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(54) **AIR SUPPLEMENT CONTROL METHOD FOR AIR CONDITIONER, AND AIR CONDITIONER, CONTROLLER AND COMPUTER-READABLE STORAGE MEDIUM**

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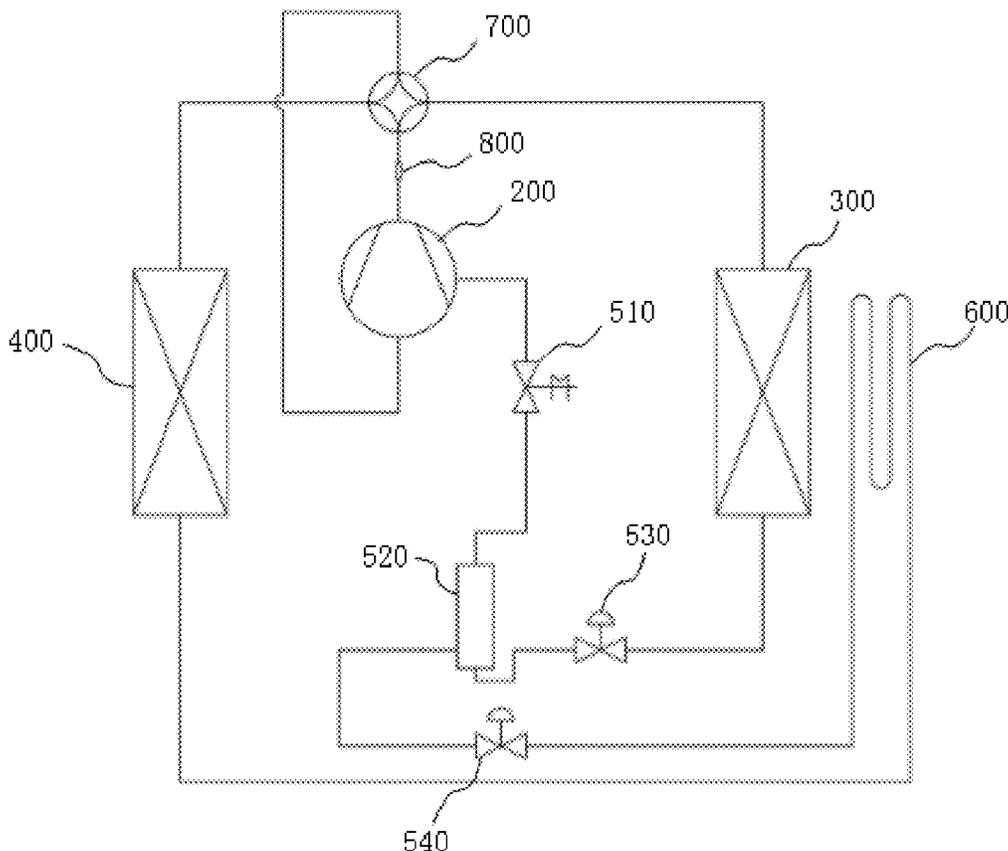
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(57) **ABSTRACT**

An air supplement control method for an air conditioner, and an air conditioner, a controller and a computer-readable storage medium are provided. The air conditioner includes a compressor, an outdoor heat exchanger, an indoor heat exchanger, an enthalpy-increasing system and a gas bypass. The enthalpy-increasing system is provided with a one-way electromagnetic valve. The one-way electromagnetic valve is arranged on the second refrigerant flow path; and the gas bypass is arranged on the first refrigerant flow path and is positioned between the enthalpy-increasing system and the indoor heat exchanger. The air supplement control method includes acquiring an outdoor ambient temperature and an operating state of the compressor, and controlling the on-off state of the one-way electromagnetic valve according to the outdoor ambient temperature and the operating state.



