(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 741 735 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
13.05.2026 Bulletin 2026/20

(21) Application number: **24847896.8**

(22) Date of filing: **27.06.2024**

(51) International Patent Classification (IPC):
F25B 13/00 *(2006.01)* ***F25B 41/24*** *(2021.01)*
F25B 41/42 *(2021.01)* ***F25B 49/02*** *(2006.01)*
F24F 5/00 *(2006.01)* ***F24F 11/64*** *(2018.01)*

(52) Cooperative Patent Classification (CPC):
F24F 5/00; F25B 13/00; F25B 41/24; F25B 41/42; F25B 49/02; F24F 2110/64

(86) International application number:
PCT/CN2024/102076

(87) International publication number:
WO 2025/025935 (06.02.2025 Gazette 2025/06)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **31.07.2023 CN 202310954065**

(71) Applicants:
- **Midea Group Co., Ltd.**
  Foshan, Guangdong 528311 (CN)
- **GD Midea Air-Conditioning Equipment Co., Ltd.**
  Foshan, Guangdong 528311 (CN)

(72) Inventors:
- **WANG, Fang**
  Foshan, Guangdong 528311 (CN)
- **XU, Ke**
  Foshan, Guangdong 528311 (CN)
- **LIU, Qunbo**
  Foshan, Guangdong 528311 (CN)
- **LI, Bin**
  Foshan, Guangdong 528311 (CN)
- **YANG, Qingcheng**
  Foshan, Guangdong 528311 (CN)

(74) Representative: **RGTH**
Patentanwälte PartGmbB
Mönckebergstraße 11
20095 Hamburg (DE)

(54) CONTROL METHOD FOR HEAT PUMP SYSTEM, HEAT PUMP SYSTEM AND STORAGE MEDIUM

(57) The present application discloses a method for controlling a heat pump system, a heat pump system and a storage medium. The method includes: acquiring an energy storage temperature of an energy storage device; controlling the heat pump system to operate according to the energy storage temperature, so as to reach a corresponding target state; different target states correspond to different heat storage states of the energy storage device and/or different heating capacity of an indoor unit.

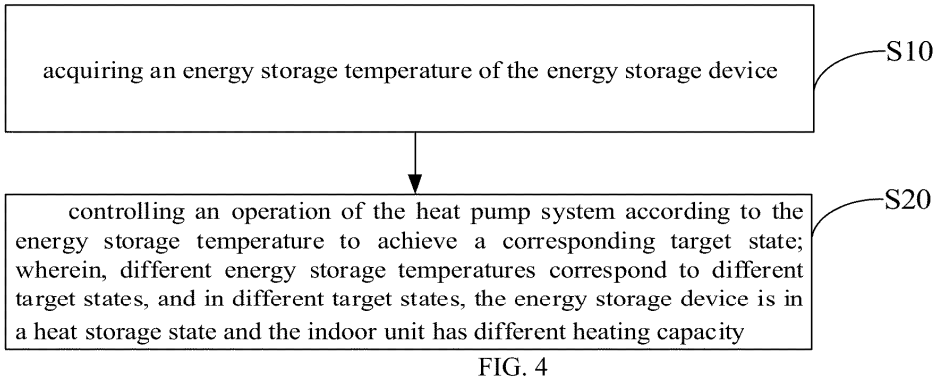

FIG. 4

EP 4 741 735 A1

Description

[0001] The present application claims priority to Chinese Patent Applications No. 202310954065.9, filed on July 31, 2023, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present application relates to the technical field of heat pumps, in particular to a method for controlling a heat pump system, a heat pump system, and a storage medium.

BACKGROUND

[0003] Many heat pump systems such as air conditioners are equipped with energy storage devices. In addition to being configured to regulate the indoor environment, the energy in the circulating refrigerant can also be stored in the energy storage device to meet other usage needs.

[0004] Among them, the heat pump system needs to use heat both for indoor heating and for storing heat in the energy storage device. When the user has both indoor heating and heat storage needs, the operation of the heat pump system will prioritize satisfying one need according to the parameters configured by the user and then switch the operation mode to satisfy the other need. However, this is easy to cause the poor actual operating conditions of the heat pump system, resulting in insufficient heat provided by the system and low energy efficiency, and resulting in poor indoor heating and heat storage effects.

SUMMARY

TECHNICAL PROBLEM

[0005] The main purpose of the present application is to provide a method for controlling a heat pump system, a heat pump system and a storage medium, aiming to improve the energy efficiency of the heat pump system and improve the balance between the indoor heating effect and the heat storage effect of the heat pump system.

TECHNICAL SOLUTION

[0006] To achieve the above purpose, the present application provides a method for controlling a heat pump system; the heat pump system comprises a refrigerant main circuit and a refrigerant branch circuit connected to the refrigerant main circuit; the refrigerant main circuit comprises an indoor unit, and the refrigerant branch circuit comprises an energy storage device; characterized in that the method for controlling the heat pump system comprises:

acquiring an energy storage temperature of the energy storage device; and

controlling an operation of the heat pump system according to the energy storage temperature to achieve a corresponding target state;

different energy storage temperatures correspond to different target states, and in different target states, the energy storage device remains in a heat storage state and the indoor unit has different heating capacities.

[0007] In an embodiment, the target state comprises a first state or a second state; the controlling the operation of the heat pump system according to the energy storage temperature to achieve the corresponding target state comprises:

in response to that the energy storage temperature is less than a first preset temperature, controlling the heat pump system to operate to reach the first state;

in response to that the energy storage temperature is greater than a second preset temperature, controlling the heat pump system to operate to reach the second state; and

in response to that the energy storage temperature is greater than or equal to the first preset temperature, and the energy storage temperature is less than or equal to the second preset temperature, controlling the heat pump system to operate so as to maintain a current state of the heat pump system, wherein the current state is the first state or the second state;

the first preset temperature is less than the second preset temperature; in the first state, the energy storage device is in the heat storage state and the heating capacity of the indoor unit is less than a preset value; in the second state, the energy storage device is in the heat storage state and the heating capacity of the indoor unit is greater than or equal to the preset value.

[0008] In an embodiment, the in response to that the energy storage temperature is less than the first preset temperature, controlling the heat pump system to operate to reach the first state further comprises:

controlling an electric heater to turn on to increase a heat storage capacity of the energy storage device.

[0009] In an embodiment, the indoor unit comprises an indoor heat exchanger and a first control valve connected in series with the indoor heat exchanger; the controlling the heat pump system to operate to reach the first state comprises:

controlling the first control valve to operate at an opening degree less than or equal to a preset opening degree;

the controlling the heat pump system to operate to reach the second state comprises:

controlling the first control valve to operate at an

opening degree greater than the preset opening degree.

[0010] In an embodiment, the refrigerant main circuit further comprises a compressor connected to the indoor unit; the controlling the first control valve to operate at the opening degree less than or equal to the preset opening degree further comprises:

acquiring a current first high-side pressure of the heat pump system, and determining a first target high-side pressure corresponding to the heat pump system according to the energy storage temperature;
determining a first target frequency of the compressor according to the first high-side pressure and the first target high-side pressure; and
controlling the compressor to operate at the first target frequency.

[0011] In an embodiment, the refrigerant main circuit further comprises a compressor connected to the indoor unit; the controlling the first control valve to operate at the opening degree greater than the preset opening degree further comprises:

acquiring a current second high-side pressure of the heat pump system, and determining a second target high-side pressure corresponding to the heat pump system according to the energy storage temperature and an indoor temperature of an indoor space regulated by the indoor unit;
determining a second target frequency of the compressor according to the second high-side pressure and the second target high-side pressure; and
controlling the compressor to operate at the second target frequency.

[0012] In an embodiment, the indoor unit further comprises an indoor fan corresponding to the indoor heat exchanger; the in response to that the energy storage temperature is less than the first preset temperature, controlling the heat pump system to operate to reach the first state further comprises:
controlling the indoor fan to stop operating.

[0013] In an embodiment, the method for controlling the heat pump system, further comprising:

in response to that the heat pump system starts a preset mode, performing the step of acquiring the energy storage temperature of the energy storage device; and
in the preset mode, the indoor unit has a heating demand and the energy storage device has a heat storage demand.

