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(54) METHOD FOR DETECTING POWER CONSUMPTION OF MULTI-SPLIT AIR CONDITIONER, HEAT RECOVERY MULTI-SPLIT AIR CONDITIONER, STORAGE MEDIUM, AND DEVICE

(57) The present application discloses a method for detecting the power consumption of a multi-split air conditioner, a heat recovery multi-split air conditioner, a storage medium, and a device. Compared to the existing means in which only the overall power consumption of a multi-split air conditioner is detected, the present application comprises: acquiring hydraulic module data of a heat recovery multi-split air conditioner, and determining a hydraulic module heat absorption value according to the hydraulic module data; acquiring outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner; determining, according to the outdoor unit data, the indoor unit data, and the hydraulic module data, the heating capacity of a condenser and the cooling capacity of an evaporator; and determining, according to the hydraulic module heat absorption value, the power consumption data, the heating capacity of the condenser, and the cooling capacity of the evaporator, the power consumption of an indoor unit and the power consumption of a hydraulic module. Therefore, the disadvantage in the existing technology in which the power consumed by each indoor unit and hydraulic module cannot be detected is overcome. Accordingly, the power consumption of each indoor unit and hydraulic module of a heat recovery multi-split air conditioner can be rapidly detected.

EP 4 269 894 A1

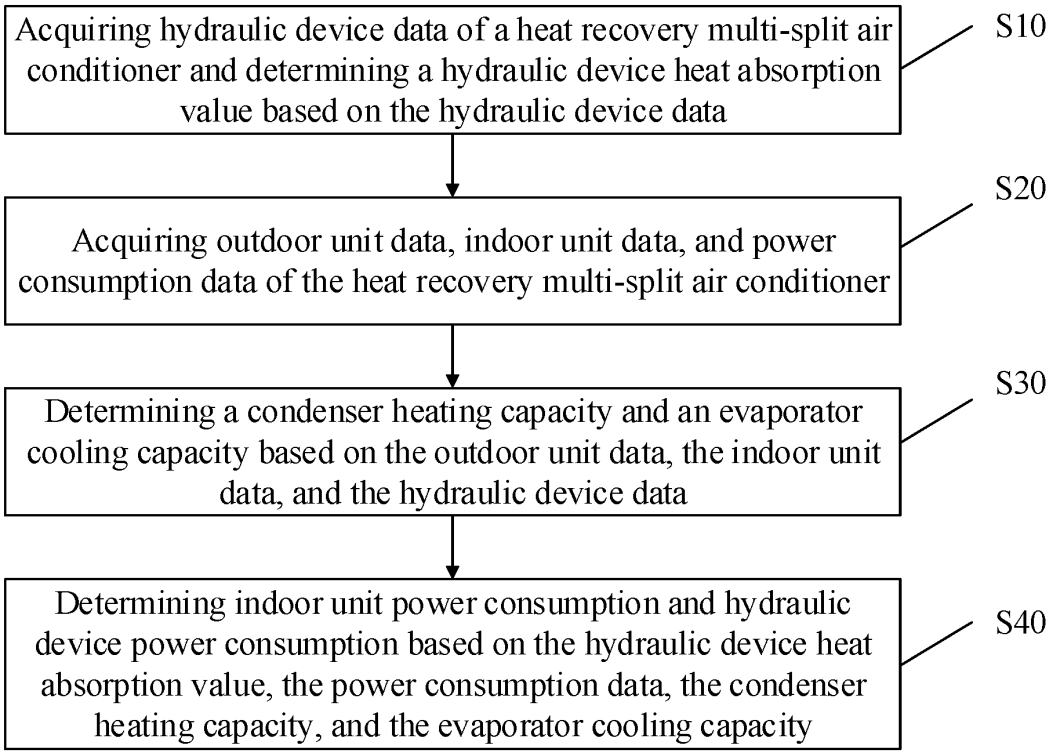

Acquiring hydraulic device data of a heat recovery multi-split air conditioner and determining a hydraulic device heat absorption value based on the hydraulic device data
S10
Acquiring outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner
S20
Determining a condenser heating capacity and an evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data
S30
Determining indoor unit power consumption and hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity
S40

FIG. 2

Description

PRIORITY INFORMATION

[0001] This application claims priority to Chinese Patent Application No. 202110086371.6, filed on January 21, 2021, the entire content of which is incorporated herein by reference.

FIELD

[0002] The present disclosure relates to the field of air conditioner technologies, and more particularly, to a method for detecting power consumption of a multi-split air conditioner, a heat recovery multi-split air conditioner, a storage medium, and an apparatus.

BACKGROUND

[0003] With the continuous progress of society and the ongoing development of science and technology, the use of a multi-split air conditioner as a heating, ventilation, and air conditioning device for a building is becoming more and more widespread. An existing heat recovery multi-split air conditioner system requires cooling, heating, and provision of hot water, which results in high energy consumption.

[0004] However, instead of detecting power consumed by individual indoor units and a hydraulic device separately, an existing power consumption detection system can only detect overall power consumption of the multi-split air conditioner system. Thus, it is impossible to optimize power consumption of the indoor units and the hydraulic device separately.

[0005] The above content is intended to assist in understanding of technical solutions of the present disclosure only, and does not represent an admission that the above content is the related art.

SUMMARY

[0006] Embodiments of the present disclosure provide a method for detecting power consumption of a multi-split air conditioner, a heat recovery multi-split air conditioner, a storage medium, and an apparatus, which can solve a technical problem in the related art of an inability to detect power consumed by each indoor unit and a hydraulic device.

[0007] Embodiments of the present disclosure provide a method for detecting power consumption of a multi-split air conditioner. The method for detecting the power consumption of the multi-split air conditioner includes: acquiring hydraulic device data of a heat recovery multi-split air conditioner and determining a hydraulic device heat absorption value based on the hydraulic device data; acquiring outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner; determining a condenser heating capacity and an evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data; and determining indoor unit power consumption and hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0008] In one embodiment, the determining the indoor unit power consumption and the hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity includes: acquiring a current operation mode of the heat recovery multi-split air conditioner; and determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0009] In one embodiment, the determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity includes: extracting target power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode; determining heating indoor unit power consumption through a first predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining cooling indoor unit power consumption through a first predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining the hydraulic device power consumption through a first predetermined hydraulic device power consumption model based on the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity; and determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

[0010] In one embodiment, the determining the indoor unit power consumption and the hydraulic device power con-

sumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity may also include: extracting first power consumption data and second power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode; determining heating indoor unit power consumption through a second predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining cooling indoor unit power consumption through a second predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining the hydraulic device power consumption through a second predetermined hydraulic device power consumption model based on the first power consumption data, the second power consumption data, the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity; and determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

[0011] In one embodiment, the acquiring the hydraulic device data of the heat recovery multi-split air conditioner and determining the hydraulic device heat absorption value based on the hydraulic device data includes: acquiring the hydraulic device data of the heat recovery multi-split air conditioner, and determining a return gas temperature, a compressor frequency, a compressor displacement, a compressor volumetric efficiency, a condenser outlet temperature, and a return gas pressure of a hydraulic device based on the hydraulic device data; determining a return gas density and a hydraulic device return gas enthalpy based on the return gas pressure and the return gas temperature; determining a hydraulic device circulation flow rate based on the compressor frequency, the compressor displacement, the compressor volumetric efficiency, and the return gas density; and determining a hydraulic device condenser outlet enthalpy based on the condenser outlet temperature, and determining hydraulic device absorption outdoor unit heat quantity based on the hydraulic device condenser outlet enthalpy, the hydraulic device circulation flow rate, and the hydraulic device return gas enthalpy.

[0012] In one embodiment, the determining the condenser heating capacity and the evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data includes: determining a condenser average inlet enthalpy, a condenser average outlet enthalpy, an evaporator average outlet enthalpy, and an evaporator inlet enthalpy based on the outdoor unit data, the indoor unit data, and the hydraulic device data; extracting a compressor circulation flow rate of an outdoor unit from the outdoor unit data; determining the condenser heating capacity based on the compressor circulation flow rate, the condenser average inlet enthalpy, and the condenser average outlet enthalpy; and determining the evaporator cooling capacity based on the compressor circulation flow rate, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy.

[0013] In one embodiment, the determining the condenser average inlet enthalpy, the condenser average outlet enthalpy, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy based on the outdoor unit data, the indoor unit data, and the hydraulic device data includes: extracting a compressor return gas pressure, an external heat exchanger inlet temperature, an external heat exchanger outlet temperature, and a compressor exhaust pressure of an outdoor unit from the outdoor unit data; extracting a heat exchanger inlet temperature of a heating indoor unit, an outlet temperature of the heating indoor unit, and an outlet temperature of a cooling indoor unit from the indoor unit data; extracting a heat exchanger inlet temperature of a hydraulic device and a heat exchanger outlet temperature of the hydraulic device from the hydraulic device data; determining the condenser average inlet enthalpy based on the heat exchanger inlet temperature of the hydraulic device, the heat exchanger inlet temperature of the heating indoor unit, the external heat exchanger inlet temperature, and the compressor exhaust pressure; determining the condenser average outlet enthalpy based on the heat exchanger outlet temperature of the hydraulic device, the outlet temperature of the heating indoor unit, and the external heat exchanger outlet temperature, and determining the condenser average outlet enthalpy as the evaporator inlet enthalpy; and determining the evaporator average outlet enthalpy based on the cooling indoor unit outlet temperature and the compressor return gas pressure.

[0014] In addition, embodiments of the present disclosure provide a heat recovery multi-split air conditioner. The heat recovery multi-split air conditioner includes a memory, a processor, and a multi-split air conditioner power consumption detection program stored in the memory and executable on the processor The multi-split air conditioner power consumption detection program, when executed by the processor, implements the method for detecting the power consumption of the multi-split air conditioner as described above.

[0015] In addition, embodiments of the present disclosure provide a storage medium having a multi-split air conditioner power consumption detection program stored thereon. The multi-split air conditioner power consumption detection program, when executed by a processor, implements the method for detecting the power consumption of the multi-split air conditioner as described above.

[0016] In addition, embodiments of the present disclosure provide an apparatus for detecting power consumption of a multi-split air conditioner. The apparatus includes a determination module, an acquiring module, and a detection module. The determination module is configured to acquire hydraulic device data of a heat recovery multi-split air

conditioner and determine a hydraulic device heat absorption value based on the hydraulic device data. The acquiring module is configured to acquire outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner. The determination module is further configured to determine a condenser heating capacity and an evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data. The detection module is configured to determine indoor unit power consumption and hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0017] In the present disclosure, the hydraulic device data of the heat recovery multi-split air conditioner is acquired, and the hydraulic device heat absorption value is determined based on the hydraulic device data. Further, the outdoor unit data, the indoor unit data, and the power consumption data of the heat recovery multi-split air conditioner are acquired, and the condenser heating capacity and the evaporator cooling capacity are determined based on the outdoor unit data, the indoor unit data, and the hydraulic device data. Furthermore, the indoor unit power consumption and the hydraulic device power consumption are determined based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity. Compared with an existing method of detecting overall power consumption of a multi-split air conditioner only, in the present disclosure, it is possible to determine the indoor unit power consumption and the hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity. Therefore, a defect in the related art that power consumed by each indoor unit and the hydraulic device cannot be detected is overcome. Accordingly, power consumption of each indoor unit and the hydraulic device of the heat recovery multi-split air conditioner can be quickly detected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a schematic structural diagram of a hardware operating environment of a heat recovery multi-split air conditioner according to an embodiment of the present disclosure.

FIG. 2 is a flowchart illustrating an embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure.

FIG. 3 is a schematic diagram of a power consumption detection system of a heat recovery multi-split air conditioner according to an embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure.

FIG. 4 is a flowchart illustrating another embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure.

FIG. 5 is a schematic diagram of a system circulation when only a high-temperature hydraulic device is turned on according to an embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure.

FIG. 6 is a flowchart illustrating yet another embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure.

FIG. 7 is a schematic diagram of a heat recovery multi-split air conditioner system operating in a main cooling mode according to an embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure.

