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(54) CONTROL METHOD AND CONTROL APPARATUS FOR AIR CONDITIONER, AND AIR CONDITIONER AND READABLE STORAGE MEDIUM

(57) Provided in the present application are a control method and control apparatus for an air conditioner, and an air conditioner and a readable storage medium. In the control method for an air conditioner, the air conditioner comprises an indoor unit and at least two temperature sensors, wherein the at least two temperature sensors are used for acquiring at least two corresponding temperature parameter values in the indoor unit. The control method for an air conditioner comprises: acquiring a fault parameter value of at least two temperature parameter values on the basis of any temperature sensor of at least two temperature sensors being in a fault state; according to a running parameter of an air conditioner, obtaining a parameter replacement value corresponding to the fault parameter value; and controlling the running of the air conditioner according to the parameter replacement value. By means of the present application, when there is a fault in a temperature sensor in an indoor unit of an air conditioner, the indoor unit of the air conditioner can still keep running, such that it is ensured that the air conditioner can still operate during the process of waiting for maintenance, thereby reducing the shutdown duration of the air conditioner during the process of waiting for maintenance.

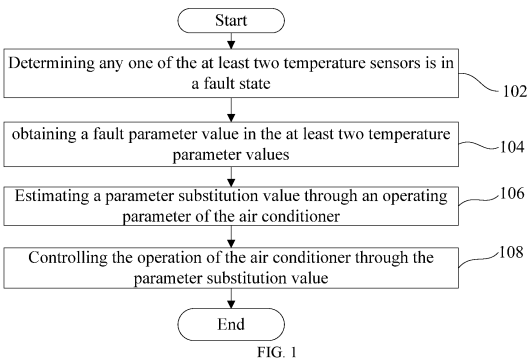

FIG. 1

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Description

[0001] This application claims priority to Chinese patent application No. 202110780857.X, filed with CNIPA on July 9, 2021, and entitled "Method and apparatus for controlling air conditioner, air conditioner and readable storage medium.", the entire contents of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present application relates to the field of air conditioner control technologies, and more particularly, to a method for controlling an air conditioner, an apparatus for controlling an air conditioner, an air conditioner, and a readable storage medium.

BACKGROUND

[0003] An air conditioner is provided with a plurality of temperature sensors, and the plurality of temperature sensors may detect a plurality of temperature parameter values in the air conditioner. In the related art, the air conditioner is controlled to stop operation in the event that one temperature sensor of an indoor unit of the air conditioner malfunctions, and inconvenience may be brought to a user.

SUMMARY

[0004] The present application aims to solve one of the technical problems existing in the related art or related technologies.

[0005] For this purpose, a method for controlling an air conditioner is provided according to the first aspect of the present application.

[0006] An apparatus for controlling an air conditioner is provided according to the second aspect of the present application.

[0007] An air conditioner is provided according to the third aspect of the present application.

[0008] An air conditioner is provided according to the fourth aspect of the present application.

[0009] A readable storage medium is provided according to the fifth aspect of the present application.

[0010] In view of this, according to the first aspect of the present application, the method for controlling the air conditioner is provided. The air conditioner includes an indoor unit and at least two temperature sensors, the at least two temperature sensors are configured to obtain at least two corresponding temperature parameter values in the indoor unit. The method for controlling the air conditioner includes: obtaining a fault parameter value in the at least two temperature parameter values if any one of the at least two temperature sensors is in a fault state; obtaining a parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner; and controlling the air conditioner to be operated according to the parameter substitution value.

[0011] The method for controlling the air conditioner provided in the present application is used for controlling the air conditioner. An indoor unit and a plurality of temperature sensors are provided in the air conditioner, the plurality of temperature sensors are provided at different positions of each indoor unit, and the plurality of temperature sensors may detect temperature parameter values at different positions respectively. A throttle valve and a draught fan are further provided in the indoor unit, the throttle valve and the draught fan of the indoor unit are controlled according to the plurality of corresponding temperature parameter values collected by the plurality of temperature sensors, and a control of the operation of the indoor unit is realized accordingly.

[0012] The indoor unit of the air conditioner continuously collects temperature parameter values through the plurality of temperature sensors, and continuously collects operating parameters of the air conditioner, and controls the operation of the air conditioner according to the collected temperature parameter values and the operating parameters. Where, the throttle valve and the draught fan in the indoor unit are controlled through the temperature parameter values collected by the temperature sensors.

[0013] Whether there exists malfunctioning temperature sensor(s) arranged in the indoor unit is detected during the operation of the air conditioner. When detecting that at least two temperature sensors are in the fault state, a fault sensor in the plurality of temperature sensors is detected and located. Thus, the fault parameter value in the temperature parameter values collected by the plurality of temperature sensors may be determined, and the true value of the fault parameter value is estimated through other operating parameters of the air conditioner and the parameter substitution value is obtained. The plurality of collected temperature parameter values is updated by replacing the fault parameter value in the plurality of temperature parameter values with the parameter substitution value. The operation of the air conditioner is continued to be controlled through the parameter substitution value, such that the indoor unit of the air conditioner can still keep operating under the condition that the temperature sensor in the indoor unit of the air conditioner

are in the fault state. It is ensured that the air conditioner can still be operated in a queueing process for maintenance, so a downtime of the air conditioner in the queueing process for maintenance is shortened. Thus, a user experience is improved.

[0014] Additionally, according to the method for controlling the air conditioner in the aforesaid technical solutions provided in the present application, the following additional technical features may also be included:

[0015] In any one of the aforesaid technical solutions, the indoor unit includes a heat exchanger, the at least two temperature sensors include a first temperature sensor, a second temperature sensor and a third temperature sensor. The first temperature sensor and the second temperature sensor are arranged at two ends of the heat exchanger, the third temperature sensor is arranged at an air inlet of the indoor unit. The step of obtaining the fault parameter value in the at least two temperature parameter values specifically includes: determining fault states of the first temperature sensor, the second temperature sensor and the third temperature sensor; and determining a fault parameter value according to the fault states. Where, the fault parameter value includes a temperature value at a refrigerant inlet, a temperature value at a refrigerant outlet and an ambient temperature value.

[0016] In this arrangement, the indoor unit of the air conditioner includes the heat exchanger, and when the air conditioner is operated in a refrigeration mode, refrigerant flows to a second end through a first end of the heat exchanger. When the air conditioner is operated in a heating mode, the refrigerant flows to the first end through the second end of the heat exchanger. A plurality of temperature sensors are further arranged in the indoor unit. The plurality of temperature sensors include the first temperature sensor arranged at the first end of the heat exchanger. The first temperature sensor may collect a temperature value at the refrigerant inlet of the indoor unit under a refrigeration mode. The first temperature sensor may collect a temperature value at a refrigerant outlet of the indoor unit under a heating mode. The plurality of temperature sensors further include the second temperature sensor arranged at the second end of the heat exchanger, the second temperature sensor may detect a temperature value at a refrigerant outlet of the indoor unit in the refrigeration mode. The second temperature sensor may collect a temperature value at the refrigerant inlet of the indoor unit under the heating mode. The plurality of temperature sensors further include a third temperature sensor arranged at the air inlet of the indoor unit, and the third temperature sensor may collect the temperature of the air entering the indoor unit. That is, the third temperature sensor may collect the ambient temperature value of the indoor unit.

[0017] A throttle valve and a draught fan are provided in the indoor unit of the air conditioner. During the operation of the indoor unit, the operation of the indoor unit is controlled by controlling parameters such as an opening degree of the throttle valve and a rotation speed of the draught fan. The details of the control method include: adjusting the opening degree of the throttle valve according to the collected temperature value at the refrigerant inlet, the temperature value at the refrigerant outlet and the ambient temperature value, and adjusting the rotation speed of the draught fan.

[0018] Whether there exists a fault parameter value in the at least two temperature parameter values is determined by determining whether each of the plurality of temperature sensors in the indoor unit of the air conditioner malfunctions. When a malfunctioned temperature sensor in the plurality of temperature sensors is detected, it is also determined that a fault parameter value is included in the collected at least two temperature parameter values. The fault parameter value in the temperature parameter values collected by the three temperature sensors may be determined by determining whether the three temperature sensors malfunction respectively, under the determination of the operation mode of the air conditioner. Thus, the fault parameter value in the collected temperature parameter values is determined rapidly when there exists a malfunctioned temperature sensor in the indoor unit, and the air conditioner is prevented from being continuously controlled according to the fault parameter value, and the duration of operation of the air conditioner in the fault state is reduced.

[0019] In the aforesaid technical solution, before the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner, the method further includes: controlling the air conditioner to be operated in a preset operation mode; and obtaining operating parameters of the air conditioner in the preset operation mode. Where, the preset operation mode includes the refrigeration mode and the heating mode.

[0020] In this arrangement, since the control parameters and the operating parameters of the air conditioner operated in the refrigeration mode and the control parameters and the operating parameters of the air conditioner operated in the heating mode are different, flow directions of the refrigerant flowing through the heat exchanger of the indoor unit are also different when the air conditioner is operated in different modes. Thus, the temperature parameter values collected by the first temperature sensor and the second temperature sensor are also different. The current operation mode of the air conditioner needs to be determined before estimating the parameter substitution value, the fault parameter value is determined according to the operation mode and whether each temperature sensor in the plurality of temperature sensors malfunctions. The corresponding operating parameters are collected in the process of operating the air conditioner in the preset operation mode, then, the parameter substitution value is estimated through the collected operating parameters. Thus, the calculated parameter substitution value is consistent with the operation mode of the air conditioner, an accuracy of operation of the air conditioner according to the parameter substitution value is improved, and a malfunction of the air conditioner caused due to the control of the air conditioner according to the parameter substitution value that

does not conform to the operation mode is avoided.

[0021] It can be understood that, the operation mode of the air conditioner further includes an air supplying mode. When the air conditioner is in the air supplying mode, a compressor of the air conditioner does not need to be operated, and a cut-off valve in the indoor unit does not need to be started. Thus, the malfunction of the temperature sensor does not affect the air supplying operation of the air conditioner, and the corresponding parameter substitution value does not need to be estimated.

[0022] In any one of the aforesaid technical solutions, the first temperature sensor is in the fault state, the number of the indoor units is at least two, and the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically includes: determining the fault parameter value as the temperature value at the refrigerant outlet based on the operation of the air conditioner in the heating mode, and obtaining the number of the indoor units in the operation state in the air conditioner; obtaining high-pressure saturation temperatures, target subcooling degrees, pressure values at refrigerant outlets and preset amount of heat output of the at least two indoor units; and determining the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the number of the indoor units, the high-pressure saturation temperatures, the target subcooling degrees, the pressure values at the refrigerant outlets and the preset amount of heat output.

