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(54) **DEFROSTING SYSTEM, DEFROSTING METHOD AND AIR CONDITIONER**

(57) Disclosed is a defrosting system, belonging to the technical field of air conditioner defrosting. The defrosting system comprises: an auxiliary water path (2) and a controller (3). The auxiliary water path (2) is arranged on a condenser (4) side. The controller (3) comprises: a first unit (301), which is used for acquiring an ambient temperature; a second unit (302), which is used for acquiring a coil temperature of the auxiliary water path (2); and a third unit (303), which is used for controlling the auxiliary water path (2) to be connected to high-temperature water in a main water path (1) according to the

ambient temperature and the coil temperature of the auxiliary water path (2). According to the embodiments, where a heat pump unit does not shut down, the high-temperature water in the main water path (1) can be introduced into the auxiliary water path (2) on the condenser (4) side so as to complete the condenser (4) defrosting operation, thereby ensuring the continuous operation of the heat pump unit and avoiding frequent starting and stopping during defrosting. A defrosting method and an air conditioner are further involved.

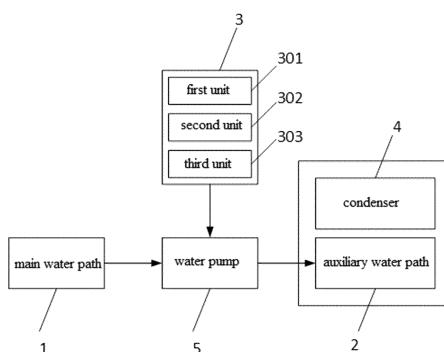


Fig.1

Description

FIELD OF THE INVENTION

[0001] The present disclosure relates to the technical field of air conditioner defrosting, and in particular to a defrosting system, a defrosting method and an air conditioner.

BACKGROUND OF THE INVENTION

[0002] At present, when a heat pump unit is in a heating mode, if a surface temperature of an evaporator is below zero, frost will be formed on a surface of a heat exchanger. If the frost on the surface of the heat exchanger is not cleared in time, it will block an air passage and reduce a heat transfer area. An air flow resistance is obviously increased, and a heat exchange efficiency is reduced, thus leading to a reduced overall performance of the heat pump unit. Therefore, regular defrosting is required.

[0003] In existing air conditioner defrosting technologies, when a defrosting condition is reached for an air conditioner unit, a four-way valve changes direction, and a high-temperature hot water on an exhaust side of a compressor directly enters a fin side for defrosting. After the defrosting is completed, a direction-changing unit of the four-way valve enters a heating mode; during defrosting, the unit is in a non-heating state, and a heating capacity of the unit is also reduced due to frequent defrosting.

[0004] Therefore, how to solve the frosting problem of the heat pump unit so as to reduce the influence of the defrosting process on the heating capacity of the heat pump unit is an urgent problem to be addressed by those skilled in the art.

SUMMARY OF THE INVENTION

[0005] Embodiments of the present disclosure provide a defrosting system, a defrosting method, and an air conditioner. In order to have a basic understanding of some aspects of the disclosed embodiments, a brief summary is given below. This summary is not a general comment, nor is it intended to identify key/important elements or describe the scope of protection of these embodiments. Its sole purpose is to present some concepts in a simple form as a prelude to the detailed description that follows.

[0006] According to a first aspect of the embodiments of the present disclosure, a defrosting system is provided.

[0007] In some optional embodiments, the defrosting system includes: an auxiliary water path and a controller; the auxiliary water path is arranged on a condenser side; and the controller includes: a first unit, which is configured to obtain an ambient temperature; a second unit, which is configured to obtain a coil temperature of the auxiliary water path; and a third unit, which is configured to control the auxiliary water path to be connected to high-temperature hot water of a main water path according to the

ambient temperature and the coil temperature of the auxiliary water path.

[0008] Optionally, the third unit includes: a first judging unit, which is configured to judge whether the ambient temperature meets a first condition; and a second judging unit, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition; when the ambient temperature meets the first condition and the coil temperature of the auxiliary water path meets the second condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

[0009] Optionally, the third unit includes: a first judging unit, which is configured to judge whether the ambient temperature meets a first condition; a second judging unit, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition; and a third judging unit, which is configured to judge whether a running time of a heat pump unit in a heating mode meets a third condition; when the ambient temperature meets the first condition, the coil temperature of the auxiliary water path meets the second condition, and the running time of the heat pump unit in the heating mode meets the third condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

[0010] Optionally, the third unit includes: a first judging unit, which is configured to judge whether the ambient temperature meets a first condition; a second judging unit, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition; a third judging unit, which is configured to judge whether a running time of a heat pump unit in a heating mode meets a third condition; and a fourth judging unit, which is configured to judge whether the time since a last defrosting process meets a fourth condition; when the ambient temperature meets the first condition, the coil temperature of the auxiliary water path meets the second condition, the running time of the heat pump unit in the heating mode meets the third condition, and the time since the last defrosting process meets the fourth condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

[0011] Optionally, a water pump is provided between the auxiliary water path and the main water path, and the controller controls the water pump to be turned on or off.

[0012] According to a second aspect of the embodiments of the present disclosure, an air conditioner is provided.

[0013] In some optional embodiments, the air conditioner includes a condenser, and further includes the defrosting device described in any of the above optional embodiments.

[0014] According to a third aspect of the embodiments of the present disclosure, a defrosting method for defrosting an air conditioner is provided.

[0015] In some optional embodiments, the defrosting

method is used to defrost an air conditioner which is provided with an auxiliary water path on a condenser side, and the defrosting method includes the following steps: obtaining an ambient temperature, and a coil temperature of the auxiliary water path; and controlling the auxiliary water path to be connected to high-temperature hot water of a main water path according to the ambient temperature and the coil temperature of the auxiliary water path.

[0016] Optionally, the step of controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path according to the ambient temperature and the coil temperature of the auxiliary water path includes: controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition and the coil temperature of the auxiliary water path meets a second condition.

