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(54) **CONTROL METHOD AND DEVICE FOR AIR CONDITIONER**

(57) A control method for an air conditioner includes: determining the frosting state of an indoor unit when an air conditioner is operated in a refrigeration mode (S301); and controlling to block a refrigerant pipeline flowing to the indoor unit (S302) when the indoor unit frosts in the refrigeration mode. According to the control method, by controlling to block the refrigerant pipeline flowing to a heat exchanger which frosts, continuous input of a low-temperature refrigerant to the frosted heat exchanger can be stopped, so as to avoid further aggravation of the frosting problem. Moreover, the heat exchanger can be naturally defrosted and deiced by means of the temperature of an environment of the heat exchanger, so as to achieve the freezing protection effect for the heat exchanger of the air conditioner. A control device for an air conditioner is further disclosed.

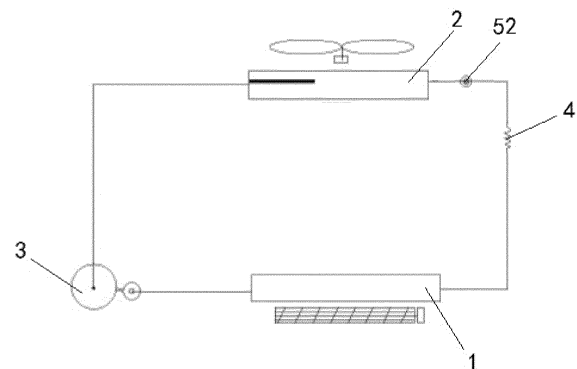


FIG. 2

Description

[0001] The present application is proposed based on China patent application No. 201710348657.0, filed on May 17, 2017, and claims priority to the China patent application, the entire contents of which are hereby incorporated by reference.

Technical Field

[0002] The present invention relates to the technical field of air conditioners, and particularly relates to a control method and device for an air conditioner.

Background

[0003] During the operation of the existing air conditioner product, an indoor unit and an outdoor unit of the air conditioner often have a freezing problem under different working conditions. For example, when the air conditioner is operated in a refrigeration mode in summer, if a set refrigeration temperature and indoor and outdoor actual environment temperatures are too low and the rotating speed of an internal fan is small, then the temperature of an inner coil pipe is too low, causing that the indoor heat exchanger of the indoor unit will generate freezing phenomena such as icing and frosting. Or, when the air conditioner is operated in a heating mode in winter, if a set heating temperature and the indoor and outdoor actual environment temperatures are too low, then the temperature of an outer coil pipe is also too low, causing that the outdoor heat exchanger of the outdoor unit will also generate freezing phenomena such as icing and frosting. The freezing problem of the outdoor heat exchanger and the indoor heat exchanger will affect the normal heat exchange work of the heat exchangers and shorten the service life of the heat exchangers. Therefore, in the related art, in order to reduce the occurrence of the freezing problem, a freezing protection function is added to the air conditioner product. Most of the protection principles of the existing freezing protection function are as follows: when the indoor heat exchanger or the outdoor heat exchanger of the air conditioner freezes, the compressor stops operating, and is restarted after the freezing phenomenon disappears. However, this mode will cause frequent start and stop of the compressor, which not only consumes a lot of energy, but also affects the service life of the compressor.

Summary

[0004] The present invention provides a control method and device for an air conditioner, so as to solve a freezing problem of heat exchangers of an air conditioner. In order to basically understand some aspects of the disclosed embodiments, a brief summary is given below. The summary is not a general comment, nor tends to determine key/critical constituent elements or describe

a protection scope of these embodiments, and merely aims to present some concepts in a simplified form as an introduction of the following detailed description.

[0005] According to a first aspect of the present invention, a control method for an air conditioner is provided, including: determining a frosting state of an indoor unit when an air conditioner is operated in a refrigeration mode; and controlling to block a refrigerant pipeline flowing to the indoor unit when the indoor unit frosts in the refrigeration mode.

[0006] Further, the controlling to block a refrigerant pipeline flowing to the indoor unit includes: controlling to turn off a first electromagnetic valve connected to the refrigerant pipeline between an indoor heat exchanger of the indoor unit and a throttle valve.

[0007] Further, the control method further includes: acquiring a first refrigerant pressure of the first electromagnetic valve adjacent to a side of the throttle valve; and controlling to turn on the first electromagnetic valve when the first refrigerant pressure is greater than or equal to a preset first refrigerant pressure threshold.

[0008] Further, the control method further includes: acquiring a first duration for blocking the refrigerant pipeline; and controlling to unblock the refrigerant pipeline when the first duration is greater than or equal to a preset first set duration, wherein the first set duration is determined according to a frequency of a compressor of the air conditioner.

[0009] Further, the first set duration is determined according to the frequency of the compressor of the air conditioner, includes: acquiring a current frequency of the compressor of the air conditioner; and determining the first set duration corresponding to the current frequency according to a corresponding relationship between a preset frequency of the compressor and the first set duration. According to a second aspect of the present invention, a control method for an air conditioner is further provided, including: determining a frosting state of an outdoor unit when an air conditioner is operated in a heating mode; and controlling to block a refrigerant pipeline flowing to the outdoor unit when the outdoor unit frosts in the heating mode.

[0010] Further, the controlling to block a refrigerant pipeline flowing to the outdoor unit includes: controlling to turn off a second electromagnetic valve connected to the refrigerant pipeline between an outdoor heat exchanger of the outdoor unit and a throttle valve.

[0011] Further, the control method further includes: acquiring a second refrigerant pressure of the second electromagnetic valve adjacent to a side of the throttle valve; and controlling to turn on the second electromagnetic valve when the refrigerant pressure is greater than or equal to a preset second refrigerant pressure threshold.

[0012] Further, the control method further includes: acquiring a second duration for blocking the refrigerant pipeline; and controlling to unblock the refrigerant pipeline when the second duration is greater than or equal to a preset second set duration, wherein the second set

duration is determined according to a frequency of a compressor of the air conditioner.

[0013] Further, the second set duration is determined according to the frequency of the compressor of the air conditioner, includes: acquiring a current frequency of the compressor of the air conditioner; and determining the second set duration corresponding to the current frequency according to a corresponding relationship between a preset frequency of the compressor and the second set duration.

[0014] According to a third aspect of the present invention, a control device for an air conditioner is further provided, including: a determining unit configured to determine a frosting state of an indoor unit when the air conditioner is operated in a refrigeration mode; and a control unit configured to control to block a refrigerant pipeline flowing to the indoor unit when the indoor unit frosts in the refrigeration mode.

[0015] According to a fourth aspect of the present invention, a control device for an air conditioner is further provided, including: a determining unit configured to determine a frosting state of an outdoor unit when the air conditioner is operated in a heating mode; and a control unit configured to control to block a refrigerant pipeline flowing to the outdoor unit when the outdoor unit frosts in the heating mode.

[0016] The control method for the air conditioner in the present invention controls to block the refrigerant pipeline flowing to the heat exchangers that generate the frosting problem to stop continuously inputting low-temperature refrigerants to the frosted heat exchangers so as to avoid further increasing the frosting problem, and can also utilize the temperature of the environment in which the heat exchangers are located to naturally defrost and deice the heat exchangers to achieve the freezing protection effect on the heat exchangers of the air conditioner.

[0017] It should be understood that the above general descriptions and the following detailed descriptions are merely exemplary and illustrative and not restrictive to the present invention.

Brief Description of the Drawings

[0018] The accompanying drawings herein, which are incorporated in the description and constitute a part of the description, illustrate embodiments consistent with the present invention and serve to explain principles of the present invention together with the description.

FIG. 1 is a structural schematic diagram I of an air conditioner of the present invention shown according to an exemplary embodiment;
FIG. 2 is a structural schematic diagram II of an air conditioner of the present invention shown according to an exemplary embodiment;
FIG. 3 is a flow chart I of a control method for an air conditioner of the present invention shown according to an exemplary embodiment; and

FIG. 4 is a flow chart II of a control method for an air conditioner of the present invention shown according to an exemplary embodiment.