[0023] In this arrangement, the air conditioner is a multi-split air conditioner, that is, the air conditioner includes a plurality of indoor units. The air conditioner is operated in the heating mode, the high-temperature and high-pressure refrigerant generated by the compressor flows to the first end through the second end of the heat exchanger of the indoor unit. Since the first temperature sensor is arranged at the first end of the heat exchanger, the temperature parameter value collected by the first temperature sensor is the temperature value at the refrigerant outlet. When the first temperature sensor is in the fault state, the temperature value at the refrigerant outlet may be determined as the fault parameter value.

[0024] When the air conditioner is operated in the heating mode and the temperature value at the refrigerant outlet is the fault parameter value, the number of the started indoor units in the air conditioner needs to be determined, and the operating parameters including the high-pressure saturation temperature of the air conditioner, the preset amount of heat output, the pressure value at the refrigerant outlet, the target subcooling degree of the indoor unit are obtained. The parameter substitution value is estimated through the obtained operating parameters and the number of the indoor unit in operation, and the temperature value at the refrigerant outlet in the collected temperature parameter values is substituted with the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to inaccurate temperature value at the refrigerant outlet may be avoided.

[0025] It is worth noting that, the high-voltage saturation temperature is the hardware parameter of the air conditioner system. Thus, when the parameter substitution value is calculated, the high-voltage protection temperature of the system may be directly invoked. The target subcooling degree is the parameter value obtained through calculation according to an operation instruction after the operation instruction is received by the air conditioner. The pressure value at the refrigerant outlet may be directly collected by arranging the pressure sensors. As an alternative, the pressure value at the refrigerant outlet may be calculated through other parameter values such as the temperature at the refrigerant outlet. The preset heat output may be calculated according to the high-pressure saturation temperature and the ambient environment.

[0026] In any one of the aforesaid technical solutions, the step of determining the parameter substitution value corresponding to the temperature value at the refrigerant outlet specifically includes: calculating the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the high-voltage saturation temperature and the target subcooling degree, when determining that the number of indoor units is less than the preset number; calculating the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the pressure value at the refrigerant outlet and the preset amount of heat output, when determining that the number of the indoor units is greater than or equal to the preset number.

[0027] In this arrangement, if it is detected that the number of indoor units in operation is less than the preset number, when the parameter substitution value of the temperature value at the refrigerant outlet is calculated, the difference value between the high-voltage saturation temperature and the target subcooling degree is calculated, and thus an estimated temperature value at the refrigerant outlet is obtained. The estimated temperature value at the refrigerant outlet is used as the parameter substitution value of the temperature value at the refrigerant outlet.

[0028] The temperature value at the refrigerant outlet is estimated according to the pressure saturation temperature and the target subcooling degree by using a formula which is expressed as:

$$T_1=T_C\text{-}SCS;$$

[0029] Where, T_1 is the parameter substitution value corresponding to the temperature value at the refrigerant outlet, T_C is the high-voltage saturation temperature, and the SCS is the target subcooling degree.

[0030] In this arrangement, if it is detected that the number of the started indoor units is greater than or equal to the preset number, whether the temperature sensor in each indoor unit malfunctions is detected. If a fault-free indoor unit is detected, a pressure value at the refrigerant outlet of an indoor unit without sensor fault is calculated, and a pressure value at the refrigerant outlet of an indoor unit having a sensor fault is calculated, the preset amount of heat output is obtained according to the two pressure values at the refrigerant outlet, enthalpy value of the refrigerant outlet of the heat exchanger is calculated according to the preset amount of heat output, and the temperature value at the refrigerant outlet is estimated according to the enthalpy value of the refrigerant outlet, and the parameter substitution value corresponding to the temperature value at the refrigerant outlet is calculated accordingly.

[0031] The pressure value at the refrigerant outlet of the indoor unit without sensor fault is calculated through the formula which is expressed as:

$$P_1=P_C\text{-}dP_1;$$

[0032] Where, P_1 is the pressure value at the refrigerant outlet of the indoor unit without sensor fault, P_C is the maximum pressure value of an outdoor unit, and dP_1 is a pressure drop across an electronic expansion valve of the indoor unit without sensor fault.

[0033] It can be understood that, the pressure drop across the electronic expansion valve of the indoor unit without sensor fault may be calculated by calculating the pressure values at the two ends of the electronic expansion valve collected by the sensors. The pressure drop may also be obtained by calculation according to a refrigerant flow value, the enthalpy value of the refrigerant outlet, and the preset amount of heat output of the indoor unit.

[0034] The pressure value at the refrigerant outlet of the indoor unit having a sensor fault is calculated through a formula which is expressed as:

$$P_2= P_1+(H_1\text{-}H_2)\times den\times 9.8;$$

[0035] H_1 is a liquid column pressure value caused due to height difference between a malfunctioned indoor unit and a reference point, Hz is the liquid column pressure value caused due to height difference between the indoor unit having a sensor fault and the reference point, den is a density of the refrigerant of the malfunctioned indoor unit, P_2 is the pressure value at the refrigerant outlet of the malfunctioned indoor unit, and P_1 is the pressure value at the refrigerant outlet of the indoor unit without sensor fault.

[0036] It can be understood that, the liquid column pressure value caused due to the height difference between the indoor unit and the reference point is calculated during a trial operation stage of the air conditioner. The density of the refrigerant may be obtained by calculating a physical property function of the liquid refrigerant, and a segmented fitting curve may be adopted in the process of calculation of the density of the refrigerant.

[0037] A refrigerant flow value is calculated through a formula, which is expressed as:

$$mf=(dp_2, cv, den);$$

[0038] Where, mf is the refrigerant flow value, dp_2 is the pressure drop across the electronic expansion valve of the indoor unit having a sensor fault, cv is an opening value of the electronic expansion valve, and den is the density of the refrigerant of the malfunctioned indoor unit.

[0039] The pressure drop across the electronic expansion valve of the indoor unit having a sensor fault is calculated through a formula, which is expressed as:

$$dp_2=P_C\text{-}P_2;$$

[0040] dp_2 is the pressure drop across the electronic expansion valve of the indoor unit having a sensor fault, P_C is the maximum pressure value of the outdoor unit, and P_2 is the pressure value at the refrigerant outlet of the malfunctioned indoor unit.

[0041] The preset heat output is calculated through a formula, which is expressed as:

$$Q=K_A\times(T_C-T_3);$$

[0042] Where, Q is the preset amount of heat output, K_A is a coefficient, T_C is the high-voltage saturation temperature, and T_3 is the ambient temperature value.

[0043] The enthalpy value of the refrigerant outlet of the heat exchanger is calculated through a formula according to the preset amount of heat output, the formula is expressed as:

$$h_1=h_2-Q/mf;$$

[0044] H_1 is an enthalpy value of the refrigerant outlet, H_2 is an enthalpy value at the refrigerant inlet, Q is a preset amount of heat output, and mf is the refrigerant flow value.

[0045] The parameter substitution value of the temperature value at the refrigerant outlet is calculated according to the enthalpy value of the refrigerant outlet by using the following formula. :

$$T_1=f_1(h_1, T_C);$$

[0046] Where, T_1 is the parameter substitution value corresponding to the temperature value at the refrigerant outlet, hi is the enthalpy value of the refrigerant outlet, T_C is the high-voltage saturation temperature, and f_1 is a preset function.

[0047] According to the aforesaid formula, the parameter substitution value of the temperature value at the refrigerant outlet of the indoor unit having a sensor fault is accurately obtained by collecting corresponding parameters of the indoor unit without sensor fault and calculating according to the corresponding parameters, under the condition that a plurality of indoor units are powered on. The accuracy of operation of the air conditioner controlled according to the parameter substitution value is further improved, and occurrence of other faults during the operation process of the air conditioner is avoided.

[0048] It may be understood that, when the preset number is selected to be greater than 2, the parameter substitution value of the temperature value at the refrigerant outlet of the indoor unit having a plurality of malfunctioned sensors may be calculated by collecting corresponding parameters of one indoor unit without sensor fault, the control of the operation of the indoor unit having the plurality of malfunctioned sensors in the air conditioner is realized, and the inconvenience caused due to termination of operation of the air conditioner is avoided.

[0049] In any one of the aforesaid technical solutions, the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically includes: determining the fault parameter value as the temperature value at the refrigerant inlet on the basis that the air conditioner is in the refrigeration mode; obtaining the temperature value at the refrigerant outlet of the indoor unit every first preset time duration; and calculating the parameter substitution value corresponding to the temperature value at the refrigerant inlet according to the temperature value at the refrigerant outlet.

[0050] In this arrangement, the air conditioner is a multi-split air conditioner, that is, the air conditioner includes a plurality of indoor units. The air conditioner is operated in the refrigeration mode, and the refrigerant flows from the first end of the heat exchanger to the second end of the heat exchanger. Since the first temperature sensor is arranged at the first end of the heat exchanger, the temperature parameter value collected by the first temperature sensor is the temperature value at the refrigerant inlet. When the first temperature sensor is in the fault state, the temperature value at the refrigerant inlet may be determined as the fault parameter value.

[0051] When the air conditioner is operated in the refrigeration mode and the temperature value at the refrigerant inlet is the fault parameter value, a substitution value of the temperature value at the refrigerant inlet may be estimated according to the temperature value at the refrigerant outlet. In the refrigerant mode, the low-temperature refrigerant flows to the second end of the heat exchanger of the indoor unit through the first end of the heat exchanger of the indoor unit. During the process in which the refrigerant flows through the heat exchanger, the low-temperature refrigerant continuously exchanges heat with ambient air. Therefore, the temperature value at the refrigerant outlet should be higher than the

temperature value at the refrigerant inlet, the difference value between the temperature value at the refrigerant outlet and the first preset difference value is calculated, and the estimated temperature value at the refrigerant inlet may be obtained, the estimated temperature value at the refrigerant inlet is used as the parameter substitution value of the temperature value at the refrigerant inlet, and the temperature value at the refrigerant inlet in the collected temperature parameter values is substituted with the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to the inaccurate temperature value at the refrigerant inlet is avoided.

[0052] The parameter substitution value of the temperature value at the refrigerant inlet is estimated according to the temperature value at the refrigerant outlet by using a formula which is expressed as:

$$T_1=T_2+Z_1;$$

[0053] Where, T_1 is the parameter substitution value corresponding to the temperature value at the refrigerant inlet, T_2 is the temperature value at the refrigerant outlet, and Z_1 is the first preset difference value.

[0054] It can be understood that in the operation process of the refrigeration mode, since the ambient temperature value of the indoor unit changes continuously, energy losses of the refrigerant and the air in the heat exchanger in the heat exchange process are also variable. Thus, the estimated parameter substitution value of the refrigerant inlet is updated every first preset time duration. The updating method includes: collecting the temperature value at the refrigerant outlet every first preset time duration, and then re-estimating the parameter substitution value of the temperature value at the refrigerant inlet according to the temperature value at the refrigerant outlet. The parameter substitution value of the temperature value at the refrigerant inlet is continuously updated, the stability of the control of the air conditioner having a sensor fault is further improved.

[0055] In any one of the aforesaid technical solutions, the indoor unit includes a draught fan. Before the step of obtaining the temperature value at the refrigerant outlet of the indoor unit, the method further includes: controlling the draught fan to stop operation for a second preset time duration.