[0017] Optionally, the defrosting method further includes: obtaining a running time of a heat pump unit in a heating mode; and controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition, the coil temperature of the auxiliary water path meets a second condition, and the running time of the heat pump unit in the heating mode meets a third condition.

[0018] Optionally, the defrosting method further includes: obtaining a running time of a heat pump unit in a heating mode and the time since a last defrosting process; and controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition, the coil temperature of the auxiliary water path meets a second condition, the running time of the heat pump unit in the heating mode meets a third condition, and the time since the last defrosting process meets a fourth condition.

[0019] The technical solutions provided by the embodiments of the present disclosure may have the following advantageous effects.

[0020] The defrosting operation of the condenser can be completed by introducing the high-temperature hot water of the main water path into the auxiliary water path on the condenser side without shutting down the heat pump unit, thereby ensuring the continuous operation of the heat pump unit and avoiding frequent start and stop of the unit during the defrosting process.

[0021] It should be understood that the above general description and the following detailed description are only illustrative and exemplary, and should not be considered as limiting the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The drawings, where are herein incorporated into the specification and constitute a part of the specification, show embodiments in accordance with the

present disclosure, and are used to explain the principles of the present disclosure together with the specification.

FIG. 1 is a block diagram showing a defrosting system according to an exemplary embodiment;

FIG. 2 is a block diagram showing a third unit of a defrosting system according to an exemplary embodiment;

FIG. 3 is a block diagram showing a third unit of a defrosting system according to another exemplary embodiment;

FIG. 4 is a block diagram showing a third unit of a defrosting system according to another exemplary embodiment;

FIG. 5 is a schematic flowchart showing a defrosting method according to an exemplary embodiment;

FIG. 6 is a schematic flowchart showing a defrosting method according to another exemplary embodiment; and

FIG. 7 is a schematic flowchart showing a defrosting method according to another exemplary embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0023] Specific embodiments of the present disclosure will be fully illustrated in the following description and drawings to enable those skilled in the art to carry them out. Other embodiments may include structural, logical, electrical, procedural, and other changes. The embodiments only represent possible changes. Unless explicitly required, separate components and functions are optional, and the order of operations may be changed. Parts and features of some embodiments may be included in other embodiments or replace parts and features of other embodiments. The scope of the embodiments of the present disclosure includes the entire scope of the claims, and all available equivalents of the claims. In this document, individual embodiments may be separately or collectively represented by the term "invention", and this is only for the sake of convenience. If more than one inventions are actually disclosed, it is not intended to automatically limit the scope of the application to any single invention or inventive concept. In this document, relational terms such as "first" and "second" are only used to distinguish one entity or operation from another entity or operation, and they do not require or imply any actual relationship or order among these entities or operations. Moreover, terms "include", "contain" or any other variants thereof are intended to cover non-exclusive inclusion, so that a process, method or device including a series of elements include not only those elements, but also other

elements that are not explicitly listed, or elements inherent to the process, method or device. If there are no more restrictions, the element defined by the sentence "including a..." does not exclude the existence of other identical elements in the process, method or device that includes the element. The various embodiments in this document are described in a progressive manner. Each embodiment focuses on its differences from other embodiments, and for the same or similar parts between the various embodiments, reference may be made to each other. For the method, product and the like disclosed in the embodiments, since they correspond to the method disclosed in the embodiments, the description is relatively simple, and for related parts, reference may be made to the description of the method.

[0024] FIG. 1 shows an optional embodiment of a defrosting system.

[0025] In this optional embodiment, the defrosting system includes: an auxiliary water path 2 and a controller 3; the auxiliary water path 2 is arranged on a condenser 4 side, and the auxiliary water path 2 is a branch from a main water path 1; and the controller 3 includes: a first unit 301, which is configured to obtain an ambient temperature; a second unit 302, which is configured to obtain a coil temperature of the auxiliary water path; and a third unit 303, which is configured to control the auxiliary water path to be connected to high-temperature hot water of the main water path according to the ambient temperature and the coil temperature of the auxiliary water path.

[0026] By adopting this optional embodiment, the defrosting operation of the condenser can be completed by introducing the high-temperature hot water of the main water path into the auxiliary water path on the condenser side without shutting down the heat pump unit, thereby ensuring the continuous operation of the heat pump unit and avoiding frequent start and stop of the unit during the defrosting process. By contrast, in the traditional air conditioner defrosting method, the heat pump unit is in a non-heating state during defrosting, and the four-way valve is required to change direction; high-temperature hot water on an exhaust side of a compressor directly enters the condenser side for defrosting; after the defrosting is completed, the four-way valve changes direction, and the heat pump unit enters the heating mode again.

[0027] Optionally, a water pump is provided between the auxiliary water path and the main water path, and the controller controls the water pump to be turned on or off. When the water pump is turned on, the auxiliary water path is communicated to the main water path, and part of the high-temperature hot water in the main water path circulates to the auxiliary water path to defrost the condenser; and when the water pump is turned off, the auxiliary water path and the main water path are disconnected.

[0028] By adopting this optional embodiment, the communication between the auxiliary water path and the main water path is realized by the water pump. On one hand,

the auxiliary water path and the main water path can be reliably connected or disconnected, and on the other hand, the circulation speed of the high-temperature hot water can be increased.

[0029] Of course, according to the teaching of the present disclosure, those skilled in the art may also choose other devices, such as a solenoid valve, to realize the control of the connection or disconnection between the auxiliary water path and the main water path.

[0030] FIG. 2 shows an optional embodiment of the third unit.

[0031] In this optional embodiment, the third unit 303 includes: a first judging unit 3031, which is configured to judge whether the ambient temperature meets a first condition; and a second judging unit 3032, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition; when the ambient temperature meets the first condition and the coil temperature of the auxiliary water path meets the second condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

[0032] Optionally, the first condition is: $5^{\circ}\text{C} < T_a \leq 20^{\circ}\text{C}$, where T_a is the ambient temperature.

