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(54) HEAT EXCHANGER AND AIR CONDITIONER

(57) A heat exchanger comprises a heat transfer part that exchanges heat between an air-conditioning air and a heat exchanging medium, and a control device that adjusts a heat exchange amount between the air-conditioning air and the heat exchanging medium. The heat transfer part includes a flow dividing circuit configured to divide a heat transfer pipe group through which the heat exchanging medium flows into a plurality of groups and cause grouping ratios to be different from each other, and the control device is configured to increase or decrease a flow rate of the heat exchanging medium in a first group having a smaller grouping ratio among the plurality of groups in a case of a low air conditioning load.

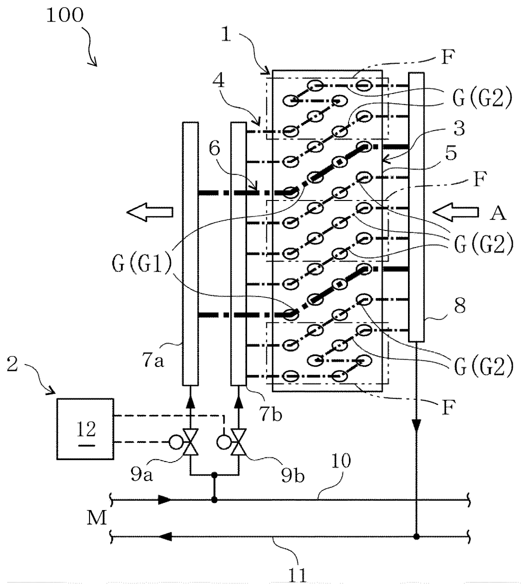

FIG.2

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Description

BACKGROUND

(1) Technical Field

[0001] The present disclosure relates to a heat exchanger and an air conditioner including the heat exchanger.

(2) Description of Related Art

[0002] For example, as heat exchangers used in air conditioners such as a fan coil unit and an air handling unit, there are some heat exchangers including a heat transfer part that exchanges heat between an air-conditioning air and a heat exchanging medium. For example, the heat exchanger is configured to adjust a heat exchange amount by increasing or decreasing a flow rate of the heat exchanging medium and control capacity to cool or heat the air-conditioning air. For example, there is a heat transfer part including a heat transfer pipe group as disclosed in Japanese Laid-Open Patent Application Publication No. 2001-280859. For example, a lower limit of the flow rate of the heat exchanging medium is reduced by equally dividing the heat transfer pipe group of the heat transfer part into two groups, and thus, a control range of a lower limit in a capacity of the heat exchanger can be widened.

SUMMARY

[0003] However, since the heat transfer pipe group is equally divided into two groups, the lower limit of the flow rate of the heat exchanging medium is limited. For example, in the case of a low air conditioning load with which the heat exchange is sufficiently performed with a small heat exchange amount (heat transmission amount), the heat exchanger overcools or overheats due to excessive capacity, and thus, there is a problem that a temperature difference of the heat exchanging medium before and after the heat exchange caused by the heat exchange in the heat transfer part is not constant. Thus, there are problems that energy is wasted and comfortability is reduced. Accordingly, the present disclosure provides a heat exchanger that improves energy saving and comfortability, and an air conditioner including the heat exchanger.

[0004] A heat exchanger according to an aspect of the present disclosure includes a heat transfer part that exchanges heat between an air-conditioning air and a heat exchanging medium, and a control device that adjusts a heat exchange amount between the air-conditioning air and the heat exchanging medium. The heat transfer part includes a flow dividing circuit configured to divide a heat transfer pipe group through which the heat exchanging medium flows into a plurality of groups and cause grouping ratios to be different from each other, and the control device is configured to increase or decrease a flow rate of the heat exchanging medium in a first group having a smaller grouping ratio among the plurality of groups in a case of a low air conditioning load.

[0005] According to the present disclosure, the energy saving and the comfortability can be improved.

[0006] The above and further objects, features and advantages of the present disclosure will more fully be apparent from the following description of preferred embodiments with accompanying the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIG. 1 is a perspective view illustrating a heat exchanger according to an embodiment;
FIG. 2 is a simplified schematic diagram illustrating an example of a cross section of the heat exchanger as viewed from arrow DA in FIG. 1;
FIG. 3 is a simplified schematic diagram illustrating an example of a cross section of the heat exchanger as viewed from arrow DB in FIG. 1;
FIG. 4 is a bottom perspective view illustrating an example of a configuration of an air conditioner according to the embodiment;
FIG. 5 is a bottom view of the air conditioner illustrated in FIG. 4;
FIG. 6 is a sectional view of the air conditioner illustrated in FIG. 5 taken along line VI-VI; and
FIG. 7 is a sectional view of the air conditioner illustrated in FIG. 6 taken along line VII-VII.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0008] In the related art, as heat exchangers used in air conditioners, there are some heat exchangers including a heat transfer part that exchanges heat between an air-conditioning air and a heat exchanging medium. For example, the heat exchanger is configured to adjust a heat exchange amount by increasing or decreasing a flow rate of the heat exchanging medium and control capacity to cool or heat the air-conditioning air. For example, as disclosed in Japanese Laid-Open Patent Application Publication No. 2001-280859, a lower limit of the flow rate of the heat exchanging medium is reduced by dividing a heat transfer pipe group included in the heat exchanger into two groups, and thus, a control range of a lower limit in a capacity of a heat exchange coil of the heat exchanger can be widened. However, when the heat transfer pipe group is divided into two equal groups, the lower limit of the flow rate of the heat exchanging medium is limited to a certain limit. For example, in a low air conditioning load region in which the heat exchange is sufficiently performed with a small heat exchange amount (heat transmission amount), the heat exchanger overcools or overheats due to excessive capacity, and thus, there is a problem that a temperature difference of the heat exchanging medium before and after the heat exchange caused by the heat exchange of the heat exchanger is not constant. Thus, the present inventors have studied a heat exchanger that improves the energy saving and the comfortability.

[0009] A pneumatic radiation air conditioner disclosed in Japanese Laid-Open Patent Application Publication No. 2011-145045 includes an air supply part that is provided such that an air cooled or heated by a heat exchanger generates an air jet, an air induction part that is provided such that an air of an air-conditioned space is drawn into by an induction action of the air jet discharged from the air supply part, and an air mixing part that is provided such that an air mixture of the air jet of the air supply part and the induction air of the air induction part is discharged to the air-conditioned space and heat of the air mixture is radiated to the air-conditioned space. Due to a heat radiation effect and an induction reheating effect caused by the configuration of the pneumatic radiation air conditioner, comfortable air conditioning without draft feeling and temperature unevenness can be performed, but a structure is complicated and cost is high. Thus, the present inventors have studied a simple pneumatic radiation air conditioner capable of cooling at a blowout temperature exceeding a dew point temperature without an induction reheating function while improving energy saving and comfortability by a heat exchanger.