[0056] In this arrangement, when the air conditioner is operated in the refrigeration mode and the temperature value at the refrigerant inlet is the fault parameter value, the temperature value at the refrigerant outlet is collected every first preset time duration, and the parameter substitution value is estimated according to the temperature value at the refrigerant outlet. Before each time the temperature value at the refrigerant outlet is collected, the draught fan is controlled to stop operation for a second preset time duration. It can be understood that the operation of the draught fan may accelerate the heat exchange between the heat exchanger and ambient air. Thus, before the collection of the temperature value at the refrigerant outlet, the draught fan is controlled to stop operation for the second preset time duration, the value of energy loss of the refrigerant in the heat exchange process may be decreased, and an accuracy of an estimated parameter substitution value of the temperature value at the refrigerant inlet is further improved.

[0057] In any one of the aforesaid technical solutions, the second temperature sensor is in the fault state, the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically includes: determining the fault parameter value as the temperature value at the refrigerant inlet based on the operation of the air conditioner in the heating mode, obtaining the high-voltage saturation temperature of the indoor unit; and calculating the parameter substitution value corresponding to the temperature value at the refrigerant inlet according to the high-voltage saturation temperature.

[0058] In this arrangement, the air conditioner is a multi-split air conditioner, that is, the air conditioner includes a plurality of indoor units. The air conditioner is operated in the heating mode, and the refrigerant flows from the second end of the heat exchanger to the first end of the heat exchanger. Since the second temperature sensor is arranged at the second end of the heat exchanger, the temperature parameter value collected by the second temperature sensor is the temperature value at the refrigerant inlet. When the second temperature sensor is in the fault state, the temperature value at the refrigerant inlet may be determined as the fault parameter value.

[0059] When the air conditioner is operated in the heating mode and the temperature value at the refrigerant inlet is the fault parameter value, the substitution value of the temperature value at the refrigerant inlet may be estimated according to the high-pressure saturation temperature. In the heating mode, the high-temperature refrigerant compressed by the compressor directly flows to the second end of the heat exchanger, thus, the parameter substitution value of the relatively accurate temperature value at the refrigerant inlet may be obtained by estimating according to hardware parameters of the air conditioning system. The high-pressure saturation temperature is the temperature value corresponding to the refrigerant under a certain pressure, it may be considered that the high-pressure saturation temperature is the temperature value of the high-pressure and high-temperature refrigerant output by the compressor, the high-temperature and high-pressure refrigerant flows to the second end of the heat exchanger of the indoor unit through a

refrigerant pipeline, and certain heat loss is caused. The second preset difference value is arranged according to heat loss. The temperature value at the refrigerant inlet of the heat exchanger in the heating mode may be estimated by calculating the difference value between the high-pressure saturation temperature and the second preset difference value, and the estimated temperature value at the refrigerant inlet is taken as the parameter substitution value of the temperature value at the refrigerant inlet, and the temperature value at the refrigerant inlet in the collected temperature parameter values is substituted with the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to the inaccurate temperature value at the refrigerant inlet is avoided.

[0060] The temperature value at the refrigerant inlet is calculated according to the high-pressure saturation temperature by using a formula which is expressed as:

$$T_2 = Tc + Z_2;$$

[0061] Where, T_2 is the parameter substitution value corresponding to the temperature value at the refrigerant inlet, T_C is the high-voltage saturation temperature, and Z_2 is the second preset difference value.

[0062] It can be understood that during the operation of the heating mode, the compressor will continue to be operated in the preset operation state, that is, variation ranges of the pressure value and the temperature value of the refrigerant output by the compressor are relatively small. Thus, only when the fault parameter value is determined as the temperature value at the refrigerant inlet, the operation of the air conditioner is continuously controlled according to the parameter substitution value calculated by the high-voltage saturation temperature and the second preset difference value, the parameter substitution value does not need to be frequently updated.

[0063] In any one of the aforesaid technical solutions, the second temperature sensor is in the fault state, the number of the indoor units is at least two, and the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically includes: determining the fault parameter value as the temperature value at the refrigerant outlet on the basis that the air conditioner is in the refrigeration mode, and obtaining the number of indoor units in operation state in the air conditioner; obtaining temperature values at refrigerant inlets, the target superheat degrees, preset amount of heat output, temperatures of exhaust air and target superheat degrees of exhaust air of compressors of the at least two indoor units; and determining the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the number of the indoor units, the temperature values at the refrigerant inlet, the target superheat degrees, the preset amount of heat output, the temperature values of the exhaust air and the target superheat degrees of the exhaust air.

[0064] In this arrangement, the air conditioner is a multi-split air conditioner, that is, the air conditioner includes a plurality of indoor units. The air conditioner is operated in the refrigeration mode, and the refrigerant flows from the first end of the heat exchanger to the second end of the heat exchanger. Since the second temperature sensor is arranged at the second end of the heat exchanger, the temperature parameter value collected by the second temperature sensor is the temperature value at the refrigerant outlet. When the second temperature sensor is in the fault state, the temperature value at the refrigerant outlet may be determined as the fault parameter value.

[0065] When the air conditioner is operated in the refrigeration mode and the temperature value at the refrigerant outlet is the fault parameter value, the number of the started indoor units in the air conditioner needs to be determined, the temperature value at the refrigerant inlet of the air conditioner, the preset amount of heat output and the target superheat degree, and the temperature of the exhaust air of the compressor and the target superheat degree of the exhaust air of the compressor are obtained. The parameter substitution value is estimated through the obtained operating parameters and the number of the started indoor units, and the temperature value at the refrigerant outlet in the collected temperature parameter values is substituted with the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to the inaccurate temperature value at the refrigerant outlet is avoided.

[0066] In any one of the aforesaid technical solutions, the step of determining the parameter substitution value corresponding to the temperature value at the refrigerant outlet specifically includes: calculating a parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the temperature value at the refrigerant inlet and the target superheat degree when determining that the number of indoor units is less than a preset number; calculating the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the superheat degree of the exhaust air, the temperature of the exhaust air, the temperature at the refrigerant inlet and the target superheat degree when determining that the number of indoor units is greater than or equal to the preset number.

[0067] In this arrangement, when detecting that the number of the started indoor units is less than the preset number, when the parameter substitution value of the temperature value at the refrigerant outlet is calculated, an estimated temperature value at the refrigerant outlet is obtained by calculating according to the temperature value at the refrigerant inlet and the target superheat degree, and the estimated temperature value at the refrigerant outlet is used as the parameter substitution value of the temperature value at the refrigerant outlet.

[0068] The temperature value at the refrigerant outlet is estimated according to the temperature value at the refrigerant inlet and the target superheat degree by using a formula which is expressed as:

$$T_2=T_1+SHS;$$

[0069] Where, T_2 is the parameter substitution value corresponding to the temperature value at the refrigerant outlet, T_1 is the temperature value at the refrigerant inlet, and SHS is the target superheat degree.

[0070] In the arrangement, when detecting that the number of the started indoor units is greater than or equal to the preset number, when the parameter substitution value of the temperature value at a refrigerant rear outlet is calculated, the parameter substitution value of the temperature value at the refrigerant outlet is calculated according to the superheat degree of the exhaust air, the temperature value at the refrigerant inlet, the temperature of the exhaust air and the target superheat degree, so that an estimated temperature value at the refrigerant outlet is obtained, and the estimated temperature value at the refrigerant rear outlet is used as the parameter substitution value of the temperature value of the refrigerant rear outlet.

[0071] The temperature value at the refrigerant outlet is estimated according to the superheat degree of the exhaust air, the temperature value at the refrigerant inlet, the temperature of the exhaust air, and the target superheat degree by using a formula, which is expressed as:

$$T2=(DSH-DSHS)/4+T1+SHS;$$

[0072] Where, T_2 is the parameter substitution value corresponding to the temperature value at the refrigerant outlet, T_1 is a temperature value at a refrigerant inlet, SHS is the target superheat degree, and DSHS is the target superheat degrees of the exhaust air, the DSH is the temperature of the exhaust air.

[0073] The parameter substitution value of the temperature value at the refrigerant outlet of the indoor unit having a malfunctioned sensor is obtained by collecting the corresponding parameters of the indoor unit and accurately calculating according to these parameters through the aforesaid formula. Furthermore, the accuracy of controlling the air conditioner to be operated through the parameter substitution value is further improved, and an occurrence of other faults in the operation process of the air conditioner is avoided.

[0074] In any one of the aforesaid technical solutions, the third temperature sensor is in the fault state, the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically includes: determining the fault parameter value as an ambient temperature value; obtaining a temperature value at the refrigerant outlet every third preset time duration; and calculating the parameter substitution value corresponding to the ambient temperature value according to the temperature value at the refrigerant outlet.

[0075] In this arrangement, during the operation of the air conditioner, when the third temperature sensor is in the fault state, the ambient temperature value collected by the third temperature sensor is determined as the fault parameter value. The substitution value of the ambient temperature value may be estimated according to the temperature value at the refrigerant outlet. The estimated ambient temperature value may be obtained by calculating the temperature value at the refrigerant outlet and the third preset difference value, the estimated ambient temperature value is used as the parameter substitution value of the ambient temperature value, and the ambient temperature value in the collected temperature parameter values is replaced by the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to the inaccurate temperature value at the refrigerant inlet is avoided.

[0076] The parameter substitution value of the ambient temperature value is estimated according to the temperature value at the refrigerant outlet by using a formula which is expressed as:

$$T_3=T_2+Z_3;$$

[0077] Where, T_3 is the parameter substitution value of the ambient temperature value, T_2 is the temperature value at the refrigerant outlet, and Z_3 is the third preset difference value.

[0078] It should be noted that, a difference value between the temperature value at the refrigerant outlet and the ambient temperature value when the air conditioner is operated in the refrigeration mode and a difference value between the temperature value at the refrigerant outlet and the ambient temperature value when the air conditioner is operated in the refrigeration mode are different. Thus, different third preset difference values are selected according to different operation modes of the air conditioner before the step of calculating the parameter substitution value of the ambient temperature value.

[0079] It can be understood that, during the operation of the air conditioner, since the ambient temperature value the indoor unit changes continuously, energy losses of the refrigerant and the air in the heat exchanger in a heat exchange process are also variable. Thus, the third preset time duration is set, and the substitution value of the estimated ambient temperature value is updated. The updating method includes: collecting the temperature value at the refrigerant outlet every third preset time duration, and then re-estimating the parameter substitution value of the ambient temperature value according to the temperature value at the refrigerant outlet. The parameter substitution value of the ambient temperature value is continuously updated, the stability of the control of the air conditioner having a sensor fault is further improved.

[0080] In any one of the aforesaid technical solutions, the indoor unit includes a throttle valve, before the step of obtaining the temperature value at the refrigerant outlet of the indoor unit, the method further includes: controlling the throttle valve to stop operation for a fourth preset time duration.