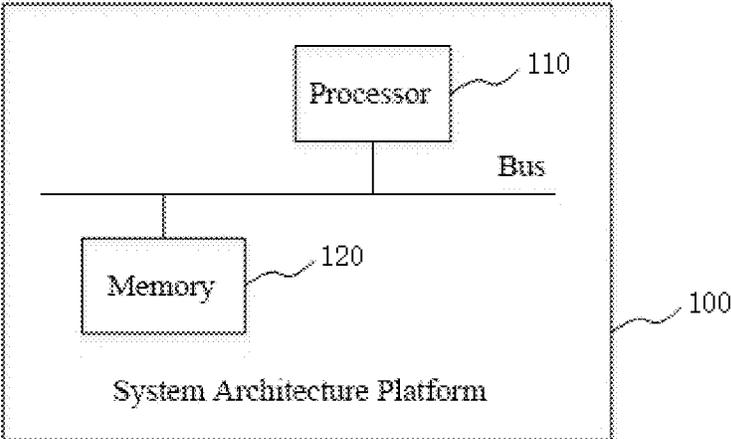


FIG. 1

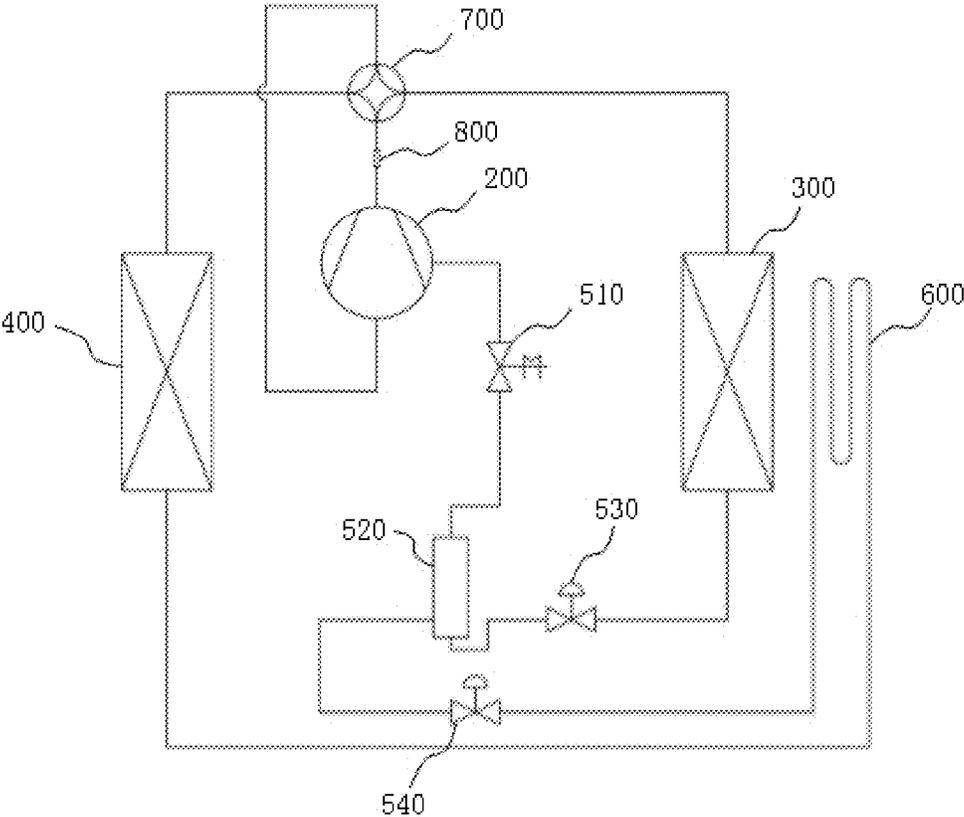


FIG. 2

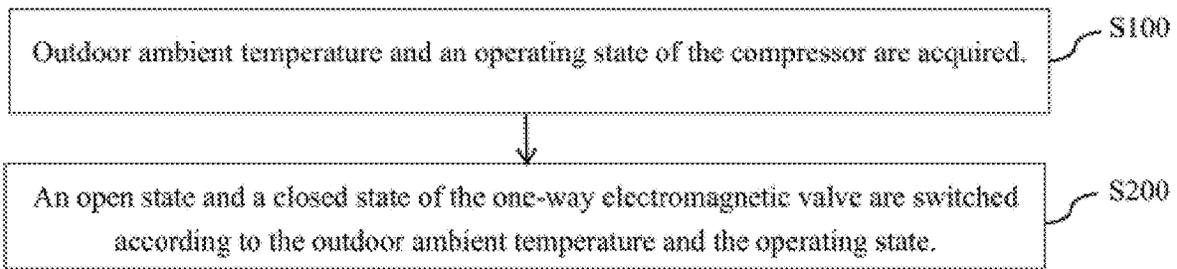


FIG. 3

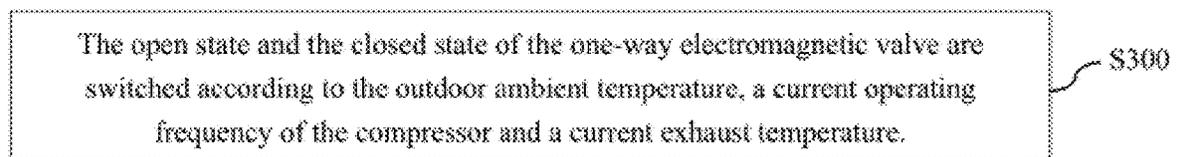


FIG. 4

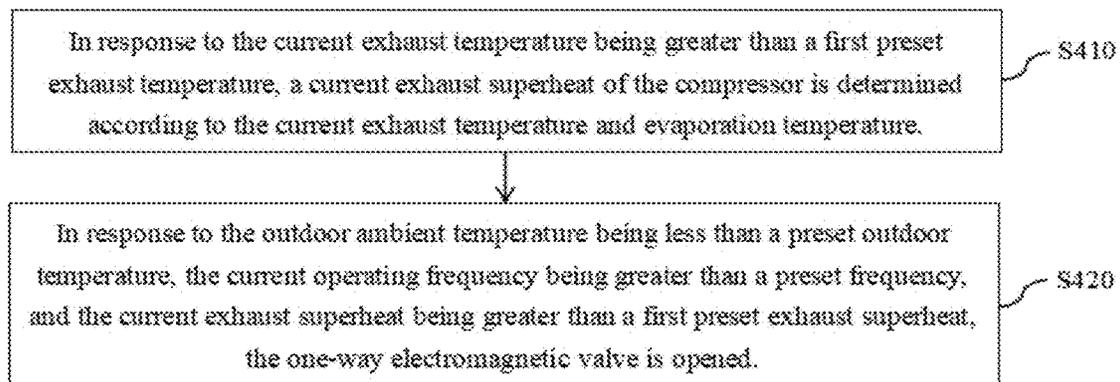


FIG. 5

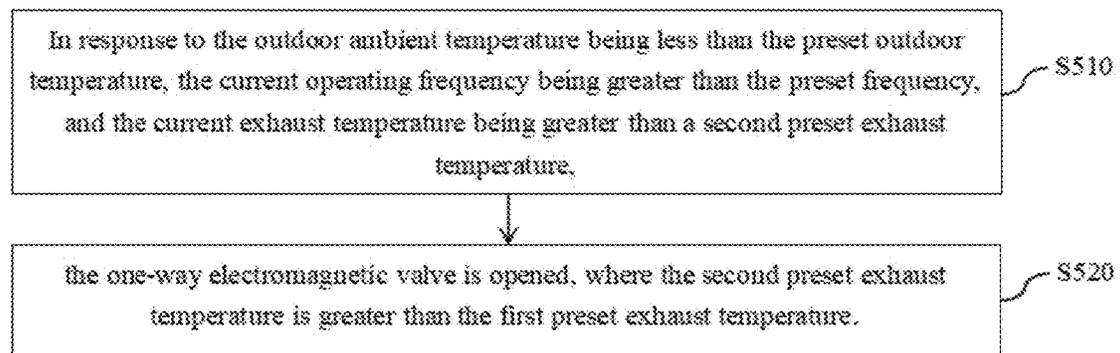


FIG. 6

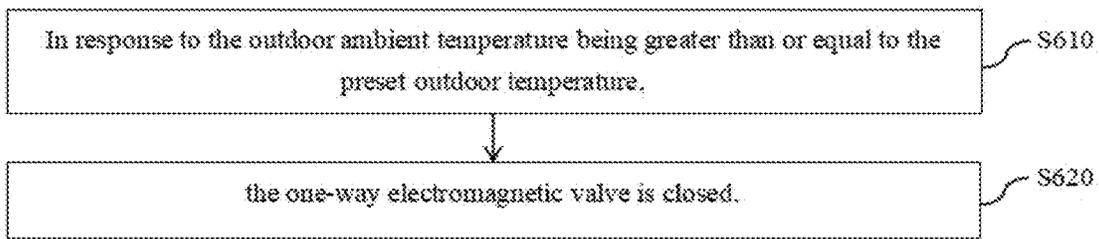


FIG. 7

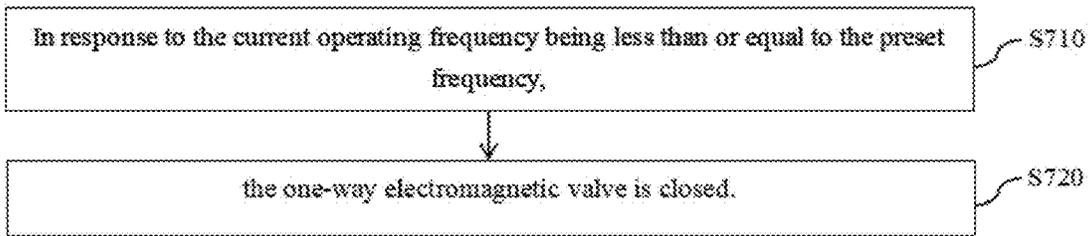


FIG. 8

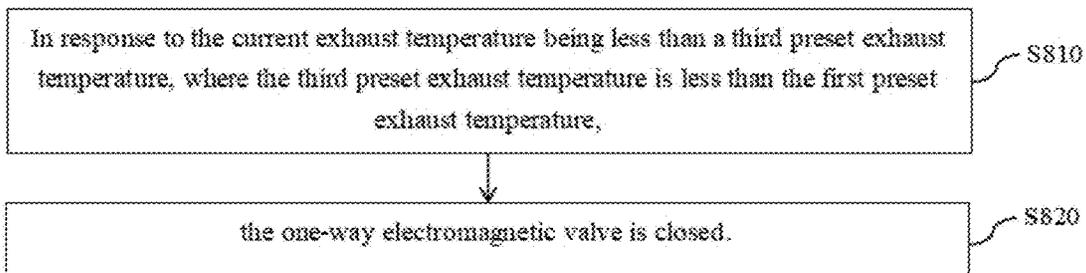


FIG. 9

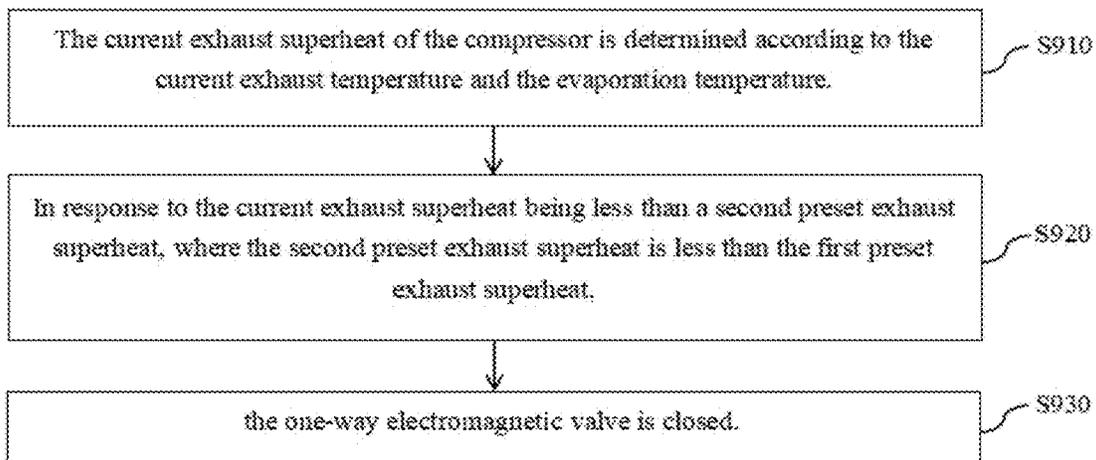


FIG. 10

**AIR SUPPLEMENT CONTROL METHOD
FOR AIR CONDITIONER, AND AIR
CONDITIONER, CONTROLLER AND
COMPUTER-READABLE STORAGE
MEDIUM**