FIG. 8 is a flowchart illustrating still yet another embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure.

FIG. 9 is a schematic diagram of a heat recovery multi-split air conditioner system operating in a main heating mode according to an embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure.

FIG. 10 is a block diagram showing a structure of an embodiment of an apparatus for detecting power consumption of a multi-split air conditioner of the present disclosure.

Reference numerals of the accompanying drawings:

1	outdoor unit	22	refrigerant switching device cooling solenoid valve
11	outdoor unit internal compressor	23	refrigerant switching device heating solenoid valve
12	four-way valve	24	refrigerant switching device cooling solenoid valve
13	four-way valve	3	indoor unit
14	external heat exchanger	31	indoor unit electronic expansion valve
15	outdoor unit main electronic expansion valve	32	indoor unit heat exchanger
16	economizer	4	hydraulic device
17	economizer auxiliary electronic expansion valve	41	hydraulic device compressor
18	liquid pipe stop valve	42	hydraulic device condenser
19	high-pressure gas pipe stop valve	43	first hydraulic device electronic expansion valve
110	low-pressure gas pipe stop valve	44	hydraulic device evaporator
111	low-pressure tank	45	second hydraulic device electronic expansion valve
2	refrigerant switching device	5	first electricity meter
21	refrigerant switching device heating solenoid valve	6	second electricity meter

[0019] Implementations of the objects, functional features, and advantages of the present disclosure will be further described in connection with the embodiments and with reference to the accompanying drawings.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0020] It should be understood that specific embodiments described herein are intended to explain the present disclosure only, rather than to limit the present disclosure.

[0021] Reference can be made to FIG. 1. FIG. 1 is a schematic structural diagram of a hardware operating environment of a heat recovery multi-split air conditioner according to an embodiment of the present disclosure.

[0022] As illustrated in FIG. 1, the heat recovery multi-split air conditioner may include a processor 1001 such as a Central Processing Unit (CPU), a communication bus 1002, a user interface 1003, a network interface 1004, and a memory 1005. The communication bus 1002 is configured to implement connection and communication between these components. The user interface 1003 may include a display. In some embodiments, the user interface 1003 may further include a standard wired interface and a wireless interface. In the present disclosure, the wired interface of the user interface 1003 may be a Universal Serial Bus (USB) interface. In some embodiments, the network interface 1004 may include a standard wired interface and a wireless interface (e.g., a Wireless-Fidelity (WI-FI) interface). The memory 1005 may be a high-speed Random Access Memory (RAM) or a Non-Volatile Memory (NVM), such as a disk memory. In some embodiments, the memory 1005 may further be a storage device independent of the aforementioned processor 1001.

[0023] It should be understood by those skilled in the art that the structure illustrated in FIG. 1 does not constitute a limitation on the heat recovery multi-split air conditioner. The heat recovery multi-split air conditioner may include more or fewer components than those illustrated in the drawings, or combine some components, or have different arrangements of the components.

[0024] As illustrated in FIG. 1, the memory 1005 regarded as a computer storage medium may include an operating system, a network communication device, a user interface device, and a multi-split air conditioner power consumption detection program.

[0025] In the heat recovery multi-split air conditioner illustrated in FIG. 1, the network interface 1004 is mainly configured to connect to a backend server to perform data communication with the backend server. The user interface 1003 is

mainly configured to connect to a user device. The heat recovery multi-split air conditioner invokes, through the processor 1001, the multi-split air conditioner power consumption detection program stored in the memory 1005, and performs the method for detecting the power consumption of the multi-split air conditioner according to the embodiments of the present disclosure.

[0026] Based on the above hardware structure, embodiments of the method for detecting the power consumption of the multi-split air conditioner of the present disclosure are provided.

[0027] Reference can be made to FIG. 2, and FIG. 2 is a flowchart illustrating an embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure. As illustrated in FIG. 2, an embodiment of a method for detecting the power consumption of the multi-split air conditioner of the present disclosure is provided.

[0028] At block S10, hydraulic device data of a heat recovery multi-split air conditioner is acquired, and a hydraulic device heat absorption value is determined based on the hydraulic device data.

[0029] It should be understood that an executive body of the embodiment is the heat recovery multi-split air conditioner, and the embodiment is not limited in this regard.

[0030] It should be noted that the hydraulic device data may include a return gas temperature, a compressor frequency, a compressor displacement, a compressor volumetric efficiency, a condenser outlet temperature, and a return gas pressure of a hydraulic device, and the embodiment is not limited in this regard.

[0031] It should be understood that acquiring the hydraulic device data of the heat recovery multi-split air conditioner may include acquiring the hydraulic device data of the heat recovery multi-split air conditioner by a predetermined sensor provided on the hydraulic device. The predetermined sensor may be preset by a manufacturer of the heat recovery multi-split air conditioner, and the present disclosure is not limited to this embodiment.

[0032] It should be understood that determining the hydraulic device heat absorption value based on the hydraulic device data may include determining the hydraulic device heat absorption value based on the hydraulic device data through a predetermined heat absorption model. The predetermined heat absorption model may be preset by the manufacturer of the heat recovery multi-split air conditioner, and the present disclosure is not limited to this embodiment.

[0033] Further, in order to improve accuracy and reliability of hydraulic device absorption outdoor unit heat, acquiring the hydraulic device data of the heat recovery multi-split air conditioner and determining the hydraulic device heat absorption value based on the hydraulic device data includes: acquiring the hydraulic device data of the heat recovery multi-split air conditioner, and determining a return gas temperature, a compressor frequency, a compressor displacement, a compressor volumetric efficiency, a condenser outlet temperature, and a return gas pressure of a hydraulic device based on the hydraulic device data; determining a return gas density and a hydraulic device return gas enthalpy based on the return gas pressure and the return gas temperature; determining a hydraulic device circulation flow rate based on the compressor frequency, the compressor displacement, the compressor volumetric efficiency, and the return gas density; and determining a hydraulic device condenser outlet enthalpy based on the condenser outlet temperature, and determining hydraulic device absorption outdoor unit heat quantity based on the hydraulic device condenser outlet enthalpy, the hydraulic device circulation flow rate, and the hydraulic device return gas enthalpy.

[0034] At block S20, outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner are acquired.

[0035] It should be noted that the outdoor unit data may include data such as a compressor return gas pressure, an external heat exchanger inlet temperature, an external heat exchanger outlet temperature, and compressor exhaust pressure of an outdoor unit, and the present disclosure is not limited to this embodiment. The indoor unit data may be data such as a heat exchanger inlet temperature of a heating indoor unit, an outlet temperature of the heating indoor unit, and an outlet temperature of a cooling indoor unit, and the present disclosure is not limited to this embodiment. The power consumption data may include first power consumption data and second power consumption data. The first power consumption data may be power consumption data of the outdoor unit. The second power consumption data may be power consumption data of the hydraulic device. The embodiment is not limited in this regard.

[0036] In an exemplary implementation, for ease of understanding, description is made with reference to FIG. 3. FIG. 3 is a schematic diagram of a power consumption detection system of a heat recovery multi-split air conditioner. In FIG. 3, the outdoor unit of the heat recovery multi-split air conditioner is denoted at 1, a refrigerant switching device of the heat recovery multi-split air conditioner is denoted at 2, the indoor unit of the heat recovery multi-split air conditioner is denoted at 3, the hydraulic device is denoted at 4, a first electricity meter is denoted at 5, and a second electricity meter is denoted at 6. The first electricity meter is configured to measure the power consumption data of the outdoor unit. The second electricity meter is configured to measure the power consumption data of the hydraulic device.

[0037] At block S30, a condenser heating capacity and an evaporator cooling capacity are determined based on the outdoor unit data, the indoor unit data, and the hydraulic device data.

[0038] It should be noted that the condenser heating capacity may be used to represent a total condensation capacity. When the heat recovery multi-split air conditioner is in a main cooling mode, the total condensation capacity includes a heat exchanger capacity of the outdoor unit, a heating indoor unit capacity, and the hydraulic device absorption outdoor unit heat. When the heat recovery multi-split air conditioner is in a main heating mode, the total condensation capacity

includes the heating indoor unit capacity and the hydraulic device absorption outdoor unit heat. In this and other embodiments, Q_h represents the total condensation capacity.

[0039] The evaporator cooling capacity may be used to represent a total evaporation capacity. When the heat recovery multi-split air conditioner is in the main cooling mode, the total evaporation capacity includes a total cooling indoor unit capacity. When the heat recovery multi-split air conditioner is in the main heating mode, the total evaporation capacity includes the total cooling indoor unit capacity and the heat exchanger capacity of the outdoor unit. In this and other embodiments, Q_c represents the total evaporation capacity.

[0040] It should be understood that determining the condenser heating capacity and the evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data may include: determining a condenser average inlet enthalpy, a condenser average outlet enthalpy, an evaporator average outlet enthalpy, and an evaporator inlet enthalpy based on the outdoor unit data, the indoor unit data, and the hydraulic device data; extracting a compressor circulation flow rate of an outdoor unit from the outdoor unit data; determining the condenser heating capacity based on the compressor circulation flow rate, the condenser average inlet enthalpy, and the condenser average outlet enthalpy; and determining the evaporator cooling capacity based on the compressor circulation flow rate, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy.

[0041] At block S40, indoor unit power consumption and hydraulic device power consumption are determined based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0042] It should be understood that determining the indoor unit power consumption and the hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity may include: acquiring a current operation mode of the heat recovery multi-split air conditioner; and determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0043] It should be understood that determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity may include: extracting target power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode; determining heating indoor unit power consumption through a first predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining cooling indoor unit power consumption through a first predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining the hydraulic device power consumption through a first predetermined hydraulic device power consumption model based on the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity; and determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

[0044] Or, it should be understood that determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity may include: extracting first power consumption data and second power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode; determining heating indoor unit power consumption through a second predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining cooling indoor unit power consumption through a second predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining the hydraulic device power consumption through a second predetermined hydraulic device power consumption model based on the first power consumption data, the second power consumption data, the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity; and determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

[0045] In the embodiment, the hydraulic device data of the heat recovery multi-split air conditioner is acquired, and the hydraulic device heat absorption value is determined based on the hydraulic device data. Further, the outdoor unit data, the indoor unit data, and the power consumption data of the heat recovery multi-split air conditioner are acquired, and the condenser heating capacity and the evaporator cooling capacity are determined based on the outdoor unit data, the indoor unit data, and the hydraulic device data. Furthermore, the indoor unit power consumption and the hydraulic device power consumption are determined based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity. Compared with an existing method of detecting

overall power consumption of the multi-split air conditioner only, in the embodiment, it is possible to determine the indoor unit power consumption and the hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity. Therefore, a defect in the related art that power consumed by each indoor unit and the hydraulic device cannot be detected is overcome. Accordingly, power consumption of each indoor unit and the hydraulic device of the heat recovery multi-split air conditioner can be quickly detected.

[0046] Reference can be made to FIG. 4, which is a flowchart illustrating another embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure. This embodiment of the method for detecting the power consumption of the multi-split air conditioner of the present disclosure is provided based on the embodiment illustrated in FIG. 2.

[0047] In the embodiment, the operation at block S10 includes operations at blocks S101 to S104.

[0048] At block S101, the hydraulic device data of the heat recovery multi-split air conditioner is acquired, and a return gas temperature, a compressor frequency, a compressor displacement, a compressor volumetric efficiency, a condenser outlet temperature, and a return gas pressure of a hydraulic device are determined based on the hydraulic device data.

[0049] It should be noted that the hydraulic device data may include the return gas temperature, the compressor frequency, the compressor displacement, the compressor volumetric efficiency, the condenser outlet temperature, and the return gas pressure of the hydraulic device. The embodiment is not limited in this regard.

[0050] At block S102, a return gas density and a hydraulic device return gas enthalpy are determined based on the return gas pressure and the return gas temperature.

[0051] It should be understood that since the hydraulic device is in a one-phase region when returning gas, the hydraulic device return gas enthalpy may be determined directly based on the return gas pressure and the return gas temperature of the hydraulic device.