[0081] In this arrangement, when the air conditioner is in operation and the ambient temperature value is the fault parameter value, the temperature value at the refrigerant outlet is collected every third preset time duration, and the parameter substitution value is estimated according to the temperature value at the refrigerant outlet. Before each time the temperature value at the refrigerant outlet is collected, the throttle valve is controlled to stope operation for the fourth preset time duration. It can be understood that when the throttle valve is in an open state, the low-temperature or high-temperature refrigerant continues to flow into the heat exchanger, and a great difference between the temperature value at the refrigerant outlet and the ambient temperature value is caused. Thus, before the temperature value at the refrigerant outlet is collected, the throttle valve is controlled to stop operation for the fourth preset time duration, the difference between the temperature value at the refrigerant outlet and the ambient temperature value may be reduced, and the accuracy of the estimated parameter substitution value of the temperature value at the refrigerant inlet is further improved.

[0082] In any one of the aforesaid technical solutions, the step of determining the fault states of the first temperature sensor, the second temperature sensor and the third temperature sensor includes: obtaining a numerical relationship between the temperature value at the refrigerant inlet, the temperature value at the refrigerant outlet and the ambient temperature value; and determining the fault state of the first temperature sensor, the fault state of the second temperature sensor and the fault state of the third temperature sensor respectively according to the numerical relationship.

[0083] In this arrangement, whether there exists one malfunctioned temperature sensor in the three temperature sensors is detected according to a data relationship between the temperature parameter value collected by the first temperature sensor, the temperature parameter value collected by the second temperature sensor and the temperature parameter value collected by the third temperature sensor, and the malfunctioned temperature sensor in the three temperature sensors may be located.

[0084] In any one of the aforesaid technical solutions, the method for controlling the air conditioner further includes: counting a time duration of an operation process of the air conditioner controlled according to the parameter substitution value; and controlling the air conditioner to stop operation when determining that the time duration reaches a fourth preset time duration.

[0085] In this arrangement, after time duration of the operation process of the air conditioner controlled according to the estimated temperature parameter value reaches the fourth preset time duration, the air conditioner is controlled to stop operation. Since the parameter substitution value of the temperature parameter value is the estimated temperature parameter value, there is a certain difference between the parameter substitution value of the temperature parameter value and a true value of the temperature parameter value. After the time duration of the operation of the air conditioner controlled according to the estimated temperature parameter value reaches the fourth time duration, the air conditioner is controlled to stop operation. Thus, the air conditioner may be prevented from being operated under a fault state of one temperature sensor for a long time. The stability of operation of the air conditioner is improved.

[0086] An apparatus for controlling an air conditioner is provided according to the second aspect of the present application, this apparatus includes: a fault parameter acquisition unit configured to acquire a fault parameter value in at least two temperature parameter values on the basis that any one of the at least two temperature sensors is in a fault state; a parameter determination unit configured to obtain a parameter substitution value corresponding to the fault parameter

value according to operating parameters of the air conditioner; and an operation control unit configured to control the air conditioner to be operated according to the parameter substitution value.

[0087] The apparatus for controlling the air conditioner provided in the present application is used for controlling the air conditioner, one indoor unit and a plurality of temperature sensors are arranged in the air conditioner, the plurality of temperature sensors are provided at different positions of the indoor unit, and the plurality of temperature sensors may respectively collect temperature parameter values at the different positions. A throttle valve and a draught fan are further provided in the indoor unit, and the throttle valve and the draught fan of the indoor unit are controlled according to the plurality of corresponding temperature parameter values collected by the plurality of temperature sensors, and a control of operation of the indoor unit is realized.

[0088] The indoor unit of the air conditioner collects the temperature parameter values continuously through the plurality of temperature sensors, and collects the operating parameters of the air conditioner continuously, and controls the operation of the air conditioner according to the collected temperature parameter values and the collected operating parameters. Where, the throttle valve and the draught fan in the indoor unit are controlled through the temperature parameter values collected by the temperature sensors.

[0089] Whether there exists malfunctioned temperature sensor(s) arranged in the indoor unit is detected during the operation of the air conditioner. When detecting that at least two temperature sensors are in the fault state, a fault sensor in the plurality of temperature sensors is detected and located. Thus, the fault parameter value in the temperature parameter values collected by the plurality of temperature sensors may be determined, and the true value of the fault parameter value is estimated through other operating parameters of the air conditioner and the parameter substitution value is obtained. The plurality of collected temperature parameter values is updated by replacing the fault parameter value in the plurality of temperature parameter values with the parameter substitution value. The operation of the air conditioner is continued to be controlled through the parameter substitution value, such that the indoor unit of the air conditioner can still keep operation under the condition that the temperature sensor in the indoor unit of the air conditioner are in the fault state. It is ensured that the air conditioner can still be operated in a queueing process for maintenance, a downtime of the air conditioner in the queueing process for maintenance is shortened. Thus, a user experience is improved.

[0090] According to the third aspect of the present application, an air conditioner is provided. The air conditioner includes: an indoor unit; and the apparatus for controlling the air conditioner according to the second aspect, the apparatus is arranged in the indoor unit.

[0091] The air conditioner provided in the present application includes the indoor unit and the apparatus for controlling the air conditioner. The apparatus for controlling the air conditioner is the device for controlling the air conditioner in the second aspect and thus has all of the beneficial effects of the apparatus for controlling the air conditioner in the second aspect, which are not repeatedly described herein.

[0092] The air conditioner further includes an outdoor unit and a refrigerant pipeline, and the outdoor unit is connected to the indoor unit through the refrigerant pipeline.

[0093] An air conditioner is provided according to the fourth aspect of the present application, the air conditioner includes: at least two indoor units; a memory; and a processor. The memory stores a program or an instruction, the processor is configured to execute the program or the instruction stored in the memory so as to implement steps of the method for controlling the air conditioner in the first aspect, and thus has all of the beneficial effects of the method for controlling the air conditioner in the first aspect, which are not repeatedly described herein.

[0094] The air conditioner provided in the present application includes at least two indoor units, a memory, and a processor. A program or an instruction is stored in the memory; and the processor is configured to execute the program or the instruction stored in the memory to implement the steps of the method for controlling the air conditioner in the first aspect, and thus has all of the beneficial effects of the method for controlling the air conditioner in the first aspect, which are not repeatedly described herein.

[0095] The air conditioner further includes an outdoor unit and a refrigerant pipeline, and the outdoor unit is connected to the at least two indoor units through the refrigerant pipeline.

[0096] A readable storage medium is provided according to the fifth aspect of the present application, the readable storage medium stores a program or an instruction. When the program or the instruction is executed by the processor, the steps of the method for controlling the air conditioner in any one of the aforesaid possible arrangements are implemented. Thus, the storage medium has all of the beneficial technical effects of the method for controlling the air conditioner in any possible arrangement, which are not repeatedly described herein.

[0097] Additional aspects and advantages of the present application will become apparent in the following descriptions or be understood through the practice of the present application.

DESCRIPTION OF THE DRAWINGS

[0098] The aforesaid and/or additional aspects and advantages of the present application will become apparent and

more understandable in the following description of embodiments with reference to the drawings. Where:

FIG. 1 illustrates a first schematic flow diagram of a method for controlling an air conditioner according to the first embodiment of the present application;
FIG. 2 illustrates a schematic structural diagram of an indoor unit of the air conditioner in the first embodiment of the present application;
FIG. 3 illustrates a second schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 4 illustrates a third schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 5 illustrates a fourth schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 6 illustrates a fifth schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 7 illustrates a sixth schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 8 illustrates a seventh schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 9 illustrates an eighth schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 10 illustrates a ninth schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 11 illustrates a tenth schematic flow diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 12 illustrates an eleventh schematic block diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 13 illustrates a twelfth schematic block diagram of the method for controlling the air conditioner according to the first embodiment of the present application;
FIG. 14 illustrates an apparatus for controlling an air conditioner according to the second embodiment of the present application;
FIG. 15 illustrates a schematic block diagram of an air conditioner according to the third embodiment of the present application;
FIG. 16 illustrates a schematic block diagram of an air conditioner according to the fourth embodiment of the present application.

[0099] Where, a correspondence relationship between reference numerals and names of components in FIG. 2 are listed below:
200 indoor unit, 202 heat exchanger, 204 first temperature sensor, 206 second temperature sensor, 208 third temperature sensor.

DETAILED DESCRIPTIOIN OF EMBODIMENTS

[0100] In order to understand the objective, the features and the beneficial effects of the present application more clearly, the present is further described in detail below with reference to the accompanying figures and the detailed description of embodiments. It is worth noting that, the various embodiments and the features in the various embodiments can be combined mutually without confliction.

[0101] Many details have been illustrated in the following description in order to facilitate a comprehensive understanding of the present application. However, the present application may also be implemented in other manners different from the manners described herein. Thus, the protection scope of the present application is not limited to the embodiments disclosed hereinafter.

First embodiment:

[0102] As shown in FIG. 1, a method for controlling an air conditioner is provided in the first embodiment of the present application, the air conditioner includes at least two temperature sensors and an indoor unit. The at least two temperature sensors may collect at least two temperature parameter values in the indoor unit, the at least two temperature parameter values correspond to the at least two temperature sensors, and each temperature sensor is configured to collect one temperature parameter value.

[0103] The method for controlling the air conditioner includes:

In a step of S102, any one of the at least two temperature sensors is determined as being in a fault state;
In a step of S104, a fault parameter value in the at least two temperature parameter values is determined.

[0104] In a step of S106, a parameter substitution value is estimated through operating parameters of the air conditioner.

[0105] In a step of S108, an operation of the air conditioner is controlled through the parameter substitution value.

[0106] Where, the parameter substitution value corresponds to the fault parameter value.

[0107] The air conditioner provided in this embodiment is used for controlling the air conditioner, indoor unit(s) and a plurality of temperature sensors are provided in the air conditioner. The plurality of temperature sensors are located at different positions of the indoor unit. The plurality of temperature sensors may collect temperature parameter values at different positions respectively. A throttle valve and a draught fan are further provided in the indoor unit, the throttle valve and the draught fan of the indoor unit are controlled according to the plurality of corresponding temperature parameter values collected by the plurality of temperature sensors. Thus, the control of the operation of the indoor unit is realized.

[0108] The indoor unit of the air conditioner collects the temperature parameter values continuously through the plurality of temperature sensors, and collects the operating parameters of the air conditioner continuously, and controls the operation of the air conditioner according to the collected temperature parameter values and the operating parameters. Where, the throttle valve and the draught fan in the indoor unit are controlled through the temperature parameter values collected by the temperature sensors.