**CROSS-REFERENCE TO RELATED
APPLICATIONS**

[0001] This application is a continuation application of International Application No. PCT/CN2023/084466 filed on Mar. 28, 2023, which claims the priority to Chinese Patent Application No. 202310041940.4 filed on Jan. 12, 2023 and Chinese Patent Application No. 202320082210.4 filed on Jan. 12, 2023, the entire contents of each of which are incorporated herein by reference for all purposes. No new matter has been introduced.

FIELD

[0002] The present disclosure relates to the field of air conditioners, and in particular, to a gas supplement control method for an air conditioner, and an air conditioner, a controller and a computer-readable storage medium.

BACKGROUND

[0003] In existing technology, an enthalpy injection system is often required for an air conditioner that can achieve ultra-low temperature heating. At present, control logic of a one-way electromagnetic valve in the enthalpy injection system is mainly adjusted according to ambient temperature. The one-way electromagnetic valve opens when the ambient temperature is lower than a certain temperature, so that an enthalpy injection gas supplement branch of the enthalpy injection system breakovers, thereby achieving air supplement.

[0004] However, the existing control method has the following disadvantages: the refrigerant entering a gas supplement port of a compressor from the enthalpy injection gas supplement branch may have liquid entrainment problems, resulting in compressor damage and poor reliability.

SUMMARY

[0005] The present disclosure is intended to at least partially solve the technical problems in existing technology. Therefore, the present disclosure provides a gas supplement control method for an air conditioner, and an air conditioner, a controller and a computer-readable storage medium, which can reduce the liquid entrainment risk when the refrigerant enters the gas supplement port of the compressor from the enthalpy injection gas supplement branch, thus improving the operation reliability of the compressor.

[0006] In accordance with a first aspect of the present disclosure, an embodiment provides a gas supplement control method for an air conditioner. The air conditioner includes a compressor, an outdoor heat exchanger, an indoor heat exchanger, an enthalpy increasing system and a gas bypass. The enthalpy increasing system includes a one-way electromagnetic valve. A first refrigerant flow path is arranged between the outdoor heat exchanger and the indoor heat exchanger. A second refrigerant flow path is arranged between the first refrigerant flow path and an enthalpy increasing port of the compressor. The one-way electromagnetic valve is arranged in the second refrigerant flow path, and the gas bypass is arranged in the first refrigerant flow

path and located between the enthalpy increasing system and the indoor heat exchanger. The gas supplement control method includes: acquiring an outdoor ambient temperature and an operating state of the compressor; and switching between open and closed states of the one-way electromagnetic valve according to the outdoor ambient temperature and the operating state.

[0007] According to some embodiments of the present disclosure, switching between open and closed states of the one-way electromagnetic valve according to the outdoor ambient temperature and the operating state includes: switching between open and closed states of the one-way electromagnetic valve according to the outdoor ambient temperature, a current operating frequency of the compressor and a current exhaust temperature.

[0008] According to some embodiments of the present disclosure, switching between open and closed state of the one-way electromagnetic valve according to the outdoor ambient temperature, a current operating frequency of the compressor and a current exhaust temperature includes: determining a current exhaust superheat of the compressor according to the current exhaust temperature and an evaporation temperature when the current exhaust temperature is greater than a first preset exhaust temperature; and in response to the outdoor ambient temperature being less than a preset outdoor temperature, the current operating frequency being greater than a preset frequency, and the current exhaust superheat being greater than a first preset exhaust superheat, opening the one-way electromagnetic valve.

[0009] According to some embodiments of the present disclosure, switching between open and closed states of the one-way electromagnetic valve according to the outdoor ambient temperature, a current operating frequency of the compressor and a current exhaust temperature further includes: in response to the outdoor ambient temperature being less than a preset outdoor temperature, the current operating frequency being greater than a preset frequency, and the current exhaust temperature being greater than a second preset exhaust temperature, opening the one-way electromagnetic valve, where the second preset exhaust temperature is greater than the first preset exhaust temperature.

[0010] According to some embodiments of the present disclosure, the outdoor ambient temperature being less than a preset outdoor temperature refers to the outdoor ambient temperature being continuously less than the preset outdoor temperature for a preset period of time.

[0011] According to some embodiments of the present disclosure, switching between open and closed states of the one-way electromagnetic valve according to the outdoor ambient temperature, a current operating frequency of the compressor and a current exhaust temperature further includes at least one of:

[0012] in response to the outdoor ambient temperature being greater than or equal to a preset outdoor temperature, closing the one-way electromagnetic valve;

[0013] in response to the current operating frequency being less than or equal to a preset frequency, closing the one-way electromagnetic valve;

[0014] in response to the current exhaust temperature being less than a third preset exhaust temperature, closing the one-way electromagnetic valve, where the third preset exhaust temperature is less than the first preset exhaust temperature;

[0015] determining the current exhaust superheat of the compressor according to the current exhaust temperature and the evaporation temperature, and in response to the current exhaust superheat being less than a second preset exhaust superheat, closing the one-way electromagnetic valve, where the second preset exhaust superheat is less than the first preset exhaust superheat.

[0016] In accordance with a second aspect of the present disclosure, an embodiment provides an air conditioner, including:

[0017] a compressor, an outdoor heat exchanger, an indoor heat exchanger and a water tray, where a first refrigerant flow path is arranged between the outdoor heat exchanger and the indoor heat exchanger, and the water tray is located below the outdoor heat exchanger;

[0018] an enthalpy increasing system, including a one-way electromagnetic valve, where a second refrigerant flow path is arranged between the first refrigerant flow path and an enthalpy increasing port of the compressor, and the one-way electromagnetic valve is arranged in the second refrigerant flow path; and

[0019] a gas bypass, arranged in the first refrigerant flow path and located between the enthalpy increasing system and the indoor heat exchanger, where the gas bypass is also arranged at the water tray.

[0020] According to some embodiments of the present disclosure, the enthalpy increasing system further includes a flash evaporator, where the flash evaporator includes a first refrigerant flow hole, a second refrigerant flow hole and a third refrigerant flow hole. The flash evaporator is connected to the enthalpy increasing port of the compressor through the first refrigerant flow hole and the one-way electromagnetic valve sequentially, is connected to the outdoor heat exchanger through the second refrigerant flow hole, and is connected to the gas bypass through the third refrigerant flow hole.

[0021] According to some embodiments of the present disclosure, the enthalpy increasing system further includes a throttling device, and the throttling device is arranged in the first refrigerant flow path and located between the outdoor heat exchanger and the gas bypass.

[0022] According to some embodiments of the present disclosure, the throttling device includes at least one of: a first throttling device, arranged in the first refrigerant flow path and located between the outdoor heat exchanger and the second refrigerant flow hole; and a second throttling device, arranged in the first refrigerant flow path and located between the third refrigerant flow hole and the gas bypass.