[0019] In the figures: 1 indoor heat exchanger; 2 outdoor heat exchanger; 3 compressor; 4 throttle valve; 51 first electromagnetic valve; and 52 second electromagnetic valve.

Detailed Description

[0020] The following description and accompanying drawings fully illustrate specific embodiments of the present invention so that those skilled in the art can practice the specific embodiments. Other embodiments may include structural, logical, electrical and process variations and other variations. Embodiments merely represent possible variations. Individual components and functions are optional unless explicitly required, and a sequence of operations is variable. Parts and features of some embodiments may be included in or substituted for parts and features of other embodiments. A scope of embodiments of the present invention includes a full scope of claims and available equivalents of the claims. In this description, various embodiments may be individually or generally represented by a term "invention" for convenience merely. If more than one invention is actually disclosed, the scope of the application is not automatically limited to any individual invention or inventive concept. In this description, relational terms such as first, second, etc. are merely used to distinguish one entity or operation from another entity or operation, and do not require or imply any actual relationship or order among these entities or operations. Moreover, the terms such as "include", "contain" or any other variation thereof are intended to cover non-exclusive inclusions, such that a process, method or apparatus including a series of elements not merely includes those elements, but also includes other elements not explicitly listed, or includes inherent elements of such process, method or apparatus. An element that is defined by the phrase "comprising a ..." does not exclude the presence of another same element in the process, method, or apparatus that includes the element. Each embodiment herein is described in a progressive manner, and focuses on illustrating differences from other embodiments. Same and similar parts of the various embodiments can be referred to each other. Methods, products and the like disclosed in embodiments correspond to the method parts disclosed in embodiments, and thus are described relatively simply; and the relevant parts refer to the descriptions of the method parts. FIG. 1 and FIG. 2 respectively disclose structural schematic diagrams of an air conditioner in different embodiments.

[0021] In the embodiment, an air conditioner generally includes an indoor unit and an outdoor unit, and is specifically provided with a compressor 3, a four-way valve, a throttle valve 4, an indoor heat exchanger 1, an outdoor

heat exchanger 2 and other functional components. The compressor 3, the four-way valve, the throttle valve 4, the outdoor heat exchanger 2 and the indoor heat exchanger 1 are connected through a refrigerant pipeline to form a refrigerant circulation loop; and the refrigerant flows along flow directions set by different operation modes through the refrigerant circulation loop to realize the functions of heating and refrigeration.

[0022] In the embodiment, the operation mode of the air conditioner includes a refrigeration mode and a heating mode. The flowing direction of the refrigerant which is set when the air conditioner is operated in the refrigeration mode means that, a high-temperature refrigerant discharged by the compressor 3 firstly flows through the outdoor heat exchanger 2 to exchange heat with the outdoor environment, then flows into the indoor heat exchanger 1 to exchange heat with the indoor environment, and finally flows back to the compressor 3 to perform compression operation again. In this process, the refrigerant that flows through the outdoor heat exchanger 2 releases heat to the outdoor environment, and the refrigerant that flows through the indoor heat exchanger 1 absorbs the heat from the indoor environment. Through the circulating flow of the refrigerants in the refrigerant circulation loop, the indoor heat can be continuously released into the outdoor environment, thereby achieving the refrigeration purpose of reducing the indoor environment temperature.

[0023] The flowing direction of the refrigerant which is set when the air conditioner is operated in the heating mode means that, a high-temperature refrigerant discharged by the compressor 3 firstly flows through the indoor heat exchanger 1 to exchange heat with the outdoor environment, then flows into the outdoor heat exchanger 2 to exchange heat with the indoor environment, and finally flows back to the compressor 3 to perform compression operation again. In this process, the refrigerant that flows through the indoor heat exchanger 1 releases heat to the indoor environment, and the refrigerant that flows through the outdoor heat exchanger 2 absorbs the heat from the outdoor environment. Through the circulating flow of the refrigerants in the refrigerant circulation loop, the outdoor heat can be continuously released into the indoor environment, thereby achieving the heating purpose of increasing the indoor environment temperature.

[0024] Therefore, when the air conditioner is operated in the refrigeration mode, the temperature of the refrigerant inputted into the indoor heat exchanger 1 is low. An outer surface of the indoor heat exchanger 1 and an inner coil pipe are affected by the temperature of the low-temperature refrigerant, and thus the temperature of the outer surface of the indoor heat exchanger 1 and the temperature of the inner coil pipe are also low. In this case, water vapor in the indoor environment will condense into a frost layer or an ice layer on the outer surface of the indoor heat exchanger 1 and the inner coil pipe, which not only blocks the heat exchange between the

refrigerant that flows in the indoor heat exchanger 1 and the outdoor environment, but also easily freezes and damages the inner coil pipe. In order to prevent the indoor unit from generating the freezing and damaging problem when the air conditioner is operated in the refrigeration mode, the present invention provides an anti-freezing control method under the refrigeration condition in summer.

[0025] FIG. 3 is a control flow chart of an air conditioner of the present invention in an embodiment under the refrigeration condition in summer.

[0026] An anti-freezing control method under the heating condition in summer in the present invention includes: S301: the frosting state of an indoor unit when an air conditioner is operated in a refrigeration mode is determined.

[0027] In the embodiment, generally, the indoor unit frosts under the working condition in summer, and the air conditioner is mainly operated in a refrigeration mode that reduces the indoor environment temperature. At this moment, the indoor heat exchanger is filled with a large amount of low-temperature refrigerants. When the refrigeration temperature set by the user is low and the actual indoor and outdoor environment temperatures are also low, the heat exchange between the refrigerants and the indoor environment is small and the temperature of the outer surface of the indoor heat exchanger and the temperature of the inner coil pipe are also low. Therefore, water vapor is easy to condense into a frost layer on the surface of the indoor heat exchanger and on the inner coil pipe. In this way, the frosting state of the indoor unit can be detected to judge whether anti-freezing protection control is required.

[0028] In the embodiment, the frosting state of the indoor unit can be determined by detecting the thickness of the frost layer condensed on the outer surface or the inner coil pipe of the indoor unit via a sensor. When the thickness of the frost layer condensed on the outer surface or the inner coil pipe of the indoor unit reaches a set thickness, a condition for defrosting is satisfied.

[0029] For example, the thickness of the frost layer which is set by the air conditioner is 10 mm. The sensor detects the thickness of the frost layer at a detection point which is preset on the inner coil pipe. If the thickness of the frost layer at the detection point is greater than or equal to 10 mm, it can be determined that the inner coil pipe of the indoor unit has reached the condition for defrosting, and the thickness of the frost layer may affect the normal use of the air conditioner. Therefore, the indoor unit needs to be defrosted. If the thickness of the frost layer at the detection point is less than 10 mm, it can be determined that the inner coil pipe of the indoor unit has not reached the condition for defrosting, and the thickness of the frost layer has less influence on the normal use of the air conditioner. Therefore, it is not necessary to defrost the indoor unit.

[0030] In another embodiment, the temperature of the outer surface or the inner coil pipe of the indoor unit can

be detected to judge the frosting state of a chassis of the indoor unit. Specifically, the actual temperature of the outer surface or the inner coil pipe of the indoor unit can be detected through a temperature sensor, and is compared with a preset frosting temperature. If the currently detected actual temperature of the outer surface or the inner coil pipe of the indoor unit is not greater than the preset frosting temperature, it may be determined that there may be a problem that the frost layer may be condensed in the chassis of the outdoor unit.