[0109] Whether there exists a malfunctioned temperature sensor in the indoor unit is detected during the operation of the air conditioner. When detecting that there exists at least two malfunctioned temperature sensors, the malfunctioned sensors in the plurality of temperature sensors are detected and located. Thus, the fault parameter values in the temperature parameter values collected by the plurality of temperature sensors may be determined, and the true value of the fault parameter value is estimated through other operating parameters of the air conditioner, and thus the parameter substitution value is obtained. The fault parameter value in the plurality of temperature parameter values is substituted with the parameter substitution value, and updating of the plurality of collected temperature parameter values is realized. The operation of the air conditioner is continued to be controlled through the parameter substitution value. The indoor unit of the air conditioner can still keep operation under the condition that there exists a malfunctioned temperature sensor in the indoor unit of the air conditioner. It is guaranteed that the air conditioner can still be operated in the queueing process for maintenance, a downtime of the air conditioner in the queueing process for maintenance is shortened, and a usage experience of a user is improved.

[0110] In some embodiments, when detecting that there exists malfunctioned temperature sensor(s) in the air conditioner, the air conditioner outputs corresponding prompt information for prompting fault(s) of the temperature sensor(s).

[0111] In some embodiments, after the air conditioner detects that there exists a malfunctioned temperature sensor in the plurality of temperature sensors, after the air conditioner receives an operation instruction from the user, the air conditioner continues to perform the step of estimating the parameter substitution value, and controlling the operation of the air conditioner through the parameter substitution value.

[0112] In these embodiments, the air conditioner may determine whether continuous operation needs to performed according to the actual requirement of the user. If the air conditioner fails to receive the operation instruction from the user, the air conditioner is controlled to stop operation after outputting prompt information of "fault and halt". A controllability of the air conditioner is improved, and the air conditioner may select to continue to be operated or stop operation according to the requirement of the user when temperature sensor(s) is/are in the fault state.

[0113] As shown in FIG. 2, in any one of the aforesaid embodiments, a heat exchanger 202 is arranged in the indoor unit 200, the temperature sensors includes a first temperature sensor 204, a second temperature sensor 206, and a third temperature sensor 208. The first temperature sensor 204 and the second temperature sensor 206 are arranged at two ends of the heat exchanger 202, the third temperature sensor 208 is arranged at an air inlet of the indoor unit 200.

[0114] In this embodiment, the indoor unit 200 of the air conditioner includes the heat exchanger 202, when the air conditioner is operated in a refrigeration mode, refrigerant flows to a second end through a first end of the heat exchanger 202. When the air conditioner is operated in a heating mode, the refrigerant flows to the first end through the second end of the heat exchanger 202. A plurality of temperature sensors are further arranged in the indoor unit 200. The plurality of temperature sensors include the first temperature sensor 204 arranged at the first end of the heat exchanger 202. The first temperature sensor 204 may collect a temperature value at the refrigerant inlet of the indoor unit 200 under a refrigeration mode. The first temperature sensor 204 may collect a temperature value at a refrigerant outlet of the indoor unit 200 under a heating mode. The plurality of temperature sensors further include the second temperature sensor 206 arranged at the second end of the heat exchanger 202, the second temperature sensor 206 may detect a temperature value at a refrigerant outlet of the indoor unit 200 in the refrigeration mode. The second temperature sensor 206 may collect a temperature value at the refrigerant inlet of the indoor unit 200 under the heating mode. The plurality of temperature sensors further include a third temperature sensor 208 arranged at the air inlet of the indoor unit 200, and the

third temperature sensor 208 may collect the temperature of the air entering the indoor unit 200. That is, the third temperature sensor 208 may collect the ambient temperature value of the indoor unit 200.

[0115] As shown in FIG. 3, in any one of the aforesaid embodiments, the step of determining the fault parameter value in the at least two temperature parameter values specifically includes:

In a step of S302, a fault state of the first temperature sensor, a fault state of the second temperature sensor, and a fault state of the third temperature sensor are detected respectively.

[0116] In a step of S304, a corresponding fault parameter value is determined according to the fault state of the first temperature sensor, the fault state of the second temperature sensor, and the fault state of the third temperature sensor.

[0117] Where, the fault parameter value includes a temperature value at the refrigerant inlet, a temperature value at the refrigerant outlet, and an ambient temperature value.

[0118] In this embodiment, the indoor unit of the air conditioner is provided with a throttle valve and a draught fan, during the operation of the indoor unit, the operation of the indoor unit is controlled by controlling parameters such as an opening degree of the throttle valve and a rotation speed of the draught fan. The detail of the control method includes: adjusting the opening degree of the throttle valve according to the collected temperature value at the refrigerant outlet, the ambient temperature value, and the temperature value at the refrigerant inlet, and adjusting the rotation speed of the draught fan.

[0119] Whether there exists a fault parameter value in the plurality of temperature parameter values is determined by determining whether each of the plurality of temperature sensors in the indoor unit of the air conditioner malfunctions. When a malfunctioned temperature sensor in the plurality of temperature sensors is detected, it is determined that a fault parameter value is included in the collected multiple temperature parameter values. The fault parameter value in the temperature parameter values collected by the three temperature sensors may be determined by determining whether the three temperature sensors malfunction respectively, under the determination of the operation mode of the air conditioner. Thus, the fault parameter value in the collected temperature parameter values is determined rapidly when there exists a malfunctioned temperature sensor in the indoor unit, and the air conditioner is prevented from being continuously controlled according to the fault parameter value, the duration of operation of the air conditioner in the fault state is reduced.

[0120] As shown in FIG. 4, in any one of the aforesaid embodiments, before estimating the parameter substitution value through the operating parameters of the air conditioner, the method includes:

In a step of S402, the air conditioner is controlled to be operated in a preset operation mode.

[0121] In a step of S404, operating parameters of the air conditioner are collected in the preset operation mode.

[0122] The preset operation mode includes a refrigeration mode and a heating mode.

[0123] In this embodiment, since the control parameters and the operating parameters of the air conditioner operated in the refrigeration mode and the control parameters and the operating parameters of the air conditioner operated in the heating mode are different, flow directions of the refrigerant flowing through the heat exchanger of the indoor unit are also different when the air conditioner is operated in different modes. Thus, the temperature parameter values collected by the first temperature sensor and the second temperature sensor are also different. The current operation mode of the air conditioner needs to be determined before estimating the parameter substitution value, the fault parameter value is determined according to the operation mode and whether each temperature sensor in the plurality of temperature sensors malfunctions. The corresponding operating parameters are collected in the process of operating the air conditioner in the preset operation mode, then, the parameter substitution value is estimated through the collected operating parameters. Thus, the calculated parameter substitution value is consistent with the operation mode of the air conditioner, an accuracy of operation of the air conditioner according to the parameter substitution value is improved, and a malfunction of the air conditioner caused due to the control of the air conditioner according to the parameter substitution value that does not conform to the operation mode is avoided.

[0124] It can be understood that the operation mode of the air conditioner further includes an air supplying mode, when the air conditioner is in the air supplying mode, a compressor of the air conditioner does not need to be operated, and a cut-off valve in the indoor unit does not need to be started, either. Thus, the malfunction of the temperature sensor does not affect air supplying operation of the air conditioner, and thus the corresponding parameter substitution value does not need to be estimated.

[0125] In some embodiments, a fault of the first temperature sensor of the air conditioner is detected. In the refrigeration mode, since the temperature parameter value collected by the first temperature sensor is the temperature value at the refrigerant inlet, the temperature value at the refrigerant inlet in the collected temperature parameter values is determined as the fault parameter value. In the heating mode, since the temperature parameter value collected by the first temperature sensor is the temperature value at the refrigerant outlet, the temperature value at the refrigerant outlet in the collected temperature parameter values is determined as the fault parameter value.

[0126] In some other embodiments, a fault of the second temperature sensor of the air conditioner is detected. In the refrigeration mode, since the temperature parameter value collected by the second temperature sensor is the temperature value at the refrigerant outlet, the temperature value at the refrigerant outlet in the collected temperature parameter values is determined as the fault parameter value. In the heating mode, since the temperature parameter value collected

by the second temperature sensor is the temperature value at the refrigerant inlet, the temperature value at the refrigerant inlet in the collected temperature parameter values is determined as the fault parameter value.

[0127] In some other embodiments, a fault of the third temperature sensor of the air conditioner is detected. Since the temperature parameter value collected by the third temperature sensor is the ambient temperature value, the ambient temperature value in the collected temperature parameter values is determined as the fault parameter value.

[0128] As shown in FIG. 5, in any one of the aforesaid embodiments, the fault in the first temperature sensor is determined, and the air conditioner includes a plurality of indoor units. The step of estimating the parameter substitution value through the operating parameters of the air conditioner specifically includes:

[0129] In a step of S502, the temperature value at the refrigerant outlet is determined as the fault parameter value according to the operation of the air conditioner in the heating mode.

[0130] In a step of S504, the number of the indoor units in the operating state is determined.

[0131] In a step of S506, a preset amount of heat output, a pressure value at the refrigerant outlet, a target subcooling degree, and a high-pressure saturation temperature.

[0132] In a step of S508, the parameter substitution value of the temperature value at the refrigerant outlet is estimated according to the preset amount of heat output, the pressure value at the refrigerant outlet, the target subcooling degree and the high-pressure saturation temperature.

[0133] In this embodiment, the air conditioner is a multi-split air conditioner, that is, the air conditioner includes a plurality of indoor units. The air conditioner is operated according to the heating mode, and the high-temperature and high-pressure refrigerant generated by the compressor flows to the first end of the heat exchanger of the indoor unit through the second end of the heat exchanger of the indoor unit. Since the first temperature sensor is arranged at the first end of the heat exchanger, the temperature parameter value collected by the first temperature sensor is the temperature value at the refrigerant outlet. When the first temperature sensor is in a fault state, the temperature value at the refrigerant outlet may be determined as the fault parameter value.

[0134] When the air conditioner is operated in the heating mode and the temperature value at the refrigerant outlet is the fault parameter value, the number of the started indoor units in the air conditioner needs to be determined, and the operating parameters including the high-pressure saturation temperature of the air conditioner, the preset amount of heat output, the pressure value at the refrigerant outlet, the target subcooling degree of the indoor unit are obtained. The parameter substitution value is estimated through the obtained operating parameters and the number of the indoor unit in operation, and the temperature value at the refrigerant outlet in the collected temperature parameter values is substituted with the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to inaccurate temperature value at the refrigerant outlet may be avoided.

[0135] It is worth noting that, the high-voltage saturation temperature is the hardware parameter of the air conditioner system. Thus, when the parameter substitution value is calculated, the high-voltage protection temperature of the system may be directly invoked. The target subcooling degree is the parameter value obtained through calculation according to an operation instruction after the operation instruction is received by the air conditioner. The pressure value at the refrigerant outlet may be directly collected by arranging the pressure sensors. As an alternative, the pressure value at the refrigerant outlet may be calculated through other parameter values such as the temperature at the refrigerant outlet. The preset heat output may be calculated according to the high-pressure saturation temperature and the ambient environment.

[0136] As shown in FIG. 6, in any one of the aforesaid embodiments, the step of estimating the parameter substitution value of the temperature value at the refrigerant outlet specifically includes:

[0137] In a step of S602, it is determined that the air conditioner is operated in a heating mode.