[0033] For example, the first judging unit includes a comparing unit, and the comparing unit is configured to compare the collected ambient temperature with upper and lower temperature limit values stored in a memory. If the ambient temperature meets the first condition, the first judging unit outputs "yes", and if the ambient temperature does not meet the first condition, the first judging unit outputs "no".

[0034] Optionally, the second condition is: $T_e \leq 5^{\circ}\text{C}$, where T_e is the coil temperature of the auxiliary water path.

[0035] For example, the second judging unit also includes a comparing unit, which is configured to compare the coil temperature of the auxiliary water path with an upper limit value of the second condition stored in the memory. If the coil temperature of the auxiliary water path meets the second condition, the second judging unit outputs "yes", and if the coil temperature of the auxiliary water path does not meet the second condition, the second judging unit outputs "no".

[0036] Optionally, the coil temperature of the auxiliary water path is a temperature of a water inlet pipeline, or the coil temperature of the auxiliary water path is a temperature of a water outlet pipeline. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water outlet pipeline of the auxiliary water path. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water inlet pipeline of the auxiliary water path.

[0037] Optionally, the second condition is: $T_e \leq 5^{\circ}\text{C}$ for a duration of t_i , where T_e is the coil temperature of the auxiliary water path, and t_i is 1 to 5 minutes.

[0038] For example, the second judging unit includes

a comparing unit and a timing unit. The comparing unit is configured to compare the collected coil temperature of the auxiliary water path with an upper temperature limit value of the second condition stored in the memory. If the coil temperature of the auxiliary water path meets a temperature condition, the comparing unit outputs "yes", and if the coil temperature of the auxiliary water path does not meet the temperature condition, the comparing unit outputs "no". The timing unit is configured to start timing when the coil temperature of the auxiliary water path meets the temperature condition. If the timing duration meets a time condition, the timing unit outputs "yes"; and if the timing duration does not meet the time condition, the timing unit outputs "no".

[0039] By adopting this optional embodiment, in which the second condition includes a temperature condition and a time condition, the defrosting operation caused by a sudden change in the coil temperature of the auxiliary water path can be prevented from being mis-triggered. If the time interval for the sudden change in the coil temperature of the auxiliary water path to return to a normal range does not meet the time condition, then the coil temperature of the auxiliary water path does not meet the second condition. If the coil temperature of the auxiliary water path meets the temperature condition and this lasts for a period of time to meet the time condition, then the coil temperature of the auxiliary water path meets the second condition.

[0040] FIG. 3 shows another optional embodiment of the third unit.

[0041] In this optional embodiment, the third unit 303 includes: a first judging unit 3031, which is configured to judge whether the ambient temperature meets a first condition; a second judging unit 3032, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition; and a third judging unit 3033, which is configured to judge whether a running time of a heat pump unit in a heating mode meets a third condition; when the ambient temperature meets the first condition, the coil temperature of the auxiliary water path meets the second condition, and the running time of the heat pump unit in the heating mode meets the third condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

[0042] By adopting this optional embodiment, when the heating mode starts, no frost will be formed on the condenser side, and no defrosting operation is required. Therefore, the heat pump unit will operate in the heating mode for a period of time before performing the defrosting operation, which can improve the operating efficiency of the air conditioner.

[0043] Optionally, the first condition is: $5^{\circ}\text{C} < T_a \leq 20^{\circ}\text{C}$, where T_a is the ambient temperature.

[0044] Optionally, the second condition is: $T_e \leq 5^{\circ}\text{C}$, where T_e is the coil temperature of the auxiliary water path.

[0045] Optionally, the coil temperature of the auxiliary

water path is a temperature of a water inlet pipeline, or the coil temperature of the auxiliary water path is a temperature of a water outlet pipeline. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water outlet pipeline of the auxiliary water path. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water inlet pipeline of the auxiliary water path.

[0046] Optionally, the second condition is: $T_e \leq 5^{\circ}\text{C}$ for a duration of t_i , where T_e is the coil temperature of the auxiliary water path, and t_i is 1 to 5 minutes.

[0047] Optionally, the third condition is: $t_1 \geq 30$ minutes, and t_1 is a running time of the heat pump unit in the heating mode.

[0048] For example, the third judging unit includes a timing unit. The timing unit is configured to start timing when the heat pump unit runs in the heating mode. If the timing duration is up, the third judging unit outputs "yes", and if the timing duration is not up, the third judging unit outputs "no".

[0049] FIG. 4 shows another optional embodiment of the third unit.

[0050] In this optional embodiment, the third unit 303 includes: a first judging unit 3031, which is configured to judge whether the ambient temperature meets a first condition; a second judging unit 3032, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition; a third judging unit 3033, which is configured to judge whether a running time of a heat pump unit in a heating mode meets a third condition; and the fourth judging unit 3034, which is configured to judge whether the time since a last defrosting process meets a fourth condition; when the ambient temperature meets the first condition, the coil temperature of the auxiliary water path meets the second condition, the running time of the heat pump unit in the heating mode meets the third condition, and the time since the last defrosting process meets the fourth condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

[0051] Optionally, the first condition is: $5^{\circ}\text{C} < T_a \leq 20^{\circ}\text{C}$, where T_a is the ambient temperature.

[0052] Optionally, the second condition is: $T_e \leq 5^{\circ}\text{C}$, where T_e is the coil temperature of the auxiliary water path.

[0053] Optionally, the coil temperature of the auxiliary water path is a temperature of a water inlet pipeline, or the coil temperature of the auxiliary water path may also be a temperature of a water outlet pipeline. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water outlet pipeline of the auxiliary water path. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water inlet pipeline of the auxiliary water path.

[0054] Optionally, the second condition is: $T_e \leq 5^{\circ}\text{C}$ for a duration of t_i , where T_e is the coil temperature of the

auxiliary water path, and t_1 is 1 to 5 minutes.

[0055] Optionally, the third condition is: $t_2 \geq 30$ minutes, and t_2 is the running time of the heat pump unit in the heating mode.

[0056] Optionally, the fourth condition is: $t_3 \geq 30$ minutes, and t_3 is the time since the last defrosting process.

