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(54) **AIR CONDITIONER OUTDOOR UNIT AND CONTROL METHOD**

(57) An air conditioner outdoor unit and a control method. The air conditioner outdoor unit comprises: a housing in which at least two compressors (550) are provided; at least two drive modules (400), each drive module respectively correspondingly driving one compressor (550); heat exchange blocks (100) of which different parts are respectively connected to different drive modules (400) in a thermal conductive mode; and a refrigerant pipe (200) in which a refrigerant is comprised, the refrigerant pipe being inserted into the heat exchange blocks (100) and capable of cooling the heat exchange blocks (100). The problem that a condensation phenomenon is easy to occur because the temperature of the drive modules (400) of multiple compressors (550) is not balanced is solved.

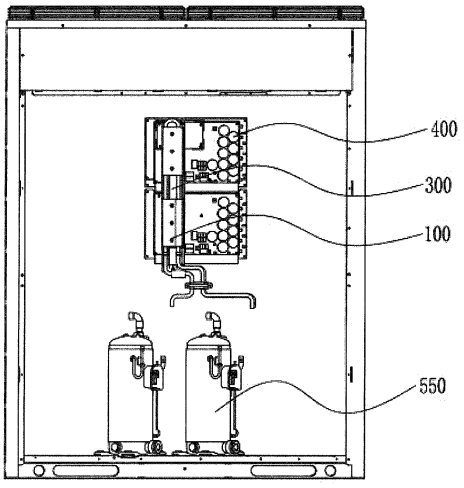

FIG. 2

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Description

[0001] The present disclosure claims priority to Chinese Patent application No. 201910970156.5, filed with the Chinese Patent Office on October 12, 2019, titled "AIR-CONDITIONER OUTDOOR UNIT, CIRCULATING SYSTEM AND CONTROL METHOD", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to a field of air conditioner technologies, and in particular, to an outdoor unit of an air conditioner and a control method.

BACKGROUND

[0003] A compressor of an outdoor unit of an air conditioner is driven by a driving module. The driving module is cooled by a refrigerant heat dissipation system, so as to prevent a temperature of the driving module from rising too high, a high temperature of the driving module may cause a failure of the driving module and safety problems such as fire. Compared with heat dissipation by air, heat dissipation by refrigerant has advantages of high heat dissipation efficiency and easy to be controlled. Therefore, the heat dissipation by refrigerant is widely used in the outdoor unit of the air conditioner.

[0004] For an outdoor unit of a multi-connected air conditioner with high-power, it is usually driven by two compressors. Therefore, an electrical system of the outdoor unit of the multi-connected air conditioner with high-power has two driving modules. As shown in FIG. 1, two heat exchange blocks 002 are provided on a refrigerant pipe 001 for circulating the refrigerant, and the two heat exchange blocks 002 are fixedly connected to circuit boards of corresponding driving modules, so as to perform heat dissipation and temperature decrease on the driving modules and the circuit boards.

[0005] However, when the outdoor unit operates, the two compressors operate separately, and heat generated by the driving modules corresponding to respective compressors is different. Therefore, the two driving modules have different temperatures. In addition, it is also possible that only one of the two compressors operates, and the driving module that does not operate does not generate heat and therefore does not need heat dissipation. When the refrigerant dissipates heat from the driving module that is operating, a temperature of the driving module that is not operating is also decreased, which causes the temperatures of the two driving modules to be different.

[0006] However, since an amount of refrigerant flowing in the refrigerant pipe 001 is the same, after a heat exchange of the refrigerant, a temperature of a driving module with a lower heat generation amount is further decreased. Therefore, a condensation phenomenon is easy to occur on the circuit board of the driving module, which short-circuits the circuit board and causes danger.

SUMMARY

[0007] Embodiments of the present disclosure provide an outdoor unit of an air conditioner, a circulation system and a control method, which are capable of controlling a heat transfer between driving modules and improving a balance of temperatures between the driving modules. In this way, a danger of short circuit of the driving module due to a condensation phenomenon caused by an excessively low temperature is avoided.

[0008] In order to achieve the above purpose, the embodiments of the present disclosure adopt the following technical solutions.

[0009] In a first aspect, embodiments of the present disclosure provide the outdoor unit of the air conditioner. The outdoor unit of the air conditioner includes: a housing provided with at least two compressors therein;

at least two driving modules, and each of the at least two driving modules correspondingly driving one of the compressors;

a heat exchange block, and different parts thereof being connected to different driving modules in a heat conducting manner; and

a refrigerant pipe having refrigerant therein, and the refrigerant pipe being inserted into the heat exchange block and being capable of cooling the heat exchange block.

[0010] In the outdoor unit of the air conditioner provided by the embodiments of the present disclosure, since two adjacent heat exchange blocks are connected to each other, heat generated in a driving module with a high heat generation amount may be transferred to a driving module with a low heat generation amount, so that the heat of two adjacent driving modules is relatively balanced, and a situation of short circuit due to the condensation phenomenon on the driving module caused by a lower temperature of one of the driving modules is avoided.

[0011] In a second aspect, embodiments of the present disclosure provide a circulation system for the air conditioner as described above. The circulation system includes a subcooling heat exchanger, a main electronic expansion valve, an outdoor heat exchanger and a four-way valve which are disposed in the outdoor unit and are in communication with each other in sequence through a main circulation liquid pipe. The main circulation liquid pipe is in communication with an indoor unit. The four-way valve is further connected with a compressor and a gas-liquid separator, the compressor is in communication with the gas-liquid separator, and the gas-liquid separator is in communication with the subcooling heat exchanger. A cooling circulation branch is disposed on the main circulation liquid pipe, the cooling circulation branch is in communication with the refrigerant pipe, and an auxiliary electronic expansion valve is disposed on the cool-

ing circulation branch.

[0012] The above circulation system of the outdoor unit of the air conditioner provided by the embodiments of the present disclosure solves the same problems and achieves the same technical effects as the outdoor unit of the air conditioner provided by the embodiments in the first aspect, which will not be repeated herein.

[0013] In a third aspect, embodiments of the present disclosure provide a method for controlling the circulation system as described above. A temperature sensor is provided in each of the driving modules, and the temperature sensor is used for detecting a temperature of the driving module. The control method includes:

monitoring the temperature of the driving module through the temperature sensor and setting a target temperature, the target temperature being within a safe temperature range, and then adjusting an auxiliary electronic expansion valve to stabilize the temperature of the driving module at the target temperature;

increasing a preset temperature value of the target temperature in a case where it is detected that a temperature difference between the temperature of the driving module with a lower temperature and an ambient temperature is less than a first preset temperature, so that an opening degree of the auxiliary electronic expansion valve is decreased, an amount of refrigerant circulating in the refrigerant pipe is decreased, a temperature of the driving module where the temperature difference is detected to be less than the first preset temperature is increased, and the temperature difference between the temperature of the driving module and the ambient temperature is greater than the first preset temperature.

[0014] In the control method of the circulation system provided by the embodiments of the present disclosure as described above, a temperature sensor is provided in each driving module to monitor the temperature of each driving module. A temperature value is selected within a safe temperature range, and the temperature value is set as a target temperature. Then, an opening degree of the auxiliary electronic expansion valve is continuously adjusted, so that the temperature of the driving module is stabilized around the target temperature, and the temperature of the driving module is within the safe temperature range.

[0015] In a case where a temperature difference between the temperature of one or more driving modules and the ambient temperature is less than the first preset temperature, it is determined that the temperature of the driving module is too low, and the condensation phenomenon may occur. Therefore, the opening degree of the auxiliary electronic expansion valve is decreased by increasing the temperature value of the preset target temperature, and an amount of refrigerant in the refrigerant pipe is decreased. That is, the amount of heat carried away by the refrigerant is decreased, so that the temperature of all the driving modules is increased. Based on a fact that a heat conduction member may transfer heat between adjacent driving modules, a driving module with a high temperature transfers heat to a driving module with a low temperature, and thus the temperature of the driving module with the low temperature increases, which makes a temperature difference between the temperature thereof and the ambient temperature greater than the first preset temperature, thereby avoiding the condensation phenomenon.