[0023] According to some embodiments of the present disclosure, a respective one of first throttling device and the second throttling device is an electronic expansion valve or a capillary tube.

[0024] According to some embodiments of the present disclosure, the air conditioner further includes a four-way valve, which is respectively communicated with the outdoor heat exchanger, the indoor heat exchanger, and a gas return hole and a gas exhaust hole of the compressor.

[0025] In accordance with a third aspect of the present disclosure, an embodiment provides a controller, which includes a memory, a processor and a computer program stored in the memory and executable on the processor, where the processor implements the gas supplement control method for the air conditioner according to the first aspect of the present disclosure when running the computer program.

[0026] In accordance with a fourth aspect of the present disclosure, an embodiment provides a computer-readable storage medium, on which computer-executable instructions are stored, where the computer-executable instructions are configured to execute the gas supplement control method for the air conditioner according to the first aspect of the present disclosure.

[0027] According to the technical scheme of the embodiment of the present disclosure, at least the following beneficial effects are achieved. The air conditioner of the embodiment of the present disclosure includes the compressor, the outdoor heat exchanger, the indoor heat exchanger, the enthalpy increasing system and the gas bypass. The enthalpy increasing system includes the one-way electromagnetic valve. The first refrigerant flow path is arranged between the outdoor heat exchanger and the indoor heat exchanger. The second refrigerant flow path is arranged between the first refrigerant flow path and the enthalpy increasing port of the compressor. The one-way electromagnetic valve is arranged in the second refrigerant flow path. The gas bypass is arranged in the first refrigerant flow path and located between the enthalpy increasing system and the indoor heat exchanger. The control logic of the one-way electromagnetic valve are as follows. Firstly, the embodiment of the present disclosure obtains the outdoor ambient temperature and the operating state of the compressor. Next, the embodiment of the present disclosure switches between the open and closed states of the one-way electromagnetic valve according to the outdoor ambient temperature and the operating state. According to the technical scheme of the embodiment of the present disclosure, the opening and closing of the one-way electromagnetic valve may be switched according to the outdoor ambient temperature and the operating state of the compressor in combination, which is different from the existing technology which switches between the open state and closed state of the one-way electromagnetic valve only according to the outdoor ambient temperature in existing technology. Therefore, the embodiment of the present disclosure can optimize the gas supplement control in the enthalpy injection system, ensure the reliable operation of the compressor, and avoid the liquid entrainment risk. In addition, the scheme of the embodiment of the present disclosure is simple and has strong realizability.

[0028] Additional aspects and advantages of the present disclosure will be set forth in part in the description which follows, and in part will be obvious from the description which follows, or may be learned by practice of the present disclosure.

BRIEF DESCRIPTION OF DRAWINGS

[0029] The accompanying drawings are provided for a further understanding of the technical scheme of the present disclosure and constitute a part of the specification. Together with the embodiments of the present disclosure, the accompanying drawings are used to explain the technical scheme of the present disclosure and do not constitute a limitation on the technical scheme of the present disclosure.

[0030] FIG. 1 is a schematic diagram of a system architecture platform for implementing a gas supplement control method for an air conditioner provided by an embodiment of the present disclosure;

[0031] FIG. 2 is a schematic structural diagram of an air conditioner provided by an embodiment of the present disclosure;

[0032] FIG. 3 is a flowchart of the gas supplement control method for the air conditioner provided by an embodiment of the present disclosure;

[0033] FIG. 4 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure;

[0034] FIG. 5 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure;

[0035] FIG. 6 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure;

[0036] FIG. 7 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure;

[0037] FIG. 8 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure;

[0038] FIG. 9 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure; and

[0039] FIG. 10 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure.

DETAILED DESCRIPTION

[0040] Embodiments of the present disclosure will be described in detail hereinafter, examples of which are illustrated in the accompanying drawings, where the same or similar reference numerals indicate the same or similar elements or elements having the same or similar functions throughout. The embodiments described below by referring to the drawings are exemplary and are only used to explain the present disclosure, and cannot be understood as limitations of the present disclosure.

[0041] In the description of the present disclosure, it should be understood that, the orientation or positional relationship related to orientation description, such as “up”, “down”, “front”, “back”, “left”, “right”, etc., is based on the orientation or positional relationship shown in the accompanying drawings, only for the convenience of describing the present disclosure and simplifying the description, and does not indicate or imply that the referred device or element must have a specific orientation, be constructed and operated in a specific orientation, so it cannot be understood as a limitation of the present disclosure.

[0042] In the description of the present disclosure, the term “several” means one or more, and the term “a plurality of” means more than two. The terms “greater than”, “less than”, “exceeding” are understood as excluding this number, and the terms “above”, “below” and “within” are understood as including this number. A description of “first” or “second” referring to a technical feature is only for the purpose of distinguishing the technical feature, and it is not to be understood as indicating or implying a relative importance or implicitly indicating the number or the precedence of the technical feature.

[0043] In the description of the present disclosure, unless otherwise specified, terms such as arrange, install, connect and the like should be understood broadly, and those skilled in the art can reasonably determine the specific meanings of

the above terms in the present disclosure in combination with the details of the technical schemes.

[0044] In some cases, an enthalpy injection system is often required for an air conditioner that can achieve ultra-low temperature heating. At present, control logic of a one-way electromagnetic valve in the enthalpy injection system is mainly adjusted according to ambient temperature. The one-way electromagnetic valve opens when the ambient temperature is lower than a certain temperature, so that an enthalpy injection gas supplement branch of the enthalpy injection system opens, thus achieving air supplement.

[0045] However, the existing control method has the following disadvantages: the refrigerant entering a gas supplement port of a compressor from the enthalpy injection gas supplement branch may have liquid entrainment problems, resulting in compressor damage and poor reliability.

[0046] Based on the above situation, embodiments of the present disclosure provide a gas supplement control method for an air conditioner, and an air conditioner, a controller and a computer-readable storage medium, which can reduce the liquid entrainment risk when the refrigerant enters the gas supplement port of the compressor from the enthalpy injection gas supplement branch, thereby improving the operation reliability of the compressor.

[0047] The embodiments of the present disclosure are further described with reference to the accompany drawings.

[0048] As shown in FIG. 1, FIG. 1 is a schematic diagram of a system architecture platform for implementing the gas supplement control method for the air conditioner provided by an embodiment of the present disclosure.

[0049] A system architecture platform 100 of the embodiment of the present disclosure includes one or more processors 110 and one or more memories 120. In an example shown in FIG. 1, the system architecture platform 100 has one processor 110 and one memory 120.

[0050] The processor 110 and the memory 120 may be connected by a bus or other means. The connection by the bus is taken as an example in FIG. 1.

[0051] As non-transitory computer-readable storage media, the memories 120 may be configured to store non-transitory software programs and non-transitory computer executable programs. In addition, the memories 120 may include high-speed random access memory, and may also include non-volatile memory, such as at least one disk memory device, flash memory device, or other non-transitory solid-state memory devices. In some embodiments, the memories 120 may include a memory 120 remotely arranged relative to the processor 110, and this remote memory may be connected to the system architecture platform 100 through a network. Examples of the above networks include, but are not limited to, Internet, Intranet, Local Area Network, Mobile Communication Network, and combinations thereof.

[0052] It can be understood by those skilled in the art that, the device structure shown in FIG. 1 does not constitute a limitation to the system architecture platform 100, and may include more or less components than shown, or combine some components, or have different component arrangements.

[0053] In the system architecture platform 100 shown in FIG. 1, the processor 110 may be configured to invoke a gas supplement control program for an air conditioner stored in the memory 120, thus realizing the gas supplement control method for the air conditioner.

[0054] Based on the hardware structure of the system architecture platform 100, various embodiments of the air conditioner of the present disclosure are provided.