[0014] In an embodiment, after the controlling the heat pump system to operate according to the energy storage temperature to reach the corresponding first state, the method further comprises:

in response to that the heat pump system is in a preset mode, controlling the indoor unit to output a prompt message to prompt that an operating state of the heat pump system conflicts with the preset mode; in the preset mode, the indoor unit has a heating demand and the energy storage device has a heat storage demand.

[0015] To achieve the above purpose, the present application further provides a heat pump system, characterized by comprising: a control device, a refrigerant main circuit and a refrigerant branch circuit connected to the refrigerant main circuit; the refrigerant main circuit comprises an indoor unit, and the refrigerant branch circuit comprises an energy storage device;
the control device comprises: a memory, a processor, and a control program of the heat pump system stored in the memory and executable on the processor; when the control program of the heat pump system is executed by the processor, the steps of the method for controlling the heat pump system are implemented.

[0016] To achieve the above purpose, the present application further provides a storage medium, characterized in that a control program of a heat pump system is stored on the storage medium, and when the control program of the heat pump system is executed by a processor, the steps of the method for controlling the heat pump system are implemented.

BENEFICIAL EFFECT

[0017] The present application provides a method for controlling a heat pump system, in which a refrigerant main circuit comprising an indoor unit and a refrigerant branch circuit comprising an energy storage device are provided in the heat pump system. In the method, the heat pump system can adapt to the energy storage temperature of the energy storage device, and selects a operation mode corresponding to the matching indoor heating capacity while the energy storage device stores heat. The operation mode of the heat pump system is no longer set by the user, and the energy storage temperature can accurately reflect the current operating conditions of the heat pump system. When the heat pump system is running, the heating capacity provided to the indoor unit during the energy storage process of the energy storage device can be accurately matched with the actual working conditions, ensuring that the heat pump system can adapt to the actual working conditions to meet user needs to the greatest extent, and effectively improve the system energy efficiency, thereby improving the degree of consideration between the indoor heating effect and the heat storage effect of the heat pump system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a schematic structural diagram of a heat pump system according to an embodiment of the present application.

FIG. 2 is a schematic structural diagram of the heat pump system according to another embodiment of the present application.

FIG. 3 is a schematic diagram of the hardware structure involved in the operation of the heat pump system according to an embodiment of the present application.

FIG. 4 is a flow chart of a method for controlling the heat pump system according to an embodiment of the present application.

FIG. 5 is a flow chart of the method for controlling the heat pump system according to another embodiment of the present application.

FIG. 6 is a flow chart of the method for controlling the heat pump system according to another embodiment of the present application.

FIG. 7 is a flow chart of the method for controlling the heat pump system according to another embodiment of the present application.

[0019] The realization of the purpose, functional features and advantages of the present application will be further explained in conjunction with embodiments and with reference to the accompanying drawings.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0020] It should be understood that the specific embodiments described herein are only configured to explain the present application and are not configured to limit the present application.

[0021] An embodiment of the present application provides a heat pump system.

[0022] In the embodiment of the present application, referring to FIGS. 1 to 3, the heat pump system comprises a control device 100, a refrigerant main circuit, and a refrigerant branch circuit connected to the refrigerant main circuit; the refrigerant main circuit comprises an indoor unit, and the refrigerant branch circuit comprises an energy storage device 6.

[0023] In an embodiment, the refrigerant main circuit comprises a compressor 1, an indoor unit, a throttling device 3, an outdoor heat exchanger 4, and a reversing assembly 5. The indoor unit, the throttling device 3, and the outdoor heat exchanger 4 are connected in sequence, and the exhaust port of the compressor 1, the return air port of the compressor 1, the indoor unit, and the outdoor heat exchanger 4 are all connected to the reversing assembly 5. The compressor 1, the throttling device 3, and the indoor unit are all connected to the control device 100.

[0024] The indoor unit comprises an indoor heat exchanger 21 and a first control valve 22 connected in series with the indoor heat exchanger 21. The indoor unit also comprises an indoor fan 23 corresponding to the indoor heat exchanger 21, and the indoor fan 23 is configured to drive indoor air to exchange heat with the indoor heat exchanger 21. The first control valve 22 and the indoor fan 23 are both connected to the control device 100.

[0025] In an embodiment, the number of the indoor unit is more than one, such as 2, 3 or 4, etc. In other embodiments, the number of the indoor unit may also be one.

[0026] The reversing assembly 5 is configured to switch the refrigerant flow direction between the indoor unit and the outdoor heat exchanger 4. When the reversing assembly 5 is in the first operating position, the exhaust port of the compressor 1 is connected to the indoor heat exchanger 21, and the return air port of the compressor 1 is connected to the outdoor heat exchanger 4; when the reversing assembly 5 is in the second operating position, the exhaust port of the compressor 1 is connected to the outdoor heat exchanger 4, and the return air port of the compressor 1 is connected to the indoor heat exchanger 21.

[0027] In an embodiment, as shown in FIG. 1, the reversing assembly 5 comprises a first multi-way valve 51 and a second multi-way valve 52. The first multi-way valve 51 comprises a first three-way valve or a first four-way valve, and the second multi-way valve 52 comprises a second three-way valve or a second four-way valve. The indoor heat exchanger 21, the exhaust port, and the return port are respectively connected to different valve ports of the first multi-way valve 51, and the outdoor heat exchanger 4, the exhaust port, and the return port are respectively connected to different valve ports of the second multi-way valve 52.

[0028] In an embodiment, as shown in FIG. 2, the reversing assembly 5 comprises a third four-way valve 53; and the indoor heat exchanger 21, the outdoor heat exchanger 4, the exhaust port and the return port are respectively connected to different valve ports of the third four-way valve 53.

[0029] In an embodiment, the heat pump system may not comprise the reversing assembly 5; and the exhaust port of the compressor 1 in the refrigerant main circuit, the indoor heat exchanger 21, the first control valve 22, the throttling device 3, the outdoor heat exchanger 4 and the return air port of the compressor 1 are connected in sequence.

[0030] In an embodiment, the energy storage device 6 comprises a water tank or a water heater. In other embodiments, the energy storage device 6 may also be a device storing other energy storage media.

[0031] The first end of the refrigerant branch circuit is connected to the exhaust port or the return port of the compressor 1, and the pipeline between the indoor unit and the outdoor heat exchanger 4 is connected to the second end of the refrigerant branch circuit.

[0032] In an embodiment, the first end of the refrigerant branch circuit is connected to the exhaust port of the compressor 1, and the pipeline between the throttling device 3 and the first control valve 22 is connected to the second end of the refrigerant branch circuit.

[0033] When the reversing assembly 5 operates in the first operating position and the first control valve 22 is closed, the refrigerant discharged from the compressor 1 flows through the refrigerant branch circuit, the throttling device 3 and the outdoor heat exchanger 4 in sequence and then flows back to the compressor 1. When the high-temperature refrigerant flows through the refrigerant branch circuit, the heat is stored in the energy storage device 6. The energy storage device 6 is in a heat storage state; the indoor heat exchanger 21 is in a heat release stop state; and the outdoor heat exchanger 4 is in an evaporating state.

[0034] When the reversing assembly 5 operates in the first operating position and the first control valve 22 is opened, a part of the refrigerant discharged from the compressor 1 flows through the refrigerant branch circuit, the throttling device 3 and the outdoor heat exchanger 4 and then flows back to the compressor 1; another part of the refrigerant discharged from the compressor 1 flows through the indoor heat exchanger 21, the first control valve 22, the throttling device 3 and the outdoor heat exchanger 4 in sequence and then flows back to the compressor 1; the energy storage device 6 is in a heat storage state; the indoor heat exchanger 21 is in a heat release state; and the outdoor heat exchanger 4 is in an evaporating state.

[0035] When the reversing assembly 5 operates in the second operating position and the first control valve 22 is opened, a part of the refrigerant discharged from the compressor 1 flows through the refrigerant branch circuit, the first control valve 22 and the indoor heat exchanger 21 and then flows back to the compressor 1, and another part of the refrigerant discharged from the compressor 1 flows through the outdoor heat exchanger 4, the throttling device 3, the first control valve 22 and the indoor heat exchanger 21 in sequence and then flows back to the compressor 1. The indoor heat exchanger 21 is in an evaporating state, and the outdoor heat exchanger 4 is in a condensing state.