[0057] For example, the fourth judging unit includes a timing unit, which is configured to start timing after the present defrosting process is completed. If the timing duration is up, the fourth judging unit outputs "yes", and if the timing duration is not up, the fourth judging unit outputs "no".

[0058] In some optional embodiments, an air conditioner is provided, which includes a condenser, and the air conditioner further includes the defrosting system described above.

[0059] FIG. 5 shows an optional embodiment of a defrosting method.

[0060] In this optional embodiment, the defrosting method is used to defrost an air conditioner which is provided with an auxiliary water path on a condenser side, and the defrosting method includes the following steps: step 11, obtaining an ambient temperature, and a coil temperature of the auxiliary water path; and step 12, controlling the auxiliary water path to be connected to high-temperature hot water of a main water path according to the ambient temperature and the coil temperature of the auxiliary water path.

[0061] By adopting this optional embodiment, the defrosting operation of the condenser can be completed by introducing the high-temperature hot water of the main water path into the auxiliary water path on the condenser side without shutting down the heat pump unit, thereby ensuring the continuous operation of the heat pump unit and avoiding frequent start and stop of the unit during the defrosting process. By contrast, in the traditional air conditioner defrosting method, the heat pump unit is in a non-heating state during defrosting, and the four-way valve is required to change direction; high-temperature hot water on an exhaust side of a compressor directly enters the condenser side for defrosting; after the defrosting is completed, the four-way valve changes direction, and the heat pump unit enters the heating mode again.

[0062] For example, the air conditioner includes a controller, which obtains an ambient temperature, and a coil temperature of the auxiliary water path, and which controls the auxiliary water path to be connected to high-temperature hot water of a main water path according to the ambient temperature and the coil temperature of the auxiliary water path.

[0063] Optionally, a water pump is provided between the auxiliary water path and the main water path, and by controlling the water pump to be turned on or off, the connection or disconnection between the auxiliary water path and the main water path is realized. When the water pump is turned on, the auxiliary water path is communicated to the main water path, and part of the high-tem-

perature hot water in the main water path circulates to the auxiliary water path to defrost the condenser; and when the water pump is turned off, the auxiliary water path and the main water path are disconnected.

[0064] By adopting this optional embodiment, the communication between the auxiliary water path and the main water path is realized by the water pump. On one hand, the auxiliary water path and the main water path can be reliably connected or disconnected, and on the other hand, the circulation speed of the high-temperature hot water can be increased.

[0065] For example, the air conditioner includes a controller that controls the water pump to be turned on or off. When the water pump is turned on, the auxiliary water path is communicated to the main water path, and part of the high-temperature hot water in the main water path circulates to the auxiliary water path to defrost the condenser; and when the water pump is turned off, the auxiliary water path and the main water path are disconnected.

[0066] Optionally, the step of controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path according to the ambient temperature and the coil temperature of the auxiliary water path includes: controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition and the coil temperature of the auxiliary water path meets a second condition.

[0067] Optionally, the first condition is: $5^\circ\text{C} < T_a \leq 20^\circ\text{C}$, where T_a is the ambient temperature.

[0068] Optionally, the second condition is: $T_e \leq 5^\circ\text{C}$, where T_e is the coil temperature of the auxiliary water path.

[0069] For example, the air conditioner includes a controller, and the controller includes a first judging unit and a second judging unit. The first judging unit includes a comparing unit, which is configured to compare the collected ambient temperature with upper and lower temperature limit values of the first condition stored in a memory. If the ambient temperature meets the first condition, the first judging unit outputs "yes", and if the ambient temperature does not meet the first condition, the first judging unit outputs "no". The second judging unit also includes a comparing unit, which is configured to compare the coil temperature of the auxiliary water path with an upper temperature limit value of the second condition stored in the memory. If the coil temperature of the auxiliary water path meets the second condition, the second judging unit outputs "yes", and if the coil temperature of the auxiliary water path does not meet the second condition, the second judging unit outputs "no". The controller controls the auxiliary water path to be connected to the high-temperature hot water of the main water path according to the output results of the first judging unit and the second judging unit.

[0070] Optionally, the coil temperature of the auxiliary water path is a temperature of a water inlet pipeline, or

the coil temperature of the auxiliary water path may also be a temperature of a water outlet pipeline. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water outlet pipeline of the auxiliary water path. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water inlet pipeline of the auxiliary water path.

[0071] Optionally, the second condition is: $T_e \leq 5^\circ\text{C}$ for a duration of t_1 , where T_e is the coil temperature of the auxiliary water path, and t_1 is 1 to 5 minutes.

[0072] For example, the second judging unit includes a comparing unit and a timing unit. The comparing unit is configured to compare the collected coil temperature of the auxiliary water path with an upper temperature limit value of the second condition stored in the memory. If the coil temperature of the auxiliary water path meets a temperature condition, the comparing unit outputs "yes", and if the coil temperature of the auxiliary water path does not meet the temperature condition, the comparing unit outputs "no". The timing unit is configured to start timing when the coil temperature of the auxiliary water path meets the temperature condition. If the timing duration meets a time condition, the timing unit outputs "yes"; and if the timing duration does not meet the time condition, the timing unit outputs "no". The second judging unit performs an "AND" operation on the output results of the comparing unit and the timing unit. When the output results of the comparing unit and the timing unit are both "yes", the second judging unit outputs "yes", and for other combinations of the results, the second judging unit outputs "no".

[0073] By adopting this optional embodiment, in which the second condition includes a temperature condition and a time condition, the defrosting operation caused by a sudden change in the coil temperature of the auxiliary water path can be prevented from being mis-triggered. If the time interval for the sudden change in the coil temperature of the auxiliary water path to return to a normal range does not meet the time condition, then the coil temperature of the auxiliary water path does not meet the second condition. If the coil temperature of the auxiliary water path meets the temperature condition and this lasts for a period of time to meet the time condition, then the coil temperature of the auxiliary water path meets the second condition.