[0016] In a case where the temperature differences between the temperature of each driving module and the ambient temperature are all greater than the first preset temperature, it is determined that there is no risk of condensation. At this time, it is not necessary to change the preset target temperature value, and it is only necessary to continuously adjust the auxiliary electronic expansion valve to stabilize the temperature of the driving module within the safe temperature range, so as to avoid the occurrence of the condensation phenomenon when the temperature of the driving module is too low.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a schematic diagram showing an overall structure of a refrigerant pipe and two heat exchange blocks disposed on the refrigerant pipe in the prior art;

FIG. 2 is a schematic diagram showing a structure of an outdoor unit of an air conditioner provided by an embodiment of the present disclosure;

FIG. 3 is a schematic diagram showing an overall structure of a heat dissipation assembly for an outdoor unit of an air conditioner provided by an embodiment of the present disclosure;

FIG. 4 is a schematic diagram showing an overall structure of a heat exchange block, a heat conduction member and a refrigerant pipe provided by an embodiment of the present disclosure;

FIG. 5 is a schematic diagram showing tan overall structure of a heat exchange block and a heat conduction member provided by an embodiment of the present disclosure;

FIG. 6 is a schematic diagram showing a structure of a heat conduction member and a heat exchange block provided by an embodiment of the present disclosure having a same structure and being connected to each other;

FIG. 7 is a schematic diagram of a through hole in a heat exchange block provided by an embodiment of the present disclosure;

FIG. 8 is a perspective diagram of two heat exchange blocks and a heat conduction member being integrally formed which are provided by an embodiment of the present disclosure;

FIG. 9 is a front view of two heat exchange blocks and a heat conduction member being integrally formed which are provided by an embodiment of the present disclosure;

FIG. 10 is a schematic diagram showing a structure of a first circulation system of an air conditioner provided by an embodiment of the present disclosure;

FIG. 11 is a schematic diagram showing a structure of a second circulation system of an air conditioner provided by an embodiment of the present disclosure; and

FIG. 12 is a flow diagram of a method for controlling a circulation system of an air conditioner provided by an embodiment of the present disclosure.

[0018] Reference signs:

heat exchange block 100;
fixing plate 110;
heat conducting portion 120;
through hole 121;
refrigerant pipe 200;
heat conduction member 300;
driving module 400;
circuit substrate 410;
main circulation liquid pipe 500;
subcooling heat exchanger 510;
main electronic expansion valve 520;
outdoor heat exchanger 530;
four-way valve 540;
compressor 550;
gas-liquid separator 560;
cooling circulation branch 600;
auxiliary electronic expansion valve 610.

DETAILED DESCRIPTION

[0019] An outdoor unit of an air conditioner, a circulation system, and a control method which are provided by embodiments of the present disclosure will be described in detail below with reference to accompanying drawings.

[0020] In the description of the present disclosure, it will be understood that, orientations or positional relationships indicated by the terms such as "center", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner" and "outer" are based on orientations or positional relationships shown in the accompanying drawings. These terms are merely to facilitate and simplify the description of the present disclosure, but not to indicate or imply that the referred devices or elements each must have a particular orientation, or must be constructed or operated in a particular orientation. Therefore, these terms should not be construed as limitations on the present disclosure.

[0021] The terms "first" and "second" are used for descriptive purposes only, and are not to be construed as indicating or implying a relative importance or implicitly indicating a number of indicated technical features. Therefore, the features defined with "first" and "second" may explicitly or implicitly include one or more of these features. In the description of the present disclosure, the term "a plurality of" means two or more unless otherwise specified.

[0022] In the description of the present disclosure, it will be noted that term "installed", "communicated" or "connected" is to be understood broadly. For example, it may be a fixed connection, a detachable connection, or an integral connection; and it may be a direct connection, or may be an indirect connection through an intermediate medium, and may be internal communication between two elements. Specific meanings of the above terms in the present disclosure may be understood by those skilled in the art according to specific situations.

[0023] An outdoor unit of an air conditioner is provided by embodiments of the present disclosure. As shown in FIGS. 2 and 3, a plurality of compressors 550 are provided in the outdoor unit, each compressor 550 is correspondingly provided with a driving module 400, and each driving module 400 is connected to a heat exchange block 100. Two heat exchange blocks 100 on two adjacent driving modules 400 are connected to each other. A same refrigerant pipe 200 is inserted in a plurality of heat exchange blocks 100, and the refrigerant pipe 200 is used for circulating the refrigerant. The heat exchange block 100 is used for exchanging heat between the refrigerant pipe 200 and the driving module 400, so as to decrease the temperature of the driving module 400.

[0024] In the air conditioner provided by the embodiments of the present disclosure, since two adjacent heat exchange blocks 100 are connected to each other, heat generated in a driving module 400 with a high heat generation amount may be transferred to a driving module 400 with a low heat generation amount, so that the heat on the two driving modules 400 is relatively balanced, which avoids a situation of short circuit due to a condensation phenomenon on one driving module 400 caused by a low temperature of the driving module 400.

[0025] In the outdoor unit of the air conditioner provided by the embodiments of the present disclosure, the two adjacent heat exchange blocks 100 are connected by a heat conduction member 300 for transferring heat between the two heat exchange blocks 100. By connecting two adjacent heat exchange blocks 100 through a single heat conduction member 300, the heat conducting efficiency between the two adjacent heat exchange blocks 100 is improved, and heat may be transferred nicely between the two adjacent driving modules 400.

[0026] The heat exchange block 100 provided by the embodiments of the present disclosure may be a thick heat dissipation plate made of a heat conductive material. A through hole 121 is provided in the heat dissipation plate in a direction parallel to a plate surface of the heat dissipation plate, the refrigerant pipe 200 is inserted into the through hole 121, and then the heat dissipation plate is fixedly connected to the driving module 400.

[0027] The heat exchange block 100 may also be de-

signed as the following structure. As shown in FIGS. 4 and 5, the heat exchange block 100 includes a fixing plate 110 and a heat conducting portion 120 disposed on the fixing plate 110.

[0028] As shown in FIG. 6, the through hole 121 is provided in the heat conducting portion 120 in a length direction of the fixing plate 110. The refrigerant pipe 200 is inserted into the through hole 121. The fixing plate 110 is connected to the driving module 400, and the fixing plate 110 and the heat conducting portion 120 are made of a same material and are integrally formed.

[0029] In the above technical solution using a heat dissipation plate, since the refrigerant pipe 200 for circulating the refrigerant needs to be inserted into the heat dissipation plate, a thickness of the heat dissipation plate is at least greater than an outer diameter of the refrigerant pipe 200. However, a portion of the heat dissipation plate in which the refrigerant pipe 200 is not disposed needs to be connected to the driving module 400 through screws, and if an overall thickness of the heat dissipation plate is large, an inconvenience of opening a hole is existed and the manufacturing difficulty is increased. Moreover, since the overall thickness of the heat dissipation plate is large, a transfer efficiency of a cooling capacity of the refrigerant circulating in the refrigerant pipe 200 to the entire heat dissipation plate is decreased, and a transfer efficiency of the cooling capacity to the driving module 400 is further decreased.

[0030] Compared with the technical solution of the above heat dissipation plate, in the technical solution of providing the heat conducting portion 120 in the heat exchange block 100 provided by the embodiments of the present disclosure, as shown in FIGS. 6 and 7, the through hole 121 for accommodating the refrigerant pipe 200 is provided in the heat conducting portion 120. Therefore, a thickness of the fixing plate 110 does not need to be set to be too large. In addition, since the thickness of the fixing plate 110 is small, as shown in FIG. 3, the cooling capacity of the refrigerant circulating in the refrigerant pipe 200 may be transferred to the driving module 400 quickly, which improves a transfer efficiency of the cooling capacity, facilitates a cooling of the driving module 400, and ensures a stable operation of the driving module 400.

[0031] The heat conduction member 300 provided by the embodiments of the present disclosure is used to connect two heat exchange blocks 100, so that heat is transferred between the two heat exchange blocks 100.

[0032] The heat conduction member 300 may use a connecting plate made of the heat conductive material to connect bottom surfaces of the two heat exchange blocks 100, thereby transferring heat between the two heat exchange blocks 100. The heat conduction member 300 may also be of a same structure as the heat exchange block 100, and may be integrally connected with the two heat exchange blocks 100, as shown in FIGS. 5 and 6. The heat conduction member 300 is tightly connected to an end surface of the heat exchange block 100.