[0010] A heat exchanger according to an aspect of the present disclosure includes a heat transfer part that exchanges heat between an air-conditioning air and a heat exchanging medium, and a control device that adjusts a heat exchange amount between the air-conditioning air and the heat exchanging medium. The heat transfer part includes a flow dividing circuit configured to divide a heat transfer pipe group through which the heat exchanging medium flows into a plurality of groups and cause grouping ratios to be different from each other, and the control device is configured to increase or decrease a flow rate of the heat exchanging medium in a first group having a smaller grouping ratio among the plurality of groups in a case of a low air conditioning load.

[0011] According to the aforementioned aspect, the heat exchanger can further lower the lower limit of the flow rate of the heat exchanging medium by increasing or decreasing the flow rate of the heat exchanging medium in the first group of the flow dividing circuit in the case of the low air conditioning load. Therefore, the control range of the capacity of the heat exchanger becomes wider toward the lower limit, and the capacity of the heat exchanger does not become excessive even in the case of the low air conditioning load. Therefore, energy waste, overcooling, and overheating are reduced, and energy saving and comfortability are improved.

[0012] For example, even in a case where the heat exchanging medium is water and the air conditioning load is low, the heat exchanger can perform the control such that the temperature difference of the heat exchanging medium before and after the heat exchange is constant. Thus, when such a heat exchanger is used in an air conditioner, it is possible to operate the air conditioner with a small water amount and a large temperature difference. In the case of the small amount of water, it is possible to simplify piping and air conditioning facilities for the air conditioner. In the case of the large temperature difference, it is possible to save energy of a heat source device that transmits and receives water as the heat exchanging medium to and from the heat exchanger and adjusts the temperature of the water.

[0013] In the heat exchanger according to the aspect of the present disclosure, non-overlapping zones which do not overlap the first group may be formed in a second group having a grouping ratio larger than the grouping ratio of the first group among the plurality of groups when viewed in an air flow direction of the air-conditioning air passing through the heat transfer part, and the non-overlapping zones may be located so as to sandwich the first group.

[0014] According to the aforementioned aspect, when the heat exchanger causes the heat exchanging medium to flow through the first group and does not cause the heat exchanging medium to flow through the second group during cooling, the overcooled and dehumidified air overcooled and dehumidified by passing through the first group may pass through the non-overlapping zones, and may be reheated by a bypass air which has a higher temperature than the overcooled and dehumidified air. Accordingly, dry air without an unpleasant cooling sensation can be obtained. At this time, since the overcooled and dehumidified air is sandwiched by the bypass air so as not to escape, the overcooled and dehumidified air is promoted to be mixed with the bypass air. Therefore, the overcooled and dehumidified air can be reliably reheated. Therefore, even in intermediate seasons in which the humidity is high and it is humid, the air conditioning can be performed by using a crisp air flow without a cold draft, and thus, comfortability is improved. Since a device such as a bypass damper for adjusting the flow rate of the bypass air is not required, cost reduction and compactness can be achieved.

[0015] In the heat exchanger according to the aspect of the present disclosure, the first group may be a group having a smallest grouping ratio.

[0016] According to the aforementioned aspect, the heat exchanger can minimize the lower limit of the flow rate of the heat exchanging medium by increasing or decreasing the flow rate of the heat exchanging medium in the first group, and can widen the control range of the capacity of the heat exchanger toward the lower limit.

[0017] The heat exchanger according to the aspect of the present disclosure may further include valves that are provided in the groups, respectively, and adjust the flow rate of the heat exchanging medium that flows in, and a valve controller that controls operations of the valves. The control device may increase or decrease the flow rate of the heat exchanging medium of each of the group by causing the valve controller to control the valves.

[0018] According to the aforementioned aspect, the heat exchanger can perform the control of the group through which the heat exchanging medium flows and the control of the flow rate of the heat exchanging medium in the group by controlling the valves.

[0019] In the heat exchanger according to the aspect of the present disclosure, the heat transfer pipe group may include a plurality of elliptical pipes.

[0020] According to the aforementioned aspect, a dead water region of the heat transfer pipe group is reduced. Ventilation resistance of the heat transfer pipe group is reduced, and thus, energy saving can be achieved. A contact area (heat transmission amount) between the heat transfer pipe group and the air-conditioning air is increased, and thus, heat exchange efficiency is improved. Accordingly, for example, when the heat exchanging medium is water, the small water amount and large temperature difference operation of an air conditioner using the heat exchanger can be performed without increasing (enlarging) the heat transfer area of the heat exchanger.

[0021] An air conditioner according to an aspect of the present disclosure includes the heat exchanger according to the aspect of the present disclosure, a radiation unit that radiates heat of the air-conditioning air while discharging the air-conditioning air to an air-conditioned space, and a fan that sends the air-conditioning air to the radiation unit.

[0022] According to the aforementioned aspect, the same effects as those of the heat exchanger according to the aspect of the present disclosure can be obtained.

[0023] In the air conditioner according to the aspect of the present disclosure, the radiation unit may include a group of through-holes that allows the air-conditioning air to be discharged therethrough to the air-conditioned space, and a heat storage. The heat storage may include a group of heat transfer plates disposed with gaps through which the air-conditioning air passes. The group of the heat transfer plates may be configured to allow the air-conditioning air to pass through the group of the heat transfer plates in a straightened flow manner while being divided and diffused by the group of the heat transfer plates and discharge to the air-conditioned space through the through-holes, and configured to store the heat of the air-conditioning air and radiate the heat to the air-conditioned space through the through-holes.

[0024] According to the aforementioned aspect, since the air conditioner in which the heat exchanger, the fan, and the radiation unit are integrated can be obtained, manufacturing of the air conditioner and construction for the air conditioner can be simplified, and the cost can be reduced. The heat storage can be used for both storing the heat of the air-conditioning air and straightening the flow of the air-conditioning air. Therefore, heat radiation capacity is improved, and comfortable air conditioning without air volume unevenness and temperature unevenness can be performed.