[0052] At block S103, a hydraulic device circulation flow rate is determined based on the compressor frequency, the compressor displacement, the compressor volumetric efficiency, and the return gas density.

[0053] It should be understood that determining the hydraulic device circulation flow rate based on the compressor frequency, the compressor displacement, the compressor volumetric efficiency, and the return gas density may include determining the hydraulic device circulation flow rate through a predetermined flow rate model based on the compressor frequency, the compressor displacement, the compressor volumetric efficiency, and the return gas density. The predetermined flow rate model may be preset by the manufacturer of the heat recovery multi-split air conditioner, and the present disclosure is not limited to this embodiment.

[0054] At block S104, a hydraulic device condenser outlet enthalpy is determined based on the condenser outlet temperature, and hydraulic device absorption outdoor unit heat quantity is determined based on the hydraulic device condenser outlet enthalpy, the hydraulic device circulation flow rate, and the hydraulic device return gas enthalpy.

[0055] It should be understood that since a refrigerant is in a liquid state when the hydraulic device returns gas, the hydraulic device condenser outlet enthalpy may be determined directly based on the condenser outlet temperature.

[0056] It should be understood that determining the hydraulic device absorption outdoor unit heat quantity based on the hydraulic device condenser outlet enthalpy, the hydraulic device circulation flow rate, and the hydraulic device return gas enthalpy may be that the hydraulic device absorption outdoor unit heat quantity=to the hydraulic device circulation flow rate*(the hydraulic device return gas enthalpy-the hydraulic device condenser outlet enthalpy). In this embodiment and other embodiments, $Q_{hydraulic}$ represents the hydraulic device absorption outdoor unit heat.

[0057] In the embodiment, the hydraulic device data of the heat recovery multi-split air conditioner is acquired, and the return gas temperature, the compressor frequency, the compressor displacement, the compressor volumetric efficiency, the condenser outlet temperature, and the return gas pressure of the hydraulic device are determined based on the hydraulic device data. Further, the return gas density and the hydraulic device return gas enthalpy are determined based on the return gas pressure and the return gas temperature, and the hydraulic device circulation flow rate is determined based on the compressor frequency, the compressor displacement, the compressor volumetric efficiency, and the return gas density. Furthermore, the hydraulic device condenser outlet enthalpy is determined based on the condenser outlet temperature, and the hydraulic device absorption outdoor unit heat quantity is determined based on the hydraulic device condenser outlet enthalpy, the hydraulic device circulation flow rate, and the hydraulic device return gas enthalpy. Therefore, the accuracy and reliability of the hydraulic device absorption outdoor unit heat quantity can be improved.

[0058] In the embodiment, the operation at block S30 includes operations at blocks S301 to S304.

[0059] At block S301, a condenser average inlet enthalpy, a condenser average outlet enthalpy, an evaporator average outlet enthalpy, and an evaporator inlet enthalpy are determined based on the outdoor unit data, the indoor unit data, and the hydraulic device data.

[0060] It should be understood that determining the condenser average inlet enthalpy, the condenser average outlet enthalpy, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy based on the outdoor unit data, the indoor unit data, and the hydraulic device data may include: determining the condenser average inlet enthalpy, the

condenser average outlet enthalpy, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy through a predetermined enthalpy model based on the outdoor unit data, the indoor unit data, and the hydraulic device data. The predetermined enthalpy model may be preset by the manufacturer of the heat recovery multi-split air conditioner, and the present disclosure is not limited to this embodiment.

[0061] Further, in order to improve accuracy of the enthalpy, the operation at block S301 includes: extracting a compressor return gas pressure, an external heat exchanger inlet temperature, an external heat exchanger outlet temperature, and a compressor exhaust pressure of an outdoor unit from the outdoor unit data; extracting a heat exchanger inlet temperature of a heating indoor unit, an outlet temperature of the heating indoor unit, and an outlet temperature of a cooling indoor unit from the indoor unit data; extracting a heat exchanger inlet temperature of a hydraulic device and a heat exchanger outlet temperature of the hydraulic device from the hydraulic device data; determining the condenser average inlet enthalpy based on the heat exchanger inlet temperature of the hydraulic device, the heat exchanger inlet temperature of the heating indoor unit, the external heat exchanger inlet temperature, and the compressor exhaust pressure; determining the condenser average outlet enthalpy based on the heat exchanger outlet temperature of the hydraulic device, the outlet temperature of the heating indoor unit, and the external heat exchanger outlet temperature, and determining the condenser average outlet enthalpy as the evaporator inlet enthalpy; and determining the evaporator average outlet enthalpy based on the cooling indoor unit outlet temperature and the compressor return gas pressure.

[0062] It should be noted that the compressor exhaust pressure is a system high pressure and the compressor return gas pressure is a system low pressure, and the embodiment is not limited in this regard.

[0063] It should be understood that determining the condenser average inlet enthalpy based on the heat exchanger inlet temperature of the hydraulic device, the heat exchanger inlet temperature of the heating indoor unit, the external heat exchanger inlet temperature, and the compressor exhaust pressure may include: determining inlet enthalpy of each component of a condenser based on the heat exchanger inlet temperature of the hydraulic device, the heat exchanger inlet temperature of the heating indoor unit, the external heat exchanger inlet temperature, and the compressor exhaust pressure, and determining the condenser average inlet enthalpy based on the inlet enthalpy of each component of the condenser.

[0064] It should be understood that determining the condenser average outlet enthalpy based on the heat exchanger outlet temperature of the hydraulic device, the outlet temperature of the heating indoor unit, and the external heat exchanger outlet temperature may include: determining outlet enthalpy of each component of the condenser based on the heat exchanger outlet temperature of the hydraulic device, the outlet temperature of the heating indoor unit, and the external heat exchanger outlet temperature, and determining the condenser average outlet enthalpy based on the outlet enthalpy of each component of the condenser

[0065] At block S302, a compressor circulation flow rate of an outdoor unit is extracted from the outdoor unit data.

[0066] It should be understood that extracting the compressor circulation flow rate of the outdoor unit from the outdoor unit data may include: performing an identifier extraction on the outdoor unit data to obtain a data identifier, and determining the compressor circulation flow rate of the outdoor unit based on the data identifier. The data identifier may be an identity identifier set for the outdoor unit data when the outdoor unit data is stored, and the embodiment is not limited in this regard.

[0067] At block S303, the condenser heating capacity is determined based on the compressor circulation flow rate, the condenser average inlet enthalpy, and the condenser average outlet enthalpy.

[0068] It should be noted that the condenser heating capacity may be used to represent a total condensation capacity. When the heat recovery multi-split air conditioner is in the main cooling mode, the total condensation capacity includes the heat exchanger capacity of the outdoor unit, the heating indoor unit capacity, and the hydraulic device absorption outdoor unit heat. When the heat recovery multi-split air conditioner is in the main heating mode, the total condensation capacity includes the heating indoor unit capacity and the hydraulic device absorption outdoor unit heat. In this and other embodiments, Q_h represents the total condensation capacity.

[0069] It should be understood that determining the condenser heating capacity based on the compressor circulation flow rate, the condenser average inlet enthalpy, and the condenser average outlet enthalpy may be that the total condensation capacity Q_h = the compressor circulation flow rate*(the condenser average inlet enthalpy-the condenser average outlet enthalpy).

[0070] At block S304, the evaporator cooling capacity is determined based on the compressor circulation flow rate, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy.

[0071] It should be noted that the evaporator cooling capacity may be used to represent the total evaporation capacity. When the heat recovery multi-split air conditioner is in the main cooling mode, the total evaporation capacity includes the total cooling indoor unit capacity. When the heat recovery multi-split air conditioner is in the main heating mode, the total evaporation capacity includes the total cooling indoor unit capacity and the heat exchanger capacity of the outdoor unit. In this and other embodiments, Q_c represents the total evaporation capacity.

[0072] It should be understood that determining the evaporator cooling capacity based on the compressor circulation flow rate, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy may be that the total evaporation capacity Q_c = the compressor circulation flow rate*(the evaporator average outlet enthalpy-the evaporator inlet enthalpy).

[0073] In this embodiment, the condenser average inlet enthalpy, the condenser average outlet enthalpy, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy are determined based on the outdoor unit data, the indoor unit data, and the hydraulic device data. Further, the compressor circulation flow rate of the outdoor unit is extracted from the outdoor unit data, and the condenser heating capacity is determined based on the compressor circulation flow rate, the condenser average inlet enthalpy, and the condenser average outlet enthalpy. Furthermore, the evaporator cooling capacity is determined based on the compressor circulation flow rate, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy. Therefore, accuracy of the condenser heating capacity and the evaporator cooling capacity can be increased.

[0074] In the embodiment, the operation at block S40 includes operations at blocks S401 and S402.

[0075] At block S401, a current operation mode of the heat recovery multi-split air conditioner is acquired.

[0076] It should be noted that an operation mode of the heat recovery multi-split air conditioner may include a predetermined only hydraulic device ON mode, the predetermined main cooling mode, and a predetermined main heating mode, and the embodiment is not limited in this regard. The predetermined only hydraulic device ON mode may be an operation mode in which the hydraulic device of the heat recovery multi-split air conditioner is turned on and the indoor unit is not turned on. The predetermined main cooling mode may be an operation mode in which the indoor unit and the high-temperature hydraulic device of the heat recovery multi-split air conditioner are turned on simultaneously and an outdoor unit heat exchanger is the condenser. The predetermined main heating mode may be an operation mode in which the indoor unit and the high-temperature hydraulic device of the heat recovery multi-split air conditioner are turned on simultaneously and the outdoor unit heat exchanger is an evaporator.

[0077] In an exemplary implementation, for ease of understanding, description is made with reference to FIG. 5. FIG. 5 is a schematic diagram of a system circulation when only a high-temperature hydraulic device is turned on. In FIG. 5, the outdoor unit of the heat recovery multi-split air conditioner system is denoted at 1, the refrigerant switching device is denoted at 2, the indoor unit of the heat recovery multi-split air conditioner system is denoted at 3, and the high-temperature hydraulic device is denoted at 4. An interior of the outdoor unit is provided with a compressor 11, a four-way valve 12 for switching a state of an external heat exchanger 14 to determine whether the external heat exchanger 14 is used as the evaporator or the condenser, a four-way valve 13 for switching a state of a high-pressure gas pipe. In addition, the external heat exchanger is denoted at 14, an outdoor unit main electronic expansion valve is denoted at 15, an economizer is denoted at 16, an economizer auxiliary electronic expansion valve is denoted at 17, a liquid pipe stop valve is denoted at 18, a high-pressure gas pipe stop valve is denoted at 19, a low-pressure gas pipe stop valve is denoted at 110, and a low-pressure tank is denoted at 111, refrigerant switching device heating solenoid valves are denoted at 21 and 23, refrigerant switching device cooling solenoid valves are denoted at 22 and 24, an indoor unit electronic expansion valve is denoted at 31, an indoor unit heat exchanger is denoted at 32, a hydraulic device compressor is denoted at 41, a hydraulic device condenser for heat exchange between a refrigerant of the hydraulic device and water is denoted at 42, a first hydraulic device electronic expansion valve is denoted at 43, a hydraulic device evaporator for heat exchange between a refrigerant in the hydraulic device and a refrigerant of the outdoor unit is denoted at 44, and a second hydraulic device electronic expansion valve is denoted at 45, which controls a flow rate of a refrigerant from the outdoor unit into the hydraulic device.

[0078] In this case, a circulation of an external refrigerant R410a only flows through the high-temperature hydraulic device. The high-temperature hydraulic device absorbs heat from the refrigerant R410a of the outdoor unit, and then heats water through a circulation of a refrigerant R134a. The second electricity meter measures power consumption of the hydraulic device itself. The first electricity meter measures power consumption of the outdoor unit. In addition, since the outdoor unit is only used to run the high-temperature hydraulic device in this case, all power measured by the first electricity meter is consumed by the hydraulic device. Therefore, the power consumption of the hydraulic device is a total power measured by the first electricity meter and the second electricity meter.