[0033] In the technical solution of connecting the two heat exchange blocks 100 through the connecting plate made of the heat conductive material, the connecting plate is connected to the bottom surface of the heat exchange block 100, that is, a connecting plate is added between the heat exchange block 100 and the driving module 400, therefore a thickness between the refrigerant pipe 200 and the driving module 400 is increased, which does not facilitate the transfer of the cooling capacity to the driving module 400. Compared with this solution, the heat conduction member 300 is set to a same structure as the heat exchange block 100, and the end surface of the heat conduction member 300 is tightly connected to the end surface of the heat exchange block 100, so that no other structure needs to be added between the heat exchange block 100 and the driving module 400. In this way, not only can the heat of the two heat exchange blocks 100 be transferred, but also an efficiency of transferring the cooling capacity of the refrigerant in the refrigerant pipe 200 to the driving module 400 is not affected.

[0034] In addition, the heat conduction member 300 and the heat exchange block 100 may be made of different heat conductive materials, and the end surfaces of the two are fixed and tightly connected by welding or other processes, so as to ensure the heat transfer efficiency between the heat exchange blocks 100. The heat conduction member 300 and the heat exchange block 100 may also be made of the same material and are integrally formed.

[0035] In the technical solution of connecting the heat conduction member 300 and the heat exchange block 100 by welding, due to differences in the heat conducting properties of different heat conductive materials, the heat transfer efficiency will be affected. In addition, the welded joints cannot be absolutely tightly attached, thus, the heat transfer efficiency is further decreased. Compared with this solution, the heat conduction member 300 and the heat exchange block 100 provided by the embodiments of the present disclosure are made of the same material and are integrally formed, as shown in FIGS. 8 and 9. That is, in this solution, an elongated heat exchange block 100 is used, and two ends of the elongated heat exchange block 100 are each connected to a driving module 400. When a difference between the temperatures of the two driving modules 400 is large, the heat is directly transferred through the elongated heat exchange block 100. Furthermore, since the heat exchange block 100 is of an integrally formed structure, there is no connection gap and the heat transfer efficiency will not be decreased.

[0036] In some embodiments of the present disclosure, as shown in FIGS. 3 and 4, the driving module 400 is disposed on a circuit substrate 410, the fixing plate 110 is tightly attached to the circuit substrate 410, and the circuit substrate 410 is capable of transferring the cooling capacity of the refrigerant to the driving module 400 to decrease the temperature of the driving module 400.

[0037] A region of the fixing plate 110 where the heat

conducting portion 120 is not provided is fixedly connected to the circuit substrate 410 through screws, and a plate surface of the fixing plate 110 is tightly attached to the circuit substrate 410, so that the temperature of the driving module 400 is decreased by the circuit substrate 410.

[0038] In some embodiments of the present disclosure, an outer wall of the refrigerant pipe 200 is tightly attached to an inner wall of the through hole 121 by expanding the refrigerant pipe 200.

[0039] The outer wall of the refrigerant pipe 200 is tightly attached to the inner wall of the through hole 121 in the heat exchange block 100, so as to enable nicely the cooling capacity of the refrigerant inside the refrigerant pipe 200 to be exchanged with heat of the driving module 400 absorbed by the heat exchange block 100, thereby decreasing the heat of the driving module 400 and enabling the driving module 400 to operate normally.

[0040] In order to decrease nicely the heat generated by the driving module 400, adding refrigerant is the most direct method. Therefore, the refrigerant pipe 200 may be bent to form a structure with a plurality of parallel sections, thereby increasing a contact area between the refrigerant pipe 200 and the heat exchange block 100.

[0041] However, since the driving module 400 is generally a chip with a small volume, a volume of the circuit substrate 410 is also small. If there are too many parallel pipe sections disposed in the refrigerant pipe 200, a volume of the heat exchange block 100 will increase, thereby increasing an overall cost of the heat exchange block 100. Therefore, the refrigerant pipe 200 provided by the embodiments of the present disclosure is a U-shaped pipe.

[0042] As shown in FIGS. 3 and 4, the heat exchange block 100 includes two heat conducting portions 120, which are disposed at edges on two sides of the fixing plate 110 in the length direction, and two straight pipe sections of the U-shaped pipe are inserted into the through holes 121 in the two heat conducting portions 120.

[0043] In the U-shaped refrigerant pipe 200, only two parallel pipe sections are arranged. In this way, not only will not increase the cost excessively, but also increases the contact area between the refrigerant pipe 200 and the heat exchange block 100. Therefore, an amount of refrigerant circulating in the heat exchange block 100 per unit time is increased. That is, the cooling capacity provided by the refrigerant is increased, and more cooling capacities can be transferred to the driving module 400, thereby decreasing the temperature of the driving module 400.

[0044] The refrigerant pipe 200 provided by the embodiments of the present disclosure is a copper pipe. The copper pipe has advantages such as good heat conductivity, good corrosion resistance and high strength at a low temperature.

[0045] The heat exchange block 100 provided by the embodiments of the disclosure is made of aluminum. Aluminum has advantages such as low price and good heat conductivity. Therefore, by adopting aluminum, costs of the heat exchange block 100 may be reduced while good heat conductivity thereof is ensured.

[0046] The embodiments of the present disclosure further provide a circulation system for the outdoor unit of the air conditioner as described in the technical solution above. As shown in FIGS. 3 and 10, the circulation system includes a subcooling heat exchanger 510, a main electronic expansion valve 520, an outdoor heat exchanger 530 and a four-way valve 540 which are disposed in the outdoor unit and are in communication with each other in sequence through a main circulation liquid pipe 500. The main circulation liquid pipe 500 is in communication with an indoor unit. The four-way valve 540 is further connected with the compressor 550 and a gas-liquid separator 560, the compressor 550 is in communication with the gas-liquid separator 560, and the gas-liquid separator 560 is in communication with the subcooling heat exchanger 510. A cooling circulation branch 600 is provided on the main circulation liquid pipe 500, the cooling circulation branch 600 is in communication with the refrigerant pipe 200, and an auxiliary electronic expansion valve 610 is provided on the cooling circulation branch 600.

[0047] The circulation system provided by the embodiments of the present disclosure solves the same problems and achieves the same technical effects as the above air conditioner, which will not be repeated herein.

[0048] The cooling circulation branch 600 provided by the embodiments of the present disclosure is disposed between the subcooling heat exchanger 510 and the outdoor heat exchanger 530, and is connected in parallel with the main electronic expansion valve 520, as shown in FIGS. 3 and 10.

[0049] In a case where the air conditioner is generating heat, a liquid refrigerant enters the cooling circulation branch 600 from the main circulation liquid pipe 500, exchanges heat with the driving module 400 in the refrigerant pipe 200, takes away the heat of the driving module 400, throttles at the auxiliary electronic expansion valve 610, becomes a low-temperature and low-pressure refrigerant, and then enters the outdoor heat exchanger 530.

[0050] In a case where the air conditioner is refrigerating, the liquid refrigerant flowing out of the outdoor heat exchanger 530 passes through the main circulation liquid pipe 500, then passes through the auxiliary electronic expansion valve 610, and then passes through the driving module 400, takes away the heat of the driving module 400, and then flows back to the main circulation liquid pipe 500, and then flows into the subcooling heat exchanger 510.

[0051] During the circulation, the temperature of the driving module 400 may be adjusted by adjusting an opening degree of the auxiliary electronic expansion valve 610. In a case where the temperature of the driving module 400 is high, the opening degree of the auxiliary

electronic expansion valve 610 is controlled to be increased, so that an amount of refrigerant in the cooling circulation branch 600 increases, thereby decreasing the temperature of the driving module 400. In a case where the temperature of the driving module 400 is low, the opening degree of the auxiliary electronic expansion valve 610 is controlled to be decreased, so that the amount of refrigerant in the cooling circulation branch 600 decreases, and the heat is generated in the driving module 400, thereby increasing the temperature of the driving module 400. Thus, the temperature of the driving modules 400 is adjusted, and heat may be transferred between the driving modules 400 through the heat conduction member 300, which further improves a balance between the driving modules 400.