(Embodiment)

[0025] Hereinafter, an embodiment of the present disclosure will be described with reference to the drawings. The embodiment described below illustrates comprehensive or specific examples. Components not described in the independent claims indicating the most generic concept among component elements in the following embodiment are described as optional component elements. Each drawing in the accompanying drawings is a schematic diagram, and is not necessarily illustrated exactly. In each drawing, substantially the same component elements are denoted by the same reference numerals, and redundant description may be omitted or simplified.

[Heat Exchanger]

[0026] A configuration of a heat exchanger 100 according to the embodiment will be described. The heat exchanger 100 according to the present embodiment is also called a heat exchanger for air conditioning. FIGS. 1 to 3 illustrate examples of the configuration of the heat exchanger 100 according to the embodiment. As illustrated in FIGS. 1 to 3, the heat exchanger 100 includes a heat transfer part 1 that cools or heats an air-conditioning air A by exchanging heat between the air-conditioning air A and a heat exchanging medium M, and a control device 2 that adjusts the heat exchange amount between the air-conditioning air A and the heat exchanging medium M. Outlined arrows in the drawings indicate an air flow direction of the air-conditioning air A.

[0027] The heat transfer part 1 includes a fin group 3 and a flow dividing circuit 4. The fin group 3 includes multiple plate fins 5. The multiple plate fins 5 are disposed with gaps such that the air-conditioning air A passes therebetween. For example, the gaps between the plate fins 5 may extend in the air flow direction of the air-conditioning air A. The flow dividing circuit 4 is configured to divide a heat transfer pipe group 6, which is a group of a plurality of heat transfer pipes through which the heat exchanging medium M flows, into a plurality of groups G, that is, to separate the heat transfer pipe group 6 into the plurality of groups G. The flow dividing circuit 4 is further configured such that grouping ratios between the plurality of groups G are different from each other. Accordingly, heat transfer areas (heat exchange amount) can be different between some or all of the groups G.

[0028] For example, as illustrated in FIGS. 2 and 3, the flow dividing circuit 4 divides, as the groups G, the heat transfer pipe group 6 into a first group G1 indicated by a thicker dashed-dotted line and a second group G2 which is obtained by excluding the first group G1 from the heat transfer pipe group 6 and is indicated by a thinner dashed-dotted line. In the present embodiment, the flow dividing circuit 4 divides the heat transfer pipe group 6 into two groups.

[0029] The first group G1 is a group having a smaller grouping ratio. The group having a smaller grouping ratio may be a group having a smaller grouping ratio than a certain group among the plurality of groups. For example, the first group G1 may be a group having the smallest grouping ratio. The group having the smallest grouping ratio may be a single group among the plurality of groups. The number of groups having the smallest grouping ratio may be only one or may be two or more among the plurality of groups. The second group G2 is a group having a larger grouping ratio, and is, for example, a group having a grouping ratio larger than the first group G1. The number of groups having the grouping ratio larger than the first group G1 may be two or more among the plurality of groups.

[0030] For example, the heat transfer pipe group 6 meanders in a zigzag manner so as to traverse the air flow direction of the air-conditioning air A, and is connected to the plate fins 5 of the fin group 3 to be heat-transferable. A straight pipe portion of the heat transfer pipe constituting the heat transfer pipe group 6 is preferably formed as an elliptical pipe, but may be formed as a circular pipe, etc.

[0031] The grouping ratio may be a ratio of the heat transfer pipes. The ratio of the heat transfer pipes may be a ratio such as a ratio of the total amount of a critical flow rate of the heat transfer pipes of each group to the total amount of a critical flow rate of all the heat transfer pipes, a ratio of the total number of the heat transfer pipes of each group to the total number of all the heat transfer pipes, a ratio of the total amount of a flow passage cross-sectional area of the heat transfer pipes of each group to the total amount of a flow passage cross-sectional area of all the heat transfer pipes, a ratio of the total length of the heat transfer pipes of each group to the total length of all the heat transfer pipes, a ratio of the total amount of a heat transfer area (such as a surface area) of the heat transfer pipes of each group to the total amount of a heat transfer area of all the heat transfer pipes, and a ratio of the total volume of a heat-exchangeable region of the heat transfer pipes of each group, in which the heat exchange is executable, to the total volume of a heat-exchangeable region of all the heat transfer pipes. The critical flow rate of the heat transfer pipe may be an upper limit of the flow rate of the heat exchanging medium M that can flow through the heat transfer pipe.

[0032] An inlet of the heat exchanging medium M of the first group G1 is connected to a first branching header 7a of branching headers 7. An inlet of the heat exchanging medium M of the second group G2 is connected to a second branching header 7b. An outlet of the heat exchanging medium M of the first group G1 and an outlet of the heat exchanging medium M of the second group G2 are both connected to a confluence header 8. Thus, each group G of the first group G1 and the second group G2 includes a group of heat transfer pipes that form continuous pipes that communicate with each other via the branching header 7a or 7b, etc.

[0033] The branching headers 7a and 7b are respectively connected to outgoing piping 10 via valves 9a and 9b. The confluence header 8 is connected to return piping 11. Accordingly, the inlet of the heat exchanging medium M of each of the first group G1 and the second group G2 communicates with the outgoing piping 10, and the outlet of the heat exchanging medium M of each of the first group G1 and the second group G2 communicates with the return piping 11. For example, heat exchanging water as the heat exchanging medium M flows through the outgoing piping 10 and the return piping 11, and a temperature of the heat exchanging water is adjusted by a heat source device such as a chiller and a boiler (not illustrated). For example, the temperature-adjusted heat exchanging water to be sent from the heat source device may flow through the outgoing piping 10, and the heat exchanging water after the heat exchange to be sent from the heat exchanger 100 to the heat source device may flow through the return piping 11.

[0034] The control device 2 includes the valves 9a and 9b that adjust a flow rate of the heat exchanging medium M, and a valve controller 12 that controls operations of the valves 9a and 9b. The valves 9a and 9b may be proportional control valves capable of steplessly adjusting the flow rate (for example, a valve opening degree), and are provided in each group G of the flow dividing circuit 4. In the case of a low air conditioning load, the valve controller 12 controls the operation of the valve 9a to increase or decrease the flow rate of the heat exchanging medium M in the first group G1 of the flow dividing circuit 4 such that a temperature difference of the heat exchanging medium M before and after the heat exchange caused by the heat exchange of the heat transfer part 1 is constant.

