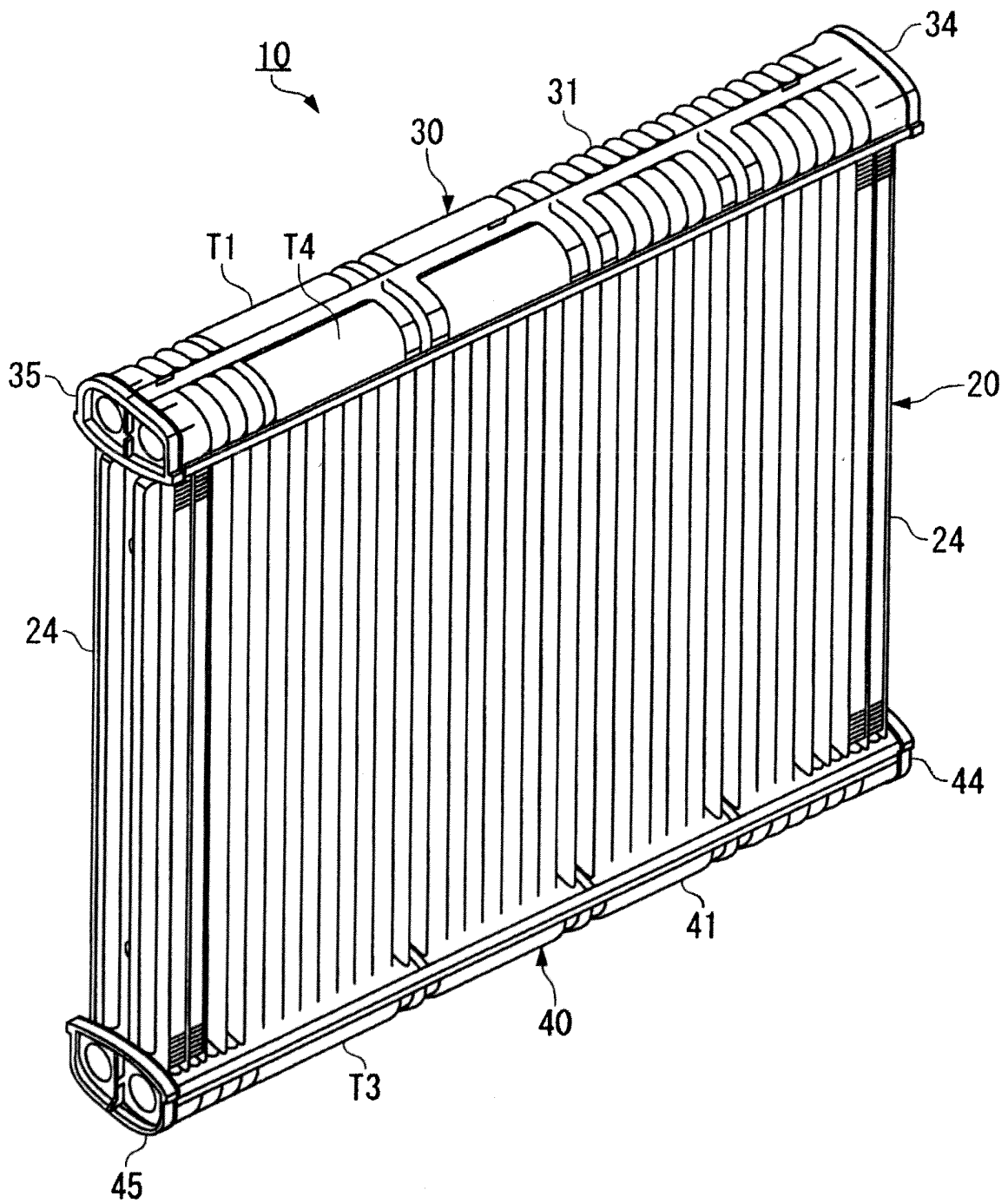


FIG. 2

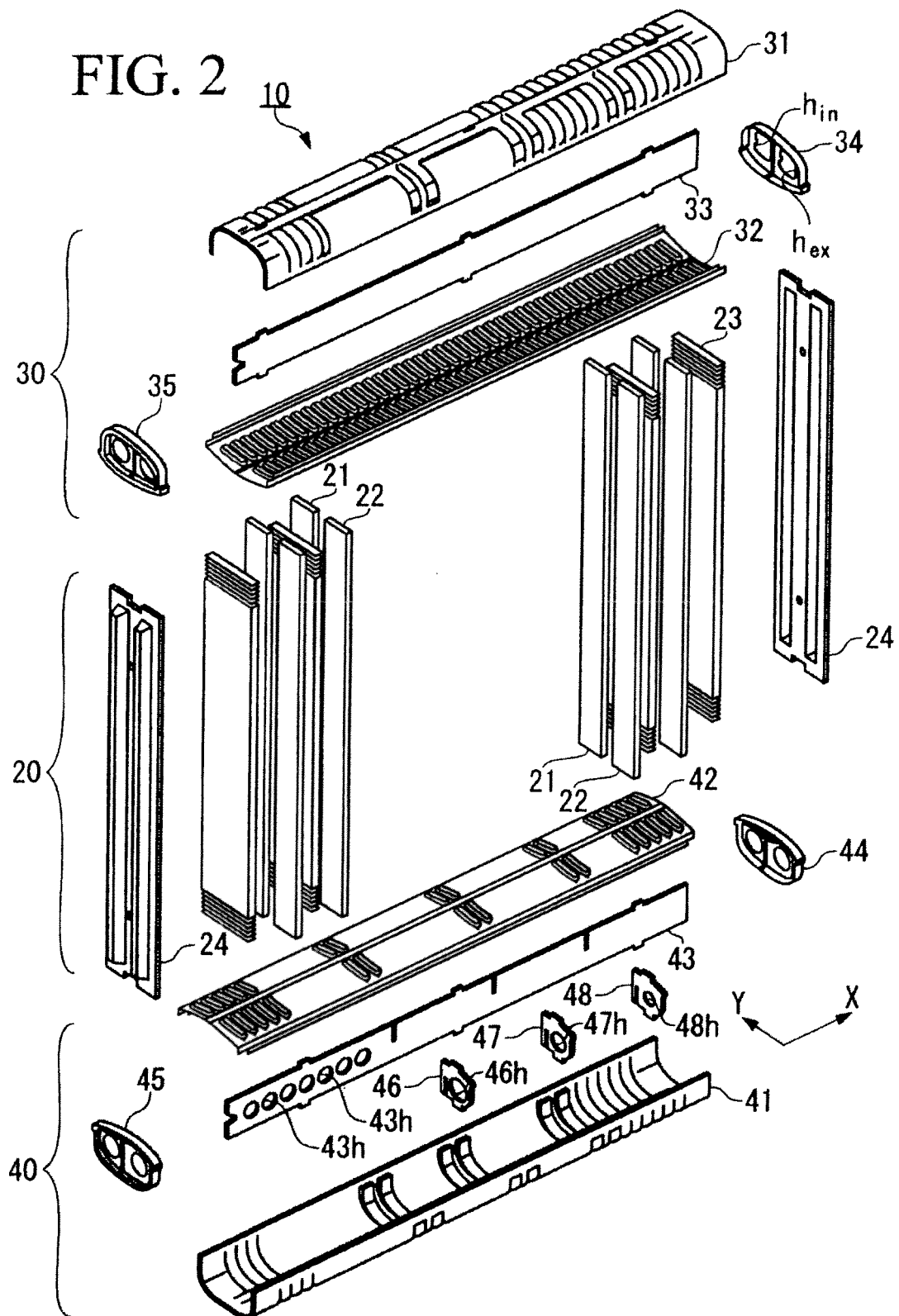


FIG. 3D