[0138] In a step of S604, whether the number of indoor units is less than a preset number is determined; if the number of the indoor units is less than the preset number, a step of S606 is performed; if the number of the indoor units is equal to or greater than the preset number, a step of S608 is performed.

[0139] In the step of S606, the parameter substitution value of the temperature value at the refrigerant outlet is estimated according to the target subcooling degree and the high-pressure saturation temperature.

[0140] In the step of S608, the parameter substitution value of the temperature value at the refrigerant outlet is estimated according to the preset amount of heat output and the pressure value at the refrigerant outlet.

[0141] In this embodiment, if it is detected that the number of started indoor units is less than the preset number, when the parameter substitution value of the temperature value at the refrigerant outlet is calculated, the parameter substitution value of the temperature value at the refrigerant outlet is obtained by calculating the difference value between the high-voltage saturation temperature and the target subcooling degree, and the estimated temperature value at the refrigerant outlet is used as the parameter substitution value of the temperature value at the refrigerant outlet.

[0142] The temperature value at the refrigerant outlet is estimated according to the target subcooling degree and the pressure saturation temperature by using a formula which is expressed as:

$$T_1=T_C\text{-}SCS;$$

[0143] Where, T_1 is the parameter substitution value corresponding to the temperature value at the refrigerant outlet, T_C is the high-voltage saturation temperature, and the SCS is the target subcooling degree.

[0144] In this embodiment, if it is detected that the number of the started indoor units is greater than or equal to the preset number, whether the temperature sensor in each indoor unit malfunctions is detected. If a fault-free indoor unit is detected, a pressure value at the refrigerant outlet of an indoor unit without sensor fault is calculated, and a pressure value at the refrigerant outlet of an indoor unit having a sensor fault is calculated, the preset amount of heat output is obtained according to the two pressure values at the refrigerant outlet, enthalpy value of the refrigerant outlet of the heat exchanger is calculated according to the preset amount of heat output, and the temperature value at the refrigerant outlet is estimated according to the enthalpy value of the refrigerant outlet, and the parameter substitution value corresponding to the temperature value at the refrigerant outlet is calculated accordingly.

[0145] The pressure value at the refrigerant outlet of the indoor unit without sensor fault is calculated through the formula which is expressed as:

$$P_1=P_C\text{-}dP_1;$$

[0146] Where, P_1 is the pressure value at the refrigerant outlet of the indoor unit without sensor fault, P_C is the maximum pressure value of an outdoor unit, and dP_1 is a pressure drop across an electronic expansion valve of the indoor unit without sensor fault.

[0147] It can be understood that, the pressure drop across the electronic expansion valve of the indoor unit without sensor fault may be calculated by calculating the pressure values at the two ends of the electronic expansion valve collected by the sensors. The pressure drop may also be obtained by calculation according to a refrigerant flow value, the enthalpy value of the refrigerant outlet, and the preset amount of heat output of the indoor unit.

[0148] The pressure value at the refrigerant outlet of the indoor unit having a sensor fault is calculated through a formula which is expressed as:

$$P_2= P_1+(H_1\text{-}H_2)\times den\times 9.8;$$

[0149] H_1 is a liquid column pressure value caused due to height difference between a malfunctioned indoor unit and a reference point, Hz is the liquid column pressure value caused due to height difference between the indoor unit having a sensor fault and the reference point, den is a density of the refrigerant of the malfunctioned indoor unit, P_2 is the pressure value at the refrigerant outlet of the malfunctioned indoor unit, and P_1 is the pressure value at the refrigerant outlet of the indoor unit without sensor fault.

[0150] It can be understood that, the liquid column pressure value caused due to the height difference between the indoor unit and the reference point is calculated during a trial operation stage of the air conditioner. The density of the refrigerant may be obtained by calculating a physical property function of the liquid refrigerant, and a segmented fitting curve may be adopted in the process of calculation of the density of the refrigerant.

[0151] A refrigerant flow value is calculated through a formula, which is expressed as:

$$mf=(dp_2, cv, den);$$

[0152] Where, mf is the refrigerant flow value, dP_2 is the pressure drop across the electronic expansion valve of the indoor unit having a sensor fault, cv is an opening value of the electronic expansion valve, and den is the density of the refrigerant of the malfunctioned indoor unit.

[0153] The pressure drop across the electronic expansion valve of the indoor unit having a sensor fault is calculated through a formula, which is expressed as:

$$dp_2=P_C-P_2;$$

[0154] dp_2 is the pressure drop across the electronic expansion valve of the indoor unit having a sensor fault, P_C is the maximum pressure value of the outdoor unit, and P_2 is the pressure value at the refrigerant outlet of the malfunctioned indoor unit.

[0155] The preset heat output is calculated through a formula, which is expressed as:

$$Q=K_A\times(T_C-T_3);$$

[0156] Where, Q is the preset amount of heat output, K_A is a coefficient, T_C is the high-voltage saturation temperature, and T_3 is the ambient temperature value.

[0157] The enthalpy value of the refrigerant outlet of the heat exchanger is calculated through a formula according to the preset amount of heat output, the formula is expressed as:

$$h_1=h_2-Q/mf;$$

[0158] H_1 is an enthalpy value of the refrigerant outlet, H_2 is an enthalpy value at the refrigerant inlet, Q is a preset amount of heat output, and mf is the refrigerant flow value.

[0159] The parameter substitution value of the temperature value at the refrigerant outlet is calculated according to the enthalpy value of the refrigerant outlet by using the following formula. :

$$T_1=f_1(h_1, T_C);$$

[0160] Where, T_1 is the parameter substitution value corresponding to the temperature value at the refrigerant outlet, hi is the enthalpy value of the refrigerant outlet, T_C is the high-voltage saturation temperature, and f_1 is a preset function.

[0161] According to the aforesaid formula, the parameter substitution value of the temperature value at the refrigerant outlet of the indoor unit having a sensor fault is accurately obtained by collecting corresponding parameters of the indoor unit without sensor fault and calculating according to the corresponding parameters, under the condition that a plurality of indoor units are powered on. The accuracy of operation of the air conditioner controlled according to the parameter substitution value is further improved, and occurrence of other faults during the operation process of the air conditioner is avoided.

[0162] In some embodiments, a value range of the preset number is greater than or equal to 2.

[0163] In these embodiments, when the number of started indoor units in the air conditioner is greater than or equal to 2, and the started indoor units includes indoor units having fault-free sensor(s), the parameter substitution value of the temperature value at the refrigerant outlet of the indoor unit having sensor fault is calculated by collecting corresponding parameters of the indoor unit having the fault-free sensor(s).

[0164] It may be understood that, when the preset number is selected to be greater than 2, the parameter substitution value of the temperature value at the refrigerant outlet of the indoor unit having a plurality of malfunctioned sensors may be calculated by collecting corresponding parameters of one indoor unit without sensor fault, the control of the operation of the indoor unit having the plurality of malfunctioned sensors in the air conditioner is realized, and the inconvenience caused due to termination of operation of the air conditioner is avoided.

[0165] As shown in FIG. 7, in any one of the aforesaid embodiments, the first temperature sensor is in the fault state, the step of estimating the parameter substitution value through the operating parameters of the air conditioner specifically includes:

[0166] In a step of S702, the temperature value at the refrigerant inlet is determined as the fault parameter value according to the operation of the air conditioner in the refrigeration mode.

[0167] In a step of S704, the draught fan is controlled to stop operation for a second preset time duration every first preset time duration, and the temperature value at the refrigerant outlet is collected.

[0168] In a step of S706, the parameter substitution value of the temperature value at the refrigerant inlet is estimated according to the temperature value at the refrigerant outlet.

[0169] In this embodiment, the air conditioner is a multi-split air conditioner, that is, the air conditioner includes a

plurality of indoor units. The air conditioner is operated in the refrigeration mode, and the refrigerant flows from the first end of the heat exchanger to the second end of the heat exchanger. Since the first temperature sensor is arranged at the first end of the heat exchanger, the temperature parameter value collected by the first temperature sensor is the temperature value at the refrigerant inlet. When the first temperature sensor is in the fault state, the temperature value at the refrigerant inlet may be determined as the fault parameter value.

[0170] When the air conditioner is operated in the refrigeration mode and the temperature value at the refrigerant inlet is the fault parameter value. A substitution value of the temperature value at the refrigerant inlet may be estimated according to the temperature value at the refrigerant outlet. In the refrigerant mode, the low-temperature refrigerant flows to the second end of the heat exchanger of the indoor unit through the first end of the heat exchanger of the indoor unit. During the process in which the refrigerant flows through the heat exchanger, the low-temperature refrigerant continuously exchanges heat with ambient air. Therefore, the temperature value at the refrigerant outlet should be higher than the temperature value at the refrigerant inlet, the difference value between the temperature value at the refrigerant outlet and the first preset difference value is calculated, and the estimated temperature value at the refrigerant inlet may be obtained, the estimated temperature value at the refrigerant inlet is used as the parameter substitution value of the temperature value at the refrigerant inlet, and the temperature value at the refrigerant inlet in the collected temperature parameter values is substituted with the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to the inaccurate temperature value at the refrigerant inlet is avoided.

[0171] The parameter substitution value of the temperature value at the refrigerant inlet is estimated according to the temperature value at the refrigerant outlet by using a formula which is expressed as:

$$T_1=T_2+Z_1;$$

[0172] Where, T_1 represents the parameter substitution value corresponding to the temperature value at the refrigerant inlet, T_2 represents the temperature value at the refrigerant outlet, Z_1 represents the first preset difference value.

[0173] It can be understood that, in the operation process of the air conditioner in the refrigeration mode, since the ambient temperature value of the indoor unit changes continuously, energy losses of the refrigerant and the air in the heat exchanger in the heat exchange process are also variable. Thus, the estimated parameter substitution value of the refrigerant inlet is updated every first preset time duration. The updating method includes: collecting the temperature value at the refrigerant outlet every first preset time duration, and then re-estimating the parameter substitution value of the temperature value at the refrigerant inlet according to the temperature value at the refrigerant outlet. The parameter substitution value of the temperature value at the refrigerant inlet is continuously updated, the stability of the control of the air conditioner having a sensor fault is further improved.

[0174] When the air conditioner is operated in the refrigeration mode and the temperature value at the refrigerant inlet is the fault parameter value, the temperature value at the refrigerant outlet is collected every first preset time duration, and the parameter substitution value is estimated according to the temperature value at the refrigerant outlet. Before each time the temperature value at the refrigerant outlet is collected, the draught fan is controlled to stop operation for a second preset time duration. It can be understood that the operation of the draught fan may accelerate the heat exchange between the heat exchanger and ambient air. Thus, before the collection of the temperature value at the refrigerant outlet, the draught fan is controlled to stop operation for the second preset time duration, the value of energy loss of the refrigerant in the heat exchange process may be decreased, and an accuracy of an estimated parameter substitution value of the temperature value at the refrigerant inlet is further improved.

[0175] In some embodiments, a value range of the second preset time duration is between 10 seconds and 40 seconds.