[0035] In the case of a high air conditioning load, the valve controller 12 controls the operations of the valves 9a and 9b to increase or decrease the flow rate of the heat exchanging medium M in all the groups G such that the temperature difference of the heat exchanging medium M before and after the heat exchange caused by the heat exchange of the heat transfer part 1 is constant. In the case of a normal air conditioning load between the high air conditioning load and the low air conditioning load, the valve controller 12 controls the operation of the valve 9b to increase or decrease the flow rate of the heat exchanging medium M in the second group G2 such that the temperature difference of the heat exchanging medium M before and after the heat exchange caused by the heat exchange of the heat transfer part 1 is constant. Accordingly, the heat exchanger 100 can widely cope with a small water amount and large temperature difference operation of an air conditioner using the heat exchanger 100 from the case of the high air conditioning load requiring a maximum heat exchange amount such as midsummer and midwinter to the case of the low air conditioning load requiring a small heat exchange amount such as intermediate seasons.

[0036] For example, some or all of functions of the control device 2 may be realized by a computer system (not illustrated) that includes a processor such as a Central Processing Unit (CPU), a volatile memory such as a Random Access Memory (RAM), and a nonvolatile memory such as a Read-Only Memory (ROM) and so on. Such functions may be realized by the CPU executing a program recorded in the ROM by using the RAM as a work area. Alternatively, some or all of the functions of the control device 2 may be realized by a dedicated hardware circuit such as an electronic circuit or an integrated circuit or the like, or may be realized by a combination of the computer system and the hardware circuit. Further, some or all of the functions of the valve controller 12 may be realized by a dedicated hardware circuit, or may be realized by a combination of the computer system and the hardware circuit.

[0037] As illustrated in FIG. 2, the flow dividing circuit 4 forms, in the second group G2, a plurality of non-overlapping zones F which are zones that do not overlap with the first group G1 when viewed in the air flow direction (a direction of the outlined arrow of FIG. 2) of the air-conditioning air A passing through the heat transfer part 1. The plurality of non-overlapping zones F are located such that the first group G1 is sandwiched between the non-overlapping zones F.

[Air Conditioner]

[0038] A configuration of an air conditioner 200 according to the embodiment will be described. FIG. 4 is a bottom perspective view illustrating an example of a configuration of the air conditioner 200 according to the embodiment. FIG. 5 is a bottom view of the air conditioner 200 illustrated in FIG. 4. FIG. 6 is a cross-sectional view of the air conditioner 200 illustrated in FIG. 5 taken along line VI-VI. FIG. 7 is a cross-sectional view of the air conditioner 200 illustrated in FIG. 6 taken along line VII-VII. In the present embodiment, a case where the air conditioner 200 includes the heat exchanger 100 according to the embodiment and is a pneumatic radiation air conditioner will be described below.

[0039] As illustrated in FIGS. 4 to 7, the air conditioner 200 includes a radiation unit 201 that radiates the heat of the air-conditioning air while discharging the air-conditioning air into an air-conditioned space S, the heat exchanger 100 that performs heat exchange between an outdoor air, a return air, or an air mixture thereof as the air-conditioning air and the heat exchanging medium, and a fan 203 that sends the air-conditioning air to the radiation unit 201. The air conditioner 200 includes a drain pan 204, a casing 205, and the control device 2. The casing 205 accommodates the radiation unit 201, the heat exchanger 100, the fan 203, and the drain pan 204. The air conditioner 200 is installed on a ceiling CB of the air-conditioned space S, etc., in a state in which a bottom surface of the radiation unit 201 is exposed toward the air-conditioned space S. Thick dashed arrows in FIGS. 4 to 7 indicate a flow direction of the air-conditioning air.

[0040] The radiation unit 201 includes a chamber 212 through which the air-conditioning air flows, a group of through-holes 207 formed in a bottom of the chamber 212, and a heat storage 208 provided in the chamber 212. The heat storage 208 includes a group of heat transfer plates 209 that can store the heat of the air-conditioning air that is in contact therewith and radiate the heat to the air-conditioned space S through the through-holes 207. The group of the heat transfer plates 209 is disposed with gaps through which the air-conditioning air passes. The group of the heat transfer plates 209 is configured to allow the air-conditioning air to pass therethrough in a straightened flow manner while being divided and diffused by the group of the heat transfer plates 209 and discharge into the air-conditioned space S through the through-holes 207. The heat of the air-conditioning air is transferred to the group of the heat transfer plates 209, and the transferred heat is radiated from the group of the heat transfer plates 209 to the air-conditioned space S through the group of the through-holes 207.

[0041] The casing 205 includes a return air inlet portion 210 and an outdoor air inlet portion 211. The return air inlet portion 210 is configured to take in air (return air) in the air-conditioned space S via a ceiling chamber T formed in a ceiling plenum space and a duct (not illustrated) and so on. The outdoor air inlet portion 211 is configured to take in the outdoor air, and is connected to the outside through a duct 223.

[0042] The fan 203 sends the return air taken in from the return air inlet portion 210 and the outdoor air taken in from the outdoor air inlet portion 211 to cause the return air and the outdoor air to pass through the heat exchanger 100 and cause the passed return air and outdoor air to flow into the radiation unit 201.

[0043] The heat exchanger 100 may have a structure for exchanging heat between cold water or hot water as the heat exchanging medium and the air-conditioning air, a structure for exchanging heat between a refrigerant such as chlorofluorocarbons as the heat exchanging medium and the air-conditioning air, or a structure for exchanging heat between another exchange medium and the air-conditioning air. In the illustrated example, the heat exchanger 100 has a structure for exchanging heat between the cold water or the hot water and the air-conditioning air. The heat exchanger 100 cools or heats the air-conditioning air by exchanging the heat between the air-conditioning air and the heat exchanging medium.

[0044] The control device 2 includes the valves 9a and 9b for adjusting the flow rate of the heat exchanging medium flowing to the heat exchanger 100, the valve controller 12 for controlling the operations of the valves 9a and 9b, and a temperature difference detector (not illustrated). The temperature difference detector detects the temperature difference of the heat exchanging medium before and after the heat exchange caused by the heat exchange with the air-conditioning air in the heat exchanger 100, based on the temperature of the heat exchanging medium flowing into the branching headers 7a and 7b of the heat exchanger 100 and the temperature of the heat exchanging medium flowing out from the confluence header 8. Similarly to the above-described control in each air conditioning load, the control device 2 increases or decreases the flow rate of the heat exchanging medium in each group G of the heat transfer pipe group 6 by causing the valve controller 12 to control the valves 9a and 9b based on the detected temperature difference of the heat exchanging medium before and after the heat exchange.