[0036] In an embodiment, referring to FIGS. 1 to 3, the refrigerant branch circuit further comprises a second control valve 7 connected in series with the energy storage device 6. The second control valve 7 can be configured to control the flow of the refrigerant branch circuit. The second control valve 7 is connected to the control device 100.

[0037] In an embodiment, the reversing assembly 5 further comprises a switching valve (not shown), and the first end of the refrigerant branch circuit is connected to the exhaust port or the return port of the compressor through the switching valve. The switching valve can be a four-way valve or a three-way valve, and the switching valve has a first state and a second state. When the switching valve is in the first state, the return port of the compressor 1 is connected to the energy storage device 6; when the switching valve is in the second state, the exhaust port of the compressor 1 is connected to the energy storage device 6.

[0038] In an embodiment, referring to FIG. 1 to FIG. 3, the heat pump system further comprises a temperature sensor 01 provided in the energy storage device 6, and the temperature sensor 01 is configured to detect the energy storage temperature of the energy storage device 6. The temperature sensor 01 is connected to the control device 100.

[0039] In an embodiment, referring to FIG. 3, the heat pump system further comprises an electric heater 8, which is connected to the control device 100. The electric heater 8 can be configured to heat the energy storage device 6 to increase the capacity of heat stored in the energy storage device 6.

[0040] In an embodiment, referring to FIGS. 1 to 3, the heat pump system further comprises a pressure sensor 02, which is provided on the exhaust side of the compressor 1 and is configured to detect the high-side pressure of the heat pump system. The pressure sensor 02 is connected to the control device 100.

[0041] In the embodiment of the present application, referring to FIG. 3, the control device 100 of the heat pump system comprises: a processor 1001, such as a CPU, a memory 1002, and a timer 1003. Among them, these components are connected and communicated through a communication bus. The memory 1002 can be a high-speed RAM memory or a stable memory (non-volatile memory, NVM), such as a disk memory. The memory 1002 can also be a storage device independent of the aforementioned processor 1001.

[0042] Those skilled in the art will appreciate that the device structure shown in FIG. 3 does not constitute a limitation on the device, and may comprise more or fewer components than shown, or a combination of certain components, or a different arrangement of components.

[0043] As shown in FIG. 3, the memory 1002 as a computer storage medium may comprise a control program of the heat pump system.

[0044] In the device shown in FIG. 3, the processor 1001 can be configured to call the control program of the heat pump system stored in the memory 1002 and execute the relevant steps of the method for controlling the heat pump system in the following embodiment.

[0045] The embodiment of the present application also provides a method for controlling the heat pump system, which is applied to the above-mentioned heat pump system.

[0046] Referring to FIG. 4, an embodiment of the method for controlling the heat pump system of the present application is provided. In an embodiment, the method for controlling the heat pump system comprises:

[0047] Step S10, acquiring the energy storage temperature of the energy storage device;

[0048] The energy storage temperature can be speci-

fically obtained based on data detected by a temperature sensor provided in the energy storage device. It can be a temperature value currently detected in real time by the temperature sensor, or it can be a temperature value determined by temperature data detected by the temperature sensor within a current preset time period.

[0049] In an embodiment, when the heat pump system is in a preset mode, step S10 is performed. In the preset mode, the indoor unit has a heating demand and the energy storage device has a heat storage demand. The preset mode can be turned on in response to a command input by a user.

[0050] Step S20, controlling the operation of the heat pump system according to the energy storage temperature to achieve a corresponding target state; different energy storage temperatures correspond to different target states; and in different target states, the energy storage device is in a heat storage state and the indoor unit has different heating capacity.

[0051] Whether the energy storage device is in a heat storage state can be controlled by a control valve on the refrigerant branch circuit and/or a control valve on the refrigerant main circuit. The control valve can be configured to control whether the high-temperature refrigerant is allowed to flow into or stop flowing into the energy storage device.

[0052] The heating capacity of the indoor unit can be specifically adjusted by the refrigerant flow rate flowing through the indoor heat exchanger and/or the indoor fan speed corresponding to the indoor heat exchanger, etc. The refrigerant flow rate flowing through the indoor heat exchanger can be adjusted by the refrigerant regulating member on the refrigerant branch circuit and/or by the refrigerant regulating member on the refrigerant main circuit.

[0053] In an embodiment, the energy storage device is in a heat storage state in different target states but corresponds to different heating capacity of the indoor units. Different energy storage temperature intervals correspond to different heating capacity of the indoor units.

[0054] Among them, the target state corresponding to the energy storage temperature can be determined, and the operation of the heat pump system can be controlled according to the operation corresponding to the target state. In one implementation, at least two temperature intervals corresponding to the energy storage device are pre-divided, and different temperature intervals correspond to different target states or different target state selection rules. Based on this, the temperature interval in which the energy storage temperature is located can be determined, and the state corresponding to the temperature interval can be determined as the target state, or the target state can be determined according to the state selection rule corresponding to the temperature interval. In another implementation, the temperature difference between the energy storage temperature and the preset temperature can be determined; the target state is determined according to the temperature difference, and different temperature differences correspond to different target states.

[0055] A method for controlling a heat pump system is provided in an embodiment of the present application. In the heat pump system, a refrigerant main circuit comprising an indoor unit and a refrigerant branch circuit comprising an energy storage device are provided. In the method, the heat pump system can adapt to the energy storage temperature of the energy storage device, and selects a mode corresponding to the matching indoor heating capacity while the energy storage device stores heat. The operation mode of the heat pump system is no longer set by the user. The energy storage temperature can accurately reflect the current operating condition of the heat pump system. When the heat pump system is running, the heating capacity provided to the indoor unit during the energy storage process of the energy storage device can be accurately matched with the actual working condition, thereby ensuring that the heat pump system can adapt to the actual working condition to meet user needs to the greatest extent, and effectively improve the system energy efficiency, thereby improving the degree of consideration between the indoor heating effect and the heat storage effect of the heat pump system.

[0056] Furthermore, after step S20, the execution may return to step S10, thereby automatically switching the operating state of the heat pump system based on the energy storage temperature, and further improving the balance between heat storage demand and indoor heating.

[0057] Further, based on the above embodiment, another embodiment of the method for controlling the heat pump system of the present application is provided. In an embodiment, referring to FIG. 5, the target state comprises the first state or the second state, and the step S20 comprises:

[0058] Step S21, when the energy storage temperature is less than a first preset temperature, controlling the heat pump system to operate to reach the first state; in the first state, the energy storage device is in a heat storage state and the heating capacity of the indoor unit is less than a preset value;

[0059] The first preset temperature is specifically the minimum temperature allowed for the energy storage device to reach when the heating state value (heating capacity and/or air outlet temperature, etc.) corresponding to the indoor unit's heating capacity is greater than or equal to the target heating capacity during the operation of the heat pump system in the second state.

[0060] In this embodiment, when the heat pump system is in the first state, the energy storage device 6 is in a heat storage state; the outdoor heat exchanger 4 is in an evaporating state; and the indoor heat exchanger 21 is in a heat release stop state.

[0061] In an embodiment, the refrigerant branch circuit comprises an energy storage device and a second control valve connected in series with the energy storage

device, and the first end of the refrigerant branch circuit is connected to the exhaust port of the compressor. The second control valve is opened (if the reversing assembly 5 comprises a switching valve, the switching valve is in the second state, and the exhaust port of the compressor 1 is connected to the energy storage device 6) to put the energy storage device in a heat storage state. When the energy storage temperature is less than the first preset temperature, the opening degree of the second control valve can be a fixed opening degree, or the second control valve can also be determined according to the actual operating state of the heat pump system. In an embodiment, the saturation temperature corresponding to the high-side pressure of the heat pump system and the outlet temperature of the energy storage device determine the corresponding supercooling degree, and the opening degree of the second control valve is determined according to the supercooling degree. In other embodiments, the first end of the refrigerant branch circuit is connected to the exhaust port of the compressor, and the refrigerant branch circuit may not be provided with a second control valve, so that the energy storage device is maintained in a heat storage state when the heat pump system is turned on; or, if the reversing assembly 5 comprises a switching valve, the switching valve is in the second state, and the exhaust port of the compressor 1 is connected to the energy storage device 6.

[0062] The heat pump system can limit the capacity of refrigerant flowing into the indoor unit to be less than a preset flow rate through the refrigerant regulating member of the refrigerant main circuit and/or the refrigerant regulating member on the refrigerant branch circuit, thereby making the heating capacity of the indoor unit less than a preset value. The heating capacity of the indoor unit corresponding to the preset opening degree is the preset value.