[0079] At block S402, the indoor unit power consumption and the hydraulic device power consumption are determined based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0080] It should be understood that determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity may include: extracting target power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode; determining heating indoor unit power consumption through a first predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining cooling indoor unit power consumption through a first predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining the hydraulic device power consumption through a first predetermined hydraulic device power consumption model based on the hydraulic device heat absorption value, the condenser heating

capacity, and the evaporator cooling capacity; and determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

[0081] Or, it should be understood that determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity may include: extracting first power consumption data and second power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode; determining heating indoor unit power consumption through a second predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining cooling indoor unit power consumption through a second predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining the hydraulic device power consumption through a second predetermined hydraulic device power consumption model based on the first power consumption data, the second power consumption data, the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity; and determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

[0082] In this embodiment, the current operation mode of the heat recovery multi-split air conditioner is acquired. Further, the indoor unit power consumption and the hydraulic device power consumption are determined based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity. Therefore, the indoor unit power consumption and the hydraulic device power consumption can be determined quickly.

[0083] Reference can be made to FIG. 6, which is a flowchart illustrating yet another embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure. This embodiment of the method for detecting the power consumption of the multi-split air conditioner of the present disclosure is provided based on the embodiment illustrated in FIG. 4.

[0084] In this embodiment, the operation at block S402 includes operations at blocks S4021 to S4025.

[0085] At block S4021, target power consumption data is extracted from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode.

[0086] In an exemplary implementation, for ease of understanding, description is made with reference is to FIG. 7. FIG. 7 is a schematic diagram of a heat recovery multi-split air conditioner system operating in a main cooling mode. When the current operation mode is the main cooling mode, the indoor unit and the high-temperature hydraulic device are turned on simultaneously and the outdoor unit heat exchanger is the condenser In this case, the refrigerant R410a of the outdoor unit is condensed into a liquid refrigerant in the external heat exchanger, the heating indoor unit, and the high-temperature hydraulic device to release heat, enters the cooling indoor unit to be evaporated, and then flows back to the compressor for a recirculation. In this case, the hydraulic device can absorb heat from the refrigerant R410a of the outdoor unit, and then carry out one recirculation of R134a to exchange heat with water for condensation to release heat to heat the water. For a use side, the refrigerant of the outdoor unit circulates through the high-temperature hydraulic device, the heating indoor unit, and the cooling indoor unit. Therefore, calculating a proportion of power consumption of each part requires calculation of a proportion of a capacity of the part.

[0087] In an exemplary implementation, the target power consumption data may be measurement data of the first electricity meter, and the present disclosure is not limited to this embodiment.

[0088] At block S4022, heating indoor unit power consumption is determined through a first predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0089] It should be noted that the heating indoor unit power consumption may be power consumption of an *i*-th heating indoor unit of the heat recovery multi-split air conditioner, where *i* may be preset by a user and the present disclosure is not limited to this embodiment.

[0090] It should be understood that the first predetermined heating indoor unit power consumption model may satisfy:

$$I_{i\text{heating}}=\sum_{j}^{j+n}K_i*A_i*\frac{T_c-T_{1i}}{\sum K_i*A_i*(T_c-T_{1i})+KA*(T_c-T_4)}*\frac{Q_n-Q_{\text{hydraulic}}}{\sum K_i*A_i*\frac{T_c-T_{1i}}{\sum K_i*A_i*(T_c-T_{1i})+KA*(T_c-T_4)}*(Q_n-Q_{\text{hydraulic}})+Q_{\text{hydraulic}}+Q_c}*M_{i1}.$$

[0091] In the above equation, $I_{i\text{heating}}$ represents the power consumption of the *i*-th heating indoor unit, $j \sim j+n$ represent a time period during which power consumption is detected, K_i represents a heat transfer coefficient of the *i*-th heating indoor unit, A_i represents a heat transfer area of the *i*-th heating indoor unit, T_{1i} represents a high pressure saturation temperature, K represents a heat transfer coefficient of the outdoor unit, A represents a heat transfer area of the outdoor

unit, T_4 represents an ambient temperature of the outdoor unit, $Q_{hydraulic}$ represents the hydraulic device absorption outdoor unit heat, Q_h represents the total condensation capacity, i.e., the condenser heating capacity, Q_c represents the total evaporation capacity, i.e., the evaporator cooling capacity, and M_{i1} represents the target power consumption data.

[0092] It should be noted that, the heat transfer coefficient and the heat transfer area of the heating indoor unit may be obtained based on the indoor unit data, the heat transfer coefficient, the heat transfer area, and the ambient temperature of the outdoor unit may be obtained based on the outdoor unit data, and the embodiment is not limited in this regard.

[0093] At block S4023, cooling indoor unit power consumption is determined through a first predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0094] It should be noted that the cooling indoor unit power consumption may be power consumption of a *k* -th cooling indoor unit of the heat recovery multi-split air conditioner *k* may be preset by the user and the present disclosure is not limited to this embodiment.

[0095] It should be understood that the first predetermined cooling indoor unit power consumption model may satisfy:

$$I_{k\text{cooling}} = \sum_{j}^{j+n} \frac{cvk}{\sum cvk} * \frac{Q_c}{\sum K_i * A_i * \frac{T_c - T_{1i}}{\sum K_i * A_i * (T_c - T_{1i}) + KA * (T_c - T_4)} * (Q_h - Q_{\text{hydraulic}}) + Q_{\text{hydraulic}} + Q_c} * M_{i1}.$$

[0096] In the above equation, $I_{k\text{cooling}}$ represents the power consumption of the *k* -th cooling indoor unit, $j \sim j + n$ represent the time period during which the power consumption is detected, *cvk* represents a flow rate coefficient of a *k* -th indoor unit, K_i represents the heat transfer coefficient of the *i*-th heating indoor unit, A_i represents the heat transfer area of the *i*-th heating indoor unit, T_{1i} represents the high pressure saturation temperature, *K* represents the heat transfer coefficient of the outdoor unit, *A* represents the heat transfer area of the outdoor unit, T_4 represents the ambient temperature of the outdoor unit, $Q_{hydraulic}$ represents the hydraulic device absorption outdoor unit heat, Q_h represents the total condensation capacity, i.e., the condenser heating capacity, Q_c represents the total evaporation capacity, i.e., the evaporator cooling capacity, and M_{i1} represents the target power consumption data.

[0097] At block S4024, the hydraulic device power consumption is determined through a first predetermined hydraulic device power consumption model based on the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity.

[0098] It should be understood that the first predetermined hydraulic device power consumption model may satisfy:

$$I_{\text{hydraulic}} = \sum_{j}^{j+n} \frac{Q_{\text{hydraulic}}}{\sum K_i * A_i * \frac{T_c - T_{1i}}{\sum K_i * A_i * (T_c - T_{1i}) + KA * (T_c - T_4)} * (Q_h - Q_{\text{hydraulic}}) + Q_{\text{hydraulic}} + Q_c}.$$

[0099] In the above equation, $I_{\text{hydraulic}}$ represents the power consumption of the hydraulic device, $j \sim j + n$ represent the time period during which the power consumption is detected, K_i represents the heat transfer coefficient of the *i*-th heating indoor unit, A_i represents the heat transfer area of the *i*-th heating indoor unit, T_{1i} represents the high pressure saturation temperature, *K* represents the heat transfer coefficient of the outdoor unit, *A* represents the heat transfer area of the outdoor unit, T_4 represents the ambient temperature of the outdoor unit, $Q_{hydraulic}$ represents the hydraulic device absorption outdoor unit heat, Q_h represents the total condensation capacity, i.e., the condenser heating capacity, Q_c represents the total evaporation capacity, i.e., the evaporator cooling capacity, and M_{i1} represents the target power consumption data.

[0100] At block S4025, the indoor unit power consumption is determined based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

[0101] It should be noted that the indoor unit power consumption may be a sum of the power consumption of the *i*-th heating indoor unit and the power consumption of the *k* -th cooling indoor unit, or a sum of power consumption of all heating indoor units and power consumption of all cooling indoor units.

[0102] In the embodiment, the target power consumption data is extracted from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is the predetermined main cooling mode. Further, the heating indoor unit power consumption is determined through the first predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity, and the cooling indoor unit power consumption is determined through the first predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling

capacity. Furthermore, the hydraulic device power consumption is determined through the first predetermined hydraulic device power consumption model based on the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity, and the indoor unit power consumption is determined based on the heating indoor unit power consumption and the cooling indoor unit power consumption. Therefore, power consumption of each heating indoor unit, each cooling indoor unit, and the hydraulic device is calculated separately when the current operation mode of the heat recovery multi-split air conditioner is the predetermined main cooling mode. Therefore, accuracy of power consumption measurements of the indoor unit and the hydraulic device can be enhanced.

[0103] Reference can be made to FIG. 8, which is a flowchart illustrating still yet another embodiment of a method for detecting power consumption of a multi-split air conditioner of the present disclosure. This embodiment of the method for detecting the power consumption of the multi-split air conditioner of the present disclosure is provided based on the embodiment illustrated in FIG. 4.

[0104] In the embodiment, the operation at block S402 includes operations at blocks S4021' to S4025'.

[0105] At block S4021', first power consumption data and second power consumption data are extracted from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode.

[0106] In an exemplary implementation, for ease of understanding, description is made with reference is to FIG. 7. FIG. 7 is a schematic diagram of a heat recovery multi-split air conditioner system operating in a main heating mode. When the current operation mode of the heat recovery multi-split air conditioner is the predetermined main heating mode, the indoor unit and the high-temperature hydraulic device are turned on simultaneously and the outdoor unit heat exchanger is the evaporator. In this case, the refrigerant R410a of the outdoor unit is condensed into a liquid refrigerant in the heating indoor unit and the high-temperature hydraulic device to release heat, enters the cooling indoor unit and the outdoor unit heat exchanger to be evaporated, and then flows back to the compressor for a recirculation. In this case, the hydraulic device can absorb heat from the refrigerant R410a of the outdoor unit, and then carry out one recirculation of R134a to exchange heat with water for condensation to release heat to heat the water. For a use side, the refrigerant of the outdoor unit circulates through the high-temperature hydraulic device, the heating indoor unit, and the cooling indoor unit. Likewise, calculating the proportion of the power consumption of each part requires calculation of the proportion of the capacity of the part.

[0107] It should be noted that the first power consumption data may be the power consumption data of the outdoor unit, the second power consumption data may be the power consumption data of the hydraulic device, and the embodiment is not limited in this regard.

[0108] At block S4022', heating indoor unit power consumption is determined through a second predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0109] It should be noted that the heating indoor unit power consumption may be the power consumption of the i-th heating indoor unit of the heat recovery multi-split air conditioner, where i may be preset by the user and the present disclosure is not limited to this embodiment.

[0110] It should be understood that the second predetermined heating indoor unit power consumption model may satisfy:

$$I'_{i\text{heating}} = \sum_{j}^{j+n} K_i * A_i * \frac{T_c - T_{1i}}{\sum K_i * A_i (T_c - T_{1i})} * \frac{Q_h - Q_{\text{hydraulic}}}{Q_h + \frac{\sum cvk}{\sum cvk + cv} * Q_c} * M_{i1}$$

[0111] In the above equation, $I'_{i\text{heating}}$ represents the power consumption of the i-th heating indoor unit, $j \sim j+n$ represent the time period during which the power consumption is detected, K_i represents the heat transfer coefficient of the i-th heating indoor unit, A_i represents the heat transfer area of the i-th heating indoor unit, T_{1i} represents the high pressure saturation temperature, cvk represents the flow rate coefficient of the k-th indoor unit, cv represents an electronic expansion valve flow rate coefficient of the outdoor unit, $Q_{\text{hydraulic}}$ represents the hydraulic device absorption outdoor unit heat, Q_h represents the total condensation capacity, i.e., the condenser heating capacity, Q_c represents the total evaporation capacity, i.e., the evaporator cooling capacity, and M_{i1} represents the first power consumption data.

[0112] At block S4023', cooling indoor unit power consumption is determined through a second predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0113] It should be noted that the cooling indoor unit power consumption may be the power consumption of the *k* -th cooling indoor unit of the heat recovery multi-split air conditioner, where *k* may be preset by the user and the present disclosure is not limited to this embodiment.