[0031] For example, the frosting temperature of the indoor unit which is preset by the air conditioner is 0°C, and the temperature sensor detects the current coil pipe temperature of the coil pipe of the indoor unit. If the current coil pipe temperature is less than or equal to 0°C, it can be determined that the coil pipe of the indoor unit has reached the condition for defrosting, and the condensed frost layer may affect the normal use of the air conditioner. Therefore, the indoor unit needs to be defrosted. If the current coil pipe temperature is greater than 0°C, it can be determined that the water vapor of the indoor environment has not reached the condition for frosting on the inner coil pipe and no frost or a less amount of frost is condensed on the inner coil pipe of the indoor unit. Therefore, it is not necessary to defrost the indoor unit.

[0032] S302: a refrigerant pipeline flowing to the indoor unit is controlled to be blocked when the indoor unit frosts in the refrigeration mode.

[0033] When the indoor unit frosts, it can be determined that the defrosting condition is satisfied, and the indoor unit needs the freezing protection control of the defrosting, and the refrigerant pipeline flowing to the indoor unit is controlled to be blocked, so as to stop the continuous input of the low-temperature refrigerant into the indoor unit. In this way, the temperature of the newly inputted low-temperature refrigerant can be prevented from continuing to affect the temperature of the outer surface and the inner coil pipe of the indoor unit, so as to maintain the temperature of the indoor unit at a frosting temperature or even lower, thereby avoiding further aggravating the freezing problem.

[0034] In the embodiment, the blocked refrigerant pipeline flowing to the indoor unit is the refrigerant pipeline on a side connected to an inlet end of the indoor heat exchanger. In this way, the input of the low-temperature refrigerant to the indoor heat exchanger can be directly stopped. Meanwhile, part of the low-temperature refrigerant that has been inputted into the indoor heat exchanger before the refrigerant pipeline is blocked can flow out of an outlet end and continue to flow back into the compressor along the refrigerant circulation loop, thereby gradually reducing the quantity of the low-temperature refrigerant that causes the freezing problem for the indoor heat exchanger. Meanwhile, part of the low-temperature refrigerant that remains in the indoor heat exchanger can continue to exchange heat with the indoor environment. Since the indoor environment temperature is always

higher than the refrigerant temperature in the indoor heat exchanger, during the heat exchange, the low-temperature refrigerant absorbs the heat in the outdoor environment and the temperature rises, and the temperature of the outer surface of the indoor heat exchanger and the temperature of the inner coil pipe also rise together. When the temperature of the outer surface of the indoor heat exchanger and the temperature of the inner coil pipe are higher than the frosting temperature, the frost layers condensed on the outer surface and the inner coil pipe will gradually melt into water. In this way, anti-freezing protection for the indoor unit is realized.

[0035] In the embodiment, the inlet end of the indoor heat exchanger is communicated to the throttle valve and the outdoor heat exchanger through the refrigerant pipeline in sequence. Therefore, when the throttle valve is turned off, a refrigerant flow path between the indoor heat exchanger and the outdoor heat exchanger is in a blocked state. The outdoor heat exchanger cannot continue to input the refrigerants into the indoor heat exchanger according to the flow direction of the refrigerant defined by the refrigeration mode. Therefore, one of the implementation modes of controlling to block the refrigerant pipeline flowing to the indoor unit in step S302 is to turn off the throttle valve to cut off a conveying path of the refrigerants to the indoor heat exchanger, thereby realizing the anti-freezing protection for the indoor heat exchanger.

[0036] However, in the air conditioner structure shown in the embodiment of FIG. 1, a first electromagnetic valve 51 is separately disposed between the refrigerant inlet end of the indoor heat exchanger 1 and the throttle valve 4, and can be used to control to turn on or turn off the refrigerant pipeline between the indoor heat exchanger 1 and the throttle valve 4. Specifically, when the first electromagnetic valve is in the turn-on state, the refrigerant pipeline between the indoor heat exchanger and the throttle valve is in a turn-on state, and the refrigerants can flow into the indoor heat exchanger along the refrigerant pipeline. When the first electromagnetic valve is in a turn-off state, the refrigerant pipeline between the indoor heat exchanger and the throttle valve is in a turn-off state, and the refrigerants cannot continue to flow into the indoor heat exchanger along the refrigerant pipeline. In this way, another implementation mode of controlling to block the refrigerant pipeline flowing to the indoor unit in step S302 is to control to turn off the first electromagnetic valve, which also cuts off the conveying path of the refrigerants to the indoor heat exchanger, thereby realizing the purpose of anti-freezing protection for the indoor heat exchanger. In the control method of the present invention, in the process of controlling the turn-on and turn-off of the refrigerant pipeline, the compressor is in a turn-on state and the refrigerants will still move along the refrigerant circulation loop under the driving force of the compressor. Since the refrigerant circulation loop performs delivery in a single flow direction in the refrigeration mode, after the refrigerant pipeline flowing to the indoor

unit is blocked in step S302, the refrigerants gradually accumulate on a refrigerant input side of a refrigerant pipeline blocking position, causing that the pressure of the refrigerants in this side is gradually increased. For example, in the embodiment of FIG. 1, after the electromagnetic valve is turned off, a side of the electromagnetic valve adjacent to the throttle valve is the aforementioned refrigerant input side. The refrigerants discharged from a compressor vent pass through the four-way valve and the outdoor heat exchanger and then are blocked on the input side of the electromagnetic valve, so that the pressure of the refrigerants at this side is increased. When too many refrigerants accumulate on the input side of the electromagnetic valve and the hydraulic pressure of the refrigerants is too large, the refrigerant pipeline may burst and the electromagnetic valve may be damaged. Therefore, the time of blocking the refrigerant pipeline in step S302 shall not be too long, and it is necessary to re-unblock the refrigerant pipeline in proper time for performing pressure relief operation, so as to avoid excessively large hydraulic pressure of the local refrigerants.

[0037] In the embodiment, the re-unblocking of the refrigerant pipeline is controlled according to the refrigerant pressure on the refrigerant input side of the refrigerant pipeline blocking position. Specifically, the pressure relief control process for the air conditioner structure shown in FIG. 1 includes: a first refrigerant pressure on a side of the electromagnetic valve adjacent to the throttle valve is acquired; and the first electromagnetic valve is controlled to be turned on when the first refrigerant pressure is greater than or equal to a preset first refrigerant pressure threshold.

[0038] The first refrigerant pressure threshold is a safety critical pressure value of the refrigerant pipeline. When the refrigerant pressure in the refrigerant pipeline is higher than the first refrigerant pressure threshold, there may be a problem that the refrigerant pipeline bursts and the electromagnetic valve is damaged by the high hydraulic pressure of the refrigerants. When the refrigerant pressure in the refrigerant pipeline is lower than a second refrigerant pressure threshold, it is less likely to burst the refrigerant pipeline and damage the electromagnetic valve by the high hydraulic pressure of the refrigerants. Therefore, the control method of the present invention ensures that the pressure on the refrigerant input side of the electromagnetic valve is less than the first refrigerant pressure threshold to guarantee the safety and the stability of the air conditioner during the anti-freezing protection.

[0039] For the above-mentioned air conditioner that directly controls to turn on and turn off the refrigerant pipeline through the throttle valve, the acquired first refrigerant pressure is the refrigerant pressure of the throttle valve adjacent to a side of the outdoor heat exchanger. The pressure at this side is the refrigerant pressure on the refrigerant input side. Therefore, when the refrigerant pressure on a side of the throttle valve adjacent to the outdoor heat exchanger is greater than or equal to the

preset first refrigerant pressure threshold, the throttle valve can be controlled to be turned on to perform pressure relief operation, so as to ensure that the throttle valve is not damaged by high hydraulic pressure of the refrigerants.

[0040] In another embodiment of the present invention, besides the mode of judging whether to unblock the refrigerant pipeline to perform pressure relief operation according to the real-time refrigerant pressure on the refrigerant input side in the above embodiment, another control method of the present invention is: a first duration for blocking the refrigerant pipeline is acquired; and the refrigerant pipeline is controlled to be unblocked when the first duration is greater than or equal to a preset first set duration, wherein the first set duration is determined according to the frequency of the compressor of the air conditioner.