[0063] In an embodiment, the indoor unit comprises an indoor heat exchanger and a first control valve connected in series with the indoor heat exchanger, and the first control valve is controlled to operate at an opening degree less than or equal to a preset opening degree. In an embodiment, the preset opening degree is the minimum opening degree allowed for the first control valve to operate. In an embodiment, when the energy storage temperature is less than the first preset temperature, the first control valve is controlled to operate at the minimum opening degree. In other embodiments, when the energy storage temperature is less than the first preset temperature, the first control valve may also be controlled to close. In other embodiments, the preset opening degree may also be greater than the minimum opening degree of the first control valve, and the preset opening degree may also be 30% of the maximum opening degree of the first control valve.

[0064] Step S22, when the energy storage temperature is greater than a second preset temperature, controlling the heat pump system to operate to reach the second state; the energy storage device is in a heat storage state and the heating capacity of the indoor unit is greater than or equal to the preset value;

[0065] The second preset temperature can be obtained by increasing the first preset temperature by a temperature adjustment value. The temperature adjustment value here can be a preset fixed value or a value determined according to the actual operation of the heat pump system; for example, the temperature adjustment value here can be determined according to the outdoor ambient temperature corresponding to the heat pump system.

[0066] In this embodiment, when the heat pump system is in the first state, the energy storage device 6 is in a heat storage state; the outdoor heat exchanger 4 is in an evaporating state; and the indoor heat exchanger 21 is in a heat release state.

[0067] In an embodiment, the refrigerant branch circuit comprises an energy storage device and a second control valve connected in series with the energy storage device, and the first end of the refrigerant branch circuit is connected to the exhaust port of the compressor (if the reversing assembly 5 comprises a switching valve, the switching valve is in the second state, and the exhaust port of the compressor 1 is connected to the energy storage device 6). The second control valve is opened to put the energy storage device in a heat storage state. When the energy storage temperature is greater than the second preset temperature, the opening degree of the second control valve can be a fixed opening degree, or it can be determined according to the actual operating state of the heat pump system. In an embodiment, the saturation temperature corresponding to the high-side pressure of the heat pump system and the outlet temperature of the energy storage device determine the corresponding supercooling degree, and the opening degree of the second control valve is determined according to the supercooling degree. In other embodiments, the first end of the refrigerant branch circuit is connected to the exhaust port of the compressor, and the refrigerant branch circuit may not be provided with a second control valve. When the heat pump system is turned on (if the reversing assembly 5 comprises a switching valve, the switching valve is in the second state, and the exhaust port of the compressor 1 is connected to the energy storage device 6), the energy storage device is maintained in a heat storage state. When the energy storage temperature is greater than the second preset temperature, the opening degree of the second control valve may be smaller than the opening degree of the second control valve when the energy storage temperature is less than the first preset temperature.

[0068] The heat pump system can limit the capacity of refrigerant flowing into the indoor unit to be greater than or equal to a preset flow rate through the refrigerant regulating members on the refrigerant main circuit and/or the refrigerant regulating members on the refrigerant branch circuit, thereby making the heat generated by

the indoor unit greater than or equal to a preset value.

[0069] In an embodiment, the indoor unit comprises an indoor heat exchanger and a first control valve connected in series with the indoor heat exchanger. The first control valve is controlled to operate at an opening degree greater than a preset opening degree. The operating opening degree of the first control valve can be determined based on the corresponding indoor ambient temperature and the corresponding set temperature, and can also be determined based on the corresponding indoor ambient temperature and the corresponding set temperature as well as the energy storage temperature and the corresponding target energy storage temperature.

[0070] Step S23, when the energy storage temperature is greater than or equal to the first preset temperature, and the energy storage temperature is less than or equal to the second preset temperature, controlling the heat pump system to operate to maintain the current state of the heat pump system in the first state or the second state; the first preset temperature is less than the second preset temperature.

[0071] In the preset mode, the heat pump system can operate in one of the first state and the second state and detect the energy storage temperature of the energy storage device. When the energy storage temperature is greater than or equal to the first preset temperature, and the energy storage temperature is less than or equal to the second preset temperature, if the heat pump system is currently operating in the first state, the heat pump system can be controlled to operate to maintain the first state; if the heat pump system is currently operating in the second state, the heat pump system can be controlled to operate to maintain the second state.

[0072] In an embodiment, the energy storage temperature is less than the first preset temperature, indicating that the high-side pressure of the heat pump system is too low when the heat pump system is running in the second state, and it is unable to provide sufficient heat for the energy storage device to store heat and indoor heating. Therefore, the heat pump system is controlled to run to reach the first state at this time, giving priority to meeting the heat storage demand of the energy storage device, which is conducive to quickly increasing the high-side pressure of the system to improve the heat storage effect of the energy storage device. In addition, the energy storage temperature is greater than the first preset temperature, indicating that the high-side pressure of the heat pump system is high enough at this time, and sufficient heat can be provided for the energy storage device to store heat and indoor heating at the same time. Therefore, the heat pump system is controlled to run to reach the second state at this time, so that the energy storage device stores heat while the indoor unit heats and transports heat to the room, achieving simultaneous improvement of the heat storage effect and the indoor heating effect. When the energy storage temperature is between the first preset temperature and the second preset temperature, the heat pump system runs while maintaining the current state in the first state and the second state, which is conducive to reducing unnecessary state switching of the system and improving the system operation stability.

[0073] Furthermore, after step S21 or step S22 or step S23, the process may return to step S10, so that the heat pump system can automatically switch operating states to simultaneously meet heat storage needs and indoor needs with better energy efficiency.

[0074] In other embodiments, when the energy storage temperature is greater than or equal to the first preset temperature, the heat pump system can be controlled to operate to reach the second state. In other embodiments, the target state may also comprise a third state. In other embodiments, when the energy storage temperature is greater than or equal to the first preset temperature, and the energy storage temperature is less than or equal to the second preset temperature, when the heat pump system operates in a state other than the first state and the second state, the heat pump system may also be controlled to operate in a maintained state.

[0075] Among them, when one end of the energy storage device is directly connected to the exhaust port of the compressor, when the energy storage temperature is low, even if the energy storage device stops storing heat, the high-side pressure of the system will be low, and the heat provided for indoor heating will be small. Based on this, the heat storage demand of the energy storage device is met first, and after the energy storage temperature is increased, the indoor heating and heat storage are performed at the same time, which is conducive to meeting the heat storage demand while improving the indoor heating effect.

[0076] In an embodiment, during the execution of step S21, the step further comprises: controlling the electric heater to turn on to increase the heat storage capacity of the energy storage device.

[0077] When the electric heater is turned on, the energy storage device can store the heat generated by the electric heater and the heat flowing through the refrigerant at the same time.

[0078] The electric heater can be turned on with fixed operating parameters or with operating parameters determined according to the actual operating state of the heat pump system. For example, the operating parameters of the electric heater here can be determined according to the temperature difference between the energy storage temperature and the target energy storage temperature and/or the difference between the high-side pressure of the heat pump system and the target high-side pressure, thereby improving the heat storage efficiency and the system operation reliability.

[0079] In an embodiment, while the heat pump system is operating in the first state, the electric heater is turned on to assist heating, thereby effectively improving the heat storage efficiency.

[0080] In an embodiment, the indoor unit also comprises an indoor fan corresponding to the indoor heat

exchanger. When the energy storage temperature is less than a first preset temperature, the step of controlling the heat pump system to operate to reach the first state further comprises: controlling the indoor fan to stop operation.

[0081] The shutdown of the indoor fan can reduce the heat exchange between the indoor air conditioned by the corresponding indoor unit and the indoor heat exchanger, ensuring that more heat is used for heat storage in the energy storage device, thereby effectively improving the heat storage efficiency of the energy storage device and quickly reaching the required temperature.

[0082] Further, based on any of the above embodiments, the refrigerant main circuit further comprises a compressor connected to the indoor unit, and another embodiment of the method for controlling the heat pump system of the present application is provided. In an embodiment, referring to FIG. 6, during the execution of step S21, the following further comprises:

[0083] Step S211, acquiring the current first high-side pressure of the heat pump system, and determining the first target high-side pressure corresponding to the heat pump system according to the energy storage temperature;

[0084] The first high-side pressure can be specifically detected by the above-mentioned pressure sensor.