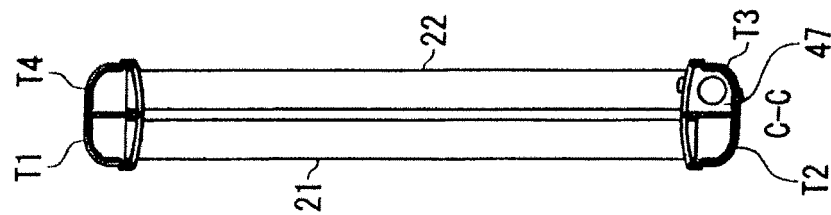


FIG. 3B

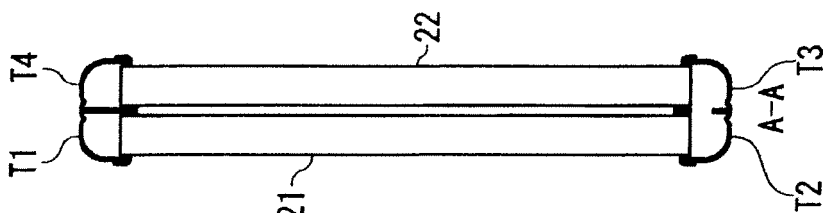


FIG. 3C

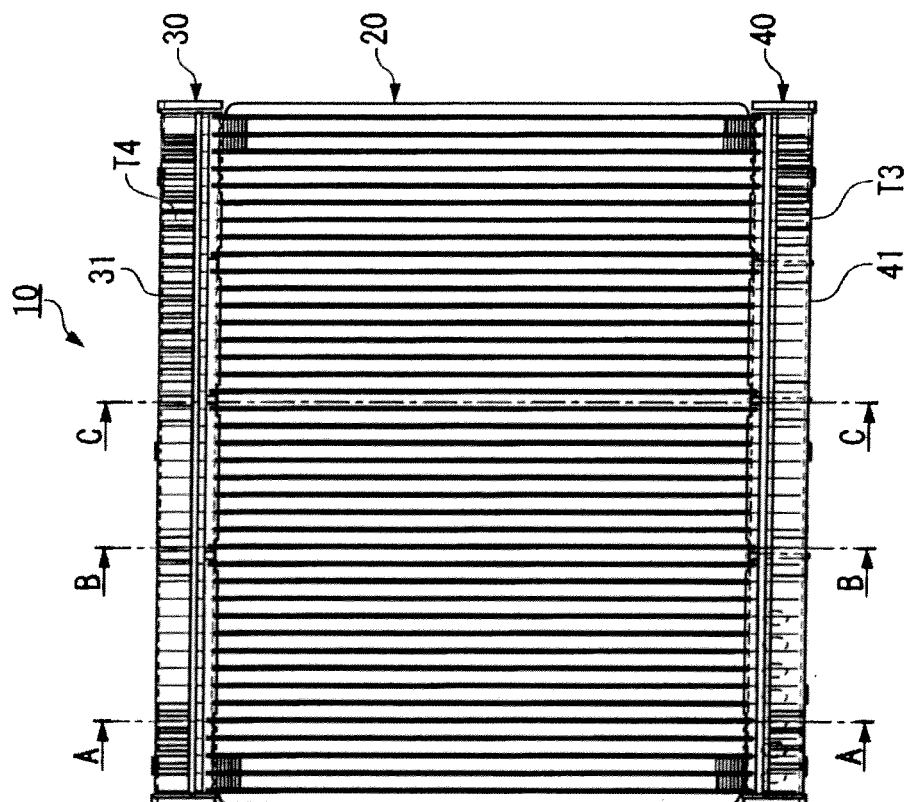