[0176] In these embodiments, the value of the second preset time duration is set to be greater than or equal to 10 seconds, such that there is enough time for the temperature value at the refrigerant outlet to approach the temperature value at the refrigerant inlet. The value of the second preset time duration is set to be less than or equal to 40 seconds, such that a malfunction of air conditioner caused due to long time of poor heat exchange of refrigerant in the heat exchanger may be avoided.

[0177] As shown in FIG. 8, in any one of the aforesaid embodiments, the second temperature sensor is in the fault state, and the step of estimating the parameter substitution value through the operating parameters of the air conditioner specifically includes:

[0178] In a step of S802, the temperature value at the refrigerant inlet is determined as the fault parameter value according to the operation of the air conditioner in the heating mode.

[0179] In a step of S804, a high-voltage saturation temperature is obtained.

[0180] In a step of S806, the parameter substitution value of the temperature value at the refrigerant inlet is estimated

according to the high-pressure saturation temperature.

[0181] In this embodiment, the air conditioner is a multi-split air conditioner, that is, the air conditioner includes a plurality of indoor units. The air conditioner is operated in the heating mode, the high-temperature and high-pressure refrigerant generated by the compressor flows to the first end of the heat exchanger of the indoor unit through the second end of the heat exchanger of the indoor unit. Since the first temperature sensor is arranged at the first end of the heat exchanger, the temperature parameter value collected by the first temperature sensor is the temperature value at the refrigerant outlet. When the first temperature sensor is in the fault state, the temperature value at the refrigerant outlet may be determined as the fault parameter value.

[0182] When the air conditioner is operated in the heating mode and the temperature value at the refrigerant inlet is the fault parameter value, the substitution value of the temperature value at the refrigerant inlet may be estimated according to the high-pressure saturation temperature. In the heating mode, the high-temperature refrigerant compressed by the compressor directly flows to the second end of the heat exchanger, thus, the parameter substitution value of the relatively accurate temperature value at the refrigerant inlet may be obtained by estimating according to hardware parameters of the air conditioning system. The high-pressure saturation temperature is the temperature value corresponding to the refrigerant under a certain pressure, it may be considered that the high-pressure saturation temperature is the temperature value of the high-pressure and high-temperature refrigerant output by the compressor, the high-temperature and high-pressure refrigerant flows to the second end of the heat exchanger of the indoor unit through a refrigerant pipeline, and certain heat loss is caused. The second preset difference value is arranged according to heat loss. The temperature value at the refrigerant inlet of the heat exchanger in the heating mode may be estimated by calculating the difference value between the high-pressure saturation temperature and the second preset difference value, and the estimated temperature value at the refrigerant inlet is taken as the parameter substitution value of the temperature value at the refrigerant inlet, and the temperature value at the refrigerant inlet in the collected temperature parameter values is substituted with the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to the inaccurate temperature value at the refrigerant inlet is avoided.

[0183] The temperature value at the refrigerant inlet is calculated according to the high-pressure saturation temperature by using a formula which is expressed as:

$$T_2=Tc+Z_2;$$

[0184] Where, T_2 is the parameter substitution value corresponding to the temperature value at the refrigerant inlet, T_C is the high-voltage saturation temperature, and Z_2 is the second preset difference value.

[0185] It can be understood that, during the operation of the heating mode, the compressor will continue to be operated in the preset operation state, that is, variation ranges of the pressure value and the temperature value of the refrigerant output by the compressor are relatively small. Thus, only when the fault parameter value is determined as the temperature value at the refrigerant inlet, the operation of the air conditioner is continuously controlled according to the parameter substitution value calculated by the high-voltage saturation temperature and the second preset difference value, the parameter substitution value does not need to be frequently updated.

[0186] As shown in FIG. 9, in any one of the aforesaid embodiments, the second temperature sensor is in the fault state, and the air conditioner includes a plurality of indoor units. The step of estimating the parameter substitution value according to the operating parameters of the air conditioner specifically includes:

[0187] In a step of S902, the temperature value at the refrigerant outlet is determined as the fault parameter value according to the operation of the air conditioner in the refrigeration mode.

[0188] In a step of S904, the number of indoor units in the operation state is determined.

[0189] In a step of S906, the target superheat degree, the temperature value at the refrigerant inlet, the temperature of the exhaust air of the compressor, the preset amount of heat output, and the target superheat degree of the exhaust air of the compressor are collected.

[0190] In a step of S908, the parameter substitution value of the temperature value at the refrigerant outlet is estimated according to the number of indoor units, the target superheat degree, the temperature value at the refrigerant inlet, the temperature of the exhaust air of the compressor, the preset amount of heat output and the target superheat degree of the exhaust air of the compressor.

[0191] In this embodiment, the air conditioner is a multi-split air conditioner, that is, the air conditioner includes a plurality of indoor units. The air conditioner is operated in the refrigeration mode, and the refrigerant flows from the first end of the heat exchanger to the second end of the heat exchanger. Since the second temperature sensor is arranged at the second end of the heat exchanger, the temperature parameter value collected by the second temperature sensor

is the temperature value at the refrigerant outlet. When the second temperature sensor is in the fault state, the temperature value at the refrigerant outlet may be determined as the fault parameter value.

[0192] When the air conditioner is operated in the refrigeration mode and the temperature value at the refrigerant outlet is the fault parameter value, the number of the started indoor units in the air conditioner needs to be determined, the temperature value at the refrigerant inlet of the air conditioner, the preset amount of heat output and the target superheat degree, and the temperature of the exhaust air of the compressor and the target superheat degree of the exhaust air of the compressor are obtained. The parameter substitution value is estimated through the obtained operating parameters and the number of the started indoor units, and the temperature value at the refrigerant outlet in the collected temperature parameter values is substituted with the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to the inaccurate temperature value at the refrigerant outlet is avoided.

[0193] As shown in FIG. 10, in any one of the aforesaid embodiments, the step of estimating the parameter substitution value of the temperature value at the refrigerant outlet specifically includes:

[0194] In a step of S 1002, operation of the air conditioner in the refrigeration mode is determined.

[0195] In a step of S 1004, whether the number of indoor units is less than a preset number is determined; if the number of indoor units is less than the preset number, a step of S 1006 is performed, if the number of indoor units is equal to or greater than the preset number, a step of S1008 is performed.

[0196] In the step of S 1006, the parameter substitution value of the temperature value at the refrigerant outlet is estimated according to the target superheat degree and the temperature value at the refrigerant inlet.

[0197] In the step of S 1008, the parameter substitution value of the temperature value at the refrigerant outlet is estimated according to temperature of the exhaust air, the superheat degree of the exhaust air, the target superheat degree, and the temperature at the refrigerant inlet.

[0198] In this embodiment, when detecting that the number of the started indoor units is less than the preset number, when the parameter substitution value of the temperature value at the refrigerant outlet is calculated, an estimated temperature value at the refrigerant outlet is obtained by calculating according to the temperature value at the refrigerant inlet and the target superheat degree, and the estimated temperature value at the refrigerant outlet is used as the parameter substitution value of the temperature value at the refrigerant outlet.

[0199] The temperature value at the refrigerant outlet is estimated according to the temperature value at the refrigerant inlet and the target superheat degree by using a formula which is expressed as:

$$T_2=T_1+SHS;$$

[0200] Where, T_2 is the parameter substitution value corresponding to the temperature value at the refrigerant outlet, T_1 is the temperature value at the refrigerant inlet, and SHS is the target superheat degree.

[0201] In this embodiment, when detecting that the number of the started indoor units is greater than or equal to the preset number, when the parameter substitution value of the temperature value at a refrigerant rear outlet is calculated, the parameter substitution value of the temperature value at the refrigerant outlet is calculated according to the superheat degree of the exhaust air, the temperature value at the refrigerant inlet, the temperature of the exhaust air and the target superheat degree, so that an estimated temperature value at the refrigerant outlet is obtained, and the estimated temperature value at the refrigerant rear outlet is used as the parameter substitution value of the temperature value of the refrigerant rear outlet.

[0202] The temperature value at the refrigerant outlet is estimated according to the superheat degree of the exhaust air, the temperature value at the refrigerant inlet, the temperature of the exhaust air, and the target superheat degree by using a formula, which is expressed as:

$$T2=(DSH-DSHS)/4+T1+SHS;$$

[0203] Where, T_2 is the parameter substitution value corresponding to the temperature value at the refrigerant outlet, T_1 is a temperature value at a refrigerant inlet, SHS is the target superheat degree, and DSHS is the target superheat degrees of the exhaust air, the DSH is the temperature of the exhaust air.

[0204] The parameter substitution value of the temperature value at the refrigerant outlet of the indoor unit having a malfunctioned sensor is obtained by collecting the corresponding parameters of the indoor unit and accurately calculating according to these parameters through the aforesaid formula. Furthermore, the accuracy of controlling the air conditioner

to be operated through the parameter substitution value is further improved, and an occurrence of other faults in the operation process of the air conditioner is avoided.

[0205] As shown in FIG. 11, in any one of the aforesaid embodiments, the third temperature sensor is in the fault state, the step of estimating the parameter substitution value according to the operating parameters of the air conditioner specifically includes:

In a step of S1102, an ambient temperature value is determined as the fault parameter value.

[0206] In a step of S1104, the throttle valve is controlled to inactivate the fourth preset time duration every third preset time duration and the temperature value at the refrigerant outlet is obtained.

[0207] In a step of S 1106, the parameter substitution value of the ambient temperature value is estimated according to the temperature value at the refrigerant outlet.

[0208] In this embodiment, during the operation of the air conditioner, when the third temperature sensor is in the fault state, the ambient temperature value collected by the third temperature sensor is determined as the fault parameter value. The substitution value of the ambient temperature value may be estimated according to the temperature value at the refrigerant outlet. The estimated ambient temperature value may be obtained by calculating the temperature value at the refrigerant outlet and the third preset difference value, the estimated ambient temperature value is used as the parameter substitution value of the ambient temperature value, and the ambient temperature value in the collected temperature parameter values is replaced by the parameter substitution value. By controlling the operation of the throttle valve and the draught fan in the indoor unit of the air conditioner using the updated temperature parameter value, a condition that the air conditioner cannot be accurately controlled to be operated in the heating mode due to the inaccurate temperature value at the refrigerant inlet is avoided.

[0209] The parameter substitution value of the ambient temperature value is estimated according to the temperature value at the refrigerant outlet by using a formula which is expressed as:

$$T_3=T_2+Z_3;$$

[0210] Where, T_3 is the parameter substitution value of the ambient temperature value, T_2 is the temperature value at the refrigerant outlet, and Z_3 is the third preset difference value.

[0211] It should be noted that, a difference value between the temperature value at the refrigerant outlet and the ambient temperature value when the air conditioner is operated in the refrigeration mode and a difference value between the temperature value at the refrigerant outlet and the ambient temperature value when the air conditioner is operated in the refrigeration mode are different. Thus, different third preset difference values are selected according to different operation modes of the air conditioner before the step of calculating the parameter substitution value of the ambient temperature value.