[0085] The first target high-side pressure is the target value that the high-side pressure of the heat pump system needs to reach in the first state. Different energy storage temperatures correspond to different first target high-side pressures. The energy storage temperature is positively correlated with the corresponding first target high-side pressure. The first target high-side pressure can be obtained by looking up the table or calculating the energy storage temperature.

[0086] Step S212, determining a first target frequency of the compressor according to the first high-side pressure and the first target high-side pressure;

[0087] A magnitude relationship or a quantitative relationship between the first high-side pressure and the first target high-side pressure is determined, and a first target frequency is determined according to the magnitude relationship or the quantitative relationship.

[0088] In one implementation, when the first high-side pressure is less than the first target high-side pressure, the current frequency of the compressor can be increased according to the frequency adjustment value as the first target frequency; when the first high-side pressure is greater than the first target high-side pressure, the current frequency of the compressor can be reduced according to the frequency adjustment value as the first target frequency.

[0089] In another implementation, the pressure difference between the first high-side pressure and the first target high-side pressure may be determined, and the first target frequency of the compressor may be determined based on the pressure difference. For example, the first target frequency may be obtained by looking up a table or calculating the pressure difference.

[0090] Step S213, controlling the compressor to operate at the first target frequency.

[0091] In an embodiment, when the heat pump system is operating in the first state, the target high-side pressure of the system is determined according to the energy storage temperature of the energy storage device, and the target frequency required for the compressor to operate is determined based on the target high-side pressure and the actual high-side pressure to control the operation of the compressor, thereby ensuring that the output capacity of the compressor in the first state can be accurately matched with the heat storage demand of the energy storage device, ensuring that there is enough target high-side pressure to increase sufficient heat to meet the heat storage demand of the energy storage device, and improving the heat storage effect of the energy storage device.

[0092] Further, based on any of the above embodiments, another embodiment of the method for controlling the heat pump system of the present application is provided. In an embodiment, referring to FIG. 5, during the execution of step S22, the following steps are further comprised:

[0093] Step S221, acquiring the current second high-side pressure of the heat pump system, and determining the second target high-side pressure corresponding to the heat pump system according to the energy storage temperature and the indoor temperature of the indoor space regulated by the indoor unit;

[0094] The second high-side pressure can be specifically detected by the pressure sensor. The indoor temperature is specifically detected by a temperature detection module provided in the indoor space regulated by the indoor unit.

[0095] It should be noted that the indoor unit here is the indoor unit that currently has indoor heating demand.

[0096] The second target high-side pressure is the target value that the high-side pressure of the heat pump system needs to reach in the second state. Different energy storage temperatures and different indoor temperatures correspond to different second target high-side pressures. Both the energy storage temperature and the indoor temperature are positively correlated with the corresponding second target high-side pressure. The second target high-side pressure can be obtained by looking up the table or calculating the energy storage temperature and the indoor temperature.

[0097] Step S222, determining a second target frequency of the compressor according to the second high-side pressure and the second target high-side pressure;

[0098] A magnitude relationship or a quantitative relationship between the second high-side pressure and the second target high-side pressure is determined, and a second target frequency is determined according to the magnitude relationship or the quantitative relationship.

[0099] In one implementation, when the second high-

side pressure is less than the second target high-side pressure, the current frequency of the compressor can be increased according to the frequency adjustment value as the second target frequency; when the second high-side pressure is greater than the second target high-side pressure, the current frequency of the compressor can be reduced according to the frequency adjustment value as the second target frequency.

[0100] In another implementation, the pressure difference between the second high-side pressure and the second target high-side pressure may be determined, and the second target frequency of the compressor may be determined based on the pressure difference. For example, the second target frequency may be obtained by looking up a table or calculating the pressure difference.

[0101] Step S223, controlling the compressor to operate at the second target frequency.

[0102] In an embodiment, when the heat pump system is operating in the second state, the target high-side pressure of the system is determined according to the energy storage temperature of the energy storage device and the indoor temperature, and the target frequency of the compressor required to operate is determined based on the target high-side pressure and the actual high-side pressure to control the operation of the compressor, thereby ensuring that the output capacity of the compressor in the second state can be accurately matched with the heat storage demand of the energy storage device and the indoor heating demand, ensuring that there is enough target high-side pressure to provide enough heat to ensure the heat storage demand of the energy storage device and the indoor heating demand of the indoor unit, thereby effectively improving the heat storage effect of the energy storage device and the indoor heating demand.

[0103] Furthermore, based on any of the above embodiments, another optional embodiment of the method for controlling the heat pump system of the present application is provided. In an embodiment, when the heat pump system starts a preset mode, the step of acquiring the energy storage temperature of the energy storage device is executed; in the preset mode, the indoor unit has a heating demand and the energy storage device has a heat storage demand.

[0104] When receiving a preset instruction input by the user, the heat pump system can start the preset mode. When the preset mode is started, it is determined whether the operating state needs to be switched based on the energy storage temperature.

[0105] Furthermore, based on any of the above embodiments, another embodiment of the method for controlling the heat pump system of the present application is provided. In an embodiment, when the heat pump system starts a preset mode, the heat pump system is controlled to operate to reach the second state, and the step of acquiring the energy storage temperature of the energy storage device is executed; in the preset mode, the indoor unit has a heating demand and the energy storage device has a heat storage demand.

[0106] When receiving a preset instruction input by the user, the heat pump system can start the preset mode. When the preset mode is started, the heat pump system can first operate in the second state, during which it is determined whether the operating state needs to be switched based on the energy storage temperature.

[0107] In an embodiment, when the preset mode is started, the heat pump system first operates in the second state, which is beneficial for the heat pump system to operate in accordance with the actual needs of the user first, ensuring that the operation matches the user needs. In this process, it is further determined based on the energy storage temperature whether to switch the operating state, thereby ensuring that when different user needs cannot be met at the same time, some user needs can be met first; when different user needs can be met at the same time, different user needs are met at the same time, thereby further improving the indoor heating effect and/or heat storage effect of the heat pump system and the degree of matching with the user.

[0108] Furthermore, based on any of the above embodiments, another optional embodiment of the method for controlling the heat pump system of the present application is provided. When the heat pump system is in a preset mode, the indoor unit is controlled to output a prompt message to prompt that there is a conflict between the operating state of the heat pump system and the preset mode; in the preset mode, the indoor unit has a heating demand and the energy storage device has a heat storage demand.

[0109] The prompt information can be output in any form such as sound and/or display and/or vibration and/or light.

[0110] In an embodiment, when the heat pump system operates in the first state in the preset mode, the output of prompt information ensures that the user can know the current operating state of the heat pump system based on the prompt information, thereby preventing the user from mistakenly believing that the heat pump system is faulty. The user can also confirm whether to switch the operation mode based on his or her own needs, thereby further ensuring that the operation of the heat pump system is accurately matched with user needs.

[0111] In addition, an embodiment of the present application further provides a storage medium, on which a control program of the heat pump system is stored. When the control program of the heat pump system is executed by a processor, the relevant steps of any embodiment of the method for controlling the heat pump system are implemented.

[0112] It should be noted that, in this article, the terms "comprise", "comprise" or any other variations thereof are intended to cover non-exclusive inclusion, so that a process, method, article or system comprising a series of elements comprises not only those elements, but also other elements not explicitly listed, or also comprises

elements inherent to such process, method, article or system. In the absence of further restrictions, an element defined by the sentence "comprises a ..." does not exclude the existence of other identical elements in the process, method, article or system comprising the element.

[0113] The serial numbers of the above-mentioned embodiments of the present application are for description only and do not represent the advantages or disadvantages of the embodiments.

[0114] Through the description of the above implementation methods, those skilled in the art can clearly understand that the above-mentioned embodiment methods can be implemented by means of software plus a necessary general hardware platform, and of course by hardware, but in many cases the former is a better implementation method. Based on such an understanding, the technical solution of the present application is essentially or the part that contributes to the prior art can be embodied in the form of a software product, which is stored in a storage medium (such as ROM/RAM, magnetic disk, optical disk) as described above, and comprises a number of instructions for a terminal device (which can be a mobile phone, computer, server, heat pump system, or network device, etc.) to execute the methods described in each embodiment of the present application.