[0074] FIG. 6 shows another optional embodiment of the defrosting method.

[0075] In this optional embodiment, the defrosting method includes the following steps: step 21, obtaining an ambient temperature, a coil temperature of the auxiliary water path, and a running time of a heat pump unit in a heating mode; and step 22, controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition, the coil temperature of the auxiliary water path meets a second condition, and the running time of the heat pump unit in the heating mode

meets a third condition.

[0076] Optionally, the first condition is: $5^\circ\text{C} < T_a \leq 20^\circ\text{C}$, where T_a is the ambient temperature.

[0077] Optionally, the second condition is: $T_e \leq 5^\circ\text{C}$, where T_e is the coil temperature of the auxiliary water path.

[0078] Optionally, the coil temperature of the auxiliary water path is a temperature of a water inlet pipeline, or the coil temperature of the auxiliary water path may also be a temperature of a water outlet pipeline. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water outlet pipeline of the auxiliary water path. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water inlet pipeline of the auxiliary water path.

[0079] Optionally, the second condition is: $T_e \leq 5^\circ\text{C}$ for a duration of t_1 , where T_e is the coil temperature of the auxiliary water path, and t_1 is 1 to 5 minutes.

[0080] Optionally, the third condition is: $t_1 \geq 30$ minutes, and t_1 is a running time of the heat pump unit in the heating mode.

[0081] For example, the air conditioner includes a controller, and the controller includes a first judging unit, a second judging unit, and a third judging unit. The third judging unit includes a timing unit, which is configured to start timing when the heat pump unit runs in the heating mode. If the timing duration is up, the third judging unit outputs "yes", and if the timing duration is not up, the third judging unit outputs "no". If the first judging unit, the second judging unit and the third judging unit all output "yes", the controller controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

[0082] FIG. 7 shows another optional embodiment of the defrosting method.

[0083] In this optional embodiment, the defrosting method includes the following steps: step 31, obtaining an ambient temperature, a coil temperature of the auxiliary water path, a running time of a heat pump unit in a heating mode and the time since a last defrosting process; and step 32, controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition, the coil temperature of the auxiliary water path meets a second condition, the running time of the heat pump unit in the heating mode meets a third condition, and the time since the last defrosting process meets a fourth condition.

[0084] Optionally, the first condition is: $5^\circ\text{C} < T_a \leq 20^\circ\text{C}$, where T_a is the ambient temperature.

[0085] Optionally, the second condition is: $T_e \leq 5^\circ\text{C}$, where T_e is the coil temperature of the auxiliary water path.

[0086] Optionally, the coil temperature of the auxiliary water path is a temperature of a water inlet pipeline, or the coil temperature of the auxiliary water path may also be a temperature of a water outlet pipeline. Optionally,

the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water outlet pipeline of the auxiliary water path. Optionally, the coil temperature of the auxiliary water path is obtained by a temperature sensor arranged in a water inlet pipeline of the auxiliary water path.

[0087] Optionally, the second condition is: $T_e \leq 5^\circ\text{C}$ for a duration of t_1 , where T_e is the coil temperature of the auxiliary water path, and t_1 is 1 to 5 minutes.

[0088] Optionally, the third condition is: $t_2 \geq 30$ minutes, and t_2 is the running time of the heat pump unit in the heating mode.

[0089] Optionally, the fourth condition is: $t_3 \geq 30$ minutes, and t_3 is the time since the last defrosting process.

[0090] For example, the air conditioner includes a controller, and the controller includes a first judging unit, a second judging unit, a third judging unit, and a fourth judging unit. The fourth judging unit includes a timing unit, which is configured to start timing after the present defrosting process is completed. If the timing duration is up, the fourth judging unit outputs "yes", and if the timing duration is not up, the fourth judging unit outputs "no". When the first judging unit, the second judging unit, the third judging unit and the fourth judging unit all output "yes", the controller controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

[0091] In an exemplary embodiment, a computer device is also provided. The computer device includes a memory, a processor, and a program that is stored on the memory and can be executed by the processor, and when the program is executed by the processor, the defrosting method described above is implemented.

[0092] In an exemplary embodiment, a non-transitory computer-readable storage medium including instructions is also provided, such as a memory including instructions, which can be executed by a processor to implement the defrosting method described above. The aforementioned non-transitory computer-readable storage medium may be a read only memory (ROM), a random access memory (RAM), a magnetic tape, an optical storage device, and the like.

[0093] It can be recognized by those skilled in the art that the units and algorithm steps of the examples described in combination with the embodiments disclosed herein can be implemented by electronic hardware or a combination of computer software and electronic hardware. Whether these functions are executed by hardware or software depends on the specific application and design constraint conditions of the technical solution. Those skilled in the art can use a different method for each specific application to implement the described functions, but such implementation should not be considered as going beyond the scope of the present disclosure. It can be clearly understood by those skilled in the art that for the sake of the convenience and brevity of description, for the specific working process of the above-described system, device and units, reference may be made to the

corresponding process in the foregoing method embodiment, and a repeated description is omitted herein.

[0094] In the embodiments disclosed herein, it should be understood that the disclosed methods and products (including but not limited to devices, apparatuses, etc.) can be implemented in other ways. For example, the device embodiments described above are only illustrative. For example, the division of the units is only a division of logical function, and there may be other divisions in actual implementation. For example, multiple units or components may be combined or integrated into another system, or some features may be ignored or not implemented. In addition, the mutual coupling or direct coupling or communication connection as illustrated or discussed may be indirect coupling or communication connection implemented through some interfaces, devices or units, and may be in electrical, mechanical or other forms. The units described as separate components may or may not be physically separated, and the components displayed as units may or may not be physical units, that is, they may be located in one place, or they may be distributed on multiple network units. Some or all of the units may be selected according to actual needs to achieve the objects of the solutions of the embodiments. In addition, the functional units in various embodiments of the present disclosure may be integrated into one processing unit, or each unit may exist alone physically, or two or more units may be integrated into one unit.