[0041] The compressor is operated at a set frequency, and the refrigerants discharged into the refrigerant circulation loop per unit time are also quantitative. In this way, the quantity of the refrigerants accumulated on the refrigerant input side of the first electromagnetic valve or the throttle valve is linearly proportional to the blocking time of the refrigerant pipeline. Namely, if the blocking time is longer, then the quantity of refrigerants accumulated on the refrigerant input side is larger and the pressure of the refrigerants is higher. Therefore, the time taken for the refrigerants accumulated on the refrigerant input side of the electromagnetic valve or the throttle valve to reach the safety critical pressure value is also a fixed value. When the duration of blocking the refrigerant pipeline does not exceed the fixed time, the refrigerant pressure on the refrigerant input side is less than the safety critical pressure value, and the pressure damage to the first electromagnetic valve or the throttle valve and the refrigerant pipeline is small. When the duration of blocking the refrigerant pipeline exceeds the fixed time, the refrigerant pressure on the refrigerant input side is greater than the safety critical pressure value, and the pressure damage to the first electromagnetic valve or the throttle valve and the refrigerant pipeline is large. Therefore, the duration of blocking the refrigerant pipeline for a single time by the control method of the present invention shall not exceed the preset first set duration, wherein the first set duration is the aforementioned fixed time.

[0042] In the embodiment, if the frequency of the compressor is higher, then the quantity of refrigerants discharged per unit time is larger, and the time taken for the refrigerant pressure on the refrigerant input side of the first electromagnetic valve or the throttle valve to reach the safety critical pressure value is shorter. Therefore, the first set duration is determined according to the frequency of the compressor of the air conditioner, and is inversely linearly proportional to the frequency. Namely, if the frequency of the compressor is higher, then the first set duration is shorter. Specifically, the process that the first set duration is determined according to the frequency of the compressor of the air conditioner in the present

invention includes: the current frequency of the compressor of the air conditioner is acquired; and the first set duration corresponding to the current frequency is determined according to a corresponding relationship between the preset frequency of the compressor and the first set duration.

[0043] In the embodiment, the corresponding relationship between the preset frequency of the compressor and the first set duration is determined according to the data collected by experiments before the air conditioner is dispatched from the factory. For example, for a certain type of air conditioner product, a safety refrigerant pressure critical value of the first electromagnetic valve is 600 kpa, and an operating frequency range of the air conditioner compressor is 50 hz to 100 hz. The operating frequency of the compressor can be divided into five gears, including a first frequency gear (50 hz to 60 hz), a second frequency gear (60 hz to 70 hz), a third frequency gear (70 hz to 80 hz), a fourth frequency gear (80 hz to 90 hz) and a fifth frequency gear (90 hz to 100 hz). The total duration taken for the first electromagnetic valve to reach the safety refrigerant pressure critical value from the beginning of blocking the refrigerant pipeline when the compressor is operated at a maximum frequency of each of the aforementioned frequency gears is detected respectively. The detected total duration is taken as the first set duration corresponding to each frequency gear. For example, the first set duration corresponding to the first frequency gear is 5 min, the first set duration corresponding to the second frequency gear is 4 min, and the like. In this way, the first set duration corresponding to the current frequency of the compressor can be determined by acquiring the current frequency of the compressor at which the air conditioner is operated and matching the current frequency with the preset corresponding relationship.

[0044] In the embodiment, the control method of the present invention further includes: the temperature of the outer surface of the indoor heat exchanger or the temperature of the inner coil pipe of the indoor unit is detected within the first set duration, and is compared with a preset freezing critical temperature; and if the detected temperature of the outer surface of the indoor heat exchanger or the detected temperature of the inner coil pipe within the first set duration is greater than or equal to the freezing critical temperature, the refrigerant pipeline flowing into the indoor heat exchanger can be controlled to be unblocked.

[0045] The freezing critical temperature is the temperature of the outer surface of the indoor heat exchanger or the temperature of the inner coil pipe when the indoor unit is frosted and frozen. Namely, when the temperature of the outer surface of the indoor heat exchanger or the temperature of the inner coil pipe is less than or equal to the freezing critical temperature, the indoor unit will generate a freezing phenomenon; and when the temperature of the outer surface of the indoor heat exchanger or the temperature of the inner coil pipe is greater than the freez-

ing critical temperature, the freezing phenomenon of the indoor unit will gradually disappear. Therefore, when the freezing phenomenon of frosting occurs in the air conditioner of the present invention, the temperature of the outer surface of the indoor heat exchanger or the temperature of the inner coil pipe is less than or equal to the freezing critical temperature. In this way, in the control method of the present invention, within the first set duration after the refrigerant pipeline flowing into the indoor heat exchanger is blocked, since no new low-temperature refrigerant is replenished into the indoor heat exchanger under the influence of the temperature of the indoor environment, the temperature of the outer surface of the indoor heat exchanger or the temperature of the inner coil pipe gradually rises. If the temperature rises to be greater than the freezing critical temperature in advance within the first set duration, the refrigerant pipeline flowing into the indoor heat exchanger can be turned on in advance, thereby shortening the process time of the anti-freezing control to recover the normal operation of the air conditioner.

[0046] Optionally, the freezing critical temperature is a critical frosting temperature under the current working conditions.

[0047] In addition, if the freezing critical temperature is not reached after the refrigerant pipeline is blocked for a single time for the first set duration, the refrigerant pipeline needs to be turned on for pressure relief; and after a set interval time, the refrigerant pipeline flowing into the indoor heat exchanger is blocked again according to the method of the above embodiment, so as to continue the anti-freezing protection control for the indoor unit.

[0048] In order to prevent malfunction caused by the fault of the temperature sensor used for detecting the temperature of the outer surface of the indoor heat exchanger or the temperature of the inner coil pipe of the indoor unit, in the embodiment, if the temperature of the outer surface of the indoor heat exchanger or the temperature of the inner coil pipe detected in several consecutive control processes is not greater than the freezing critical temperature, then control will be performed to issue a sensor failure alarm, and the temperature sensor needs to be repaired.

[0049] FIG. 4 is a control flow chart of an air conditioner of the present invention in an embodiment under the heating condition in winter.

[0050] The present invention further provides an anti-freezing control method under the heating condition in winter, including:

S401: the frosting state of an outdoor unit when an air conditioner is operated in a heating mode is determined.

[0051] In the embodiment, generally, the outdoor unit frosts under the working condition in winter, and the air conditioner is mainly operated in a heating mode that increases the outdoor environment temperature. At this moment, the outdoor heat exchanger is filled with a large amount of low-temperature refrigerants. When the heating temperature set by the user is low and the actual

indoor and outdoor environment temperatures are also low, the heat exchange between the refrigerants and the outdoor environment is small and the temperature of the outer surface of the outdoor heat exchanger and the temperature of an outer coil pipe are also low. Therefore, water vapor is easy to condense into a frost layer on the surface of the outdoor heat exchanger and on the outer coil pipe. In this way, the frosting state of the outdoor unit can be detected to judge whether anti-freezing protection control is required.

[0052] In the embodiment, the frosting state of the outdoor unit can be determined by detecting the thickness of the frost layer condensed on the outer surface or the outer coil pipe of the outdoor unit via a sensor. When the thickness of the frost layer condensed on the outer surface or the outer coil pipe of the outdoor unit reaches a set thickness, a condition for defrosting is satisfied.

[0053] For example, the thickness of the frost layer which is set by the air conditioner is 10 mm. The sensor detects the thickness of the frost layer at a detection point which is preset on the outer coil pipe. If the thickness of the frost layer at the detection point is greater than or equal to 10 mm, it can be determined that the outer coil pipe of the outdoor unit has reached the condition for defrosting, and the thickness of the frost layer may affect the normal use of the air conditioner. Therefore, the outdoor unit needs to be defrosted. If the thickness of the frost layer at the detection point is less than 10 mm, it can be determined that the outer coil pipe of the outdoor unit has not reached the condition for defrosting, and the thickness of the frost layer has less influence on the normal use of the air conditioner. Therefore, it is not necessary to defrost the outdoor unit.