(Other embodiments)

[0045] Although the embodiments of the present disclosure have been described, the present disclosure is not limited to the aforementioned embodiments. That is, various modifications and improvements are possible within the scope of the present disclosure. For example, embodiments in which various modifications are implemented on the embodiments, and embodiments in which component elements in different embodiments are combined are also included in the scope of the present disclosure.

[0046] For example, although it has been described in the embodiment that the flow dividing circuit 4 of the heat exchanger 100 divides the heat transfer pipe group 6 into two groups G1 and G2 as the plurality of groups G, as illustrated in the accompanying drawings, the heat transfer pipe group may be divided into three or more groups G. The grouping ratio of one of the groups G may be freely minimized. The heat exchanger 100 can be freely configured to have a structure in which an aqueous solution, a refrigerant such as chlorofluorocarbons, and another heat exchanging medium are used as the heat exchanging medium in addition to the water. The heat exchanging medium may be any of a gas or a liquid.

[0047] As this disclosure may be embodied in several forms without departing from the spirit of essential characteristics thereof, the present embodiments are therefore illustrative and not restrictive, since the scope of the disclosure is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalence of such metes and bounds thereof are therefore intended to be embraced by the claims.

Claims

1. A heat exchanger comprising:

a heat transfer part that exchanges heat between an air-conditioning air and a heat exchanging medium; and
a control device that adjusts a heat exchange amount between the air-conditioning air and the heat exchanging medium,
wherein
the heat transfer part includes a flow dividing circuit configured to divide a heat transfer pipe group through which the heat exchanging medium flows into a plurality of groups and cause grouping ratios to be different from each other, and
the control device is configured to increase or decrease a flow rate of the heat exchanging medium in a first group having a smaller grouping ratio among the plurality of groups in a case of a low air conditioning load.

2. The heat exchanger according to claim 1, wherein non-overlapping zones which do not overlap the first group are formed in a second group having a grouping ratio larger than the grouping ratio of the first group among the plurality of groups when viewed in an air flow direction of the air-conditioning air passing through the heat transfer part, and the non-overlapping zones are located so as to sandwich the first group.

3. The heat exchanger according to claim 1 or 2, wherein the first group is a group having a smallest grouping ratio.

4. The heat exchanger according to any one of claims 1 to 3, further comprising:

valves that are provided in the groups, respectively, and adjust the flow rate of the heat exchanging medium that flows in; and
a valve controller that controls operations of the valves,
wherein the control device increases or decreases the flow rate of the heat exchanging medium of each of the group by causing the valve controller to control the valves.

5. The heat exchanger according to any one of claims 1 to 4, wherein the heat transfer pipe group comprises a plurality of elliptical pipes.

6. An air conditioner comprising:

the heat exchanger according to any one of claims 1 to 5;
a radiation unit that radiates heat of the air-conditioning air while discharging the air-conditioning air to an air-conditioned space; and
a fan that sends the air-conditioning air to the radiation unit.

7. The air conditioner according to claim 6, wherein the radiation unit includes a group of through-holes that allows the air-conditioning air to be discharged therethrough to the air-conditioned space, and a heat storage,

the heat storage includes a group of heat transfer plates disposed with gaps through which the air-conditioning air passes, and
the group of the heat transfer plates is configured to allow the air-conditioning air to pass through the group of the heat transfer plates in a straightened flow manner while being divided and diffused by the group of the heat transfer plates and discharge to the air-conditioned space through the through-holes, and configured to store the heat of the air-conditioning air and radiate the heat to the air-conditioned space through the through-holes.