[0095] It should be understood that the flowcharts and block diagrams in the drawings show implementable system architectures, functions, and operations of the system, method and computer program product according to multiple embodiments of the present disclosure. In this regard, each block in the flowchart or block diagram may represent a module, a program segment, or part of codes, and the module, the program segment, or the part of codes contain one or more executable instructions for realizing specified logical functions. It should also be noted that in some alternative implementations, functions labelled in the blocks may also be implemented in an order different from that shown in the drawings. For example, two consecutive blocks may actually be executed substantially in parallel, or they may sometimes be executed in a reverse order, depending on the functions involved. It should also be noted that each block in the block diagram and/or flowchart, and the combination of the blocks in the block diagram and/or flowchart, may be implemented by a dedicated hardware-based system that performs specified functions or actions, or may be implemented by a combination of dedicated hardware and computer instructions. The present disclosure is not limited to the processes and structures that have been described above and shown in the drawings, and various modifications and changes can be made without departing from the scope of the present disclosure. The scope of the present disclosure is only defined by the appended claims.

Claims

1. A defrosting system, comprising an auxiliary water path and a controller;

wherein the auxiliary water path is arranged on a condenser side; and
the controller comprises:

a first unit, which is configured to obtain an ambient temperature;
a second unit, which is configured to obtain a coil temperature of the auxiliary water path; and
a third unit, which is configured to control the auxiliary water path to be connected to high-temperature hot water of a main water path according to the ambient temperature and the coil temperature of the auxiliary water path.

2. The defrosting system according to claim 1, wherein the third unit comprises:

a first judging unit, which is configured to judge whether the ambient temperature meets a first condition; and
a second judging unit, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition;
wherein when the ambient temperature meets the first condition and the coil temperature of the auxiliary water path meets the second condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

3. The defrosting system according to claim 1, wherein the third unit comprises:

a first judging unit, which is configured to judge whether the ambient temperature meets a first condition;
a second judging unit, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition; and
a third judging unit, which is configured to judge whether a running time of a heat pump unit in a heating mode meets a third condition;
wherein when the ambient temperature meets the first condition, the coil temperature of the auxiliary water path meets the second condition, and the running time of the heat pump unit in the heating mode meets the third condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

4. The defrosting system according to claim 1, wherein the third unit comprises:

a first judging unit, which is configured to judge whether the ambient temperature meets a first condition;
a second judging unit, which is configured to judge whether the coil temperature of the auxiliary water path meets a second condition;
a third judging unit, which is configured to judge whether a running time of a heat pump unit in a heating mode meets a third condition; and
a fourth judging unit, which is configured to judge whether the time since a last defrosting process meets a fourth condition;
wherein when the ambient temperature meets the first condition, the coil temperature of the auxiliary water path meets the second condition, the running time of the heat pump unit in the heating mode meets the third condition, and the time since the last defrosting process meets the fourth condition, the third unit controls the auxiliary water path to be connected to the high-temperature hot water of the main water path.

5. The defrosting system according to claim 1, wherein a water pump is provided between the auxiliary water path and the main water path, and the controller controls the water pump to be turned on or off.

6. An air conditioner, comprising a condenser and further comprising the defrosting device according to any one of claims 1 to 5.

7. A defrosting method, which is used to defrost an air conditioner provided with an auxiliary water path on a condenser side, the defrosting method comprising the following steps:

obtaining an ambient temperature, and a coil temperature of the auxiliary water path; and
controlling the auxiliary water path to be connected to high-temperature hot water of a main water path according to the ambient temperature and the coil temperature of the auxiliary water path.

8. The defrosting method according to claim 7, wherein the step of controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path according to the ambient temperature and the coil temperature of the auxiliary water path comprises: controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition and the coil temperature of the auxiliary water path meets a second condition.

9. The defrosting method according to claim 7, further comprising:

obtaining a running time of a heat pump unit in a heating mode; and 5
controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition, the coil temperature of the auxiliary water path meets a second condition, and the running time of the heat pump unit in the heating mode meets a third condition. 10

10. The defrosting method according to claim 7, further comprising: 15

obtaining a running time of a heat pump unit in a heating mode and the time since a last defrosting process; and
controlling the auxiliary water path to be connected to the high-temperature hot water of the main water path, when the ambient temperature meets a first condition, the coil temperature of the auxiliary water path meets a second condition, the running time of the heat pump unit in the heating mode meets a third condition, and the time since the last defrosting process meets a fourth condition. 20
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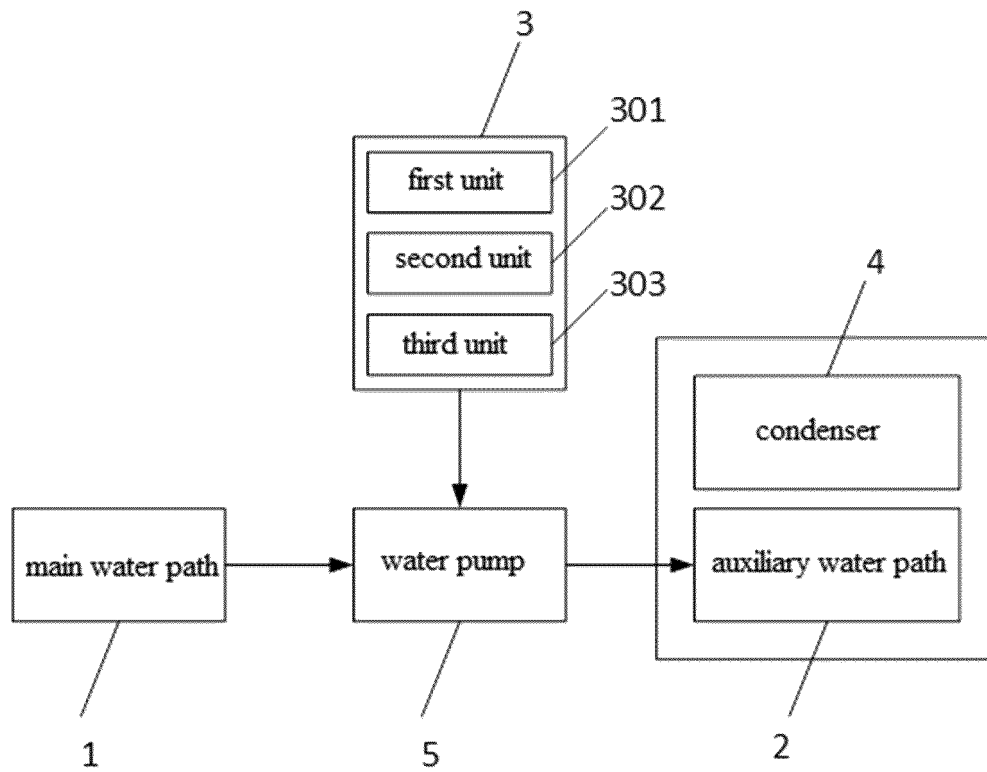