[0054] In another embodiment, the temperature of the outer surface or the outer coil pipe of the outdoor unit can be detected to judge the frosting state of a chassis of the outdoor unit. Specifically, the actual temperature of the outer surface or the outer coil pipe of the outdoor unit can be detected through a temperature sensor, and is compared with a preset frosting temperature. If the currently detected actual temperature of the outer surface or the outer coil pipe of the outdoor unit is not greater than the preset frosting temperature, it may be determined that there may be a problem that the frost layer may be condensed in the chassis of the outdoor unit. For example, the frosting temperature of the outdoor unit which is preset by the air conditioner is 0°C, and the temperature sensor detects the current coil pipe temperature of the coil pipe of the outdoor unit. If the current coil pipe temperature is less than or equal to 0°C, it can be determined that the coil pipe of the outdoor unit has reached the condition for defrosting, and the condensed frost layer may affect the normal use of the air conditioner. Therefore, the outdoor unit needs to be defrosted. If the current coil pipe temperature is greater than 0°C, it can be determined that the water vapor of the outdoor environment has not reached the condition for frosting on the outer coil pipe and no frost or a less amount of frost is con-

densed on the outer coil pipe of the outdoor unit. Therefore, it is not necessary to defrost the outdoor unit.

[0055] S402: a refrigerant pipeline flowing to the outdoor unit is controlled to be blocked when the outdoor unit frosts in the heating mode.

[0056] When the outdoor unit frosts, it can be determined that the defrosting condition is satisfied, and the outdoor unit needs the freezing protection control of the defrosting, and the refrigerant pipeline flowing to the outdoor unit is controlled to be blocked, so as to stop the continuous input of the low-temperature refrigerant into the outdoor unit. In this way, the temperature of the newly inputted low-temperature refrigerant can be prevented from continuing to affect the temperature of the outer surface and the outer coil pipe of the outdoor unit, so as to maintain the temperature of the outdoor unit at a frosting temperature or even lower, thereby avoiding further aggravating the freezing problem.

[0057] In the embodiment, the blocked refrigerant pipeline flowing to the outdoor unit is the refrigerant pipeline on a side connected to an inlet end of the outdoor heat exchanger. In this way, the input of the low-temperature refrigerant into the outdoor heat exchanger can be directly stopped. Meanwhile, part of the low-temperature refrigerant that has been inputted into the outdoor heat exchanger before the refrigerant pipeline is blocked can flow out of an outlet end and continue to flow back into the compressor along the refrigerant circulation loop, thereby gradually reducing the quantity of the low-temperature refrigerant that causes the freezing problem for the outdoor heat exchanger. Meanwhile, part of the low-temperature refrigerant that remains in the outdoor heat exchanger can continue to exchange heat with the outdoor environment. Since the outdoor environment temperature is higher than the refrigerant temperature in the outdoor heat exchanger, during the heat exchange, the low-temperature refrigerant absorbs the heat in the outdoor environment and the temperature rises, and the temperature of the outer surface of the outdoor heat exchanger and the temperature of the outer coil pipe also rise together. When the temperature of the outer surface of the outdoor heat exchanger and the temperature of the outer coil pipe are higher than the frosting temperature, the frost layers condensed on the outer surface and the outer coil pipe will gradually melt into water. In this way, anti-freezing protection for the outdoor unit is realized.

[0058] In the embodiment, the inlet end of the outdoor heat exchanger is communicated to the throttle valve and the indoor heat exchanger through the refrigerant pipeline in sequence. Therefore, when the throttle valve is turned off, a refrigerant flow path between the outdoor heat exchanger and the indoor heat exchanger is in a blocked state. The indoor heat exchanger cannot continue to input the refrigerants into the outdoor heat exchanger according to the flow direction of the refrigerant defined by the heating mode. Therefore, one of the implementation modes of controlling to block the refrigerant pipeline

flowing to the outdoor unit in step S402 is to turn off the throttle valve to cut off a conveying path of the refrigerants to the outdoor heat exchanger, thereby realizing the anti-freezing protection for the outdoor heat exchanger.

[0059] However, in the air conditioner structure shown in the embodiment of FIG. 2, a second electromagnetic valve 52 is separately disposed between the refrigerant inlet end of the outdoor heat exchanger 2 and the throttle valve 4, and can be used to control to turn on or turn off the refrigerant pipeline between the outdoor heat exchanger 2 and the throttle valve 4. Specifically, when the second electromagnetic valve is in the turn-on state, the refrigerant pipeline between the outdoor heat exchanger and the throttle valve is in a turn-on state, and the refrigerants can flow into the outdoor heat exchanger along the refrigerant pipeline. When the second electromagnetic valve is in a turn-off state, the refrigerant pipeline between the outdoor heat exchanger and the throttle valve is in a turn-on state, and the refrigerants cannot continue to flow into the outdoor heat exchanger along the refrigerant pipeline. In this way, another implementation mode of controlling to block the refrigerant pipeline flowing to the outdoor unit in step S402 is to control to turn off the second electromagnetic valve, which also cuts off the conveying path of the refrigerants to the outdoor heat exchanger, thereby realizing the purpose of anti-freezing protection for the outdoor heat exchanger.

[0060] In the control method of the present invention, in the process of controlling the turn-on and turn-off of the refrigerant pipeline, the compressor is in a turn-on state and the refrigerants will still move along the refrigerant circulation loop under the driving force of the compressor. Since the refrigerant circulation loop performs delivery in a single flow direction in the heating mode, after the refrigerant pipeline flowing to the outdoor unit is blocked in step S402, the refrigerants gradually accumulate on a refrigerant input side of a refrigerant pipeline blocking position, causing that the pressure of the refrigerants in this side is gradually increased. For example, in the embodiment of FIG. 2, after the electromagnetic valve is turned off, a side of the electromagnetic valve adjacent to the throttle valve is the aforementioned refrigerant input side. The refrigerants discharged from a compressor vent pass through the four-way valve and the indoor heat exchanger and then are blocked on the input side of the electromagnetic valve, so that the pressure of the refrigerants at this side is increased. When too many refrigerants accumulate on the input side of the electromagnetic valve and the hydraulic pressure of the refrigerants is too large, the refrigerant pipeline may burst and the electromagnetic valve may be damaged. Therefore, the time of blocking the refrigerant pipeline in step S402 shall not be too long, and it is necessary to re-unblock the refrigerant pipeline in proper time for performing pressure relief operation, so as to avoid excessively large hydraulic pressure of the local refrigerants.

[0061] In the embodiment, the re-unblocking of the refrigerant pipeline is controlled according to the refrigerant

pressure on the refrigerant input side of the refrigerant pipeline blocking position. Specifically, the pressure relief control process for the air conditioner structure shown in FIG. 2 includes: a second refrigerant pressure on a side of the second electromagnetic valve adjacent to the throttle valve is acquired; and the second electromagnetic valve is controlled to be turned on when the second refrigerant pressure is greater than or equal to a preset second refrigerant pressure threshold.

[0062] The second refrigerant pressure threshold is a safety critical pressure value of the refrigerant pipeline. When the refrigerant pressure in the refrigerant pipeline is higher than the second refrigerant pressure threshold, there may be a problem that the refrigerant pipeline bursts and the electromagnetic valve is damaged by the high hydraulic pressure of the refrigerants. When the refrigerant pressure in the refrigerant pipeline is lower than a second refrigerant pressure threshold, it is less likely to burst the refrigerant pipeline and damage the electromagnetic valve by the high hydraulic pressure of the refrigerants. Therefore, the control method of the present invention ensures that the pressure on the refrigerant input side of the electromagnetic valve is less than the second refrigerant pressure threshold to guarantee the safety and the stability of the air conditioner during the anti-freezing protection.