[0114] It should be understood that the second predetermined cooling indoor unit power consumption model may satisfy:

$$I'_{k\text{cooling}} = \sum_{j}^{j+n} \frac{\sum cvk}{\sum cvk + cv} * \frac{Q_c}{Q_h + \frac{\sum cvk}{\sum cvk + cv} * Q_c} * M_{i1} .$$

[0115] In the above equation, $I'_{k\text{cooling}}$ represents the power consumption of the *k* -th cooling indoor unit, *j* ~ *j* + *n* represent the time period during which the power consumption is detected, K_i represents the heat transfer coefficient of the *i* -th heating indoor unit, A_i represents the heat transfer area of the *i* -th heating indoor unit, T_{1i} represents the high pressure saturation temperature, *cvk* represents the flow rate coefficient of the *k* -th indoor unit, *cv* represents the electronic expansion valve flow rate coefficient of the outdoor unit, $Q_{\text{hydraulic}}$ represents the hydraulic device absorption outdoor unit heat, Q_h represents the total condensation capacity, i.e., the condenser heating capacity, Q_c represents the total evaporation capacity, i.e., the evaporator cooling capacity, and M_{i1} represents the first power consumption data.

[0116] At block S4024', the hydraulic device power consumption is determined through a second predetermined hydraulic device power consumption model based on the first power consumption data, the second power consumption data, the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity.

[0117] It should be understood that the second predetermined hydraulic device power consumption model may satisfy:

$$I'_{\text{hydraulic}} = \sum_{j}^{j+n} \frac{Q_{\text{hydraulic}}}{Q_h + \frac{\sum cvk}{\sum cvk + cv} * Q_c} * M_{i1} + M_{i2} .$$

[0118] In the above equation, $I'_{\text{hydraulic}}$ represents the power consumption of the hydraulic device, *cvk* represents the flow rate coefficient of the *k* -th indoor unit, *cv* represents the electronic expansion valve flow rate coefficient of the outdoor unit, $Q_{\text{hydraulic}}$ represents the hydraulic device absorption outdoor unit heat, Q_h represents the total condensation capacity, i.e., the condenser heating capacity, Q_c represents the total evaporation capacity, i.e., the evaporator cooling capacity, M_{i1} represents the first power consumption data, and M_{i2} represents the second power consumption data.

[0119] At block S4025', the indoor unit power consumption is determined based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

[0120] It should be noted that the indoor unit power consumption may be a sum of the power consumption of the *i* -th heating indoor unit and the power consumption of the *k* -th cooling indoor unit, or a sum of the power consumption of all the heating indoor units and the power consumption of all the cooling indoor units.

[0121] In this embodiment, the first power consumption data and the second power consumption data are extracted from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is the predetermined main cooling mode. Further, the heating indoor unit power consumption is determined through the second predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity, and the cooling indoor unit power consumption is determined through the second predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity. Furthermore, the hydraulic device power consumption is determined through the second predetermined hydraulic device power consumption model based on the first power consumption data, the second power consumption data, the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity, and the indoor unit power consumption is determined based on the heating indoor unit power consumption and the cooling indoor unit power consumption. Therefore, power consumption of each heating indoor unit, each cooling indoor unit, and the hydraulic device can be calculated separately when the current operation mode of the heat recovery multi-split air conditioner is the predetermined main heating mode. Therefore, the accuracy of the power consumption measurements of the indoor unit and the hydraulic device can be enhanced.

[0122] In addition, embodiments of the present disclosure further provide a storage medium. The storage medium has a multi-split air conditioner power consumption detection program stored thereon. The multi-split air conditioner power consumption detection program, when executed by a processor, implements the method for detecting the power consumption of the multi-split air conditioner as described above.

[0123] In addition, as illustrated in FIG. 7, embodiments of the present disclosure further provide an apparatus for detecting power consumption of a multi-split air conditioner. The apparatus for detecting the power consumption of the multi-split air conditioner includes a determination module 10, an acquiring module 20, and a detection module 30.

[0124] The determination module 10 is configured to acquire hydraulic device data of a heat recovery multi-split air conditioner and determine a hydraulic device heat absorption value based on the hydraulic device data. The acquiring module 20 is configured to acquire outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner. The determination module 10 is further configured to determine a condenser heating capacity and an evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data. The detection module 30 is configured to determine indoor unit power consumption and hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

[0125] In the embodiments, the hydraulic device data of the heat recovery multi-split air conditioner is acquired, and the hydraulic device heat absorption value is determined based on the hydraulic device data. Further, the outdoor unit data, the indoor unit data, and the power consumption data of the heat recovery multi-split air conditioner are acquired, and the condenser heating capacity and the evaporator cooling capacity are determined based on the outdoor unit data, the indoor unit data, and the hydraulic device data. Furthermore, the indoor unit power consumption and the hydraulic device power consumption are determined based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity. Compared with the existing method of detecting the overall power consumption of the multi-split air conditioner only, in this embodiment, it is possible to determine the indoor unit power consumption and the hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity. Therefore, the defect in the related art that the power consumed by each indoor unit and the hydraulic device cannot be detected is overcome. Accordingly, the power consumption of each indoor unit and the hydraulic device of the heat recovery multi-split air conditioner can be quickly detected.

[0126] Reference of other embodiments or exemplary implementations of the apparatus for detecting the power consumption of the multi-split air conditioner of the present disclosure may be made to the above method embodiments, and description thereof in detail will be omitted herein.

[0127] It should be noted that in the present disclosure, terms "include", "have", and any variations thereof are intended to cover non-exclusive inclusions, such that a process, method, product, or system that includes a series of elements is not necessarily limited to those clearly listed elements, and may also include other elements that are not clearly listed or are inherent to the process, method, product, or system. Without further limitation, an element defined by the phrase "including a ..." does not preclude the presence of additional identical elements in the process, method, product, or system that includes the element.

[0128] The above sequence numbers of the embodiments of the present disclosure are for description only, and do not represent superiority or inferiority of the embodiments. In a unit claim listing several devices, several of these devices may be specifically embodied by a same hardware item. The use of words first, second, third, etc., does not indicate any sequence. The words can be interpreted as names.

[0129] From the above description of the implementations, it will be clear to those skilled in the art that the method of the above embodiments can be implemented with the aid of software and a necessary common hardware platform or can be implemented through hardware. In many cases, the former one is a better implementation. Based on this understanding, all or part of the technical solutions according to the embodiments of the present disclosure, or the part thereof that contributes to the related art, can be embodied in the form of a software product. The computer software product may be stored in a storage medium (such as a Read Only Memory (ROM)/Random Access Memory (RAM), a disk, and an optical disk) and contain instructions to enable a terminal device (which may be a mobile phone, a computer, a server, a heat recovery multi-split air conditioner, a network device, etc.) to perform the method described in each of the embodiments of the present disclosure.

[0130] Although some embodiments of the present disclosure are described above, the scope of the present disclosure is not limited to the embodiments. Any equivalent structure or equivalent process transformation made using the contents of the specification and the accompanying drawings, or any direct or indirect application of the contents of the specification and the accompanying drawings in other related fields, shall equally fall within the scope of the present disclosure.

Claims

1. A method for detecting power consumption of a multi-split air conditioner, the method comprising: acquiring hydraulic device data of a heat recovery multi-split air conditioner and determining a hydraulic device heat absorption value based on the hydraulic device data; acquiring outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner; determining a condenser heating capacity and an evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data; and determining indoor unit power consumption and hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

2. The method for detecting the power consumption of the multi-split air conditioner according to claim 1, wherein said determining the indoor unit power consumption and the hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity comprises: acquiring a current operation mode of the heat recovery multi-split air conditioner; and determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

3. The method for detecting the power consumption of the multi-split air conditioner according to claim 2, wherein said determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity comprises: extracting target power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode; determining heating indoor unit power consumption through a first predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining cooling indoor unit power consumption through a first predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining the hydraulic device power consumption through a first predetermined hydraulic device power consumption model based on the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity; and determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

4. The method for detecting the power consumption of the multi-split air conditioner according to claim 2, wherein said determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity comprises: extracting first power consumption data and second power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode; determining heating indoor unit power consumption through a second predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining cooling indoor unit power consumption through a second predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity; determining the hydraulic device power consumption through a second predetermined hydraulic device power consumption model based on the first power consumption data, the second power consumption data, the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity; and determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption.

5. The method for detecting the power consumption of the multi-split air conditioner according to any one of claims 1 to 4, wherein said acquiring the hydraulic device data of the heat recovery multi-split air conditioner and determining the hydraulic device heat absorption value based on the hydraulic device data comprises: acquiring the hydraulic device data of the heat recovery multi-split air conditioner, and determining a return gas temperature, a compressor frequency, a compressor displacement, a compressor volumetric efficiency, a condenser outlet temperature, and a return gas pressure of a hydraulic device based on the hydraulic device data; determining a return gas density and a hydraulic device return gas enthalpy based on the return gas pressure and the return gas temperature; determining a hydraulic device circulation flow rate based on the compressor frequency, the compressor displacement, the compressor volumetric efficiency, and the return gas density; and determining a hydraulic device condenser

outlet enthalpy based on the condenser outlet temperature, and determining hydraulic device absorption outdoor unit heat quantity based on the hydraulic device condenser outlet enthalpy, the hydraulic device circulation flow rate, and the hydraulic device return gas enthalpy.

6. The method for detecting the power consumption of the multi-split air conditioner according to any one of claims 1 to 4, wherein said determining the condenser heating capacity and the evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data comprises: determining a condenser average inlet enthalpy, a condenser average outlet enthalpy, an evaporator average outlet enthalpy, and an evaporator inlet enthalpy based on the outdoor unit data, the indoor unit data, and the hydraulic device data; extracting a compressor circulation flow rate of an outdoor unit from the outdoor unit data; determining the condenser heating capacity based on the compressor circulation flow rate, the condenser average inlet enthalpy, and the condenser average outlet enthalpy; and determining the evaporator cooling capacity based on the compressor circulation flow rate, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy.

7. The method for detecting the power consumption of the multi-split air conditioner according to claim 6, wherein said determining the condenser average inlet enthalpy, the condenser average outlet enthalpy, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy based on the outdoor unit data, the indoor unit data, and the hydraulic device data comprises: extracting a compressor return gas pressure, an external heat exchanger inlet temperature, an external heat exchanger outlet temperature, and a compressor exhaust pressure of an outdoor unit from the outdoor unit data; extracting a heat exchanger inlet temperature of a heating indoor unit, an outlet temperature of the heating indoor unit, and an outlet temperature of a cooling indoor unit from the indoor unit data; extracting a heat exchanger inlet temperature of a hydraulic device and a heat exchanger outlet temperature of the hydraulic device from the hydraulic device data; determining the condenser average inlet enthalpy based on the heat exchanger inlet temperature of the hydraulic device, the heat exchanger inlet temperature of the heating indoor unit, the external heat exchanger inlet temperature, and the compressor exhaust pressure; determining the condenser average outlet enthalpy based on the heat exchanger outlet temperature of the hydraulic device, the outlet temperature of the heating indoor unit, and the external heat exchanger outlet temperature, and determining the condenser average outlet enthalpy as the evaporator inlet enthalpy; and determining the evaporator average outlet enthalpy based on the cooling indoor unit outlet temperature and the compressor return gas pressure.

8. A heat recovery multi-split air conditioner, comprising: a memory; a processor; and a multi-split air conditioner power consumption detection program stored in the memory and executable on the processor, wherein the multi-split air conditioner power consumption detection program, when executed by the processor, implements the method for detecting the power consumption of the multi-split air conditioner according to any one of claims 1 to 7.

9. A storage medium, having a multi-split air conditioner power consumption detection program stored thereon, wherein the multi-split air conditioner power consumption detection program, when executed by a processor, implements the method for detecting the power consumption of the multi-split air conditioner according to any one of claims 1 to 7.