[0055] As shown in FIG. 2, FIG. 2 is a schematic structural diagram of an air conditioner provided by an embodiment of the present disclosure.

[0056] In an embodiment, the air conditioner of the embodiment of the present disclosure includes, but is not limited to, a compressor 200, an outdoor heat exchanger 300, an indoor heat exchanger 400, a water tray, an enthalpy increasing system and a gas bypass 600. The outdoor heat exchanger 300 is connected to the indoor heat exchanger 400 through a first refrigerant flow path. The first refrigerant flow path includes a flow path branch, that is, a second refrigerant flow path. The first refrigerant flow path is capable of being connected to an enthalpy increasing port of the compressor 200 through the second refrigerant flow path. In addition, the enthalpy increasing system includes a one-way electromagnetic valve 510 in the second refrigerant flow path. The water tray is located below the outdoor heat exchanger 300. The gas bypass 600 is arranged in the first refrigerant flow path and located between the enthalpy increasing system and the indoor heat exchanger 400, and is also arranged at the water tray.

[0057] It should be noted that, the compressor 200 mentioned above is an enhanced vapor injection compressor 200, which adopts two-stage throttling intermediate gas injection technology, and uses a flash evaporator 520 for gas-liquid separation to achieve enthalpy increasing effect. By compressing and injecting gas at medium and low pressure to mix and cool the gas, and then compressing the gas normally at high pressure, an exhaust capacity of the compressor 200 is improved, and a purpose of improving heating capacity in low temperature environment is achieved.

[0058] In addition, it should be noted that, the enthalpy increasing system mentioned above can improve a heat extraction process in a heating mode, so that more outdoor heat can be sent indoors. Based on the enhanced vapor injection compressor 200, the enthalpy increasing system optimizes the medium-pressure refrigerant injection technology, inhales a part of the gas with intermediate pressure through the intermediate-pressure suction hole, and then mixes the part of the gas with the partially compressed refrigerant for recompression, thus realizing two-stage compression within a single compressor 200, increasing the refrigerant flow in the condenser and increasing the enthalpy difference of the main circulation loop, and improving the efficiency of the compressor 200. In an embodiment, the compressor 200 of enhanced vapor injection technology has an additional second suction port to cool the refrigerant in the main cycle by generating vapor. The vapor enters the compressor 200 from the second suction port, and the vapor compression process is divided into two stages by the gas supplement process, and the vapor compression process becomes a quasi-two-stage compression process. Gas injection reduces the exhaust temperature, the exhaust superheat, and a length of the gas-phase heat exchange area of the condenser, and increases the two-phase heat exchange area, thus improving the heat exchange efficiency of the condenser. The greater the difference between an evaporation temperature and a condensation temperature, the better the effect is, so the effect will be more obvious in the low temperature environment.

[0059] In addition, it should be noted that the embodiment of the present disclosure includes the gas bypass 600 located at the water tray. In an embodiment, during the heating period, the outdoor heat exchanger 300 generates condensed water and drip the water into the water tray. If the outdoor ambient temperature is relatively low, the condensed water in the water tray may be frosted or frozen, thus blocking the water tray. Therefore, the embodiment of the present disclosure adopts the gas bypass 600 to perform defrosting or deicing treatment. In an embodiment, in the heating mode, the refrigerant enters the indoor heat exchanger 400 from a gas exhaust hole of the compressor 200 and releases heat to the indoor environment, and then exits the indoor heat exchanger 400 and enters the gas bypass 600. Although the gas exiting the indoor heat exchanger 400 has released heat at this time, its temperature is still in a high heat state, so the gas bypass 600 is also in a high heat state at this time, and capable of defrosting or deicing.

[0060] It should be noted that, the gas bypass 600 of the embodiment of the present disclosure includes, but is not limited to, a plurality of U-shaped pipes spliced in sequence, so that the gas bypass 600 has large area and better defrosting effect.

[0061] In addition, it should be noted that, the air conditioner of the embodiment of the present disclosure further includes a drainage device, where one end of the drainage device is located at the water tray and configured to extract the condensed water in the water tray, and another end of the drainage device is configured to spray the condensed water to the indoor heat exchanger 400.

[0062] The embodiment of the present disclosure is capable of using the hot gas bypass, namely the gas bypass 600, to heat the water tray of the outdoor unit to ensure that the water temperature is higher than the freezing or frosting temperature, and then spray the water of the outdoor unit to the indoor unit through the drainage device, thus achieving the humidification effect.

[0063] It can be understood that, the one-way electromagnetic valve 510 may be a split combination structure of a one-way valve and an electromagnetic valve, or an integrated combination structure of the one-way valve and the electromagnetic valve.

[0064] It should be noted that, the air conditioner in the embodiment of the present disclosure may be a window-mounted air conditioner or a split air conditioner, and the structural form of the air conditioner is not specifically limited in the embodiment of the present disclosure.

[0065] In an embodiment, the enthalpy increasing system in the air conditioner of the embodiment of the present disclosure further includes a flash evaporator 520, which includes a first refrigerant flow hole, a second refrigerant flow hole and a third refrigerant flow hole. The flash evaporator 520 is connected to the enthalpy increasing port of the compressor 200 through the first refrigerant flow hole and the one-way electromagnetic valve 510 sequentially. The flash evaporator 520 is connected to the outdoor heat exchanger 300 through the second refrigerant flow hole. The flash evaporator 520 is connected to the gas bypass 600 through the third refrigerant flow hole.

[0066] It can be understood that, the flash evaporator 520 mentioned above can realize flash evaporation. The flash evaporation refers to a phenomenon that after saturated liquid with high pressure enters a relatively low pressure container, the saturated liquid become saturated vapor and

saturated liquid in combination under the pressure of a part of the container due to the sudden drop of pressure.

[0067] In an embodiment, the enthalpy increasing system in the air conditioner of the embodiment of the present disclosure further includes a throttling device, which is arranged in the first refrigerant flow path and located between the outdoor heat exchanger 300 and the gas bypass 600.

[0068] In an embodiment, the throttling device mentioned above may include a first throttling device 530 and/or a second throttling device 540. The first throttling device 530 is arranged in the first refrigerant flow path and located between the outdoor heat exchanger 300 and the second refrigerant flow hole. The second throttling device 540 is arranged in the first refrigerant flow path and located between the third refrigerant flow hole and the gas bypass 600.

[0069] In an embodiment, a respective one of the first throttling device 530 and the second throttling device 540 mentioned above may be an electronic expansion valve or a capillary tube.

[0070] It can be understood that, the capillary tube mentioned above is the simplest throttling device of the air conditioner. Generally, the capillary tube is a copper tube which has a specified length and an inner diameter of 0.5 mm to 2 mm. Advantages of such an arrangement are convenient manufacture and low price, and the disadvantage is that there is no function to adjust the flow.

[0071] In addition, it can be understood that, the structure of the electronic expansion valve mentioned above may be composed of three parts: detection, control and execution. Advantages of such an arrangement are wide flow adjustment range and high control precision, and it is suitable for intelligent control and can adapt to the rapid change of refrigerant flow with high efficiency. In other words, the electronic expansion valve can be regarded as an intelligent capillary tube with variable inner diameter.

[0072] In an embodiment, the throttling device is capable of throttling liquid refrigerant with medium-temperature and high-pressure into wet vapor with low-temperature and low-pressure, and then the refrigerant absorbs heat in the evaporator to achieve the refrigeration effect. The expansion valve controls valve flow through change of superheat at an end of the evaporator to prevent the underutilization of evaporator area and cylinder knocking.

[0073] In an embodiment, the air conditioner of the embodiment of the present disclosure further includes a four-way valve 700 respectively communicated with the outdoor heat exchanger 300, the indoor heat exchanger 400, and a gas return hole and the gas exhaust hole of the compressor 200.