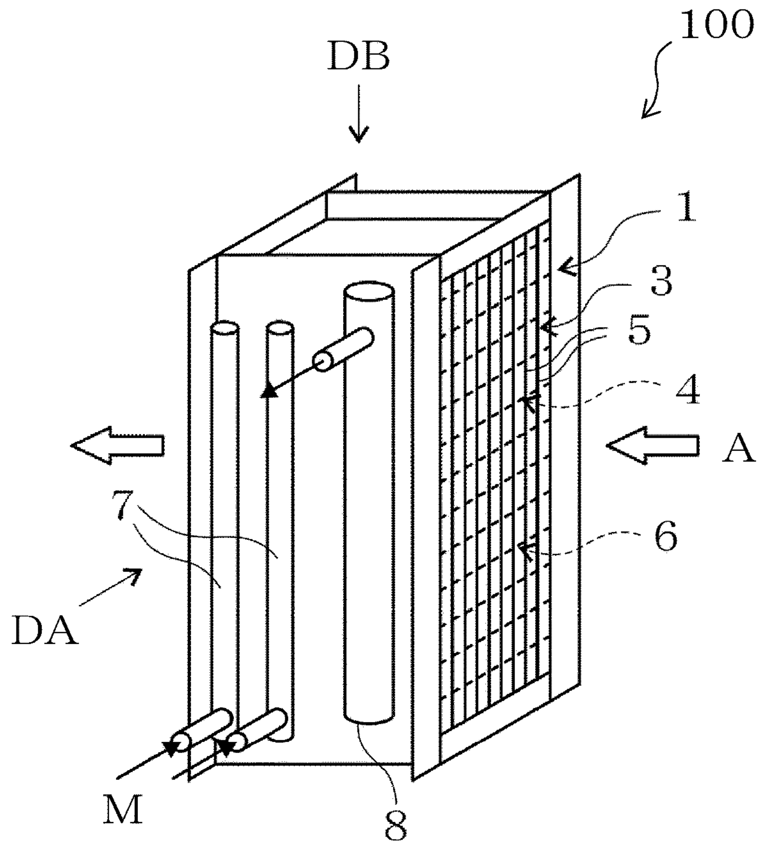


FIG.1

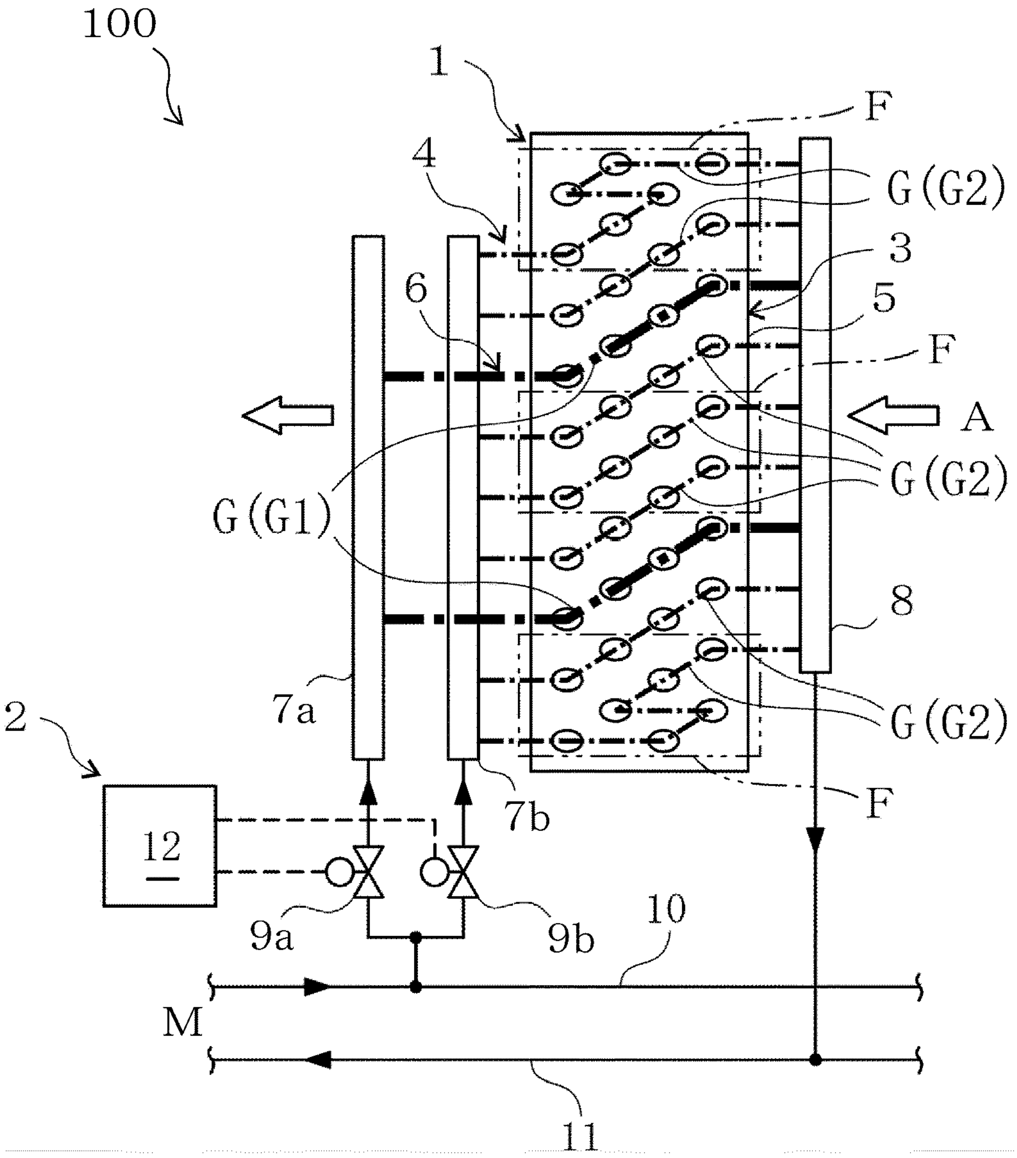


FIG.2

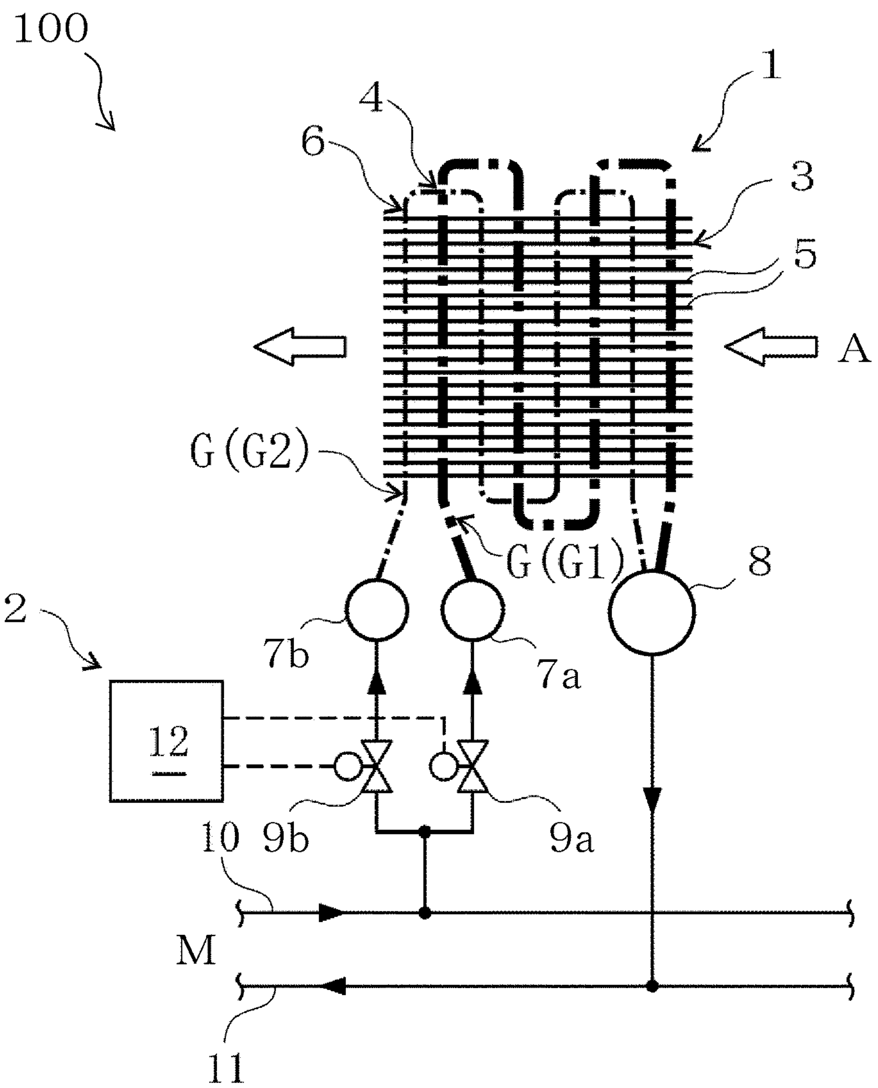


FIG.3