[0115] The above are only some embodiments of the present application, and are not intended to limit the patent scope of the present application. Any equivalent structure or equivalent process transformation made using the contents of the present application specification and drawings, or directly or indirectly applied in other related technical fields, are also comprised in the patent protection scope of the present application.

Claims

1. A method for controlling a heat pump system, wherein the heat pump system comprises a refrigerant main circuit and a refrigerant branch circuit connected to the refrigerant main circuit; the refrigerant main circuit comprises an indoor unit, and the refrigerant branch circuit comprises an energy storage device; **characterized in that** the method for controlling the heat pump system comprises:

   acquiring an energy storage temperature of the energy storage device; and
   controlling an operation of the heat pump system according to the energy storage temperature to achieve a corresponding target state; wherein, different energy storage temperatures correspond to different target states, and in the different target states, the energy storage device remains in a heat storage state and the indoor unit has different heating capacities.

2. The method for controlling the heat pump system according to claim 1, wherein the target state comprises a first state or a second state; the controlling the operation of the heat pump system according to the energy storage temperature to achieve the corresponding target state comprises:

   in response to that the energy storage temperature is less than a first preset temperature, controlling the heat pump system to operate to reach the first state;
   in response to that the energy storage temperature is greater than a second preset temperature, controlling the heat pump system to operate to reach the second state; and
   in response to that the energy storage temperature is greater than or equal to the first preset temperature, and the energy storage temperature is less than or equal to the second preset temperature, controlling the heat pump system to operate so as to maintain a current state of the heat pump system, wherein the current state is the first state or the second state;
   wherein, the first preset temperature is less than the second preset temperature; in the first state, the energy storage device is in the heat storage state and the heating capacity of the indoor unit is less than a preset value; in the second state, the energy storage device is in the heat storage state and the heating capacity of the indoor unit is greater than or equal to the preset value.

3. The method for controlling the heat pump system according to claim 2, wherein the in response to that the energy storage temperature is less than the first preset temperature, controlling the heat pump system to operate to reach the first state further comprises:
   controlling an electric heater to turn on to increase a heat storage capacity of the energy storage device.

4. The method for controlling the heat pump system according to claim 2, wherein the indoor unit comprises an indoor heat exchanger and a first control valve connected in series with the indoor heat exchanger; the controlling the heat pump system to operate to reach the first state comprises:

   controlling the first control valve to operate at an opening degree less than or equal to a preset opening degree;
   the controlling the heat pump system to operate to reach the second state comprises:
   controlling the first control valve to operate at an opening degree greater than the preset opening degree.

5. The method for controlling the heat pump system

according to claim 4, wherein the refrigerant main circuit further comprises a compressor connected to the indoor unit; the controlling the first control valve to operate at the opening degree less than or equal to the preset opening degree further comprises:

acquiring a current first high-side pressure of the heat pump system, and determining a first target high-side pressure corresponding to the heat pump system according to the energy storage temperature;
determining a first target frequency of the compressor according to the first high-side pressure and the first target high-side pressure; and
controlling the compressor to operate at the first target frequency.

6. The method for controlling the heat pump system according to claim 4, wherein the refrigerant main circuit further comprises a compressor connected to the indoor unit; the controlling the first control valve to operate at the opening degree greater than the preset opening degree further comprises:

acquiring a current second high-side pressure of the heat pump system, and determining a second target high-side pressure corresponding to the heat pump system according to the energy storage temperature and an indoor temperature of an indoor space regulated by the indoor unit;
determining a second target frequency of the compressor according to the second high-side pressure and the second target high-side pressure; and
controlling the compressor to operate at the second target frequency.

7. The method for controlling the heat pump system according to claim 2, wherein the indoor unit further comprises an indoor fan corresponding to the indoor heat exchanger; the in response to that the energy storage temperature is less than the first preset temperature, controlling the heat pump system to operate to reach the first state further comprises:
controlling the indoor fan to stop operating.

8. The method for controlling the heat pump system according to any one of claims 1 to 7, further comprising:

in response to that the heat pump system starts a preset mode, performing the step of acquiring the energy storage temperature of the energy storage device; and
in the preset mode, the indoor unit has a heating demand and the energy storage device has a heat storage demand.

9. The method for controlling the heat pump system according to any one of claims 1 to 7, wherein after the controlling the heat pump system to operate according to the energy storage temperature to reach the corresponding first state, the method further comprises:

in response to that the heat pump system is in a preset mode, controlling the indoor unit to output a prompt message to prompt that an operating state of the heat pump system conflicts with the preset mode;
wherein, in the preset mode, the indoor unit has a heating demand and the energy storage device has a heat storage demand.

10. A heat pump system, **characterized by** comprising: a control device, a refrigerant main circuit and a refrigerant branch circuit connected to the refrigerant main circuit; the refrigerant main circuit comprises an indoor unit, and the refrigerant branch circuit comprises an energy storage device;
the control device comprises: a memory, a processor, and a control program of the heat pump system stored in the memory and executable on the processor; when the control program of the heat pump system is executed by the processor, steps of a method for controlling the heat pump system according to any one of claims 1 to 9 are implemented.

11. A storage medium, **characterized in that** a control program of a heat pump system is stored on the storage medium, and when the control program of the heat pump system is executed by a processor, steps of a method for controlling the heat pump system according to any one of claims 1 to 9 are implemented.

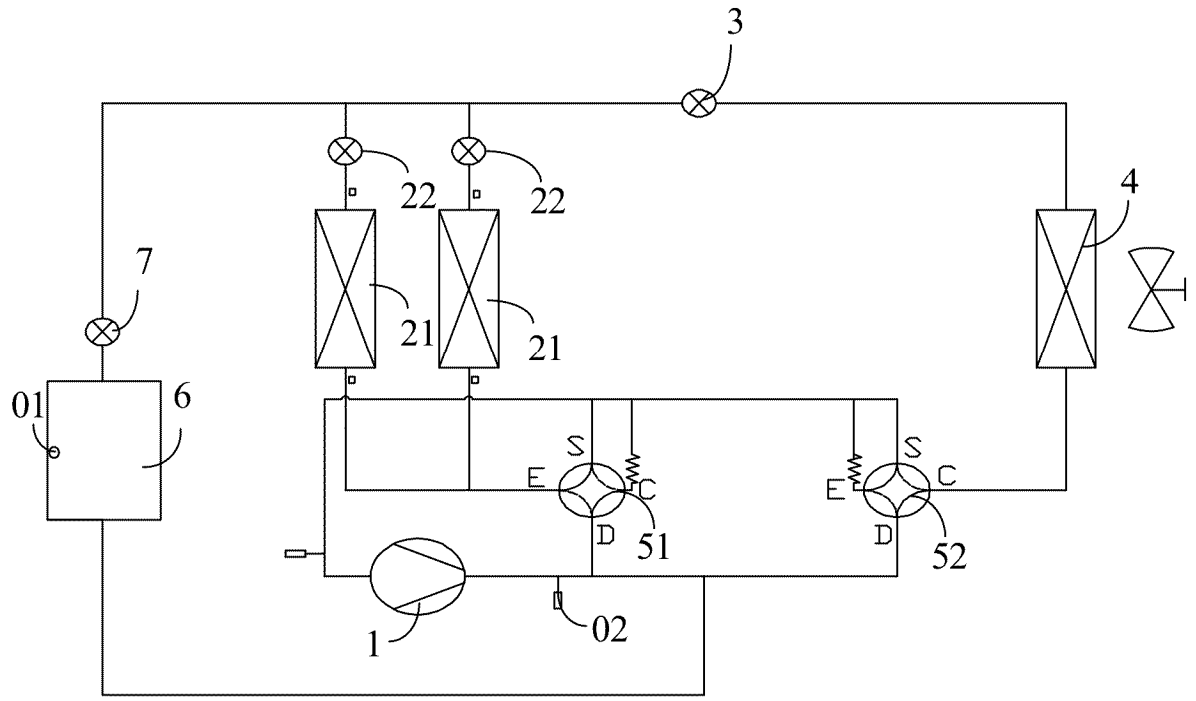
3
22
22
4
7
21
21
01
6
S
E
C
D
51
E
S
C
D
52
1
02