[0063] For the above-mentioned air conditioner that directly controls to turn on and turn off the refrigerant pipeline through the throttle valve, the acquired second refrigerant pressure is the refrigerant pressure of the throttle valve adjacent to a side of the indoor heat exchanger. The pressure at this side is the refrigerant pressure on the refrigerant input side. Therefore, when the refrigerant pressure on a side of the throttle valve adjacent to the indoor heat exchanger is greater than or equal to the preset second refrigerant pressure threshold, the throttle valve can be controlled to be turned on to perform pressure relief operation, so as to ensure that the throttle valve is not damaged by high hydraulic pressure of the refrigerants.

[0064] In another embodiment of the present invention, besides the mode of judging whether to unblock the refrigerant pipeline to perform pressure relief operation according to the real-time refrigerant pressure on the refrigerant input side in the above embodiment, another control method of the present invention is: a second duration for blocking the refrigerant pipeline is acquired; and the refrigerant pipeline is controlled to be unblocked when the second duration is greater than or equal to a preset second set duration, wherein the second set duration is determined according to the frequency of the compressor of the air conditioner.

[0065] The compressor is operated at a set frequency, and the refrigerants discharged into the refrigerant circulation loop per unit time are also quantitative. In this way, the quantity of the refrigerants accumulated on the refrigerant input side of the second electromagnetic valve or the throttle valve is linearly proportional to the blocking

time of the refrigerant pipeline. Namely, if the blocking time is longer, then the quantity of refrigerants accumulated on the refrigerant input side is larger and the pressure of the refrigerants is higher. Therefore, the time taken for the refrigerants accumulated on the refrigerant input side of the electromagnetic valve or the throttle valve to reach the safety critical pressure value is also a fixed value. When the duration of blocking the refrigerant pipeline does not exceed the fixed time, the refrigerant pressure on the refrigerant input side is less than the safety critical pressure value, and the pressure damage to the second electromagnetic valve or the throttle valve and the refrigerant pipeline is small. When the duration of blocking the refrigerant pipeline exceeds the fixed time, the refrigerant pressure on the refrigerant input side is greater than the safety critical pressure value, and the pressure damage to the second electromagnetic valve or the throttle valve and the refrigerant pipeline is large. Therefore, the duration of blocking the refrigerant pipeline for a single time by the control method of the present invention shall not exceed the preset second set duration, wherein the second set duration is the aforementioned fixed time.

[0066] In the embodiment, if the frequency of the compressor is higher, then the quantity of refrigerants discharged per unit time is larger, and the time taken for the refrigerant pressure on the refrigerant input side of the second electromagnetic valve or the throttle valve to reach the safety critical pressure value is shorter. Therefore, the second set duration is determined according to the frequency of the compressor of the air conditioner, and is inversely linearly proportional to the frequency. Namely, if the frequency of the compressor is higher, then the second set duration is shorter. Specifically, the process that the second set duration is determined according to the frequency of the compressor of the air conditioner in the present invention includes: the current frequency of the compressor of the air conditioner is acquired; and the second set duration corresponding to the current frequency is determined according to a corresponding relationship between the preset frequency of the compressor and the second set duration.

[0067] In the embodiment, the corresponding relationship between the preset frequency of the compressor and the second set duration is determined according to the data collected by experiments before the air conditioner is dispatched from the factory. For example, for a certain type of air conditioner product, a safety refrigerant pressure critical value of the second electromagnetic valve is 600 kpa, and an operating frequency range of the air conditioner compressor is 50 hz to 100 hz. The operating frequency of the compressor can be divided into five gears, including a first frequency gear (50 hz to 60 hz), a second frequency gear (60 hz to 70 hz), a third frequency gear (70 hz to 80 hz), a fourth frequency gear (80 hz to 90 hz) and a fifth frequency gear (90 hz to 100 hz). The total duration taken for the second electromagnetic valve to reach the safety refrigerant pressure critical

value from the beginning of blocking the refrigerant pipeline when the compressor is operated at a maximum frequency of each of the aforementioned frequency gears is detected respectively. The detected total duration is taken as the second set duration corresponding to each frequency gear. For example, the second set duration corresponding to the first frequency gear is 5 min, the second set duration corresponding to the second frequency gear is 4 min, and the like. In this way, the second set duration corresponding to the current frequency of the compressor can be determined by acquiring the current frequency of the compressor at which the air conditioner is operated and matching the current frequency with the preset corresponding relationship.

[0068] In the embodiment, the control method of the present invention further includes: the temperature of the outer surface of the outdoor heat exchanger or the temperature of the outer coil pipe of the outdoor unit is detected within the second set duration, and is compared with a preset freezing critical temperature; and if the detected temperature of the outer surface of the outdoor heat exchanger or the detected temperature of the outer coil pipe within the second set duration is greater than or equal to the freezing critical temperature, the refrigerant pipeline flowing into the outdoor heat exchanger can be controlled to be unblocked.

[0069] The freezing critical temperature is the temperature of the outer surface of the outdoor heat exchanger or the temperature of the outer coil pipe when the outdoor unit is frosted and frozen. Namely, when the temperature of the outer surface of the outdoor heat exchanger or the temperature of the outer coil pipe is less than or equal to the freezing critical temperature, the outdoor unit will generate a freezing phenomenon; and when the temperature of the outer surface of the outdoor heat exchanger or the temperature of the outer coil pipe is greater than the freezing critical temperature, the freezing phenomenon of the outdoor unit will gradually disappear. Therefore, when the freezing phenomenon of frosting occurs in the air conditioner of the present invention, the temperature of the outer surface of the outdoor heat exchanger or the temperature of the outer coil pipe is less than or equal to the freezing critical temperature. In this way, in the control method of the present invention, within the second set duration after the refrigerant pipeline flowing into the outdoor heat exchanger is blocked, since no new low-temperature refrigerant is replenished into the outdoor heat exchanger under the influence of the temperature of the indoor environment, the temperature of the outer surface of the outdoor heat exchanger or the temperature of the outer coil pipe gradually rises. If the temperature rises to be greater than the freezing critical temperature in advance within the second set duration, the refrigerant pipeline flowing into the outdoor heat exchanger can be turned on in advance, thereby shortening the process time of the anti-freezing control to recover the normal operation of the air conditioner. Optionally, the freezing critical temperature is a critical frosting temperature un-

der the current working conditions.

[0070] In addition, if the freezing critical temperature is not reached after the refrigerant pipeline is blocked for a single time for the second set duration, the refrigerant pipeline needs to be turned on for pressure relief; and after a set interval time, the refrigerant pipeline flowing into the outdoor heat exchanger is blocked again according to the method of the above embodiment, so as to continue the anti-freezing protection control for the outdoor unit.

[0071] In order to prevent malfunction caused by the fault of the temperature sensor used for detecting the temperature of the outer surface of the outdoor heat exchanger or the temperature of the outer coil pipe of the outdoor unit, in the embodiment, if the temperature of the outer surface of the outdoor heat exchanger or the temperature of the outer coil pipe detected in several consecutive control processes is not greater than the freezing critical temperature, then control will be performed to issue a sensor failure alarm, so that a user repairs the temperature sensor in time.

[0072] The present invention further provides a control device for an air conditioner, which can be configured to perform anti-freezing protection control for the indoor unit under the working condition in summer. Specifically, the control device includes: a determining unit configured to determine the frosting state of the indoor unit when the air conditioner is operated in a refrigeration mode; and a control unit configured to control to block a refrigerant pipeline flowing to the indoor unit when the indoor unit frosts in the refrigeration mode.

[0073] For the air conditioner structure in the embodiment shown in FIG. 1, the process that the control unit controls to block a refrigerant pipeline flowing to the indoor unit includes: the first electromagnetic valve connected to the refrigerant pipeline between the indoor heat exchanger of the indoor unit and the throttle valve is controlled to be turned off.