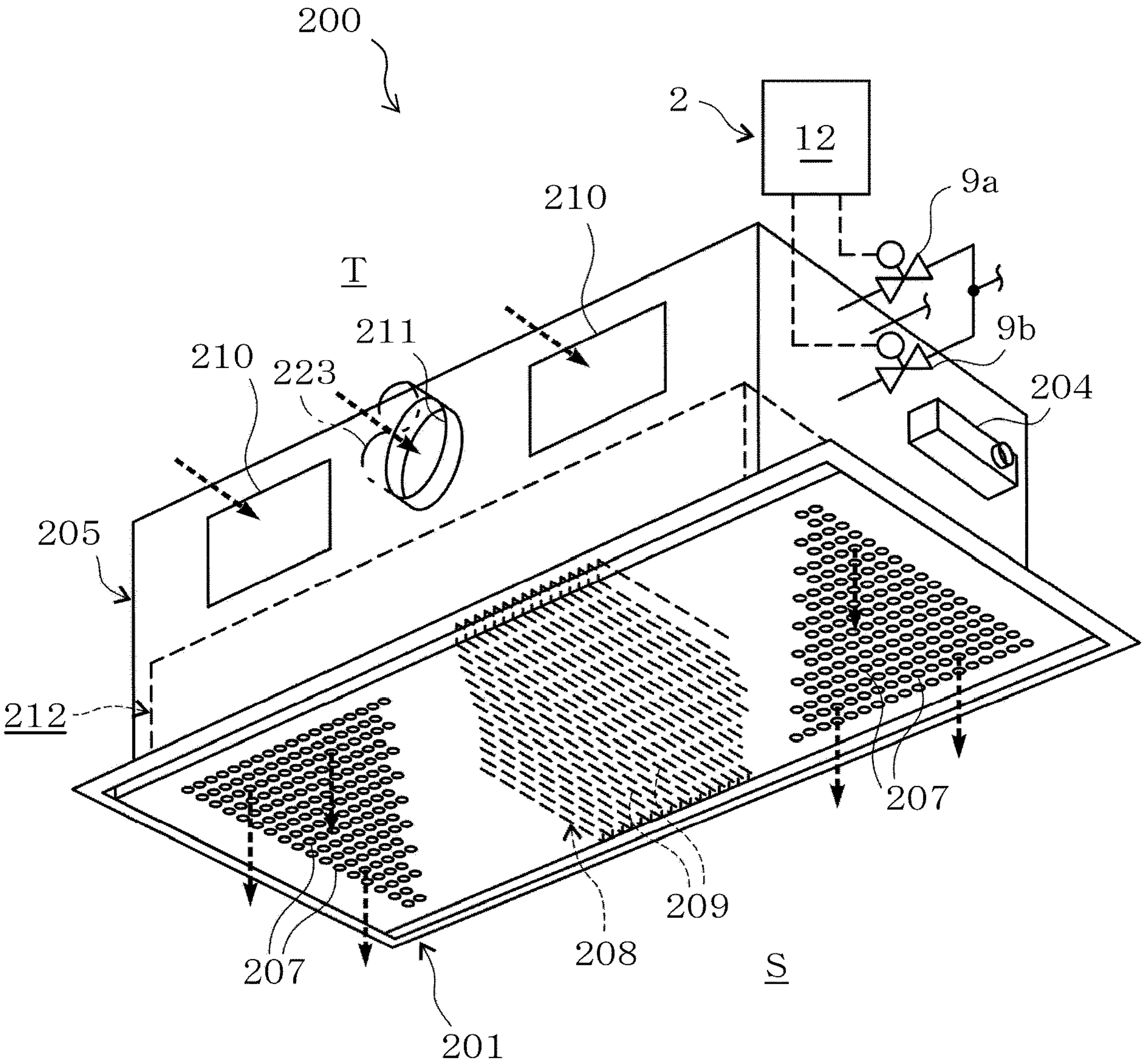


FIG.4

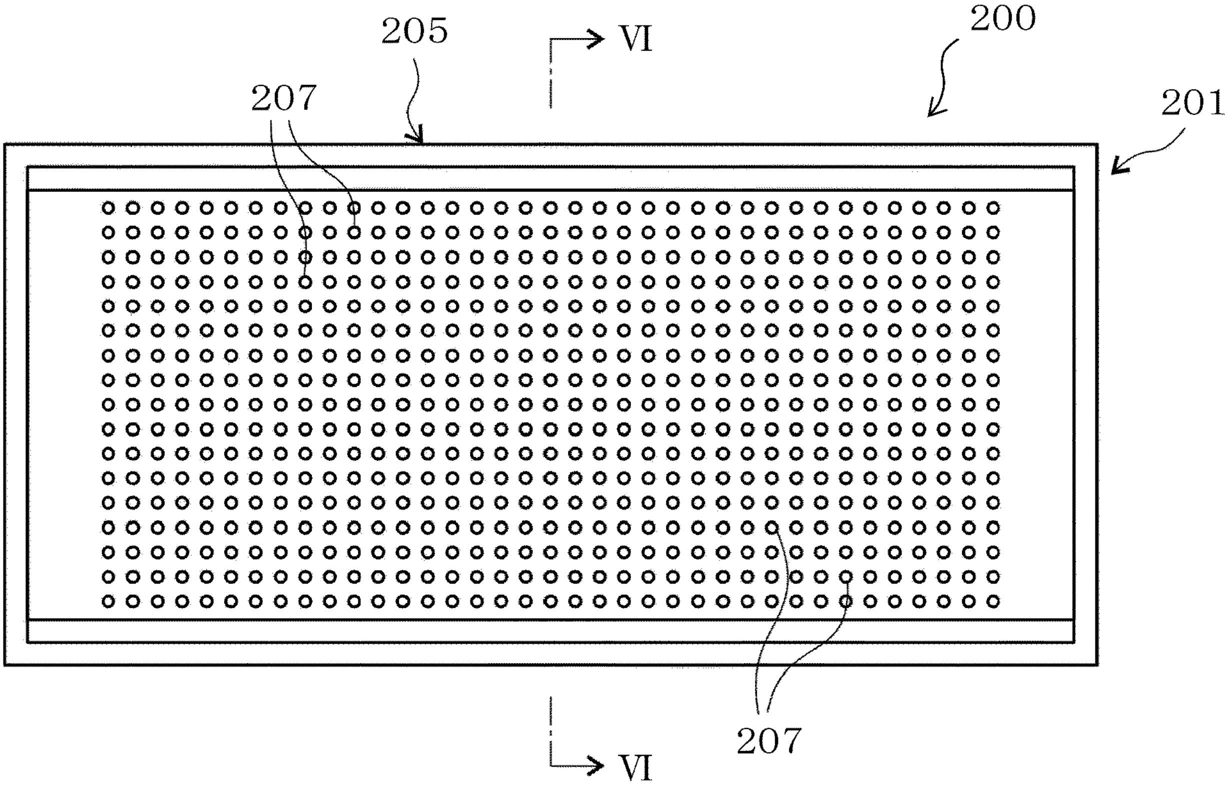
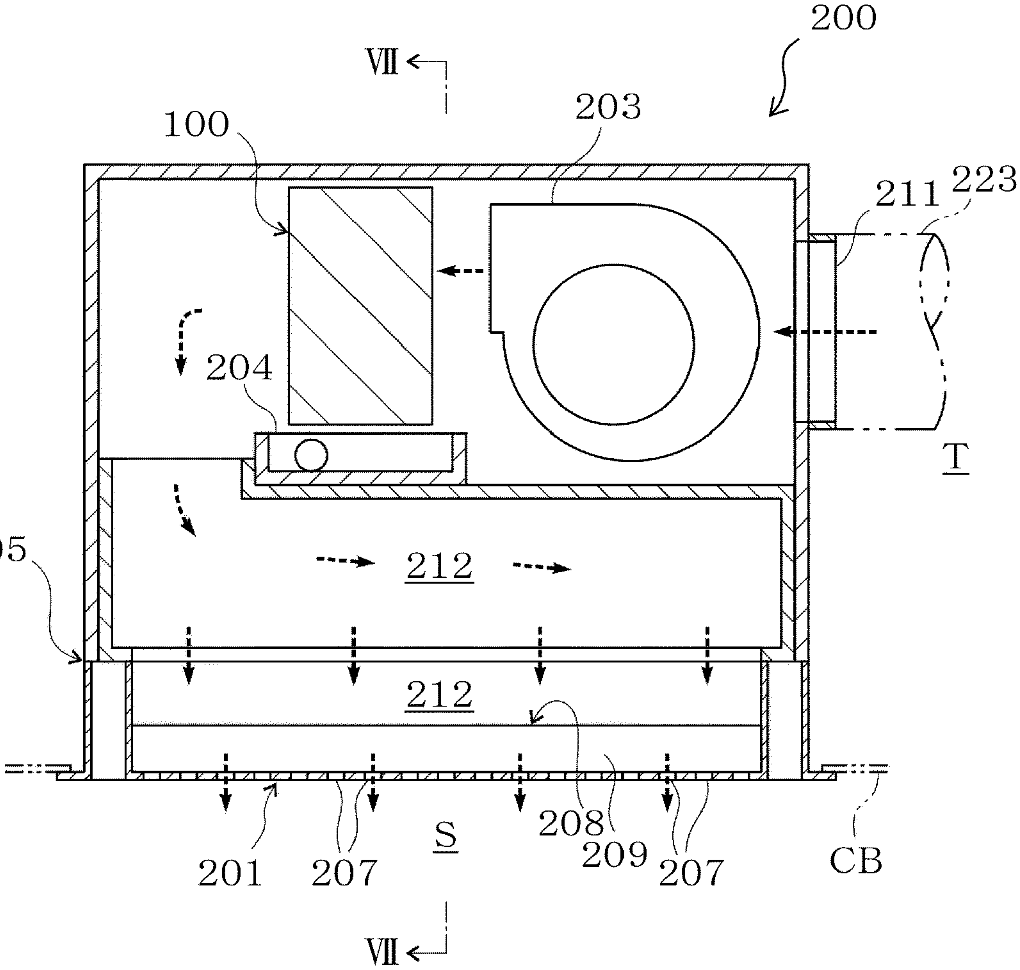


FIG.5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VII