FIG. 1

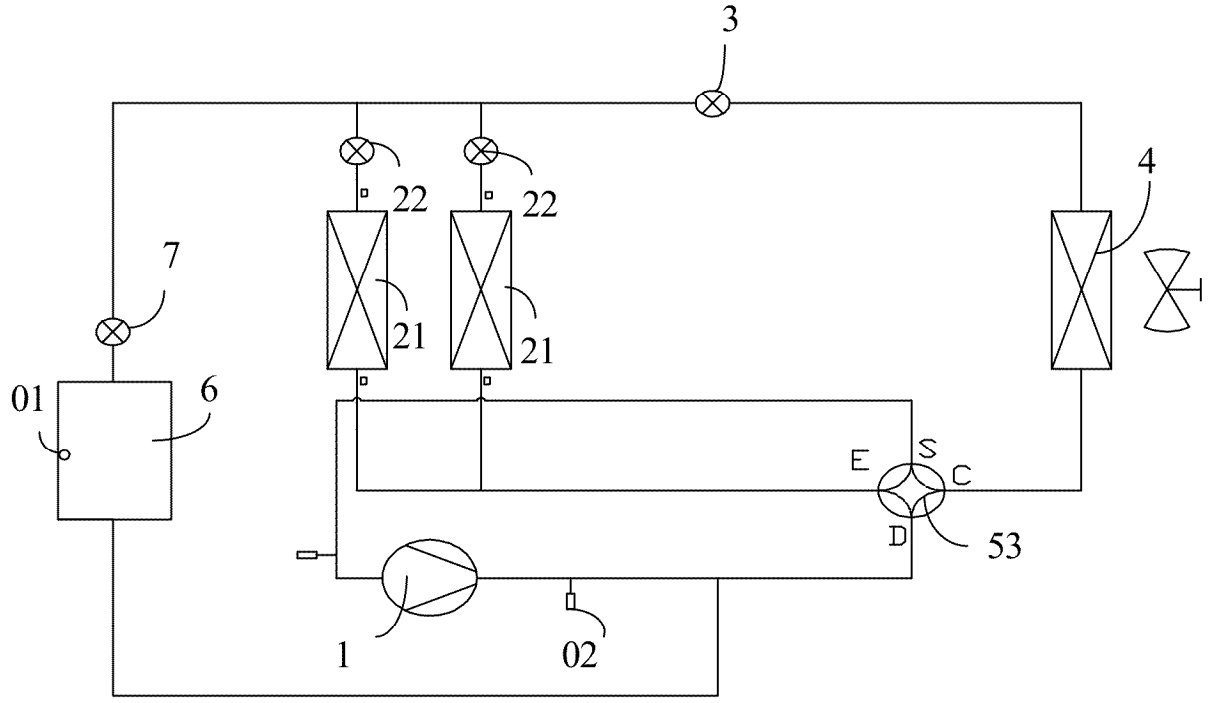
3
22
22
4
7
21
21
01
6
E
S
C
D
53
1
02

FIG. 2

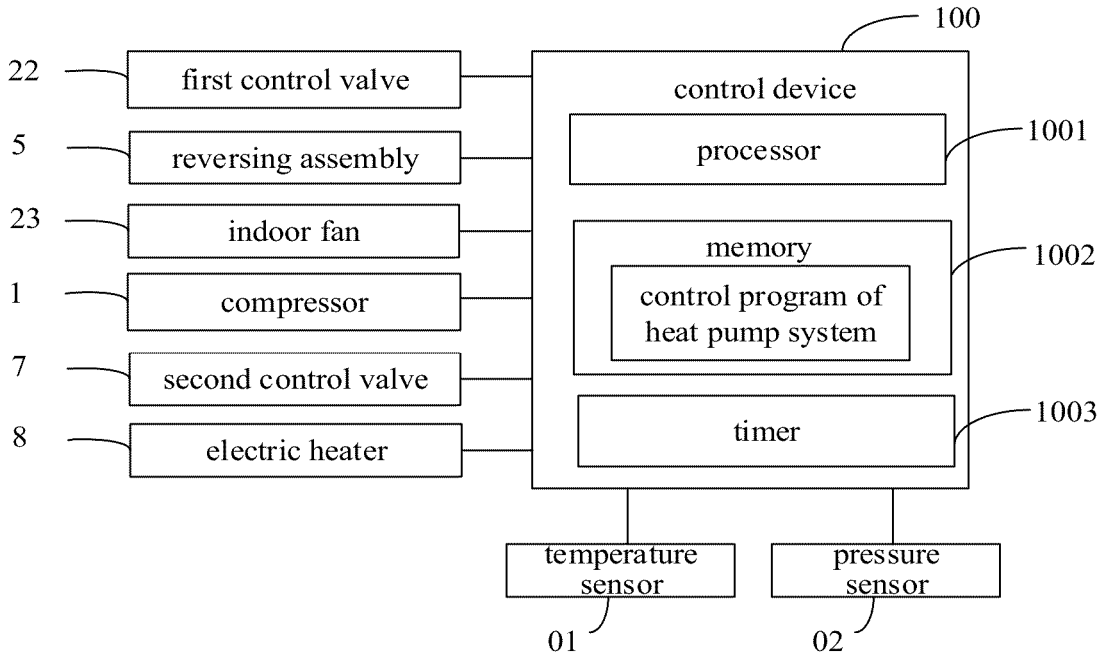

FIG. 3

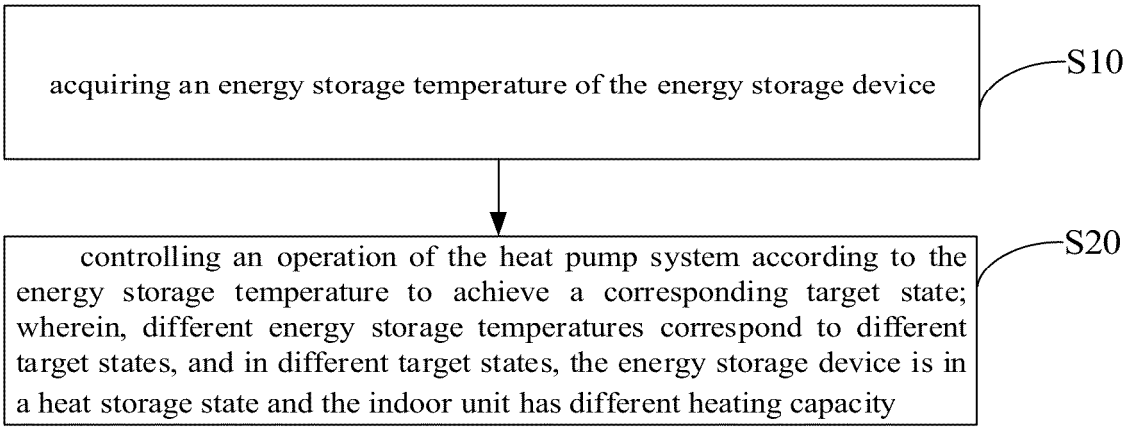

FIG. 4

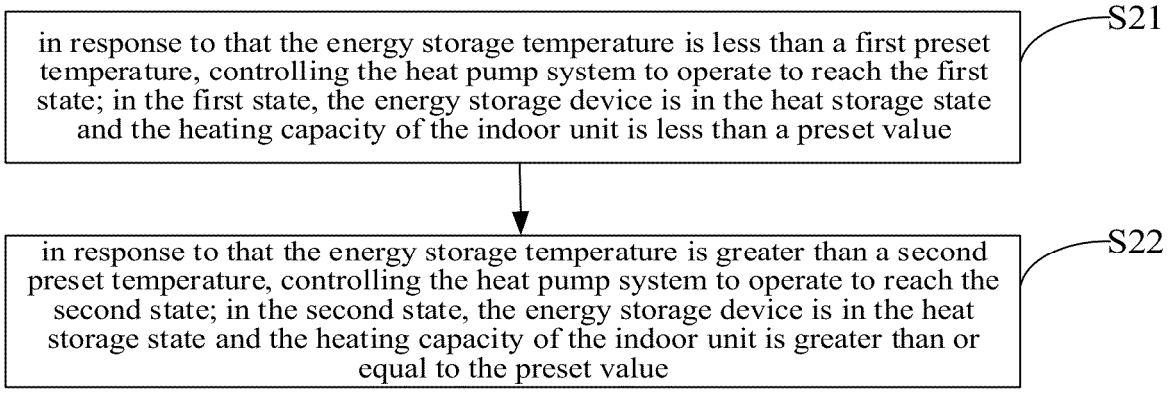

FIG. 5

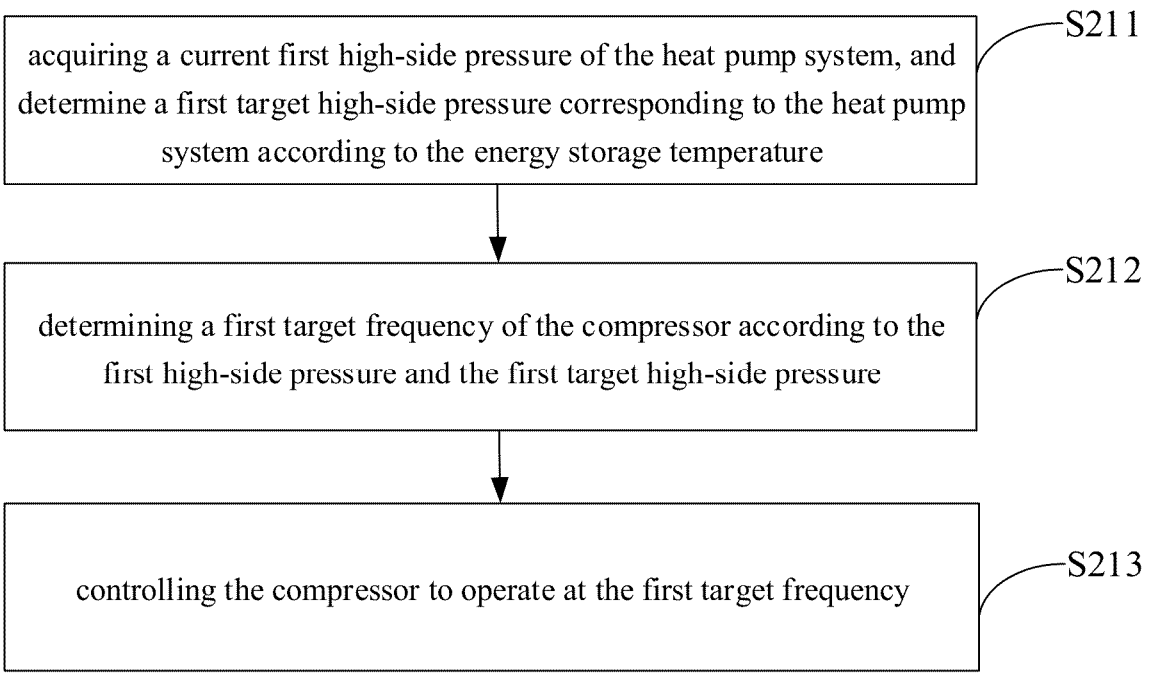
acquiring a current first high-side pressure of the heat pump system, and determine a first target high-side pressure corresponding to the heat pump system according to the energy storage temperature
S211
determining a first target frequency of the compressor according to the first high-side pressure and the first target high-side pressure
S212
controlling the compressor to operate at the first target frequency
S213

FIG. 6

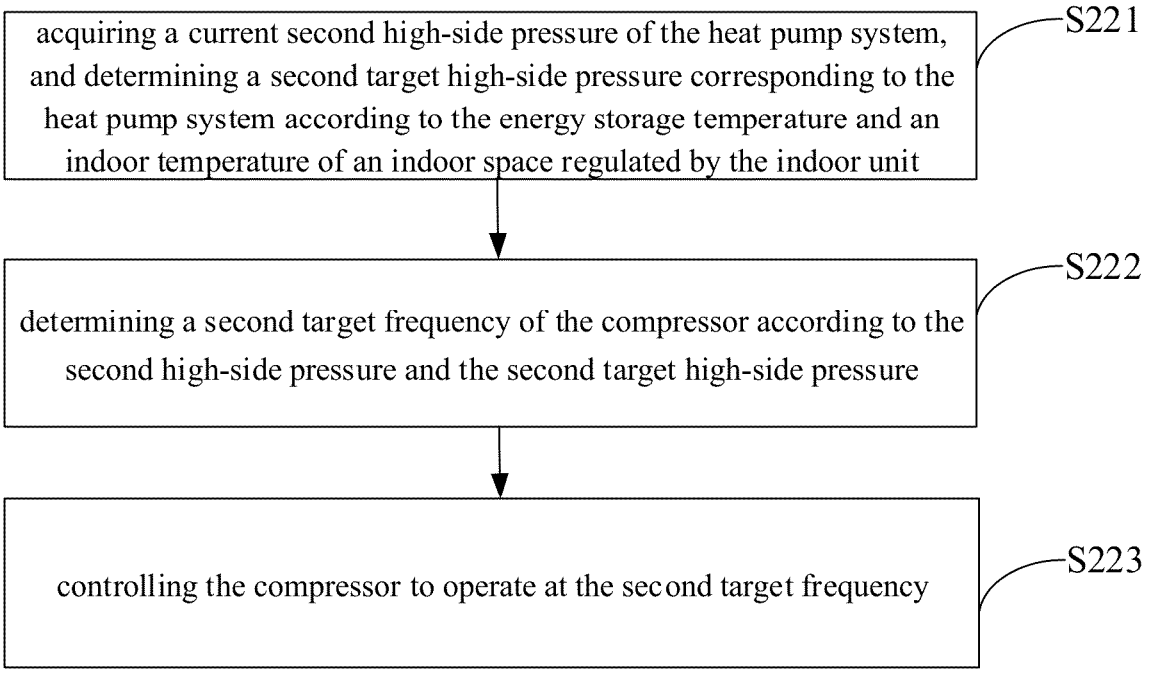
acquiring a current second high-side pressure of the heat pump system, and determining a second target high-side pressure corresponding to the heat pump system according to the energy storage temperature and an indoor temperature of an indoor space regulated by the indoor unit
S221
determining a second target frequency of the compressor according to the second high-side pressure and the second target high-side pressure
S222
controlling the compressor to operate at the second target frequency
S223

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/102076

A. CLASSIFICATION OF SUBJECT MATTER

F25B 13/00(2006.01)i; F25B 41/24(2021.01)i; F25B 41/42(2021.01)i; F25B 49/02(2006.01)i; F24F5/00(2006.01)i; F24F11/64(2018.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F25B 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)