[0052] It will be noted that in the above circulation system, since the main electronic expansion valve 520 and the auxiliary electronic expansion valve 610 are connected in parallel with each other, the main electronic expansion valve 520 and the auxiliary electronic expansion valve 610 are used through mutual adjustment. In a case where the temperature of a driving module 400 is higher than a safe range and the opening degree of the auxiliary electronic expansion valve 610 is nearly in a fully open state, since the auxiliary electronic expansion valve 610 is nearly fully opened while the temperature of the driving module 400 still exceeds the safe range, it indicates that the amount of refrigerant in the cooling circulation branch 600 is insufficient. Therefore, it is possible to adjust the opening degree of the main electronic expansion valve 520, that is, to decrease the opening degree of the main electronic expansion valve 520, so as to decrease the amount of the refrigerant passing through the main circulation liquid pipe 500.

[0053] Thus, the amount of refrigerant entering the cooling circulation branch 600 is increased, thereby increasing the cooling capacity used to decrease the temperature of the driving module 400. As a result, the temperature of the driving module 400 may be smoothly decreased to a safe range, which prevents damage to the driving module 400 due to an excessive temperature.

[0054] For example, the opening degree of the auxiliary electronic expansion valve 610 may be set to 85% of the fully open state. In a case where the temperature of the driving module 400 exceeds the safe range, and the opening degree of the auxiliary electronic expansion valve 610 is greater than 85% of the fully open state, at this time, the opening degree of the main electronic expansion valve 520 is controlled to be decreased, thereby increasing the amount of refrigerant in the cooling circulation branch 600.

[0055] The cooling circulation branch 600 provided by the embodiments of the present disclosure is disposed at an end of the subcooling heat exchanger 510 proximate to the indoor unit, and an outlet of the auxiliary electronic expansion valve 610 is in communication with the subcooling heat exchanger 510, as shown in FIGS. 3 and 11.

[0056] In a case where the cooling circulation branch 600 is disposed at an end of the subcooling heat exchanger 510 proximate to the indoor unit, the auxiliary electronic expansion valve 610 may be used to replace an electronic expansion valve at an inlet of the subcooling heat exchanger 510, that is, only two electronic expansion valves may be disposed in the circulation system, thereby reducing the cost.

[0057] In addition, in a case where the circulation structure is refrigerating or generating heat, a circulation direction of the cooling circulation branch 600 is the same. That is, the liquid refrigerant enters the cooling circulation branch 600 from the main circulation liquid pipe 500, takes away the heat in the driving module 400, and then throttles at the auxiliary electronic expansion valve 610 to become a low-temperature and low-pressure refrigerant. The low-temperature and low-pressure refrigerant passes through the subcooling heat exchanger 510 and exchanges heat with the refrigerant in the main circulation liquid pipe 500, so as to cool the refrigerant in the main circulation liquid pipe 500 and increase a subcooling degree thereof. The low-temperature and low-pressure refrigerant passing through the cooling circulation branch 600 absorbs heat to raise its own temperature and returns to the gas-liquid separator 560, and then enters the compressor 550.

[0058] During the circulation, the temperature of the driving module 400 is also adjusted by adjusting the opening degree of the auxiliary electronic expansion valve 610. In the case where the temperature of the driving module 400 is high, the opening degree of the auxiliary electronic expansion valve 610 is controlled to be increased, so that the amount of the refrigerant in the cooling circulation branch 600 increases, thereby decreasing the temperature of the driving module 400. In a case where the temperature of the driving module 400 is low, the opening degree of the auxiliary electronic expansion valve 610 is controlled to be decreased, so that the amount of refrigerant in the cooling circulation branch 600 decreases, and the heat may be generated in the driving module 400, thereby increasing the temperature of the driving module 400. Thus, the temperature of the driving modules 400 is adjusted, the heat may be transferred between the driving modules 400 through the heat conduction member 300, and a balance between the driving modules 400 is further improved.

[0059] The embodiments of the present disclosure provide a method for controlling the circulation system as described in the above technical solution. A flow diagram of the method is shown in FIG. 12. A temperature sensor is provided in each of the driving modules 400, and the temperature sensor is used for detecting the temperature of the driving module 400.

[0060] The control method includes the following steps. First, a temperature Ta of the driving module 400 is monitored by the temperature sensor, and a target temperature Tft is set. The target temperature Tft is within a safe temperature range. That is, the target temperature

Tft satisfies that Tmin is less than Tft, and Tft is less than Tmax (i.e., Tmin < Tft < Tmax), and the target temperature Tft is equal to a sum of an ambient temperature Tb and a deviation Td. The deviation Td is used to ensure that the temperature of the driving module 400 is higher than the ambient temperature, and the deviation Td is the minimum deviation value to ensure that there is no risk of condensation. For example, Td is greater than 15°C and less than 25°C (i.e., 15°C < Td < 25°C). Then, the auxiliary electronic expansion valve 610 is adjusted to stabilize the temperature of the driving module 400 at the target temperature.

[0061] In a case where it is detected that a temperature difference Tc between the temperature Ta of a driving module 400 and an ambient temperature Tb is less than a first preset temperature t1, a temperature value of the set target temperature is increased, so that the opening degree of the auxiliary electronic expansion valve 610 is decreased, an amount of refrigerant circulating in the refrigerant pipe 400 is decreased, the temperature of the driving module 400 where the temperature difference is detected to be less than the first preset temperature increased, and the temperature difference between the temperature of the driving module 400 and the ambient temperature is greater than the first preset temperature.

[0062] In a case where the temperature differences Tc between the temperature of each driving module 400 and the ambient temperature are all greater than the first preset temperature t1, it is not necessary to adjust the temperature value of the target temperature. Then, the auxiliary electronic expansion valve 610 is continuously adjusted to stabilize the temperature of the driving module 400 within the target temperature.

[0063] In the method for controlling the circulation system provided by the embodiments of the present disclosure as described above, a temperature sensor is provided in each driving module 400 to monitor the temperature of the driving module 400. A temperature value is selected within the safe temperature range, and the temperature value is set as a target temperature. Then, the opening degree of the auxiliary electronic expansion valve 610 is continuously adjusted, so that the temperature of the driving module 400 is stabilized around the target temperature, and the temperature of the driving module 400 is within the safe temperature range.

[0064] In a case where the temperature difference Tc between the temperature Ta of one or more driving modules 400 and the ambient temperature Tb is less than the first preset temperature t1, it is determined that the temperature of the driving module 400 is too low, and the condensation phenomenon may occur.

[0065] Therefore, the opening degree of the auxiliary electronic expansion valve 610 is decreased by increasing the temperature value of the set target temperature, and the amount of refrigerant in the refrigerant pipe 200 is decreased, that is, the amount of heat carried away by the refrigerant is decreased, so that the temperature of all the driving modules 400 is increased. Based on a fact that the heat conduction member 300 may transfer heat between the adjacent driving modules 400, the driving module 400 with a high temperature transfers heat to the driving module 400 with a low temperature, and thus, the temperature of the driving module with the low temperature increases, which makes a temperature difference between the temperature thereof and the ambient temperature greater than the first preset temperature, thereby avoiding the condensation phenomenon.

[0066] In the case where the temperature differences Tc between the temperature of each driving module 400 and the ambient temperature are all greater than the first preset temperature t1, it is determined that there is no risk of condensation. Therefore, it is not necessary to change the temperature value of the target temperature, and it is only necessary to continuously adjust the auxiliary electronic expansion valve 610 to stabilize the temperature of the driving module 400 around the target temperature.

[0067] In the control method of the embodiments of the present disclosure, the target temperature is set, and the temperature of the corresponding driving module is monitored by the temperature sensor, so that the target temperature is considered as the target value when continuously controlling and adjusting the opening degree of the auxiliary electronic expansion valve 610. That is, the amount of heat taken away by the refrigerant is adjusted, so that the temperature of the driving module 400 is stabilized around the target temperature, and the temperature of the driving module 400 is prevented from being too low to cause the condensation phenomenon.

[0068] Monitoring the minimum temperature of the driving module 400 can ensure that the condensation phenomenon will not occur on the driving module 400. However, if the temperature of the driving module 400 is too high, the driving module 400 may be damaged, thereby affecting the normal operation of the outdoor unit. Therefore, as shown in FIG. 12, in a case where it is detected that the temperature Ta of the driving module 400 is greater than the target temperature Tft, the opening degree of the auxiliary electronic expansion valve 610 is increased, and the amount of refrigerant circulating in the refrigerant pipe 200 is increased, so that the temperature of the driving module 400 where the temperature is detected to be greater than the target temperature is decreased, and the temperature of the driving module 400 is stabilized at the target temperature.