FIG.6

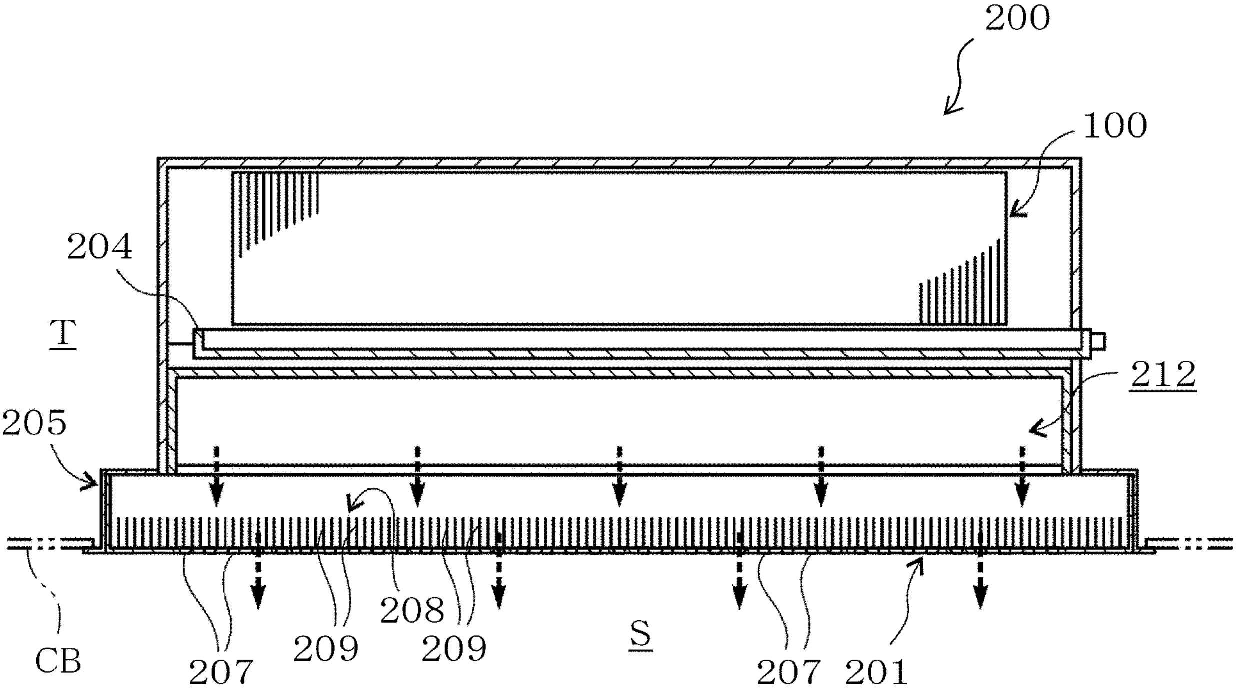

FIG.7

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
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