FIG. 3A

FIG. 4

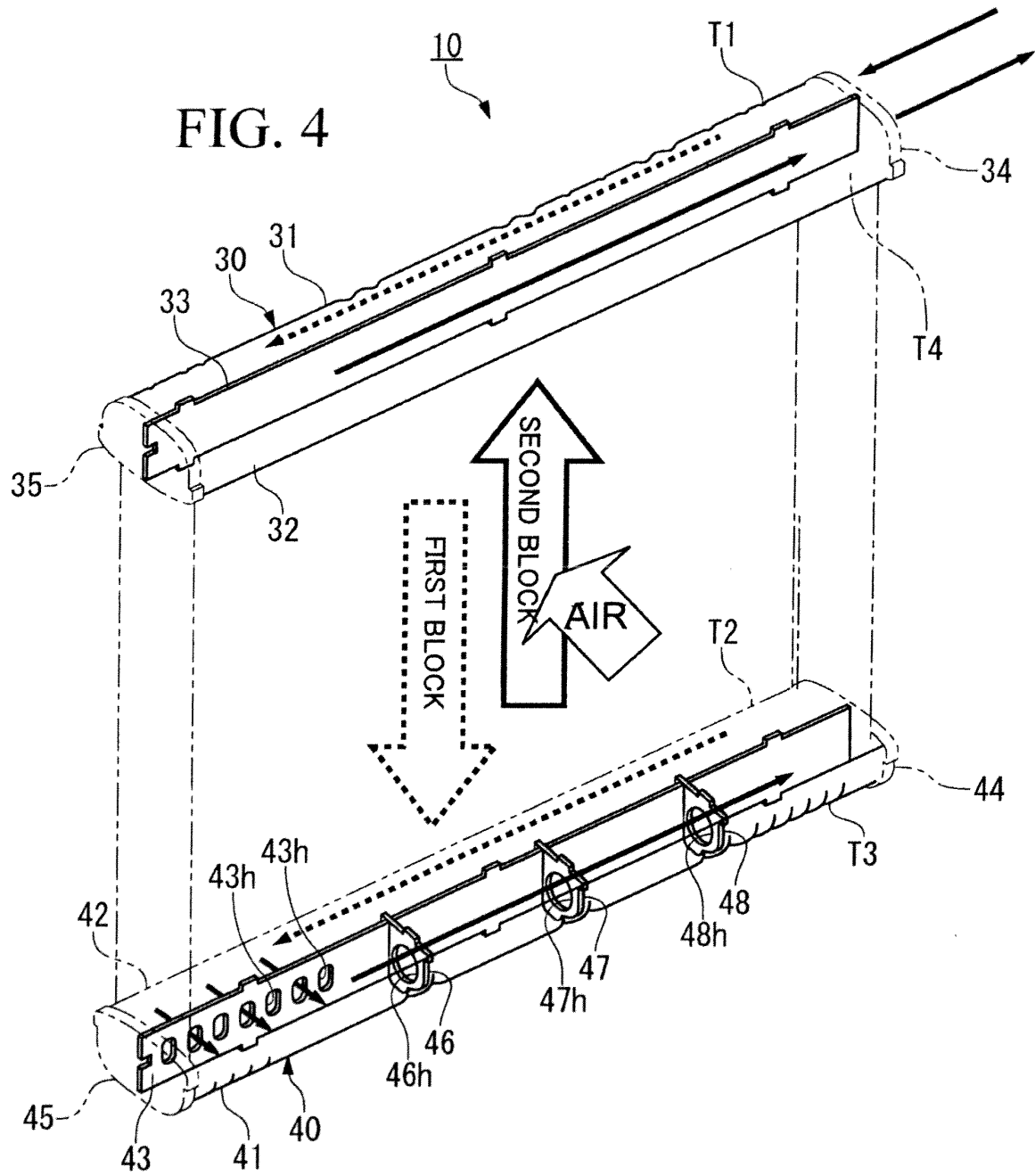
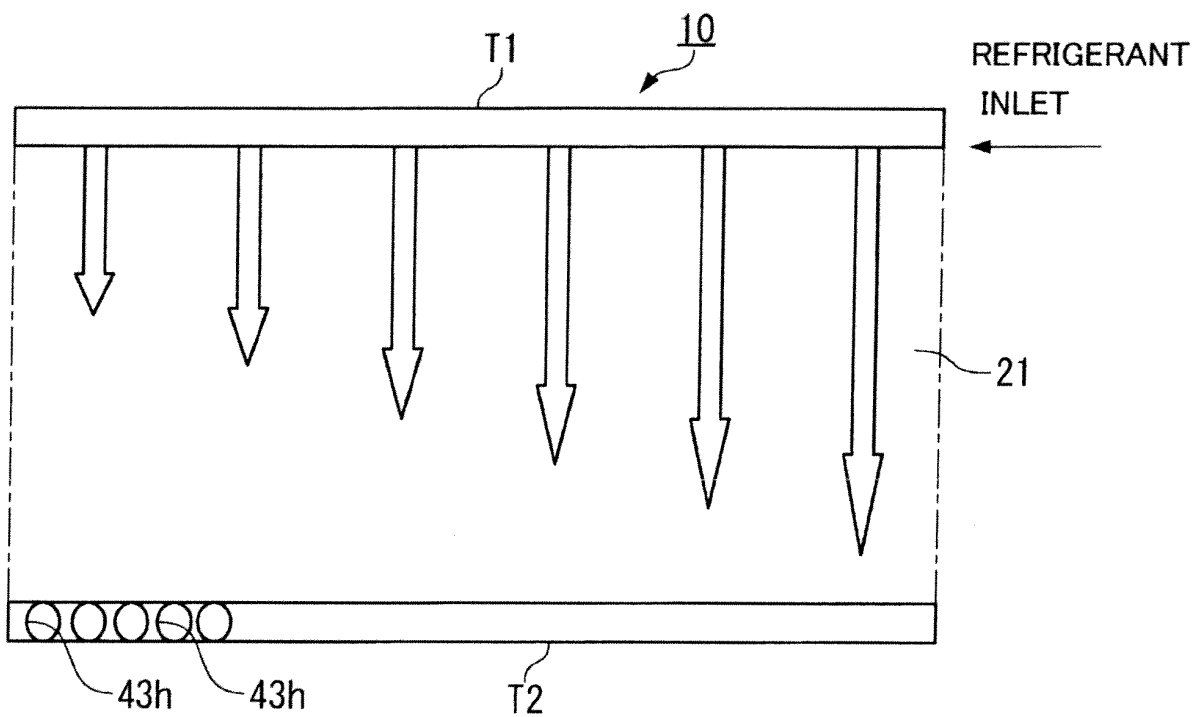