[0069] The temperature of each driving module 400 is monitored by the temperature sensor. In a case where the temperature Ta of the driving module 400 is greater than the maximum value Tmax of the safe temperature range, it is determined that the temperature of the driving module 400 is too high, which may cause burning and damage of the driving module 400. At this time, the opening degree of the auxiliary electronic expansion valve 610 is increased. That is, the amount of refrigerant circulating in the refrigerant pipe 200 is increased. The heat generated by the driving module 400 is taken away by the re-

frigerant, so that the temperature of the driving module 400 where the temperature is detected to be greater than a maximum value of the safe temperature range is decreased, and the temperature of the driving module 400 is within the safe temperature range. In addition, heat is transferred between adjacent driving modules 400 through the heat conduction member 300, so that temperatures of a plurality of driving modules 400 are more balanced, thereby preventing the temperature of the driving module 400 from being too high.

[0070] In summary, in the control method provided by the embodiments of the present disclosure, by setting a suitable target value and then continuously adjusting the opening degree of the auxiliary electronic expansion valve 610 (that is, adjusting the amount of the refrigerant), the temperature of the driving module 400 is stabilized at the target temperature.

[0071] Since the target temperature selects a value within the safe temperature range, it is possible to ensure that the temperature of the driving module 400 is within the safe temperature range. In detail, in a case where the temperature of the driving module 400 is too high, the opening degree of the auxiliary electronic expansion valve 610 is increased (that is, the amount of refrigerant is increased), so that the temperature of the driving module 400 may be decreased to the target temperature. In a case where the temperature of the driving module 400 is too low, the temperature value of the target temperature is increased. At this time, the opening degree of the auxiliary electronic expansion valve 610 is decreased (that is, the amount of refrigerant is decreased), so that the temperature of the driving module 400 is increased. Thus, the opening degree of the auxiliary electronic expansion valve 610 is continuously adjusted according to the target temperature, so that the temperature of the driving module 400 is stabilized at the target temperature, which ensures that the temperature of the driving module 400 will neither be too high nor too low, thereby ensuring the normal and stable operation of the outdoor unit.

[0072] Further, in the control method provided by the embodiments of the present disclosure, the temperature of each driving module 400 is monitored through a temperature sensor, and a target temperature value is set to continuously feedback the temperature of the driving module 400 through a PID control method. Moreover, the opening degree of the auxiliary electronic expansion valve 610 is continuously adjusted, the amount of refrigerant circulating in the refrigerant pipe 200 is increased or decreased, and the temperature of the driving module 400 is continuously adjusted. Finally, the temperature of the driving module 400 is stable within the safe temperature range. During the adjustment, the heat exchange block 100 and the heat conduction member 300 may adopt an integrated structure to transfer the heat between the driving modules 400, so that the temperatures of the driving modules 400 are more balanced, thereby effectively preventing the condensation problem due to the low temperature of the driving module, and ensuring the normal operation of the driving module 400.

[0073] In the air conditioner with the plurality of compressors 550 provided by the embodiments of the present disclosure, in a case where only one of the compressors 550 needs to be operated, the driving module 400 proximate to an inlet of the cooling circulation branch 600 is controlled to drive the compressor 550 corresponding to the driving module 400 to operate.

[0074] In a case where a compressor 550 away from the inlet of the cooling circulation branch 600 is operated, when the refrigerant enters the cooling circulation branch 600 from the inlet of the cooling circulation branch 600, since the driving module 400 at the inlet is not operated, heat dissipation is not required. When the refrigerant passes through the driving module 400 at the inlet, the temperature of the driving module 400 at the inlet is further decreased. Therefore, the condensation phenomenon may occur. Therefore, in a case where only one compressor 550 needs to be operated, the compressor 550 at the inlet is controlled to be operated, so that when the refrigerant passes through the compressor 550, the temperature of the refrigerant is increased through heat exchange, and when the refrigerant passes through the following driving module 400 that is not operating, the temperature of the driving module 400 that is not operating will not be decreased, which prevents the condensation phenomenon.

[0075] Further, in a case where a plurality of compressors 550 of all the compressors 550 need to be operated, a plurality of driving modules 400 proximate to the inlet of the cooling circulation branch 600 are controlled to drive the plurality of compressors 550 to operate.

[0076] Based on the above reasons, in order to prevent the driving modules 400 that are not operating from being cooled by the low-temperature refrigerant and thus resulting in the occurrence of the condensation phenomenon, in a case where some compressors 550 need to be operated, the plurality of driving modules 400 proximate to the inlet of the cooling circulation branch 600 are controlled to operate in sequence. For example, if two compressors 550 need to be operated, a first driving module and a second driving module 400 closest to the inlet of the cooling circulation branch 600 may be controlled to operate. When the refrigerant passes through the driving modules 400 that are operating and exchanges the heat, the temperature of the refrigerant is increased, so as to ensure that the temperature of the driving module 400 that is not operating will not be too low when the refrigerant passes through the driving module 400 that is not operating, thereby preventing the condensation phenomenon of the driving module 400.

[0077] It will be noted that when one or more of some of the compressors 550 are required to be operated, after the corresponding driving module 400 is started in the above manner and the corresponding compressor 550 is driven to be operated, the target temperature is set and the temperature of the driving module 400 is adjusted according to the aforementioned control method, so that

the temperature of the driving module 400 is stabilized at the target temperature, thereby ensuring that the temperature of the driving module 400 will neither be too high nor too low.

[0078] In addition, the control method provided by the embodiments of the present disclosure is also applicable to the outdoor unit of the mono-compressor 550.

[0079] In some embodiments of the present disclosure, the first preset temperature is in a range of 2°C to 5°C, inclusive. That is, in a case where the temperature difference between the temperature of the driving module 400 and the ambient temperature is less than the temperature value, it is determined that the condensation phenomenon may occur on the driving module 400. At this time, the opening degree of the auxiliary electronic expansion valve 610 is adjusted in time, so that the temperature of the driving module 400 is adjusted to prevent the temperature thereof from further decreasing and thus generating the condensation phenomenon.

[0080] In some embodiments of the present disclosure, the safe temperature is in a range of 50°C to 75°C, inclusive. That is, in a case where the temperature of the driving module 400 is greater than 75°C, it is determined that the temperature of the driving module 400 is too high, which may cause burning and damage of the driving module 400. At this time, the opening degree of the auxiliary electronic expansion valve 610 is adjusted in time, so that the temperature of the driving module 400 is adjusted to prevent the temperature thereof from further increasing and thus cause burning and damage of the driving module 400.

[0081] In the description of the specification, specific features, structures, materials or characteristics may be combined in any suitable manner in any one or more embodiments or examples.

[0082] The foregoing descriptions are merely specific implementation of the present disclosure, but the protection scope of the present disclosure is not limited thereto, and changes or replacements that any person skilled in the art could readily conceive of within the technical scope disclosed by the present disclosure shall be within the protection scope of the present disclosure. Therefore, the protection scope of the present disclosure shall be subject to the protection scope of the claims.

Claims

1. An outdoor unit of an air conditioner, **characterized in that**, the outdoor unit of the air conditioner comprises:

   a housing provided with at least two compressors therein;
   at least two driving modules, and each of the at least two driving modules correspondingly driving one of the compressors;
   a heat exchange block, and different parts thereof being connected to different driving modules in a heat conducting manner; and
   a refrigerant pipe having refrigerant therein, and the refrigerant pipe being inserted into the heat exchange block and being capable of cooling the heat exchange block.

2. The outdoor unit of the air conditioner according to claim 1, **characterized in that**, two adjacent heat exchange blocks are connected through a heat conduction member, and the heat conduction member is configured to transfer heat between the two adjacent heat exchange blocks.

3. The outdoor unit of the air conditioner according to claim 2, **characterized in that**, the heat conduction member and the heat exchange block are made of a same material and are integrally formed.