10. An apparatus for detecting power consumption of a multi-split air conditioner, the apparatus comprising a determination module, an acquiring module, and a detection module, wherein: the determination module is configured to acquire hydraulic device data of a heat recovery multi-split air conditioner and determine a hydraulic device heat absorption value based on the hydraulic device data; the acquiring module is configured to acquire outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner; the determination module is further configured to determine a condenser heating capacity and an evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data; and the detection module is configured to determine indoor unit power consumption and hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity.

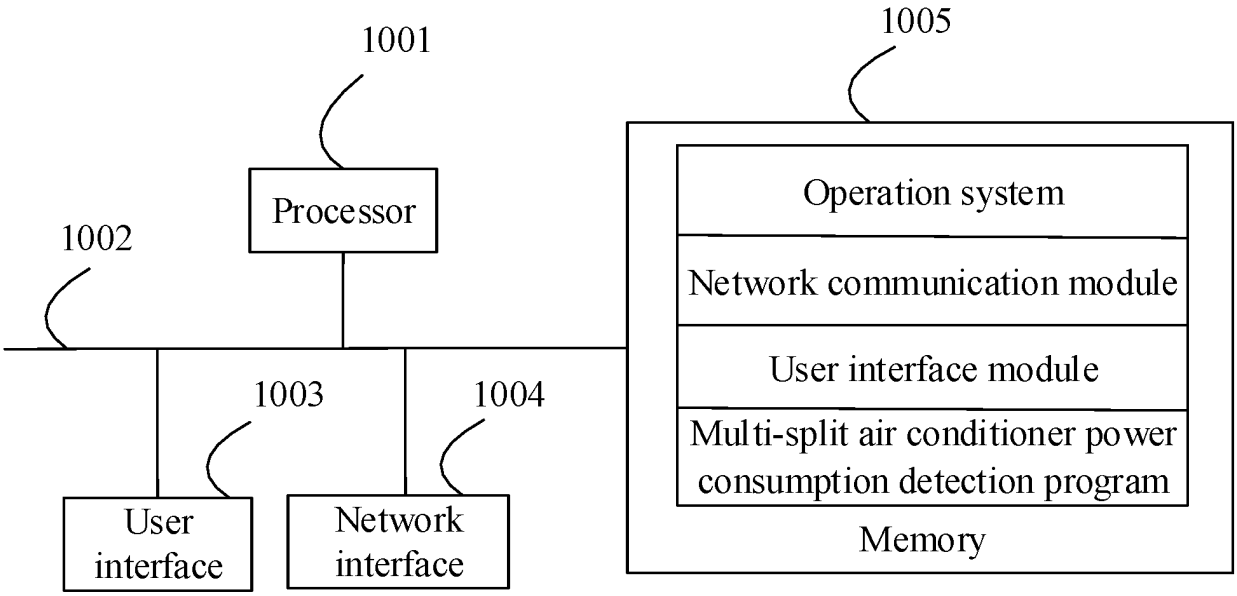

1001
1005
Processor
1002
Operation system
Network communication module
User interface module
Multi-split air conditioner power consumption detection program
Memory
1003
1004
User interface
Network interface

FIG. 1

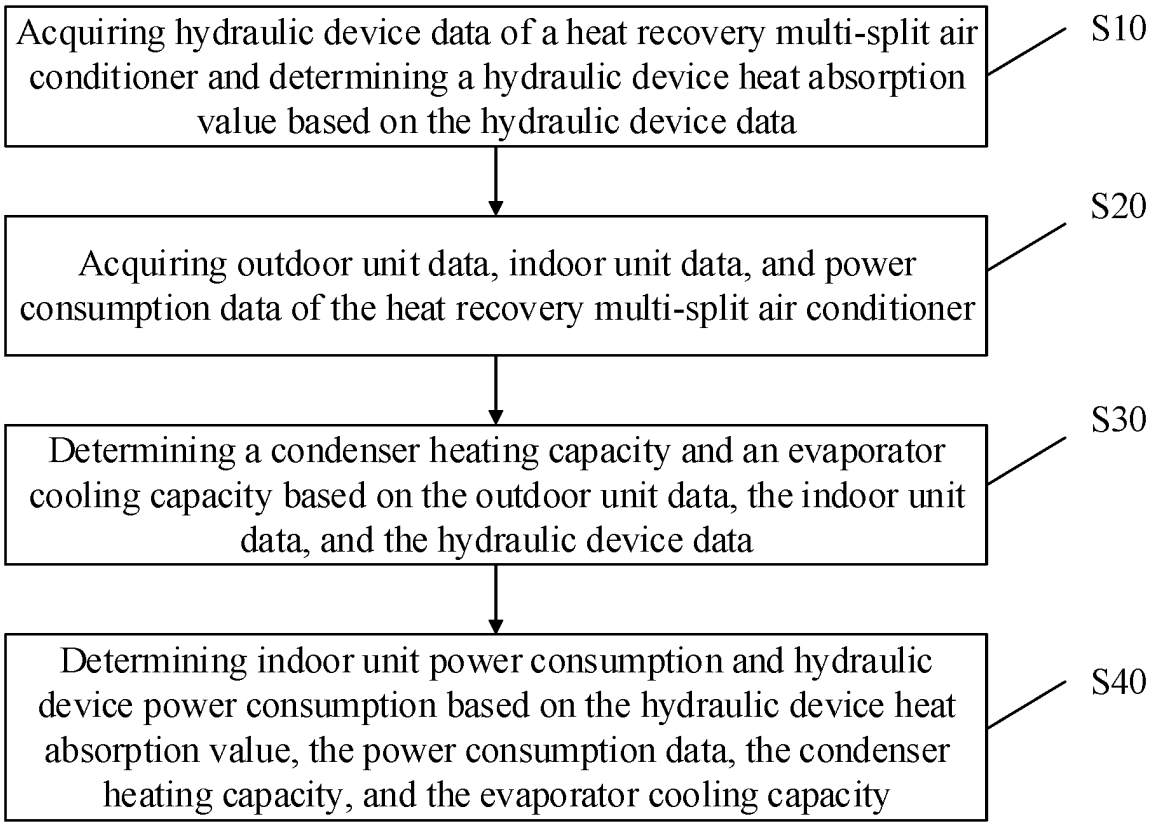

Acquiring hydraulic device data of a heat recovery multi-split air conditioner and determining a hydraulic device heat absorption value based on the hydraulic device data
S10
Acquiring outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner
S20
Determining a condenser heating capacity and an evaporator cooling capacity based on the outdoor unit data, the indoor unit data, and the hydraulic device data
S30
Determining indoor unit power consumption and hydraulic device power consumption based on the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity
S40

FIG. 2

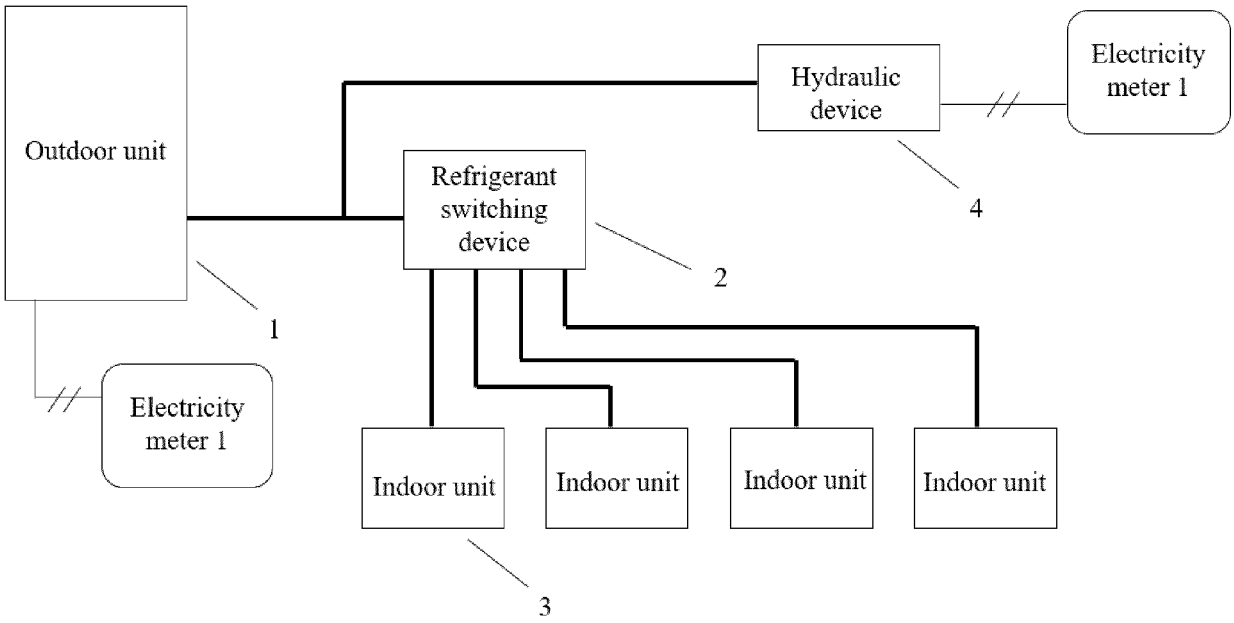

Outdoor unit
Hydraulic device
Electricity meter 1
Refrigerant switching device
4
2
1
Electricity meter 1
Indoor unit
Indoor unit
Indoor unit
Indoor unit
3

FIG. 3


Acquiring the hydraulic device data of the heat recovery multi-split air conditioner and determining a return gas temperature, a compressor frequency, a compressor displacement, a compressor volumetric efficiency, a condenser outlet temperature, and a return gas pressure of a hydraulic device based on the hydraulic device data
S101
Determining a return gas density and a hydraulic device return gas enthalpy based on the return gas pressure and the return gas temperature
S102
Determining a hydraulic device circulation flow rate based on the compressor frequency, the compressor displacement, the compressor volumetric efficiency, and the return gas density
S103
Determining a hydraulic device condenser outlet enthalpy based on the condenser outlet temperature, and determining hydraulic device absorption outdoor unit heat based on the hydraulic device condenser outlet enthalpy, the hydraulic device circulation flow rate, and the hydraulic device return gas enthalpy
S104
Acquiring outdoor unit data, indoor unit data, and power consumption data of the heat recovery multi-split air conditioner
S20
Determining a condenser average inlet enthalpy, a condenser average outlet enthalpy, an evaporator average outlet enthalpy, and an evaporator inlet enthalpy based on the outdoor unit data, the indoor unit data, and the hydraulic device data
S301
Extracting a compressor circulation flow rate of an outdoor unit from the outdoor unit data
S302
Determining the condenser heating capacity based on the compressor circulation flow rate, the condenser average inlet enthalpy, and the condenser average outlet enthalpy
S303
Determining the evaporator cooling capacity based on the compressor circulation flow rate, the evaporator average outlet enthalpy, and the evaporator inlet enthalpy
S304
Acquiring a current operation mode of the heat recovery multi-split air conditioner
S401
Determining the indoor unit power consumption and the hydraulic device power consumption based on the current operation mode, the hydraulic device heat absorption value, the power consumption data, the condenser heating capacity, and the evaporator cooling capacity
S402