[0074] In the embodiment, the control device further includes an acquiring unit. The acquiring unit is configured to acquire a first refrigerant pressure of the first electromagnetic valve adjacent to a side of the throttle valve. Correspondingly, the control unit is configured to control to turn on the first electromagnetic valve when the first refrigerant pressure is greater than or equal to a preset first refrigerant pressure threshold.

[0075] In another embodiment, the control device further includes an acquiring unit. The acquiring unit is configured to acquire a first duration for blocking the refrigerant pipeline. Correspondingly, the control unit is configured to control to unblock the refrigerant pipeline when the first duration is greater than or equal to a preset first set duration, wherein the first set duration is determined according to the frequency of a compressor of the air conditioner.

[0076] In the embodiment, a determining unit is configured to determine the first set duration according to the frequency of the compressor of the air conditioner.

Specifically, the acquiring unit acquires the current frequency of the compressor of the air conditioner; and the determining unit determines the first set duration corresponding to the current frequency according to a corresponding relationship between the preset frequency of the compressor and the first set duration.

[0077] The present invention further provides a control device for an air conditioner, which can be configured to perform anti-freezing protection control for the outdoor unit under the working condition in winter. Specifically, the control device includes: a determining unit configured to determine the frosting state of the outdoor unit when the air conditioner is operated in a heating mode; and a control unit configured to control to block a refrigerant pipeline flowing to the outdoor unit when the outdoor unit frosts in the heating mode.

[0078] For the air conditioner structure in the embodiment shown in FIG. 2, the process that the control unit controls to block a refrigerant pipeline flowing to the outdoor unit includes: the second electromagnetic valve connected to the refrigerant pipeline between the outdoor heat exchanger of the outdoor unit and the throttle valve is controlled to be turned off.

[0079] In the embodiment, the control device further includes an acquiring unit. The acquiring unit is configured to acquire a second refrigerant pressure of the second electromagnetic valve adjacent to a side of the throttle valve. Correspondingly, the control unit is configured to control to turn on the second electromagnetic valve when the second refrigerant pressure is greater than or equal to a preset second refrigerant pressure threshold.

[0080] In another embodiment, the control device further includes an acquiring unit. The acquiring unit is configured to acquire a second duration for blocking the refrigerant pipeline. Correspondingly, the control unit is configured to control to unblock the refrigerant pipeline when the second duration is greater than or equal to a preset second set duration, wherein the second set duration is determined according to the frequency of a compressor of the air conditioner.

[0081] In the embodiment, a determining unit is configured to determine the second set duration according to the frequency of the compressor of the air conditioner. Specifically, the acquiring unit acquires the current frequency of the compressor of the air conditioner; and the determining unit determines the second set duration corresponding to the current frequency according to a corresponding relationship between the preset frequency of the compressor and the second set duration.

[0082] It should be understood that the present invention is not limited to processes and structures described above and shown in the accompanying drawings, and can be subjected to various modifications and changes without departing from the scope thereof. The scope of the present invention is merely limited by the appended claims.

Claims

1. A control method for an air conditioner, comprising:

determining a frosting state of an indoor unit when an air conditioner is operated in a refrigeration mode; and
controlling to block a refrigerant pipeline flowing to the indoor unit when the indoor unit frosts in the refrigeration mode.

2. The control method according to claim 1, wherein the controlling to block a refrigerant pipeline flowing to the indoor unit comprises:

controlling to turn off a first electromagnetic valve connected to the refrigerant pipeline between an indoor heat exchanger of the indoor unit and a throttle valve.

3. The control method according to claim 2, further comprising:

acquiring a first refrigerant pressure of the first electromagnetic valve adjacent to a side of the throttle valve; and
controlling to turn on the first electromagnetic valve when the first refrigerant pressure is greater than or equal to a preset first refrigerant pressure threshold.

4. The control method according to claim 1, further comprising:

acquiring a first duration for blocking the refrigerant pipeline; and
controlling to unblock the refrigerant pipeline when the first duration is greater than or equal to a preset first set duration, wherein the first set duration is determined according to a frequency of a compressor of the air conditioner.

5. The control method according to claim 4, wherein the first set duration is determined according to the frequency of the compressor of the air conditioner, comprises:

acquiring a current frequency of the compressor of the air conditioner; and
determining the first set duration corresponding to the current frequency according to a corresponding relationship between a preset frequency of the compressor and the first set duration.

6. A control method for an air conditioner, comprising:

determining a frosting state of an outdoor unit when an air conditioner is operated in a heating

mode; and

controlling to block a refrigerant pipeline flowing to the outdoor unit when the outdoor unit frosts in the heating mode.

7. The control method according to claim 6, wherein the controlling to block a refrigerant pipeline flowing to the outdoor unit comprises:

controlling to turn off a second electromagnetic valve connected to the refrigerant pipeline between an outdoor heat exchanger of the outdoor unit and a throttle valve.

8. The control method according to claim 7, further comprising:

acquiring a second refrigerant pressure of the second electromagnetic valve adjacent to a side of the throttle valve; and

controlling to turn on the second electromagnetic valve when the refrigerant pressure is greater than or equal to a preset second refrigerant pressure threshold.

9. The control method according to claim 6, further comprising:

acquiring a second duration for blocking the refrigerant pipeline; and
controlling to unblock the refrigerant pipeline when the second duration is greater than or equal to a preset second set duration, wherein the second set duration is determined according to a frequency of a compressor of the air conditioner.

10. The control method according to claim 9, wherein the second set duration is determined according to the frequency of the compressor of the air conditioner, comprises:

acquiring a current frequency of the compressor of the air conditioner; and
determining the second set duration corresponding to the current frequency according to a corresponding relationship between a preset frequency of the compressor and the second set duration.

11. A control device for an air conditioner, comprising:

a determining unit configured to determine a frosting state of an indoor unit when the air conditioner is operated in a refrigeration mode; and
a control unit configured to control to block a refrigerant pipeline flowing to the indoor unit when the indoor unit frosts in the refrigeration mode.

12. A control device for an air conditioner, comprising:

a determining unit configured to determine a frosting state of an outdoor unit when the air conditioner is operated in a heating mode; and
a control unit configured to control to block a refrigerant pipeline flowing to the outdoor unit when the outdoor unit frosts in the heating mode.

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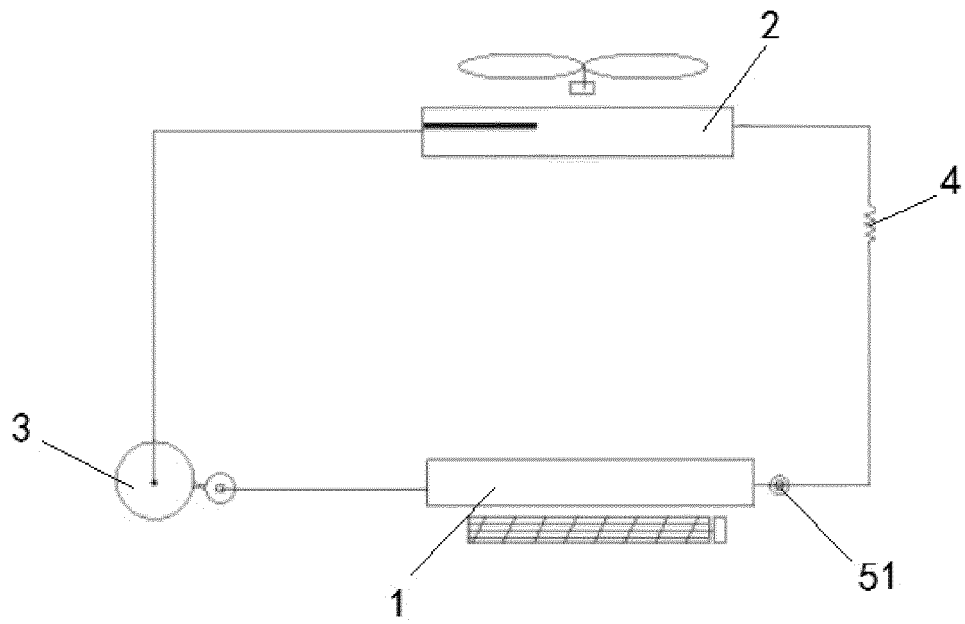