4. The outdoor unit of the air conditioner according to claim 3, **characterized in that**, the heat exchange block includes a fixing plate and a heat conducting portion disposed on the fixing plate, a through hole is provided in the heat conducting portion in a length direction of the fixing plate, the refrigerant pipe is inserted into the through hole, the fixing plate is connected to the driving module, and the fixing plate and the heat conducting portion are made of a same material and are integrally formed.

5. The outdoor unit of the air conditioner according to claim 4, **characterized in that**, the heat conduction member has a same structure as the heat exchange block, and an end surface of the heat conduction member is tightly connected to an end surface of the heat exchange block.

6. The outdoor unit of the air conditioner according to claim 4, **characterized in that**, the driving module is disposed on a circuit substrate, the fixing plate is tightly attached to the circuit substrate, and the circuit substrate is capable of transferring a cooling capacity of the refrigerant to the driving module to decrease a temperature of the driving module.

7. The outdoor unit of the air conditioner according to claim 4, **characterized in that**, an outer wall of the refrigerant pipe is tightly attached to an inner wall of the through hole by expanding the refrigerant pipe.

8. The outdoor unit of the air conditioner according to claim 4, **characterized in that**, the refrigerant pipe is a U-shaped pipe, the heat exchange block includes two heat conducting portions, which are disposed at edges on two sides of the fixing plate in the length direction, and two straight pipe sections of the U-shaped pipe are inserted into the through holes in the two heat conducting portions.

9. A circulation system for the outdoor unit of the air conditioner according to any one of claims 1 to 8, **characterized in that**, the circulation system comprises a subcooling heat exchanger, a main electronic expansion valve, an outdoor heat exchanger and a four-way valve which are disposed in the outdoor unit and are in communication with each other in sequence through a main circulation liquid pipe; the main circulation liquid pipe is in communication with an indoor unit; the four-way valve is further connected with a compressor and a gas-liquid separator, the compressor is in communication with the gas-liquid separator, and the gas-liquid separator is in communication with the subcooling heat exchanger; a cooling circulation branch is provided on the main circulation liquid pipe, the cooling circulation branch is in communication with the refrigerant pipe, and an auxiliary electronic expansion valve is provided on the cooling circulation branch.

10. The circulation system according to claim 9, **characterized in that**, the cooling circulation branch is disposed between the subcooling heat exchanger and the outdoor heat exchanger, and is in parallel with the main electronic expansion valve.

11. The circulation system according to claim 9, **characterized in that**, the cooling circulation branch is disposed at an end of the subcooling heat exchanger proximate to the indoor unit, and an outlet of the auxiliary electronic expansion valve is in communication with the subcooling heat exchanger.

12. A method for controlling the circulation system according to any one of claims 9 to 11, **characterized in that**, a temperature sensor is provided in each of the driving modules, and the temperature sensor is used for detecting a temperature of the driving module, and the control method comprises:

monitoring the temperature of the driving module through the temperature sensor and setting a target temperature, the target temperature being within a safe temperature range, and then adjusting an auxiliary electronic expansion valve to stabilize the temperature of the driving module at the target temperature; and

increasing a preset temperature value of the target temperature in a case where it is detected that a temperature difference between the temperature of the driving module and an ambient temperature is less than a first preset temperature, so that an opening degree of the auxiliary electronic expansion valve is decreased, an amount of refrigerant circulating in the refrigerant pipe is decreased, a temperature of the driving module where the temperature difference is detected to be less than the first preset temperature is increased, and the temperature difference between the temperature of the driving module and the ambient temperature is greater than the first preset temperature.

13. The control method according to claim 12, **characterized in that**, in a case where it is detected that the temperature of the driving module is greater than the target temperature, the opening degree of the auxiliary electronic expansion valve is increased, and the amount of refrigerant circulating in the refrigerant pipe is increased, so that the temperature of the driving module where the temperature is detected to be greater than the target temperature is decreased, and the temperature of the driving module is stabilized at the target temperature.

14. The control method according to claim 13, **characterized in that**, in a case where only one of all the compressors needs to be operated, a driving module proximate to an inlet of the cooling circulation branch is controlled to drive a compressor corresponding to the driving module to operate.

15. The control method according to claim 13, **characterized in that**, in a case where a plurality of compressors of all the compressors need to be operated, a plurality of driving modules proximate to an inlet of the cooling circulation branch are controlled to drive a plurality of compressors corresponding to the plurality driving modules to operate.

16. The control method according to claim 13, **characterized in that**, the first preset temperature is in a range of 2°C to 5°C, inclusive.

17. The control method according to claim 13, **characterized in that**, the safe temperature is in a range of 50°C to 75°C, inclusive.