FIG. 5A

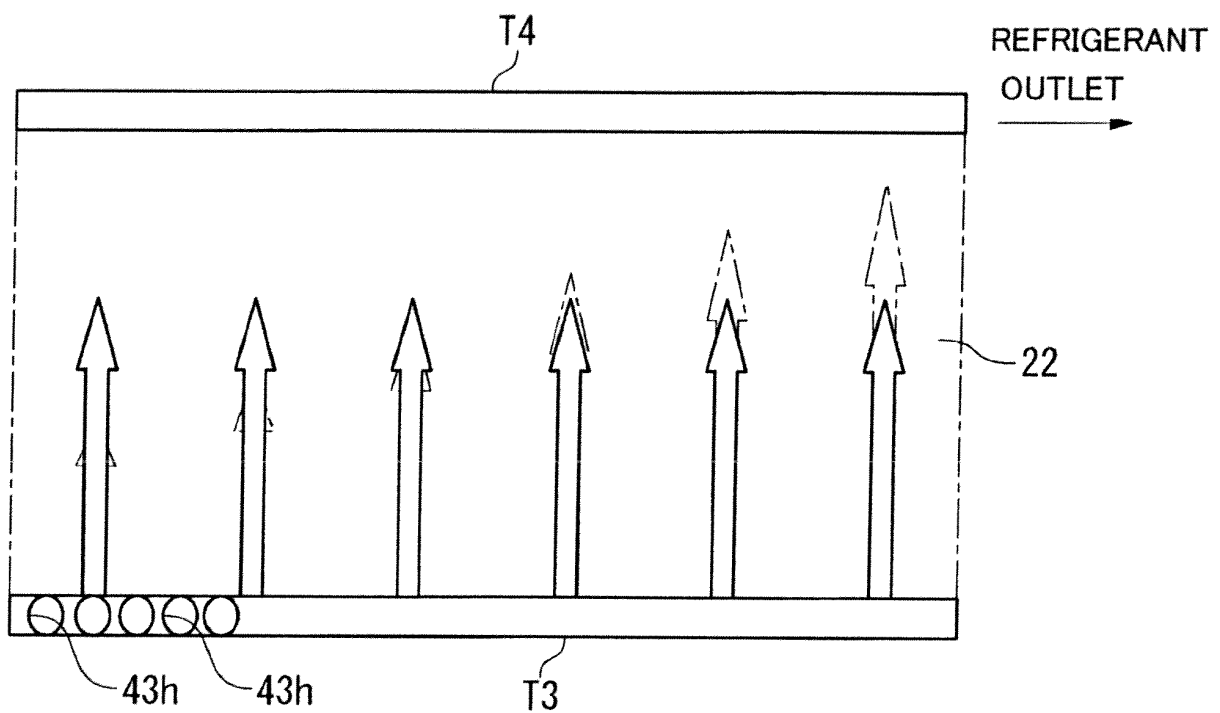
FIRST BLOCK OF HEAT EXCHANGER ACCORDING
TO THIS EMBODIMENT



*REFRIGERANT PASSAGES ARE LOCALLY PLACED
ON THE OPPOSITE SIDE OF REFRIGERANT INLET

FIG. 5B

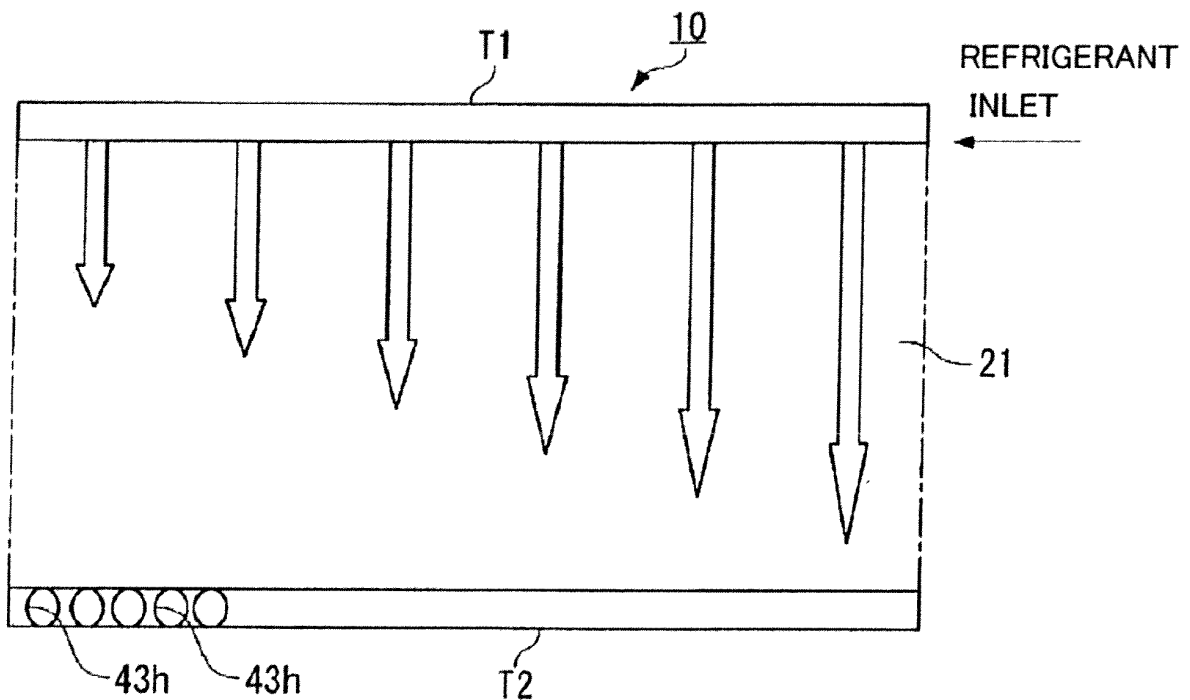
SECOND BLOCK OF HEAT EXCHANGER ACCORDING
TO THIS EMBODIMENT



*REFRIGERANT PASSAGES ARE LOCALLY PLACED