[0074] In an embodiment, the air conditioner of the embodiment of the present disclosure further includes a muffler 800 between the four-way valve 700 and the gas exhaust hole of the compressor 200.

[0075] The refrigeration operation flow of the embodiment of the present disclosure is as follows: the refrigerant comes out of the gas exhaust hole of the compressor 200, enters the outdoor heat exchanger 300 through the four-way valve 700, comes out of the outdoor heat exchanger 300, passes through the first throttling device 530 and enters the flash evaporator 520 which is in a full-operation state. In this case, the one-way electromagnetic valve 510 is in a closed state, so that gas cannot enter the enthalpy increasing port of

the compressor 200, that is, the gas supplement port. The refrigerant coming out of the flash evaporator 520 is throttled by the second throttling device 540, and then enters the indoor heat exchanger 400 through the gas bypass 600. The refrigerant evaporates in the indoor heat exchanger 400 and becomes gas, and then returns to the gas return port of the compressor 200 through the four-way valve 700.

[0076] The heating operation flow of the embodiment of the present disclosure is as follows: the refrigerant comes out of the gas exhaust hole of the compressor 200, enters the indoor heat exchanger 400 through the four-way valve 700, comes out of the indoor heat exchanger 400 into the gas bypass 600, comes out of the gas bypass 600 and enters the flash evaporator 520 through the second throttling device 540. Then the gas enters the enthalpy increasing port of the compressor 200, that is, the gas supplement port, through the one-way electromagnetic valve 510, and at the same time, the liquid enters the outdoor heat exchanger 300 after being throttled through the first throttling device 530, and then comes out of the outdoor heat exchanger 300 and returns to the gas return port of the compressor 200 through the four-way valve 700.

[0077] It can be understood that, the structure of the controller mentioned above may include a processor 110 and a memory 120 as shown in FIG. 1. The controller may be connected to the compressor 200, the one-way electromagnetic valve 510, the first throttling device 530 and the second throttling device 540, so that the controller can adjust an operating frequency of the compressor 200, and control an open state and a closed state of the one-way electromagnetic valve 510 and opening degrees of the first throttling device 530 and the second throttling device 540.

[0078] It can be understood by those having ordinary skills in the art that, the structure described above is not limited to the air conditioner, and may include more or less components than shown, or combine some components, or have different component arrangements.

[0079] Based on the above system architecture platform 100 and the hardware structure of the air conditioner, various embodiments of the gas supplement control method for the air conditioner of the present disclosure are provided.

[0080] As shown in FIG. 3, FIG. 3 is a flowchart of a gas supplement control method for an air conditioner provided by an embodiment of the present disclosure. The gas supplement control method, which can be applied to the air conditioner mentioned above, includes but not limited to a step S100 and a step S200.

[0081] At the step S100, an outdoor ambient temperature and an operating state of the compressor are acquired.

[0082] At the step S200, an open state and a closed state of the one-way electromagnetic valve are switched according to the outdoor ambient temperature and the operating state.

[0083] In an embodiment, opening and closing of the one-way electromagnetic valve can be switched according to the outdoor ambient temperature and the operating state of the compressor in combination at the same time, which is different from the existing method that switches between the open state and the closed state of the one-way electromagnetic valve only according to the outdoor ambient temperature. Therefore, the embodiment of the present disclosure can optimize the gas supplement control in the enthalpy injection system, ensure the reliable operation of the compressor and avoid the liquid entrainment risk. In addition,

the scheme of the embodiment of the present disclosure is simple and has strong realizability.

[0084] It should be noted that, the operating state of the compressor mentioned above may be the operating frequency of the compressor, the exhaust temperature of the compressor, or other parameters. The operating state of the compressor is not specifically limited in the embodiment of the present disclosure.

[0085] In addition, it should be noted that, the open state and the closed state of the one-way electromagnetic valve mentioned above may be an open state or a closed state.

[0086] In addition, as shown in FIG. 4, FIG. 4 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure. The above step S200 may include, but is not limited to, a step S300.

[0087] At the step S300, the open state and the closed state of the one-way electromagnetic valve are switched according to the outdoor ambient temperature, a current operating frequency of the compressor and a current exhaust temperature.

[0088] In an embodiment, the opening and closing of the one-way electromagnetic valve can be switched according to the outdoor ambient temperature, the current operating frequency of the compressor and the current exhaust temperature of the compressor in combination at the same time, which is different from the existing method that switches between the open state and the closed state of traditional one-way electromagnetic valve only according to the outdoor ambient temperature. Therefore, the embodiment of the present disclosure can optimize the gas supplement control in the enthalpy injection system, ensure the reliable operation of the compressor, and avoid the liquid entrainment risk. In addition, the scheme of the embodiment of the present disclosure is simple and has strong realizability.

[0089] It should be noted that, regarding a trigger flow of controlling the opening of the one-way electromagnetic valve in the above step S300, two implementations in FIG. 5 and FIG. 6 are illustrated below.

[0090] As shown in FIG. 5, FIG. 5 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure. The above step S300 may include, but is not limited to, a step S410 and a step S420.

[0091] At the step S410, in response to the current exhaust temperature being greater than a first preset exhaust temperature, a current exhaust superheat of the compressor is determined according to the current exhaust temperature and an evaporation temperature.

[0092] At the step S420, in response to the outdoor ambient temperature being less than a preset outdoor temperature, the current operating frequency being greater than a preset frequency, and the current exhaust superheat being greater than a first preset exhaust superheat, the one-way electromagnetic valve is opened.

[0093] In an embodiment, if the current exhaust temperature is greater than a certain degree, the embodiment of the present disclosure can calculate the current exhaust superheat of the compressor according to the current exhaust temperature and the evaporation temperature. In addition, if the outdoor ambient temperature is less than the preset outdoor temperature, it indicates that the compressor is in a low-temperature heating condition. If the current operating frequency of the compressor is greater than the preset

frequency, it indicates that the compressor is in a high-power state. If the current exhaust superheat is greater than the first preset exhaust superheat, it indicates that the refrigerant without liquid enters the compressor. In this case, the embodiment of the present disclosure may open the one-way electromagnetic valve to perform an enhanced vapor injection operation.

[0094] It should be noted that, the first preset exhaust temperature, the preset outdoor temperature, the preset frequency and the first preset exhaust superheat may be obtained by preset.

[0095] As shown in FIG. 6, FIG. 6 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure. The above step S300 may include, but is not limited to, a step S510 and a step S520.

[0096] At the step S510, in response to the outdoor ambient temperature being less than the preset outdoor temperature, the current operating frequency being greater than the preset frequency, and the current exhaust temperature being greater than a second preset exhaust temperature.

[0097] At the step S520, the one-way electromagnetic valve is opened, where the second preset exhaust temperature is greater than the first preset exhaust temperature.

[0098] In an embodiment, if the outdoor ambient temperature is less than the preset outdoor temperature, it indicates that the compressor is in the low-temperature heating condition. In addition, if the current operating frequency of the compressor is greater than the preset frequency, it indicates that the compressor is in a high-power state. If the current exhaust temperature is greater than the second preset exhaust temperature, it indicates that the current exhaust temperature is high enough. In this case, the embodiment of the present disclosure may open the one-way electromagnetic valve to perform the enhanced vapor injection operation.

[0099] It should be noted that, the second preset exhaust temperature mentioned above is greater than the first preset exhaust temperature, and is obtained by preset.

[0100] It should be noted that, a determination condition that the outdoor ambient temperature is less than the preset outdoor temperature may be that the outdoor ambient temperature is less than the preset outdoor temperature for a preset period of time.

[0101] In addition, it should be noted that, regarding the trigger flow of controlling the close of the one-way electromagnetic valve in the above step S300, four implementations in FIGS. 7 to 10 are illustrated below.