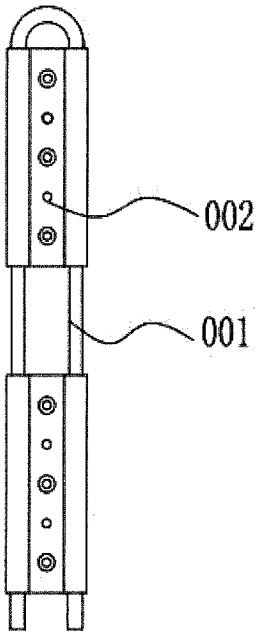

FIG. 1

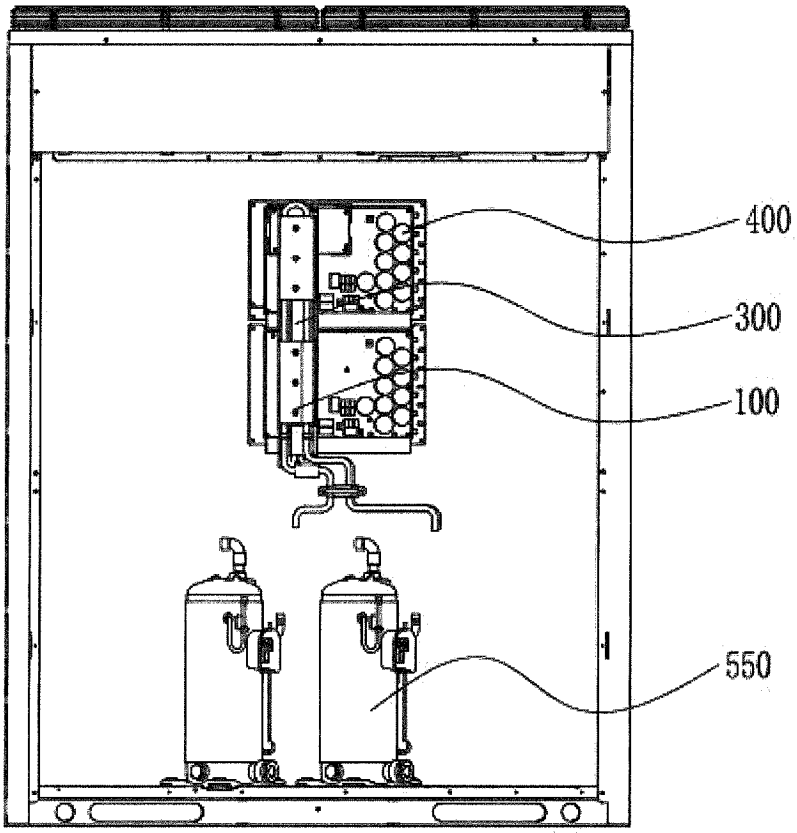

FIG. 2

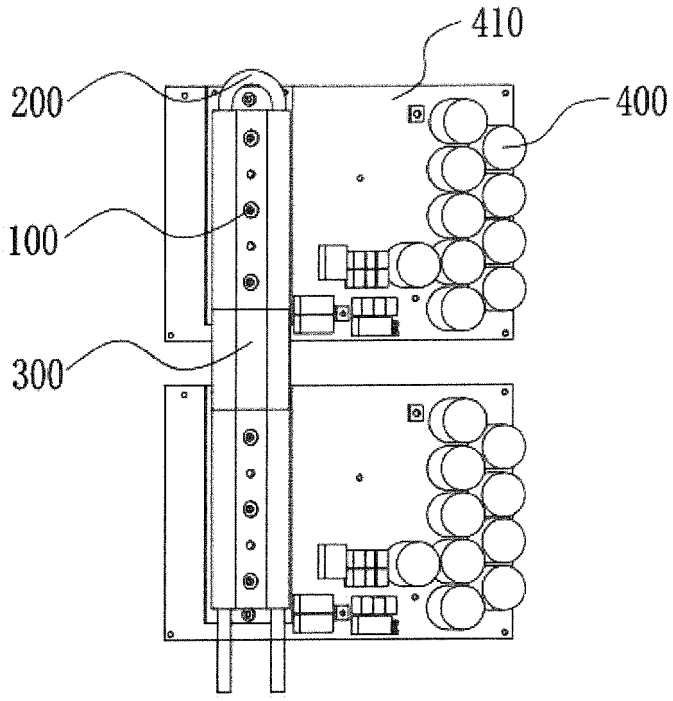

FIG. 3

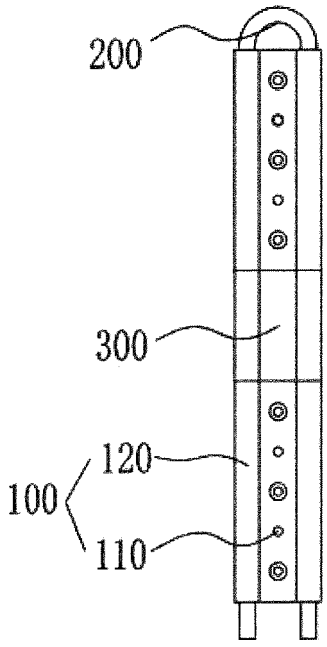

FIG. 4

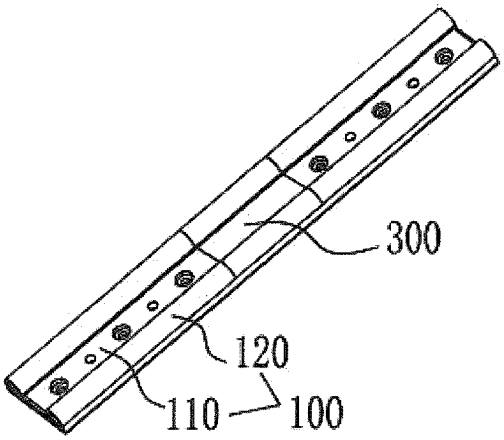

FIG. 5

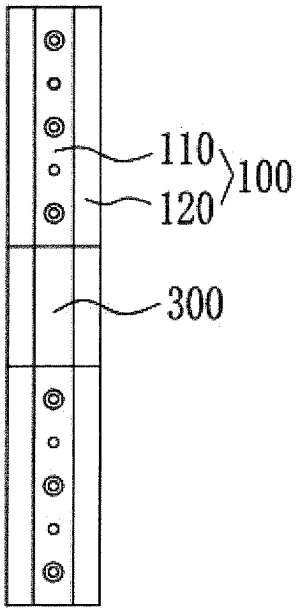

FIG. 6

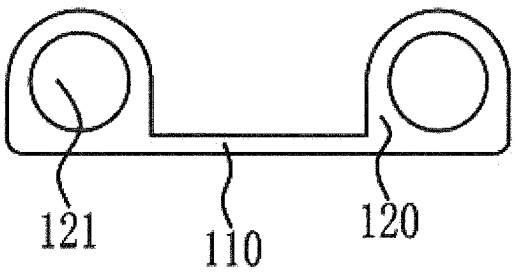

FIG. 7

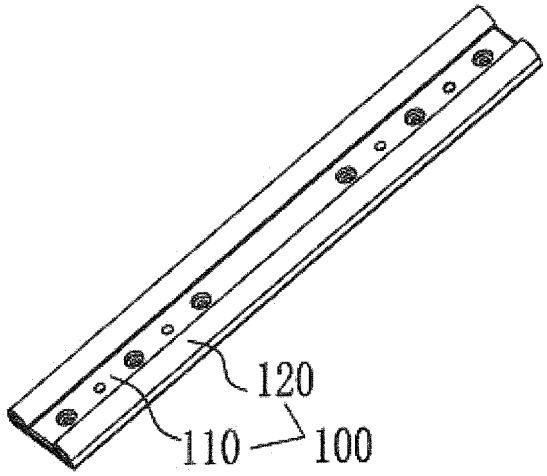

FIG. 8

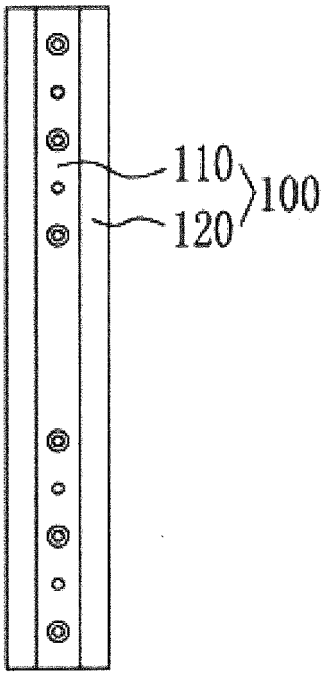

FIG. 9

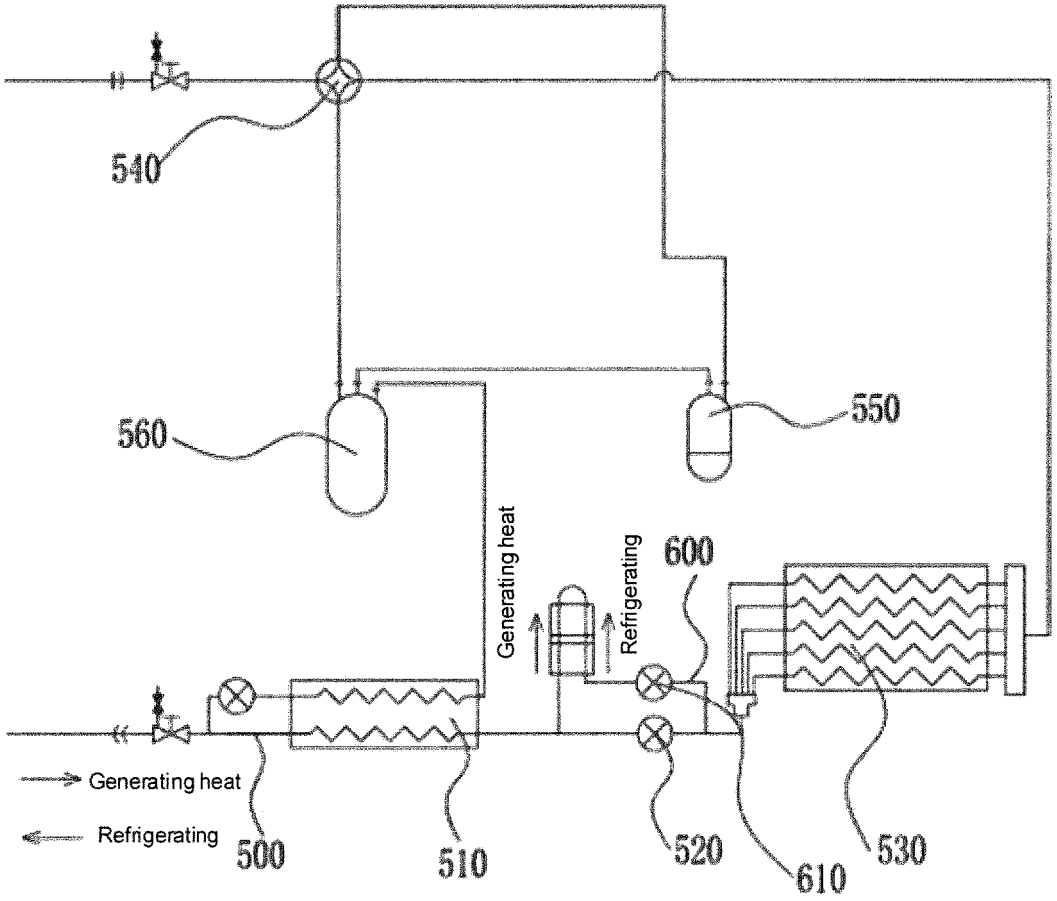
540
560
550
Generating heat
Refrigerating
600
Generating heat
Refrigerating
500
510
520
610
530