FIG. 4

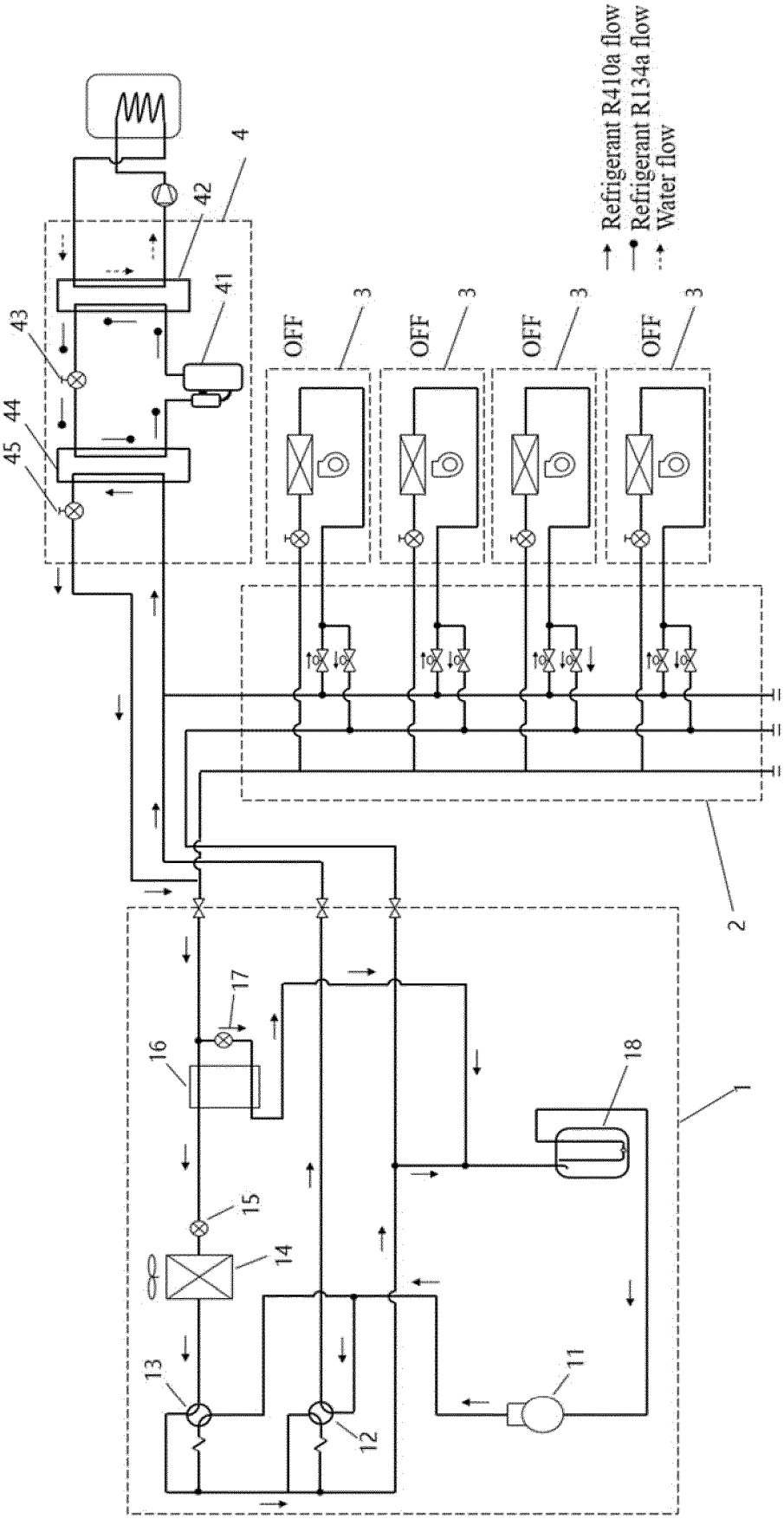

Refrigerant R410a flow
Refrigerant R134a flow
Water flow
OFF
OFF
OFF
OFF
3
3
3
3
4
42
41
43
44
45
2
1
11
12
13
14
15
16
17
18

FIG. 5

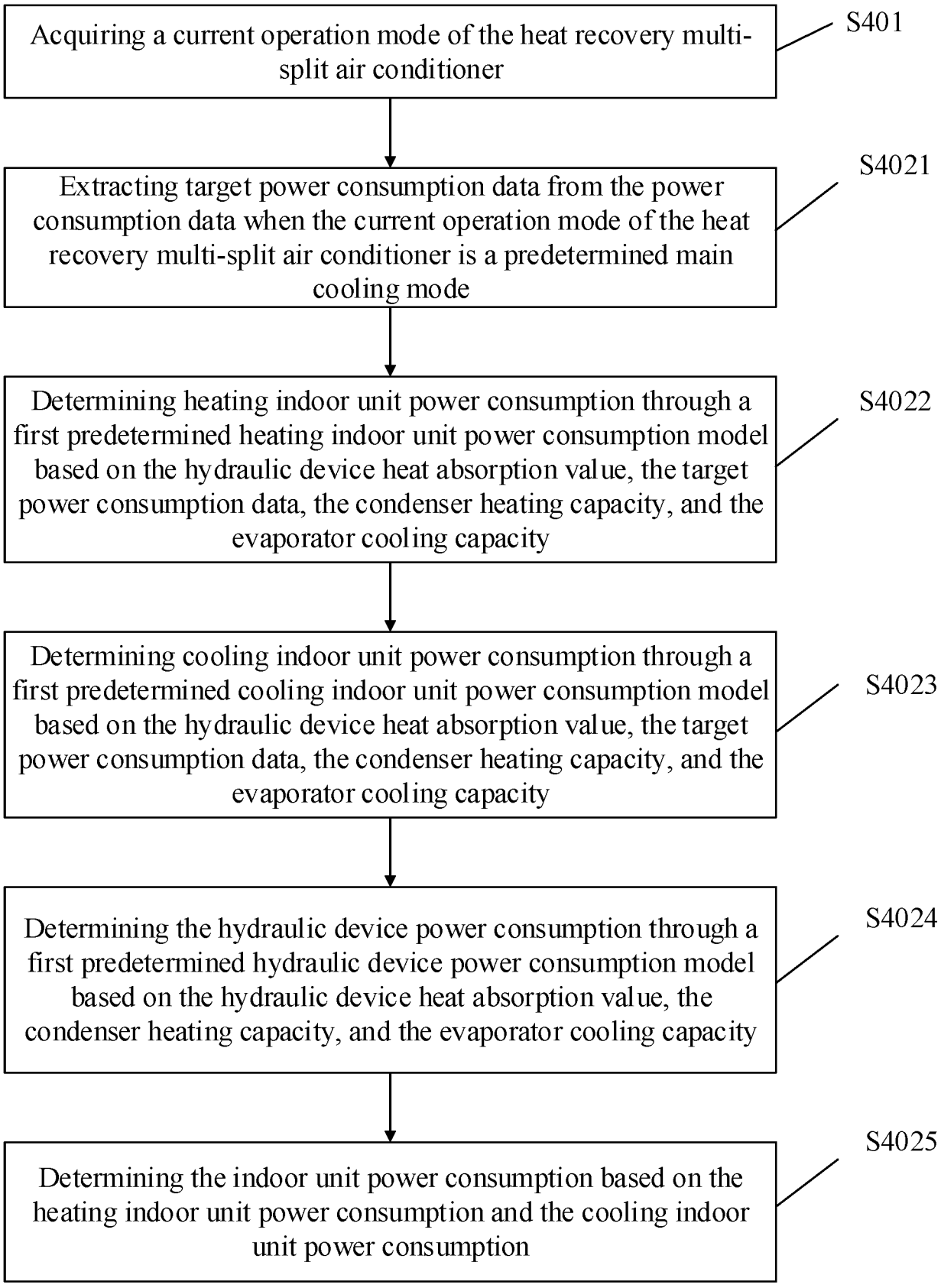
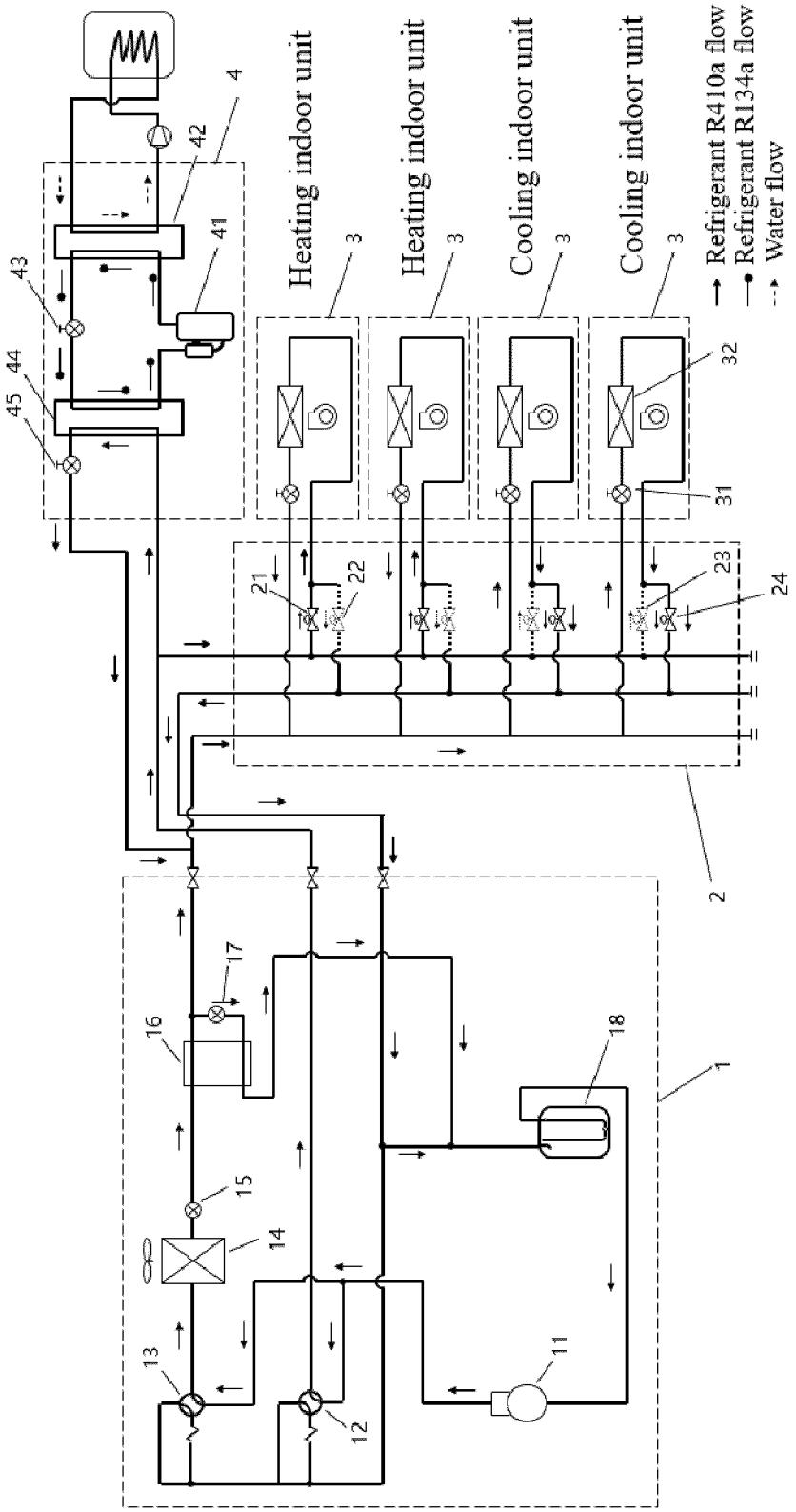

Acquiring a current operation mode of the heat recovery multi-split air conditioner
S401
Extracting target power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode
S4021
Determining heating indoor unit power consumption through a first predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity
S4022
Determining cooling indoor unit power consumption through a first predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the target power consumption data, the condenser heating capacity, and the evaporator cooling capacity
S4023
Determining the hydraulic device power consumption through a first predetermined hydraulic device power consumption model based on the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity
S4024
Determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption
S4025

FIG. 6


Heating indoor unit
Heating indoor unit
Cooling indoor unit
Cooling indoor unit
Refrigerant R410a flow
Refrigerant R134a flow
Water flow
1
2
3
4
11
12
13
14
15
16
17
18
21
22
23
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44
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FIG. 7