ON THE OPPOSITE SIDE OF REFRIGERANT INLET

FIG. 6A

FIRST BLOCK OF HEAT EXCHANGER ACCORDING
TO THIS EMBODIMENT



*REFRIGERANT PASSAGES ARE LOCALLY PLACED
ON THE OPPOSITE SIDE OF REFRIGERANT INLET

FIG. 6B

SECOND BLOCK OF HEAT EXCHANGER ACCORDING
TO THIS EMBODIMENT

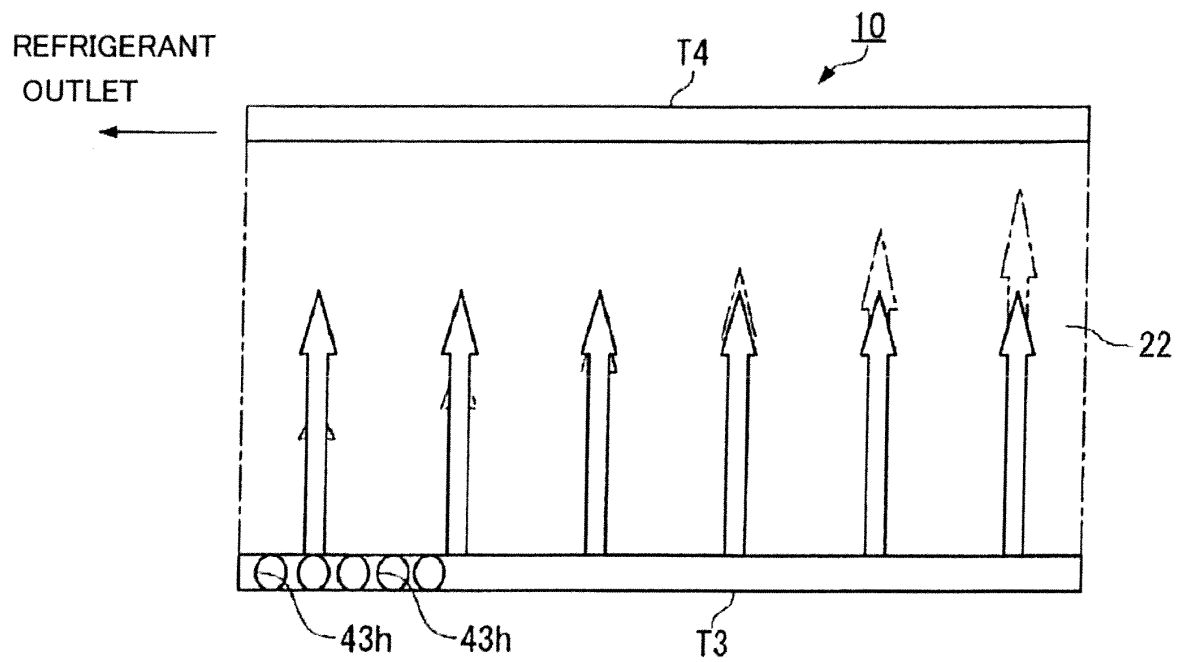
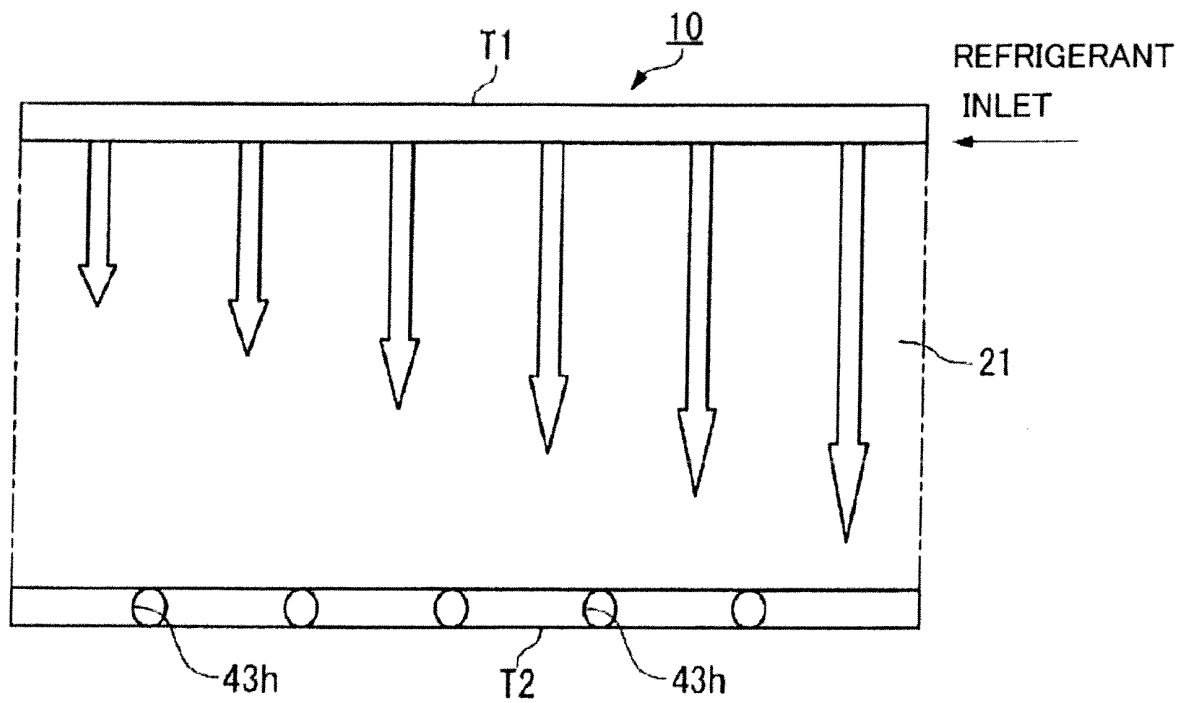