FIG. 10

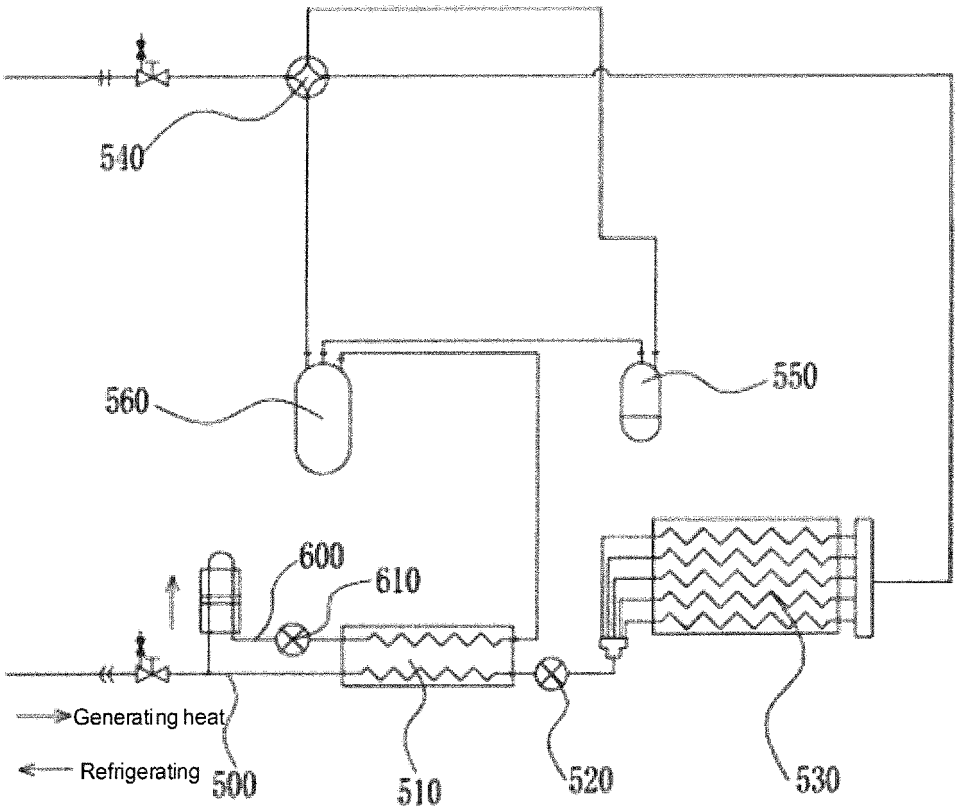
540
560
550
600
610
Generating heat
Refrigerating
500
510
520
530

FIG. 11

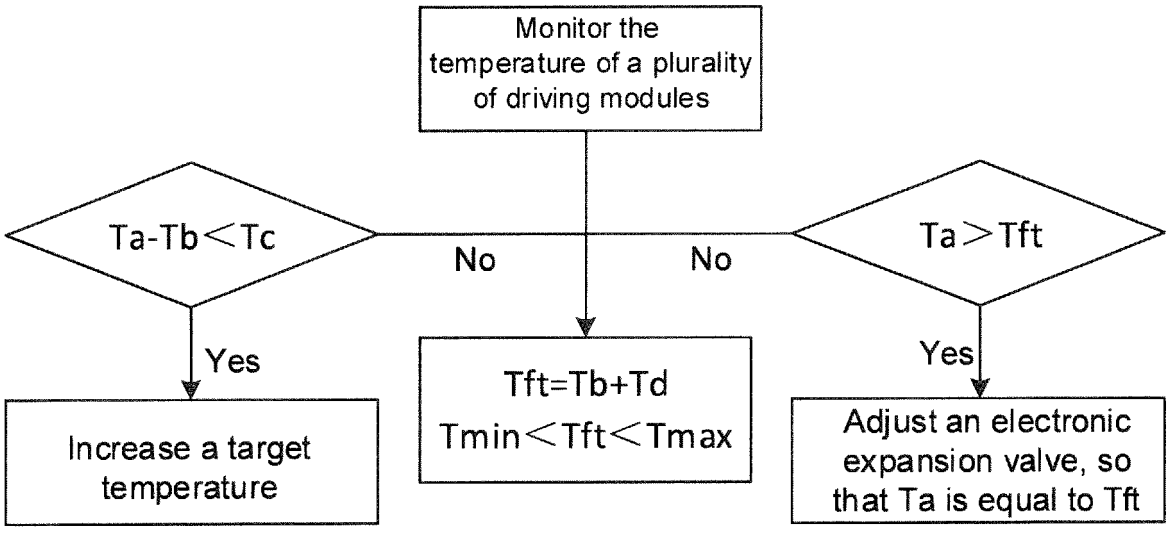
Monitor the temperature of a plurality of driving modules
Ta-Tb<Tc
No
No
Ta>Tft
Yes
Yes
Increase a target temperature
Tft=Tb+Td
Tmin<Tft<Tmax
Adjust an electronic expansion valve, so that Ta is equal to Tft

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/117285

A. CLASSIFICATION OF SUBJECT MATTER

F24F 1/24(2011.01)i; H05K 7/20(2006.01)i; F24F 11/88(2018.01)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)

F24F, H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNKI, VEN: 室外机, 压缩机, 驱动模块, 电气, 电路基板, 电路板, 控制板, 控制盒, 控制箱, 两个, 二, 双, 换热, 热交换, 冷却, 散热, 凝露, 冷媒管, 制冷剂管, 支路, 旁路, 旁通, 温度传感, outdoor, compressor, driving module, electric, control board, control casing, control box, two, second, double, exchang+, cool, radiat+, dissipat+, dew, condens+, coolant pipe, refrigerant pipe, branch, bypath, bypass, temperature sens+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2019146832 A1 (SAMSUNG ELECTRONICS CO., LTD.) 01 August 2019 (2019-08-01) description, paragraphs [7]-[84], figures 1-8	1-8
Y	WO 2019146832 A1 (SAMSUNG ELECTRONICS CO., LTD.) 01 August 2019 (2019-08-01) description, paragraphs [7]-[84], figures 1-8	9-17
Y	CN 206207598 U (QINGDAO HAIER INTELLIGENT TECHNOLOGY RESEARCH AND DEVELOPMENT CO., LTD.) 31 May 2017 (2017-05-31) description, paragraphs [0022]-[0029], and figure 1	9-17
Y	CN 208804790 U (GUANGDONG MEDIA REFRIGERATION EQUIPMENT CO., LTD. et al.) 30 April 2019 (2019-04-30) description, paragraphs [0055]-[0061], figures 1-10	12-17
X	CN 108139087 A (SAMSUNG ELECTRONICS CO., LTD.) 08 June 2018 (2018-06-08) description, paragraphs [0051]-[0085], figures 1-11	1,
A	CN 106610060 A (LG ELECTRONICS INC.) 03 May 2017 (2017-05-03) entire document	1-17

☑ 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	Date of mailing of the international search report
28 June 2020	**14 July 2020**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088** **China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/117285

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 107490090 A (GUANDONG MIDEA HVAC EQUIPMENT CO., LTD. et al.) 19 December 2017 (2017-12-19) entire document	1-17
A	CN 106016505 A (QINGDAO HAIER AIR CONDITIONER GENERAL CO., LTD.) 12 October 2016 (2016-10-12) entire document	1-17

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2019/117285

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
WO	2019146832	A1	01 August 2019	KR	20190091065	A	05 August 2019
CN	206207598	U	31 May 2017		None		
CN	208804790	U	30 April 2019		None		
CN	108139087	A	08 June 2018	KR	20170046967	A	04 May 2017
				EP	3365607	A1	29 August 2018
				EP	3365607	A4	17 October 2018
				US	2017118871	A1	27 April 2017
				WO	2017069485	A1	27 April 2017
CN	106610060	A	03 May 2017	CN	106610060	B	07 June 2019
				US	10222076	B2	05 March 2019
				EP	3163186	A1	03 May 2017
				US	2017115012	A1	27 April 2017
CN	107490090	A	19 December 2017		None		
CN	106016505	A	12 October 2016	EP	3470746	A1	17 April 2019
				US	2019049124	A1	14 February 2019
				CN	106016505	B	31 May 2019
				EP	3470746	A4	24 July 2019
				WO	2017215281	A1	21 December 2017

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201910970156 **[0001]**