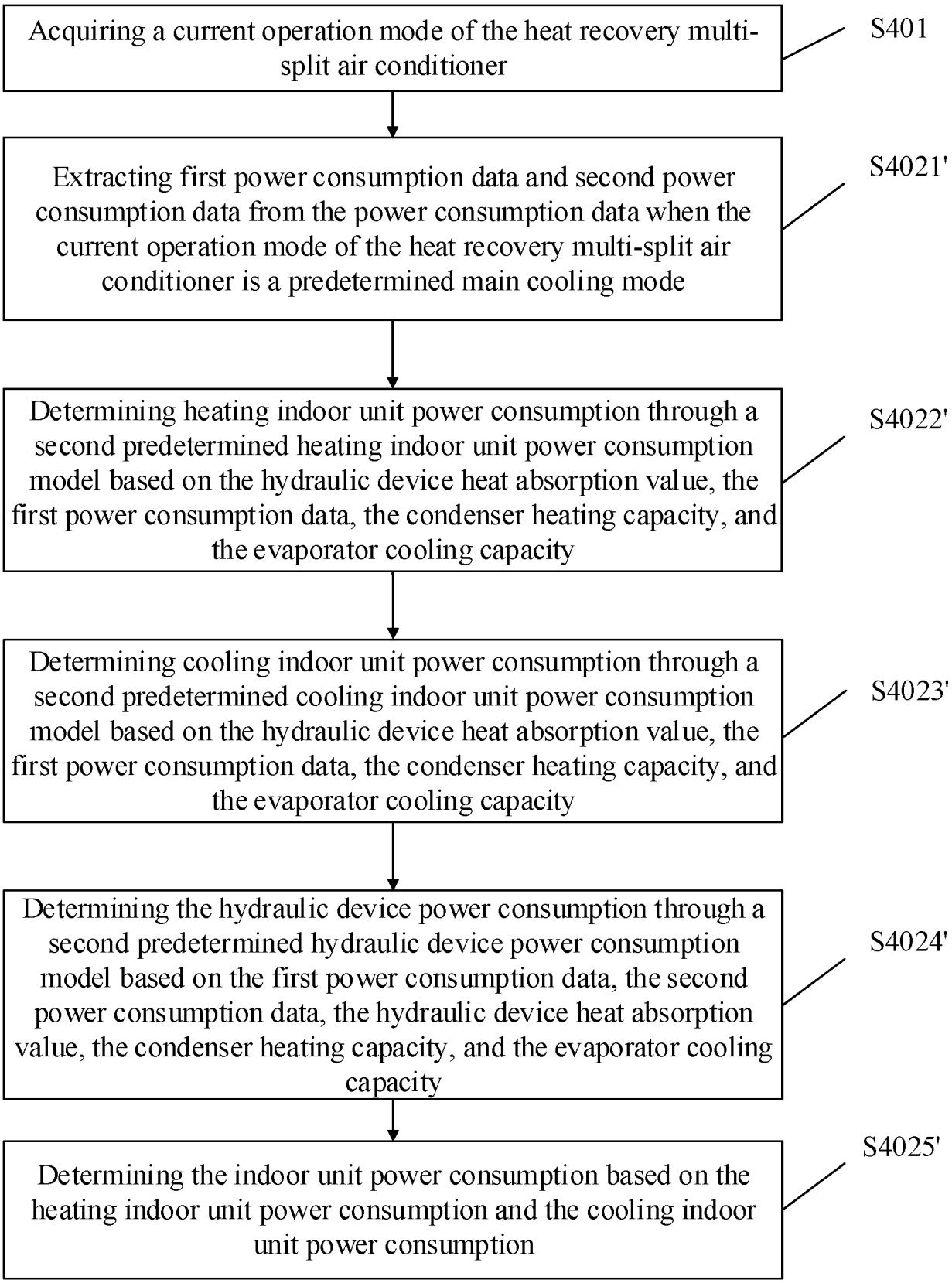
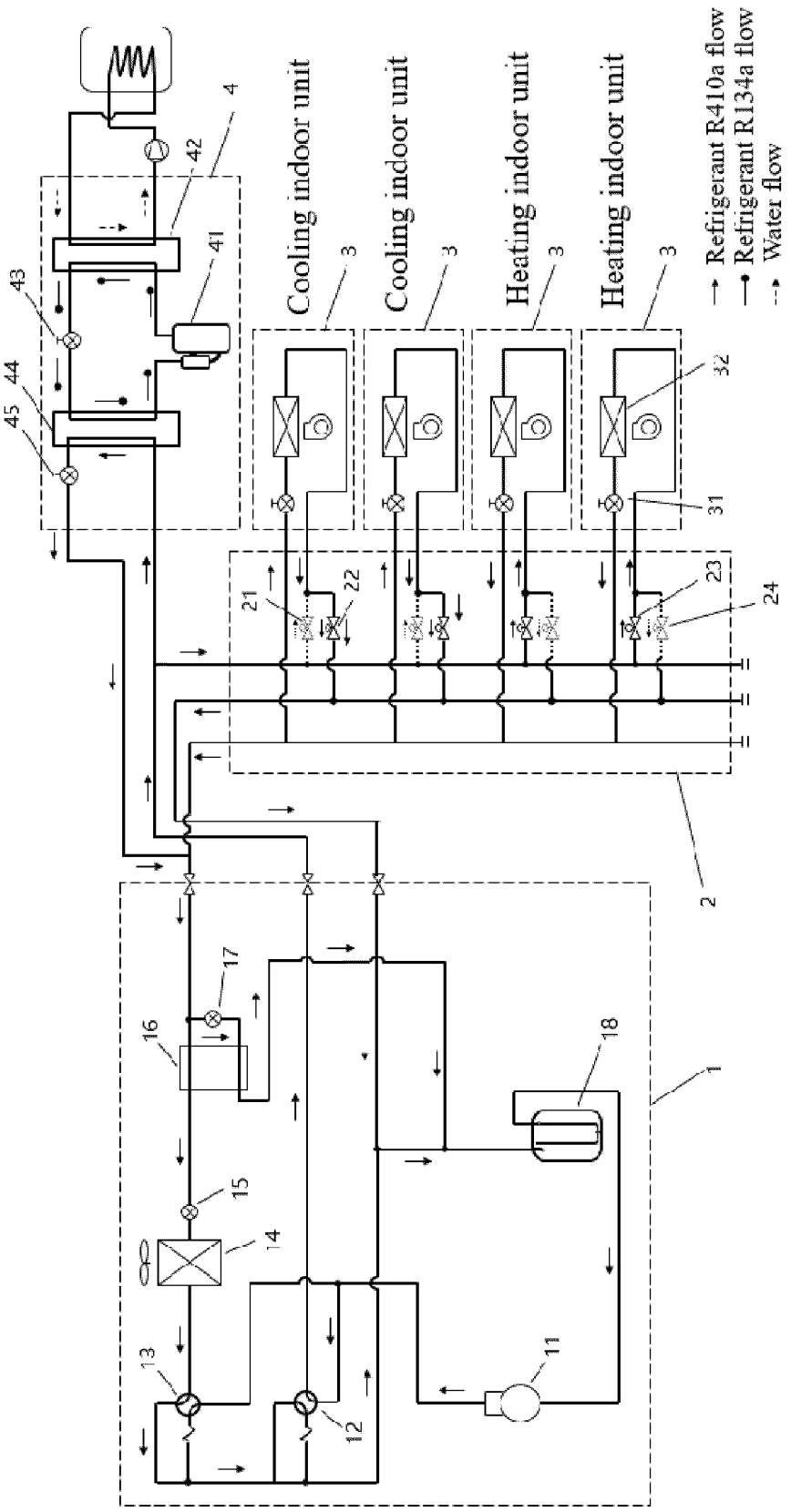

Acquiring a current operation mode of the heat recovery multi-split air conditioner
S401
Extracting first power consumption data and second power consumption data from the power consumption data when the current operation mode of the heat recovery multi-split air conditioner is a predetermined main cooling mode
S4021'
Determining heating indoor unit power consumption through a second predetermined heating indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity
S4022'
Determining cooling indoor unit power consumption through a second predetermined cooling indoor unit power consumption model based on the hydraulic device heat absorption value, the first power consumption data, the condenser heating capacity, and the evaporator cooling capacity
S4023'
Determining the hydraulic device power consumption through a second predetermined hydraulic device power consumption model based on the first power consumption data, the second power consumption data, the hydraulic device heat absorption value, the condenser heating capacity, and the evaporator cooling capacity
S4024'
Determining the indoor unit power consumption based on the heating indoor unit power consumption and the cooling indoor unit power consumption
S4025'

FIG. 8


Cooling indoor unit
Cooling indoor unit
Heating indoor unit
Heating indoor unit
Refrigerant R410a flow
Refrigerant R134a flow
Water flow
1
2
3
4
11
12
13
14
15
16
17
18
21
22
23
24
31
32
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42
43
44
45

FIG. 9

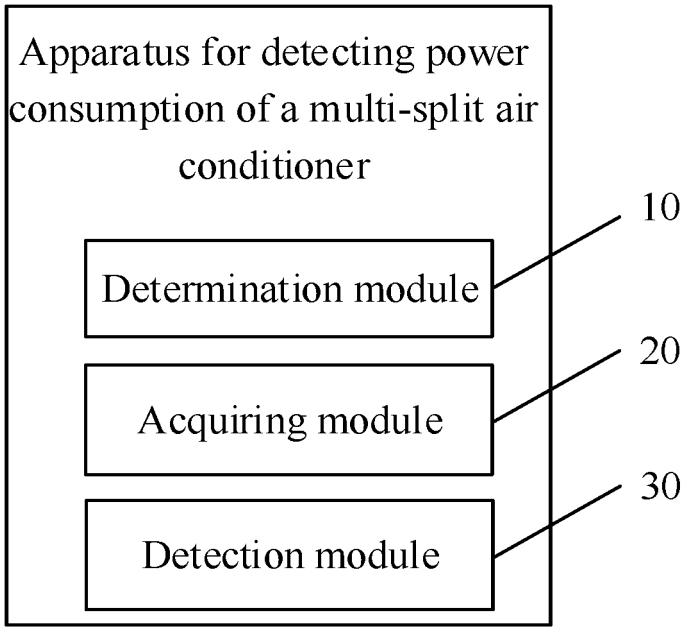
Apparatus for detecting power consumption of a multi-split air conditioner
Determination module
Acquiring module
Detection module
10
20
30

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/072344

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/46(2018.01)i; F24F 11/58(2018.01)i; F24F 11/64(2018.01)i; F24F 11/88(2018.01)i; F24F 140/12(2018.01)i; F24F 140/20(2018.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F

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

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

CNABS, CNKI, DWPI, VEN: 多联机空调, 耗电量, 水力模块, 吸收热量值, 室外机, 室内机, 数据, 冷凝器, 制热量, 蒸发器, 制冷量, multi connected air conditioner, power consumption, hydraulic module, absorbed heat value, outdoor unit, indoor unit, data, condenser, heating capacity, evaporator, refrigerating capacity

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 106771566 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 31 May 2017 (2017-05-31) description, paragraphs [0078]-[0158]	1-4, 8-10
Y	CN 106771566 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 31 May 2017 (2017-05-31) description, paragraphs [0078]-[0158]	5-7
Y	CN 106839340 A (GUANGDONG MEDIA REFRIGERATION EQUIPMENT CO., LTD. et al.) 13 June 2017 (2017-06-13) description paragraphs [0116]-[0159]	5-7
PX	CN 112665133 A (GUANGDONG MIDEA HEATING & VENTILATION EQUIPMENT CO., LTD. et al.) 16 April 2021 (2021-04-16) claims 1-10	1-10
A	CN 110094848 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 06 August 2019 (2019-08-06) entire document	1-10

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
08 April 2022	**19 April 2022**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China**	
Facsimile No. **(86-10)62019451**	Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/072344

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 110736200 A (QINGDAO HAIER AIR CONDITIONER GENERAL CO., LTD. et al.) 31 January 2020 (2020-01-31) entire document	1-10
A	CN 107614984 A (MITSUBISHI HEAVY IND THERMAL SYSTEMS LTD.) 19 January 2018 (2018-01-19) entire document	1-10

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/072344

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 106771566 A	31 May 2017	None	
CN 106839340 A	13 June 2017	None	
CN 112665133 A	16 April 2021	None	
CN 110094848 A	06 August 2019	None	
CN 110736200 A	31 January 2020	None	
CN 107614984 A	19 January 2018	WO 2016152552 A1	29 September 2016
		EP 3260792 A1	27 December 2017
		JP 2016183817 A	20 October 2016
		ES 2745753 T3	03 March 2020

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202110086371 **[0001]**