Fig.1

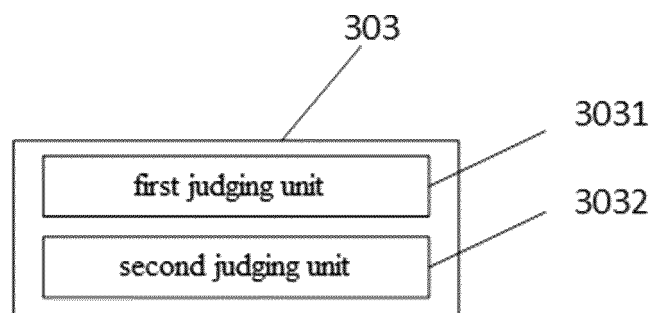


Fig.2

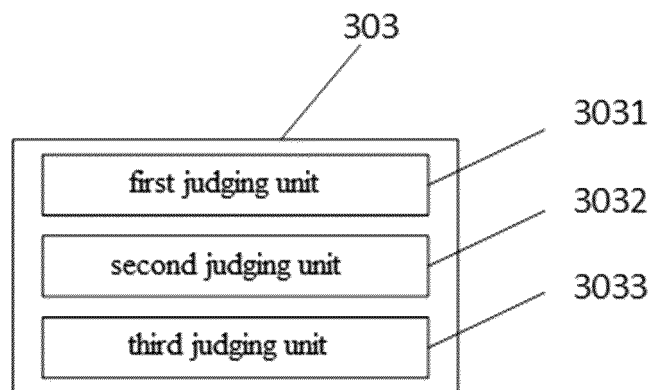


Fig.3

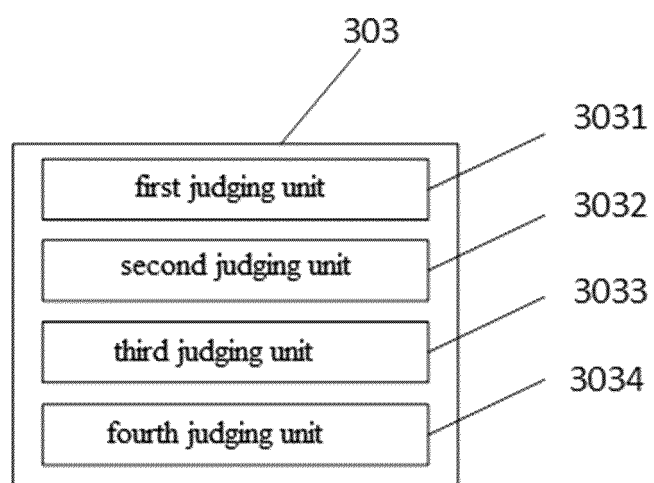


Fig.4

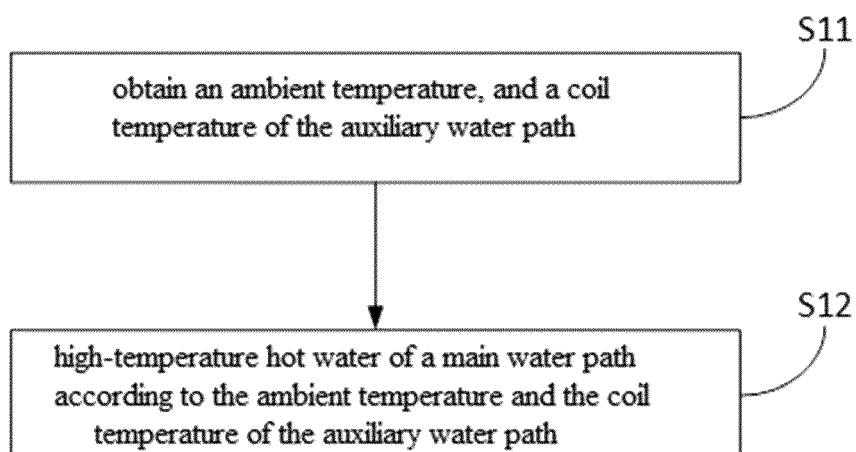


Fig.5

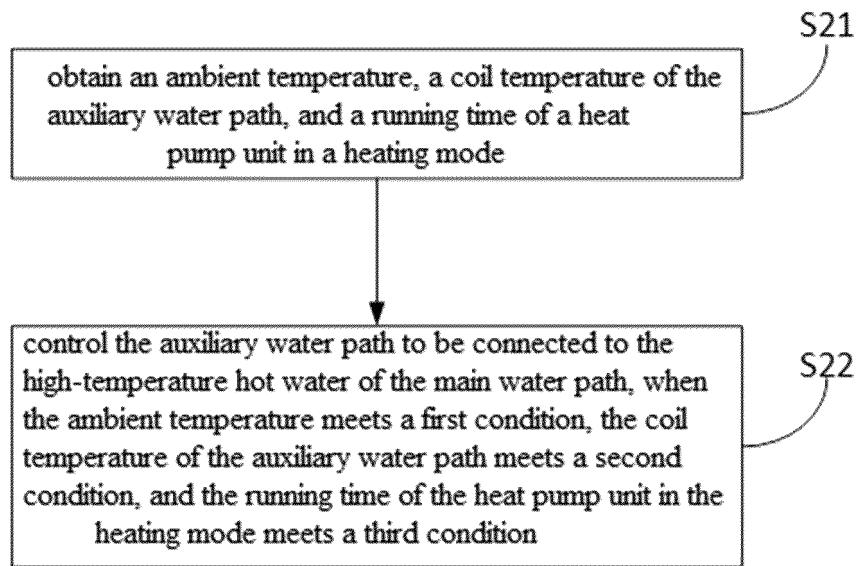


Fig.6

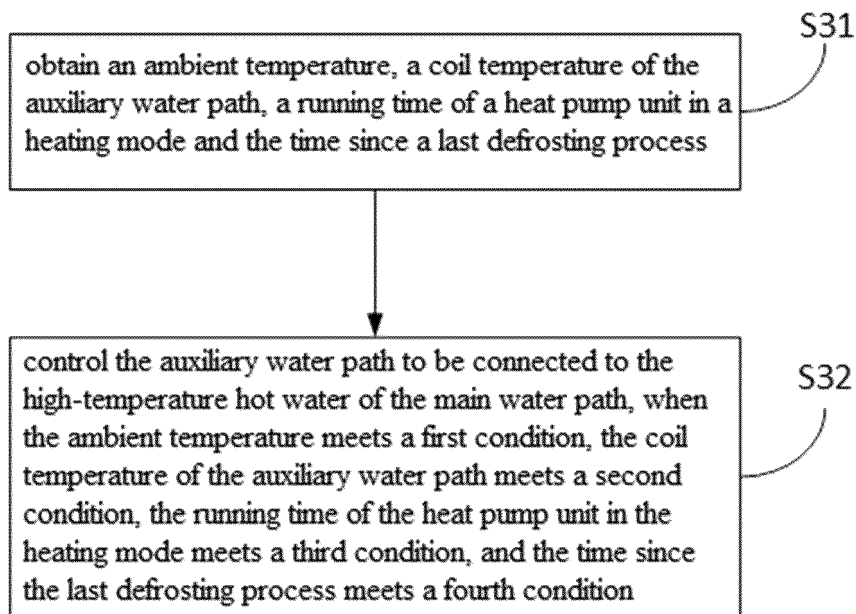


Fig.7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2019/096541

A. CLASSIFICATION OF SUBJECT MATTER F24F 11/41(2018.01)i; F24F 11/64(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 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, CNTXT, DWPI, SIPOABS; 海尔, 马东, 孙辉, 赵雷, 水, 霜, 除霜, 去霜, 融霜, 化霜, 温度, 热, 温, 冷凝器, frost, defrost, water, heat, warm, temperature, pump, condenser																		
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>PX</td> <td>CN 109489180 A (QINGDAO HAIER AIR CONDITIONER ELECTRIC CO., LTD.) 19 March 2019 (2019-03-19) entire document</td> <td>1-10</td> </tr> <tr> <td>X</td> <td>CN 107023937 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 08 August 2017 (2017-08-08) description, paragraphs [0008], [0038] and [0131], and figures 1-5</td> <td>1-10</td> </tr> <tr> <td>X</td> <td>CN 205481987 U (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 17 August 2016 (2016-08-17) description, paragraphs [0030]-[0032], and figure 1</td> <td>1-10</td> </tr> <tr> <td>X</td> <td>CN 206626758 U (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 10 November 2017 (2017-11-10) description, paragraphs [0005]-[0008], and figures 1-3</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 105783356 A (HEFEI MIDEA HEATING AND VENTILATING EQUIPMENT CO., LTD.) 20 July 2016 (2016-07-20) entire document</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	PX	CN 109489180 A (QINGDAO HAIER AIR CONDITIONER ELECTRIC CO., LTD.) 19 March 2019 (2019-03-19) entire document	1-10	X	CN 107023937 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 08 August 2017 (2017-08-08) description, paragraphs [0008], [0038] and [0131], and figures 1-5	1-10	X	CN 205481987 U (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 17 August 2016 (2016-08-17) description, paragraphs [0030]-[0032], and figure 1	1-10	X	CN 206626758 U (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 10 November 2017 (2017-11-10) description, paragraphs [0005]-[0008], and figures 1-3	1-10	A	CN 105783356 A (HEFEI MIDEA HEATING AND VENTILATING EQUIPMENT CO., LTD.) 20 July 2016 (2016-07-20) entire document	1-10