[0102] As shown in FIG. 7, FIG. 7 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure. The above step S300 may include, but is not limited to, a step S610 and a step S620.

[0103] At the step S610, in response to the outdoor ambient temperature being greater than or equal to the preset outdoor temperature.

[0104] At the step S620, the one-way electromagnetic valve is closed.

[0105] As shown in FIG. 8, FIG. 8 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure. The above step S300 may include, but is not limited to, a step S710 and a step S720.

[0106] At the step S710, in response to the current operating frequency being less than or equal to the preset frequency.

[0107] At the step S720, the one-way electromagnetic valve is closed.

[0108] As shown in FIG. 9, FIG. 9 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure. The above step S300 may include, but is not limited to, a step S810 and a step S820.

[0109] At the step S810, in response to the current exhaust temperature being less than a third preset exhaust temperature which is less than the first preset exhaust temperature.

[0110] At the step S820, the one-way electromagnetic valve is closed.

[0111] As shown in FIG. 10, FIG. 10 is a flowchart of the gas supplement control method for the air conditioner provided by another embodiment of the present disclosure. The above step S300 may include, but is not limited to, a step S910, a step S920 and a step S930.

[0112] At the step S910, the current exhaust superheat of the compressor is determined according to the current exhaust temperature and the evaporation temperature.

[0113] At the step S920, in response to the current exhaust superheat being less than a second preset exhaust superheat which is less than the first preset exhaust superheat.

[0114] At the step S930, the one-way electromagnetic valve is closed.

[0115] In an embodiment, if the outdoor ambient temperature is greater than or equal to the preset outdoor temperature, it indicates that the compressor is not currently in a low-temperature heating condition. Alternatively, if the current operating frequency of the compressor is less than or equal to the preset frequency, it indicates that the compressor is in a low-power state. In this case, it may be tried to increase the operating frequency of the compressor and observe the working condition. Alternatively, if the current exhaust temperature is less than the third preset exhaust temperature, it indicates that the current exhaust temperature is low. Alternatively, if the current exhaust superheat is less than the second preset exhaust superheat, it indicates that the refrigerant with liquid may enter the compressor. In this case, the one-way electromagnetic valve is necessary to be closed in the embodiment of the present disclosure, and the enhanced vapor injection operation is not allowed.

[0116] Based on the gas supplement control method for the air conditioner in the above embodiments, detail description of the gas supplement control method for the air conditioner in the present disclosure is set forth below.

[0117] In an embodiment, in the heating mode, the control of the one-way electromagnetic valve is as follows. When the air conditioner unit is in a heating operation, conditions for opening of the one-way electromagnetic valve are as follows:

[0118] a, when the outdoor ambient temperature $<T_c$ for T_m minutes;

[0119] b, the operating frequency of the compressor $>Fr$;

[0120] c, the exhaust temperature $T_p > T_{p1}$, and the exhaust superheat $T_s = T_p - T_2$, and $T_s > T_a$;

[0121] d, the exhaust temperature $T_p > T_{p2}$, and $T_{p2} > T_{p1}$.

When one of the conditions “a” “b”, and “c” in combination and the conditions “a”, “b”, and “d” in combination is met, the one-way electromagnetic valve is closed.

[0122] In addition, conditions for closing of the one-way electromagnetic valve are as follows:

[0123] e, when the outdoor ambient temperature $>T_c$;

[0124] f, the operating frequency of the compressor $<Fr$;

[0125] g, the exhaust temperature $T_p < T_{p3}$ or the exhaust superheat $T_s = T_p - T_2$, $T_s < T_{a1}$, $T_{p2} > T_{p1} > T_{p3}$, and $T_a > T_{a1}$.

When any one of the conditions “e”, “f”, and “g” is met, the one-way electromagnetic valve is closed.

[0126] Based on the gas supplement control method for the air conditioner in the above embodiments, embodiments of the controller, the air conditioner and the computer-readable storage medium of the present disclosure are respectively provided in the following.

[0127] An embodiment of the present disclosure provides a controller, which includes a processor, a memory and a computer program stored in the memory and executable on the processor.

[0128] The processor and the memory may be connected by a bus or other means.

[0129] It should be noted that, the controller in this embodiment may include a processor and a memory in the embodiment shown in FIG. 1, both of which belong to the same inventive concept, so they have the same implementation principle and beneficial effects, and will not be described in detail here.

[0130] Non-transitory software programs and instructions required to realize the gas supplement control method for the air conditioner of the above embodiment are stored in the memory, and when the programs and instructions are executed by the processor, the gas supplement control method for the air conditioner of the above embodiment is executed.

[0131] According to the technical scheme of the controller in the embodiment of the present disclosure, the opening and closing of the one-way electromagnetic valve can be switched based on the outdoor ambient temperature and the operating state of the compressor, which is different from the existing method that switches between the open state and the closed state of the one-way electromagnetic valve only according to the outdoor ambient temperature. Therefore, the embodiment of the present disclosure can optimize the gas supplement control in the enthalpy injection system, ensure the reliable operation of the compressor, and avoid the liquid entrainment risk. In addition, the scheme of the embodiment of the present disclosure is simple and has strong realizability.

[0132] It should be noted that, since the controller of the embodiment of the present disclosure may execute the gas supplement control method for the air conditioner of any of the above embodiments, the implementations and technical effects of the controller of the embodiment of the present disclosure may refer to that of the gas supplement control method for the air conditioner of any of the above embodiments.

[0133] In addition, an embodiment of the present disclosure provides an air conditioner, which includes but is not limited to the above controller.

[0134] According to the technical scheme of the air conditioner in the embodiment of the present disclosure, the

opening and closing of the one-way electromagnetic valve can be switched based on the outdoor ambient temperature and the operating state of the compressor, which is different from the existing technology which switches between the open state and the closed state of the one-way electromagnetic valve only according to the outdoor ambient temperature. Therefore, the embodiment of the present disclosure can optimize the gas supplement control in the enthalpy injection system, ensure the reliable operation of the compressor, and avoid the liquid entrainment risk. In addition, the scheme of the embodiment of the present disclosure is simple and has strong realizability.

[0135] It should be noted that, since the air conditioner of the embodiment of the present disclosure includes the controller of any of the above embodiments, and the controller of any of the above embodiments may execute the gas supplement control method for the air conditioner of any of the above embodiments, the implementations and technical effects of the air conditioner of the embodiment of the present disclosure may refer to that of the gas supplement control method for the air conditioner of any of the above embodiments.

[0136] In addition, an embodiment of the present disclosure provides a computer-readable storage medium storing computer-executable instructions, and the computer-executable instructions are configured to execute the gas supplement control method for the air conditioner. Illustratively, the method in FIGS. 3 to 10 described above are performed.

[0137] According to the technical scheme of the computer-readable storage medium of the embodiment of the present disclosure, the opening and closing of the one-way electromagnetic valve can be switched based on the outdoor ambient temperature and the operating state of the compressor, which is different from the existing technology which switches between the open state and the closed state of the one-way electromagnetic valve only according to the outdoor ambient temperature. Therefore, the embodiment of the present disclosure can optimize the gas supplement control in the enthalpy injection system, ensure the reliable operation of the compressor, and avoid the liquid entrainment risk. In addition, the scheme of the embodiment of the present disclosure is simple and has strong realizability.

[0138] It should be noted that, since the computer-readable storage medium of the embodiment of the present disclosure may execute the gas supplement control method for the air conditioner of any of the above embodiments, the implementations and technical effects of the computer-readable storage medium of the embodiment of the present disclosure may refer to that of the gas supplement control method for the air conditioner of any of the above embodiments.