FIG. 1

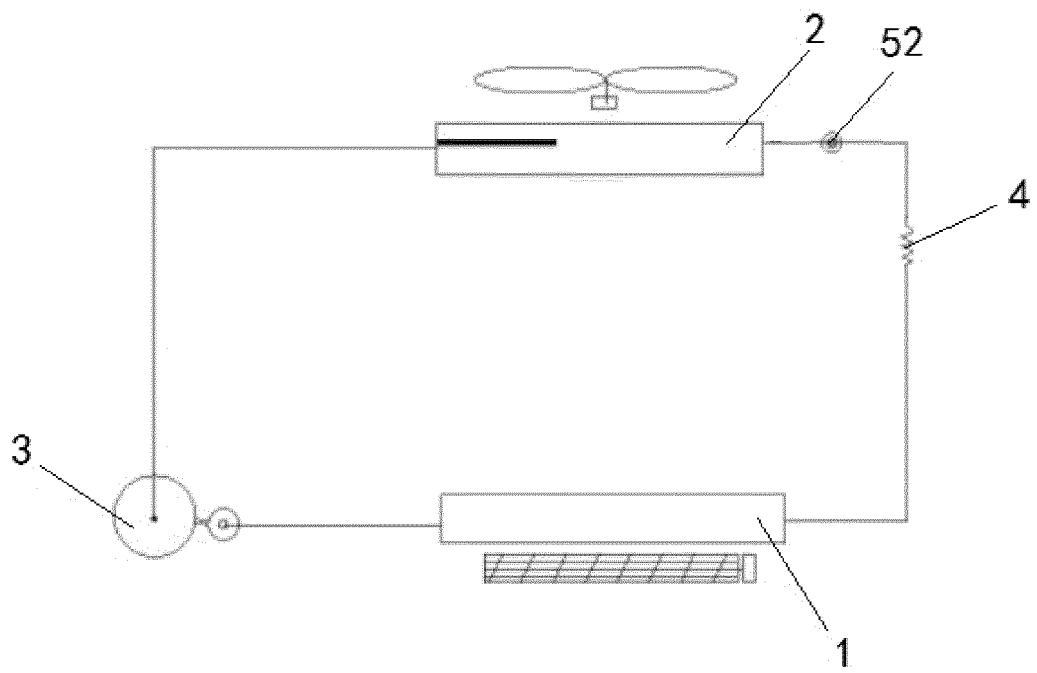


FIG. 2

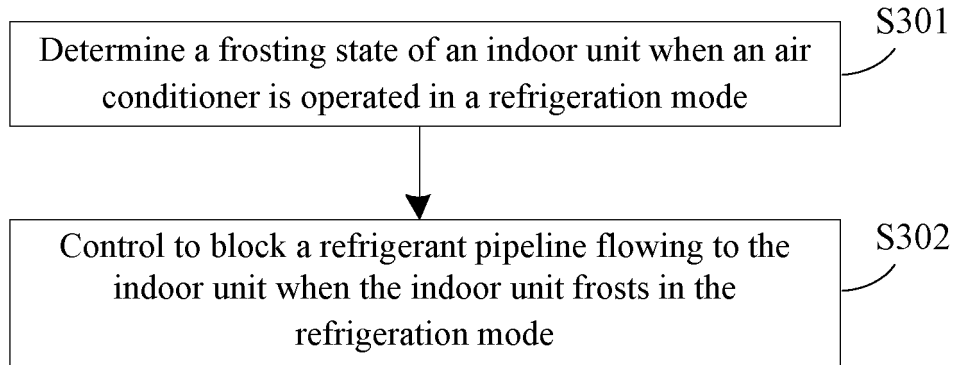


FIG. 3

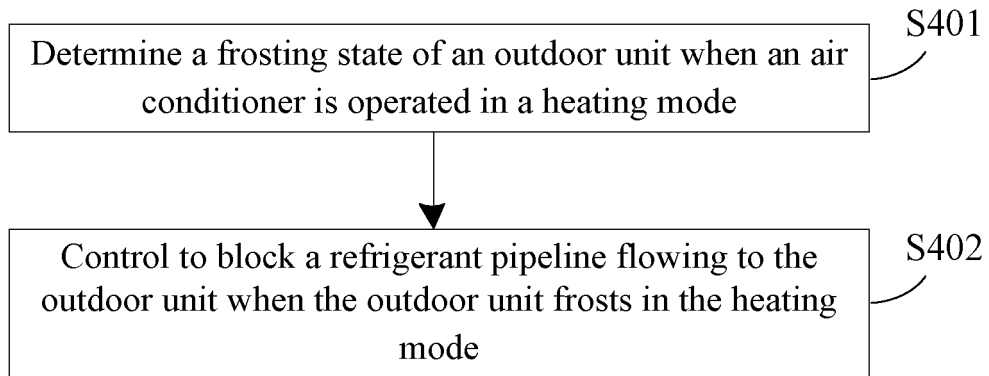


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2018/085040

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/00 (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)

CNPAT, CNKI, WPI, EPODOC: 空调, 控制, 方法, 制冷, 模式, 室内机, 结霜, 冷媒, 管路, 阻断, 化霜, air, conditioner, control+, method, mode, indoor, unit, machine, frost+, refrigeration, cold, medium, refrigerant, pipeline, cut, block, defrost+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 104596032 A (GUANGDONG MIDEA AIR-CONDITIONING EQUIPMENT CO., LTD.), 06 May 2015 (06.05.2015), description, paragraphs [0030]-[0073], and figures 1-5	1-12
PX	CN 107166643 A (QINGDAO HAIER AIR CONDITIONER CO., LTD.), 15 September 2017 (15.09.2017), description, paragraphs [0025]-[0095], and figures 1-4	1-12
A	CN 101523131 A (DAIKIN INDUSTRIES. LTD.), 02 September 2009 (02.09.2009), entire document	1-12
A	WO 2011010506 A1 (SHARP KK), 27 January 2011 (27.01.2011), entire document	1-12
A	WO 2009096915 A1 (CARRIER CORP.), 06 August 2009 (06.08.2009), entire document	1-12

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

* Special categories of cited documents:	"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
"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	"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
"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)	"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
"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	"&" document member of the same patent family

Date of the actual completion of the international search 02 July 2018	Date of mailing of the international search report 11 July 2018
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer LI, Jun Telephone No. 62085188

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

INTERNATIONAL SEARCH REPORT
 Information on patent family members

 International application No.
 PCT/CN2018/085040

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 104596032 A	06 May 2015	CN 104596032 B	29 August 2017
CN 107166643 A	15 September 2017	None	
CN 101523131 A	02 September 2009	EP 2083229 A4	25 June 2014
		AU 2007320491 B2	19 August 2010
		US 2010192624 A1	05 August 2010
		JP 5446064 B2	19 March 2014
		JP 2008121985 A	29 May 2008
		EP 2083229 A1	29 July 2009
		KR 20090067167 A	24 June 2009
		AU 2007320491 C1	27 January 2011
		CN 101523131 B	23 March 2011
		WO 2008059803 A1	22 May 2008
		KR 101173004 B1	10 August 2012
		AU 2007320491 A1	22 May 2008
		KR 20120014061 A	15 February 2012
WO 2011010506 A1	27 January 2011	JP 4836212 B2	14 December 2011
		JP 2011027286 A	10 February 2011
		EP 2458306 A4	05 August 2015
		CN 102472539 A	23 May 2012
		CN 102472539 B	09 July 2014
		EP 2458306 A1	30 May 2012
WO 2009096915 A1	06 August 2009	US 2010307172 A1	09 December 2010
		CN 101932883 A	29 December 2010
		EP 2250445 A1	17 November 2010

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 201710348657 [0001]