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<table border="1"> <tr> <td> * Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “D” document cited by the applicant in the international application “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 </td> <td> “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 </td> </tr> <tr> <td> Date of the actual completion of the international search 14 September 2019 </td> <td> Date of mailing of the international search report 18 October 2019 </td> </tr> <tr> <td> Name and mailing address of the ISA/CN China National Intellectual Property Administration No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China </td> <td> Authorized officer </td> </tr> <tr> <td> Facsimile No. (86-10)62019451 </td> <td> Telephone No. </td> </tr> </table>	* Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “D” document cited by the applicant in the international application “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 14 September 2019	Date of mailing of the international search report 18 October 2019	Name and mailing address of the ISA/CN China National Intellectual Property Administration No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China	Authorized officer	Facsimile No. (86-10)62019451	Telephone No.										
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2019/096541

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	JP 2007278551 A (MATSUSHITA ELECTRIC IND. CO., LTD.) 25 October 2007 (2007-10-25) entire document	1-10
A	KR 101830675 B1 (ENERSOLAR CO., LTD.) 21 February 2018 (2018-02-21) entire document	1-10

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2019/096541

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 109489180 A	05 May 2010	None	
CN 107023937 A	08 August 2017	None	
CN 205481987 U	17 August 2016	None	
CN 206626758 U	10 November 2017	None	
CN 105783356 A	20 July 2016	CN 105783356 B	22 March 2019
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JP 2007278551 A	25 October 2007	None	
KR 101830675 B1	21 February 2018	None	

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