[0139] Those having ordinary skills in the art may understand that, all or some steps in the methods and systems disclosed above can be implemented as software, firmware, hardware and appropriate combinations thereof. Some or all of the physical components may be implemented as software executed by a processor, such as a central processing unit, a digital signal processor or a microprocessor, or as hardware, or as an integrated circuit, such as a specific integrated circuit. Such software may be distributed on computer-readable media, which may include computer storage media (or non-transitory media) and communication media (or transitory media). As well known to those having ordinary skills in the art, the term "computer storage media" includes

volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storing information, such as computer-readable instructions, data structures, program modules or other data. Computer storage media include, but are not limited to, RAM, ROM, EEPROM, flash memory or other memory technologies, CD-ROM, digital versatile disk (DVD) or other optical disk storage, magnetic boxes, magnetic tapes, magnetic disk storage or other magnetic storage devices, or any other media that may be used to store desired information and may be accessed by a computing device. Furthermore, it is well known to those having ordinary skills in the art that communication media usually include computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transmission mechanism, and may include any information delivery media.

[0140] The above is a detailed description of the embodiments of the present disclosure, but the present disclosure is not limited to the embodiments mentioned above, and those having ordinary skills in the art may make various equivalent variations or substitutions without violating the sharing conditions of the essential of the present disclosure, which are included in the scope defined by the claims of the present disclosure.

What is claimed is:

1. A gas supplement control method for an air conditioner, wherein: the air conditioner comprises a compressor, an outdoor heat exchanger, an indoor heat exchanger, an enthalpy increasing system and a gas bypass; the enthalpy increasing system comprises a one-way electromagnetic valve; a first refrigerant flow path is arranged between the outdoor heat exchanger and the indoor heat exchanger; a second refrigerant flow path is arranged between the first refrigerant flow path and an enthalpy increasing port of the compressor; the one-way electromagnetic valve is arranged in the second refrigerant flow path; and the gas bypass is arranged in the first refrigerant flow path and located between the enthalpy increasing system and the indoor heat exchanger;
wherein the gas supplement control method comprises:
acquiring an outdoor ambient temperature and an operating state of the compressor; and
switching between an open state and a closed state of the one-way electromagnetic valve according to the outdoor ambient temperature and the operating state.
2. The gas supplement control method of claim 1, wherein the switching between the open state and the closed state of the one-way electromagnetic valve according to the outdoor ambient temperature and the operating state comprises:
switching between the open state and the closed state of the one-way electromagnetic valve according to the outdoor ambient temperature, a current operating frequency of the compressor and a current exhaust temperature.
3. The gas supplement control method of claim 2, wherein the switching between the open state and the closed state of the one-way electromagnetic valve according to the outdoor ambient temperature, the current operating frequency of the compressor and the current exhaust temperature comprises:
in response to the current exhaust temperature being greater than a first preset exhaust temperature, determining a current exhaust superheat of the compressor

according to the current exhaust temperature and an evaporation temperature; and

in response to the outdoor ambient temperature being less than a preset outdoor temperature, the current operating frequency being greater than a preset frequency, and the current exhaust superheat being greater than a first preset exhaust superheat, opening the one-way electromagnetic valve.

4. The gas supplement control method of claim 3, wherein the switching between the open state and the closed state of the one-way electromagnetic valve according to the outdoor ambient temperature, the current operating frequency of the compressor and the current exhaust temperature further comprises:

in response to the outdoor ambient temperature being less than a preset outdoor temperature, the current operating frequency being greater than a preset frequency, and the current exhaust temperature being greater than a second preset exhaust temperature, opening the one-way electromagnetic valve,

wherein the second preset exhaust temperature is greater than the first preset exhaust temperature.

5. The gas supplement control method of claim 3, wherein the outdoor ambient temperature being less than a preset outdoor temperature comprises the outdoor ambient temperature being continuously less than the preset outdoor temperature for a preset period of time.

6. The gas supplement control method of claim 4, wherein the switching between the open state and the closed state of the one-way electromagnetic valve according to the outdoor ambient temperature, the current operating frequency of the compressor and the current exhaust temperature further comprises:

in response to the outdoor ambient temperature being greater than or equal to a preset outdoor temperature, closing the one-way electromagnetic valve.

7. The gas supplement control method of claim 4, wherein the switching between the open state and the closed state of the one-way electromagnetic valve according to the outdoor ambient temperature, the current operating frequency of the compressor and the current exhaust temperature further comprises:

in response to the current operating frequency being less than or equal to a preset frequency, closing the one-way electromagnetic valve.

8. The gas supplement control method of claim 4, wherein the switching between the open state and the closed state of the one-way electromagnetic valve according to the outdoor ambient temperature, the current operating frequency of the compressor and the current exhaust temperature further comprises:

in response to the current exhaust temperature being less than a third preset exhaust temperature, closing the one-way electromagnetic valve, wherein the third preset exhaust temperature is less than the first preset exhaust temperature.

9. The gas supplement control method of claim 4, wherein the switching between the open state and the closed state of the one-way electromagnetic valve according to the outdoor ambient temperature, the current operating frequency of the compressor and the current exhaust temperature further comprises:

determining the current exhaust superheat of the compressor according to the current exhaust temperature

and the evaporation temperature, and in response to the current exhaust superheat being less than a second preset exhaust superheat, closing the one-way electromagnetic valve, wherein the second preset exhaust superheat is less than the first preset exhaust superheat.

10. An air conditioner comprising:

a compressor, an outdoor heat exchanger, an indoor heat exchanger and a water tray, wherein a first refrigerant flow path is arranged between the outdoor heat exchanger and the indoor heat exchanger, and the water tray is located below the outdoor heat exchanger;

an enthalpy increasing system, comprising a one-way electromagnetic valve, wherein a second refrigerant flow path is arranged between the first refrigerant flow path and an enthalpy increasing port of the compressor, and the one-way electromagnetic valve is arranged in the second refrigerant flow path; and

a gas bypass, arranged in the first refrigerant flow path and located between the enthalpy increasing system and the indoor heat exchanger, wherein the gas bypass is arranged at the water tray.

11. The air conditioner of claim 10, wherein:

the enthalpy increasing system further comprises a flash evaporator;

the flash evaporator comprises a first refrigerant flow hole, a second refrigerant flow hole and a third refrigerant flow hole;

the flash evaporator is connected to the enthalpy increasing port of the compressor through the first refrigerant flow hole and the one-way electromagnetic valve sequentially;

the flash evaporator is connected to the outdoor heat exchanger through the second refrigerant flow hole; and

the flash evaporator is connected to the gas bypass through the third refrigerant flow hole.

12. The air conditioner of claim 11, wherein:

the enthalpy increasing system further comprises a throttling device; and

the throttling device is arranged in the first refrigerant flow path and located between the outdoor heat exchanger and the gas bypass.

13. The air conditioner of claim 12, wherein the throttling device comprises a first throttling device, arranged in the first refrigerant flow path and located between the outdoor heat exchanger and the second refrigerant flow hole.

14. The air conditioner of claim 12, wherein the throttling device comprises a second throttling device, arranged in the first refrigerant flow path and located between the third refrigerant flow hole and the gas bypass.

15. The air conditioner of claim 13, wherein a respective one of first throttling device and the second throttling device is an electronic expansion valve or a capillary tube.

16. The air conditioner of claim 14, wherein a respective one of first throttling device and the second throttling device is an electronic expansion valve or a capillary tube.

17. The air conditioner of claim 10, further comprising a four-way valve, which is respectively communicated with the outdoor heat exchanger, the indoor heat exchanger, and a gas return hole and a gas exhaust hole of the compressor.

18. A controller comprising:

a memory; and

at least one processor,

wherein a computer program is stored in the memory and executable by the at least one processor, and

wherein when executing the computer program, the at least one processor performs the gas supplement control method for an air conditioner according to claim 1.

19. A non-transitory computer-readable storage medium, on which computer-executable instructions are stored, wherein the computer-executable instructions are configured to execute the gas supplement control method for an air conditioner according to claim 1.

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