CNTXT: CNKI: DWPI; WPABS; USTXT; WOTXT; EPTXT; Web of Science; 读秀, DUXIU: 美的, 热泵, 空调, 制热, 储热, 储能, 蓄热, 蓄能, 温度, 控制, heat pump, air condition, storage, temperature, control

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 110440414 A (ZHUHAI GREE ELECTRIC APPLIANCES INC.) 12 November 2019 (2019-11-12) description, paragraphs [0001]-[0036], and figures 1 and 2	1-11
A	CN 115235043 A (GUANGDONG MIDEA REFRIGERATION EQUIPMENT CO., LTD.) 25 October 2022 (2022-10-25) description, paragraphs [0001]-[0145], and figures 1-9	1-11
A	CN 201306804 Y (ZHOU KAIHUA) 09 September 2009 (2009-09-09) description, page 1 paragraph 1-page 9 paragraph 4, and figures 1-4	1-11
A	CN 105865073 A (GUANGDONG MEDIA REFRIGERATION EQUIPMENT CO., LTD. et al.) 17 August 2016 (2016-08-17) description, paragraphs [0034]-[0057], and figures 1-7	1-11
A	CN 206247523 U (ZHUHAI GREE ELECTRIC APPLIANCES INC.) 13 June 2017 (2017-06-13) description, paragraphs [0003]-[0050], and figures 1-3	1-11

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12.8月2024（12.08.2024）	**09 September 2024**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/102076

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008082589 A (HITACHI APPLIANCES INC.) 10 April 2008 (2008-04-10) description, paragraphs [0006]-[0045], and figures 1-9	1-11

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/102076

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 110440414 A	12 November 2019	CN 110440414 B	24 November 2020
CN 115235043 A	25 October 2022	None	
CN 201306804 Y	09 September 2009	None	
CN 105865073 A	17 August 2016	CN 105865073 B	01 June 2018
CN 206247523 U	13 June 2017	None	
JP 2008082589 A	10 April 2008	None	

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 202310954065 **[0001]**