FIG. 7A

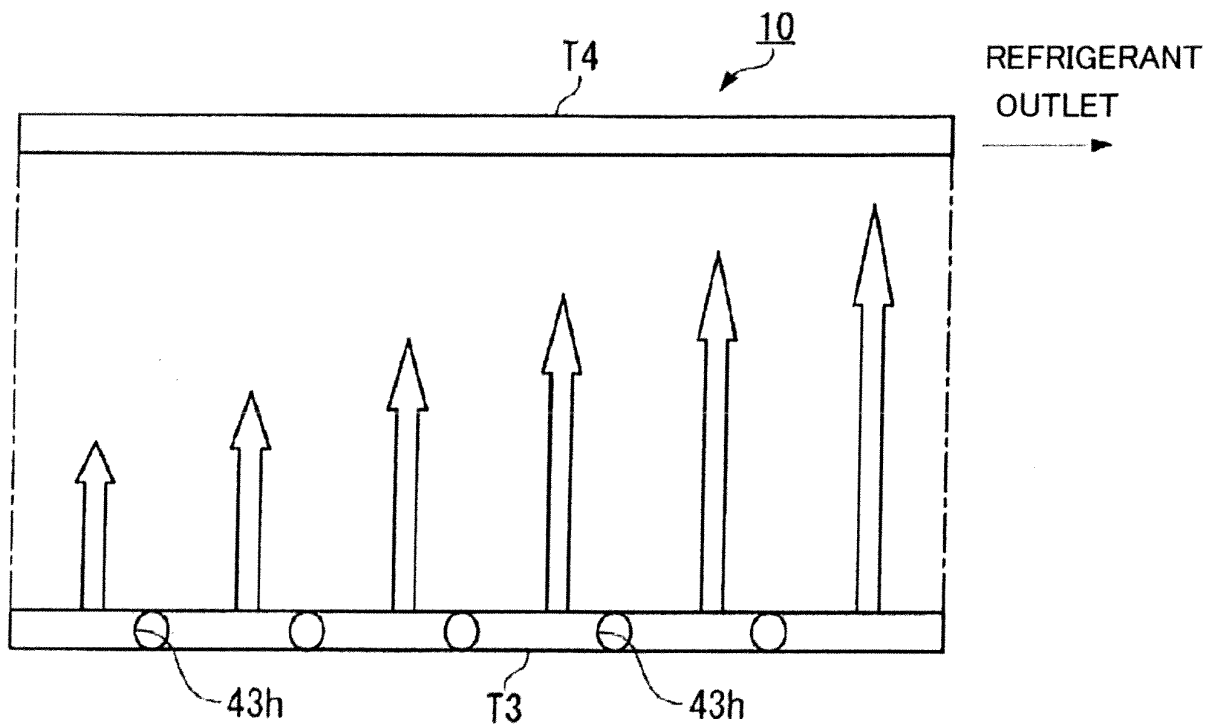
FIRST BLOCK OF HEAT EXCHANGER OF COMPARATIVE EXAMPLE



*REFRIGERANT PASSAGES ARE FORMED OVER THE ENTIRE REGION

FIG. 7B

SECOND BLOCK OF HEAT EXCHANGER OF COMPARATIVE EXAMPLE



*REFRIGERANT PASSAGES ARE FORMED OVER THE ENTIRE REGION

FIG. 8A

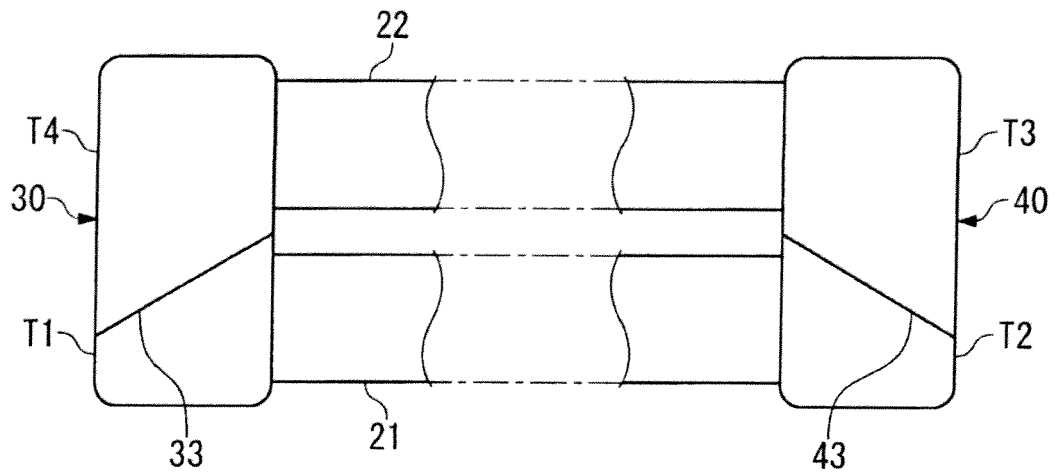


FIG. 8B

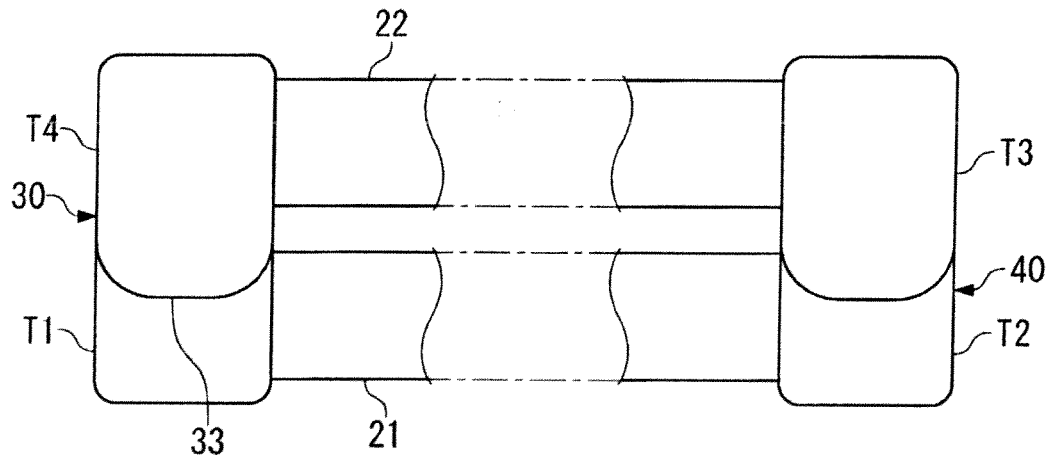


FIG. 8C

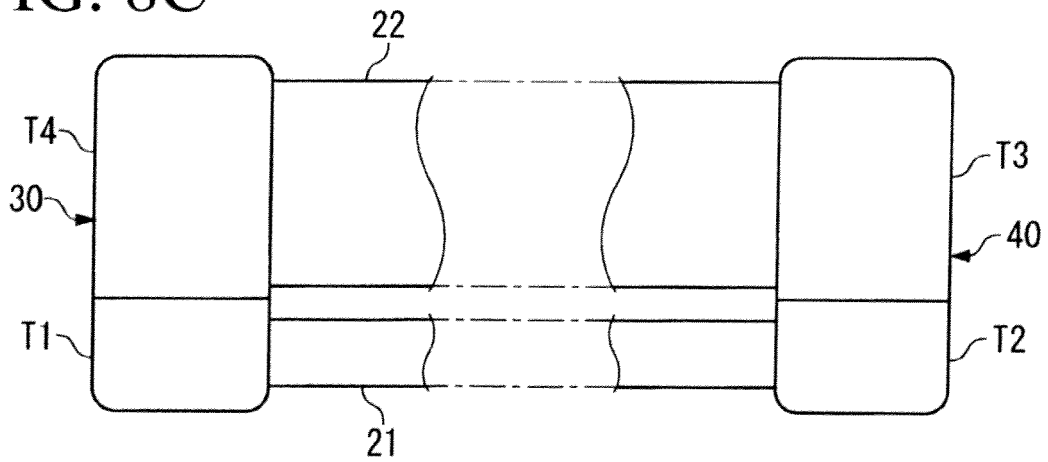
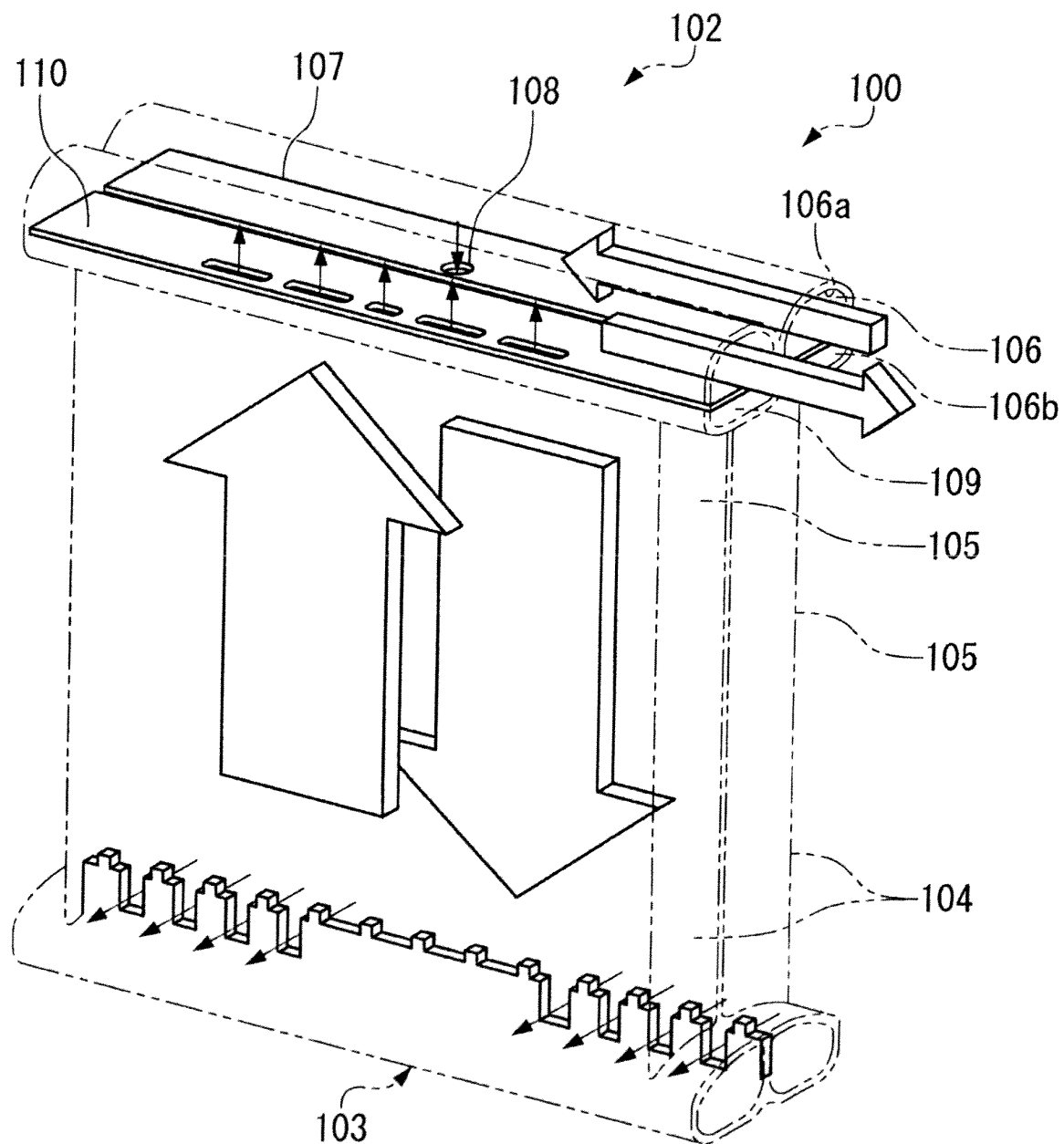


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/001125

A. CLASSIFICATION OF SUBJECT MATTER

F28F9/02 (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)

F28F9/02

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	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

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	JP 2002-147990 A (Zexel Valeo Climate Control Corp.), 22 May 2002 (22.05.2002), fig. 3, 4; paragraphs [0027] to [0033] (Family: none)	1, 2 3-9
Y	JP 2001-74388 A (Denso Corp.), 23 March 2001 (23.03.2001), fig. 1, 2; paragraphs [0020] to [0051] & US 6449979 B1 & EP 1065453 A2 & DE 60010377 D & DE 60010377 T & BR 2961 A & KR 10-2001-0015060 A & CN 1292484 A	3-6

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

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

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Date of the actual completion of the international search
31 March, 2010 (31.03.10)Date of mailing of the international search report
13 April, 2010 (13.04.10)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/001125

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2009-30882 A (Mitsubishi Heavy Industries, Ltd.), 12 February 2009 (12.02.2009), fig. 2; paragraphs [0019] to [0031] & US 2009/0266528 A & WO 2009/017042 A1	3-6
Y	JP 2004-163036 A (Japan Climate Systems Corp.), 10 June 2004 (10.06.2004), fig. 1 to 3; paragraphs [0015] to [0031] (Family: none)	7-9

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005043040 A [0011]