[0212] It can be understood that, during the operation of the air conditioner, since the ambient temperature value the indoor unit changes continuously, energy losses of the refrigerant and the air in the heat exchanger in a heat exchange process are also variable. Thus, the third preset time duration is set, and the substitution value of the estimated ambient temperature value is updated. The updating method includes: collecting the temperature value at the refrigerant outlet every third preset time duration, and then re-estimating the parameter substitution value of the ambient temperature value according to the temperature value at the refrigerant outlet. The parameter substitution value of the ambient temperature value is continuously updated, the stability of the control of the air conditioner having a sensor fault is further improved.

[0213] In this embodiment, when the air conditioner is in operation and the ambient temperature value is the fault parameter value, the temperature value at the refrigerant outlet is collected every third preset time duration, and the parameter substitution value is estimated according to the temperature value at the refrigerant outlet. Before each time the temperature value at the refrigerant outlet is collected, the throttle valve is controlled to stope operation for the fourth preset time duration. It can be understood that when the throttle valve is in an open state, the low-temperature or high-temperature refrigerant continues to flow into the heat exchanger, and a great difference between the temperature value at the refrigerant outlet and the ambient temperature value is caused. Thus, before the temperature value at the refrigerant outlet is collected, the throttle valve is controlled to stop operation for the fourth preset time duration, the difference between the temperature value at the refrigerant outlet and the ambient temperature value may be reduced, and the accuracy of the estimated parameter substitution value of the temperature value at the refrigerant inlet is further improved.

[0214] In some embodiments, a value range of the fourth preset time duration is between 60 seconds and 120 seconds.

[0215] In these embodiments, the value of the fourth preset time duration is set to be greater than or equal to 60 seconds, thus, there is enough time for the temperature value at the refrigerant outlet for approaching the ambient temperature value. The value of the fourth preset time duration is set to be less than or equal to 120 seconds, such that the malfunction of the air conditioner caused because that the refrigerant cannot enter the heat exchanger of the indoor

unit for long time may be avoided.

[0216] As shown in FIG. 12, in any one of the aforesaid embodiments, the step of detecting the fault state of the first temperature sensor, the fault state of the second temperature sensor, and the fault state of the third temperature sensor respectively specifically includes:

[0217] In a step of 1202, a numerical relationship between the temperature value at the refrigerant inlet, the ambient temperature value, and the temperature value at the refrigerant outlet is determined.

[0218] In a step of 1204, the fault state of each of the temperature sensors is determined according to the numerical relationship.

[0219] In this embodiment, whether there exists a malfunctioned temperature sensor in the three temperature sensors is detected according to the data relationship between the temperature parameter value collected by the first temperature sensor, the temperature parameter value collected by the second temperature sensor and the temperature parameter value collected by the third temperature sensor. Moreover, the malfunctioned temperature sensor in the three temperature sensors may be located.

[0220] In some embodiments, the temperature value at the refrigerant inlet, the ambient temperature value, and the temperature value at the refrigerant outlet are collected, and it is determined that two of the temperature value at the refrigerant inlet, the ambient temperature value and the temperature value at the refrigerant outlet are not fault parameter values.

[0221] When determining that any two temperature parameter values in the three temperature parameter values are non-fault parameter values, whether the other temperature parameter value is determined by the method described below.

[0222] The compressor of the air conditioner stops operation, which lasts for a fifth preset time duration. The other temperature parameter value is determined as the fault parameter value when the following determination conditions are satisfied, the determination conditions are expressed as:

$$(\mathrm{Abs}(T_3-T_1)-dT_2)\times(\mathrm{Abs}(T_3-T_2)-dT_2)\times(\mathrm{Abs}(T_2-T_1)-dT_2)<0, \text{ and } \mathrm{Abs}(T_2-T_1)<dT_2, \text{ and } \mathrm{Abs}(T_3-T_1)\geq dT_2;$$

[0223] The air conditioner is operated according to the refrigeration mode. The other temperature parameter value is determined as the fault parameter value when the following determination conditions are satisfied, the determination conditions are expressed as:

$$(T_1-T_3-dT_2)\times(T_2-T_3-dT_1)\times(T_1-T_2-dT_3)<0 \text{ reaches a preset time length, and } T_1-T_2<dT_2, \text{ and } T_1-T_3\geq dT_1;$$

[0224] The air conditioner is operated according to the heating mode. The other temperature parameter value is determined as the fault parameter value when the following determination conditions are satisfied, the determination conditions are expressed as:

$$(T_3-T_1-dT_1)\times(T_3-T_2-dT_1)\times(T_1-T_2-dT_4)<0 \text{ reaches a preset time length, and } T_1-T_2<dT_4, \text{ and } T_3-T_1\geq dT_1.$$

[0225] Where T_1 is the temperature parameter value collected by the first temperature sensor, T_2 is the temperature parameter value collected by the second temperature sensor, T_3 is the temperature parameter value collected by the third temperature sensor, dT_1 is a first preset value, dT_2 is a second preset value, dT_3 is a third preset value, and dT_4 is a fourth preset value.

[0226] As shown in FIG. 13, in any one of the aforesaid embodiments, the method for controlling the air conditioner further includes:

[0227] In a step of 1302: a time duration of the operation of the air conditioner controlled according to the parameter substitution value is counted.

[0228] In a step of 1304, the air conditioner is controlled to stop operation one the basis that the time duration reaches the fourth preset time duration.

[0229] In this embodiment, after time duration of the operation process of the air conditioner controlled according to the estimated temperature parameter value reaches the fourth preset time duration, the air conditioner is controlled to stop operation. Since the parameter substitution value of the temperature parameter value is the estimated temperature parameter value, there is a certain difference between the parameter substitution value of the temperature parameter value and a true value of the temperature parameter value. After the time duration of the operation of the air conditioner controlled according to the estimated temperature parameter value reaches the fourth time duration, the air conditioner

is controlled to stop operation. Thus, the air conditioner may be prevented from being operated under a fault state of one temperature sensor for a long time. The stability of operation of the air conditioner is improved.

Second embodiment:

[0230] As shown in FIG. 14, an apparatus 1400 for controlling an air conditioner is provided the first embodiment of the present application. The apparatus 1400 includes:

a fault parameter acquisition unit 1402 configured to determine that any one of the at least two temperature sensors is in a fault state, and determine a fault parameter value in at least two temperature parameter values;
a parameter determination unit 1404 configured to estimate a parameter substitution value according to the operating parameter of the air conditioner;
an operation control unit 1406 configured to control an operation of the air conditioner according to the parameter substitution value.

[0231] The apparatus for controlling the air conditioner provided in the present application is used for controlling the air conditioner, one indoor unit and a plurality of temperature sensors are arranged in the air conditioner, the plurality of temperature sensors are provided at different positions of the indoor unit, and the plurality of temperature sensors may respectively collect temperature parameter values at the different positions. A throttle valve and a draught fan are further provided in the indoor unit, and the throttle valve and the draught fan of the indoor unit are controlled according to the plurality of corresponding temperature parameter values collected by the plurality of temperature sensors, and a control of operation of the indoor unit is realized.

[0232] The indoor unit of the air conditioner collects the temperature parameter values continuously through the plurality of temperature sensors, and collects the operating parameters of the air conditioner continuously, and controls the operation of the air conditioner according to the collected temperature parameter values and the collected operating parameters. Where, the throttle valve and the draught fan in the indoor unit are controlled through the temperature parameter values collected by the temperature sensors.

[0233] Whether there exists malfunctioned temperature sensor(s) arranged in the indoor unit is detected during the operation of the air conditioner. When detecting that at least two temperature sensors are in the fault state, a fault sensor in the plurality of temperature sensors is detected and located. Thus, the fault parameter value in the temperature parameter values collected by the plurality of temperature sensors may be determined, and the true value of the fault parameter value is estimated through other operating parameters of the air conditioner and the parameter substitution value is obtained. The plurality of collected temperature parameter values is updated by replacing the fault parameter value in the plurality of temperature parameter values with the parameter substitution value. The operation of the air conditioner is continued to be controlled through the parameter substitution value, such that the indoor unit of the air conditioner can still keep operation under the condition that the temperature sensor in the indoor unit of the air conditioner are in the fault state. It is ensured that the air conditioner can still be operated in a queueing process for maintenance, a downtime of the air conditioner in the queueing process for maintenance is shortened. Thus, a use experience of the user is improved.

[0234] In some embodiments, when a malfunctioned temperature sensor in the air conditioner is detected, the air conditioner outputs corresponding prompt information for prompting a fault of the temperature sensor.

[0235] In some embodiments, after the air conditioner detects that there exists a malfunctioned temperature sensor in the plurality of temperature sensors, after the air conditioner receives an operation instruction from the user, the air conditioner continues to perform the step of estimating the parameter substitution value, and controlling the air conditioner to be operated according to the parameter substitution value.

[0236] In these embodiments, the air conditioner may determine whether continuous operation needs to performed according to the actual requirement of the user. If the air conditioner fails to receive the operation instruction from the user, the air conditioner is controlled to stop operation after outputting prompt information of "fault and halt". A controllability of the air conditioner is improved, and the air conditioner may select to continue to be operated or stop operation according to the requirement of the user when temperature sensor(s) is/are in the fault state.

[0237] As shown in FIG. 2, in the aforesaid embodiment, a heat exchanger 202 is arranged in the indoor unit 200. The temperature sensor includes a first temperature sensor 204, a second temperature sensor 206, and a third temperature sensor 208. The first temperature sensor 204 is arranged at a first end of the heat exchanger 202, the second temperature sensor 206 is arranged at a second end of the heat exchanger 202, and the third temperature sensor 208 is arranged at an air inlet of the indoor unit 200.

[0238] In this embodiment, the indoor unit 200 of the air conditioner includes the heat exchanger 202. When the air conditioner is operated in the refrigeration mode, the refrigerant flows to the second end of the heat exchanger 202 through the first end of the heat exchanger 202. When the air conditioner is operated in the heating mode, the refrigerant

flows to the first end of the heat exchanger 202 through the second end of the heat exchanger 202. A plurality of temperature sensors are further arranged in the indoor unit 200. The plurality of temperature sensors include the first temperature sensor 204 arranged at the first end of the heat exchanger 202. In the refrigeration mode, the first temperature sensor 204 may detect the temperature value at the refrigerant inlet of the indoor unit 200. In the heating mode, the first temperature sensor 204 may detect the temperature value at the refrigerant outlet of the indoor unit 200. The plurality of temperature sensors further includes the second temperature sensor 206 arranged at the second end of the heat exchanger 202. In the refrigeration mode, the second temperature sensor 206 may detect the temperature value at the refrigerant outlet of the indoor unit 200. In the heating mode, the second temperature sensor 206 may detect the temperature value at the refrigerant inlet of the indoor unit 200. The plurality of temperature sensors further include the third temperature sensor 208 arranged at the air inlet of the indoor unit 200, and the third temperature sensor 208 may detect the temperature of the air entering the indoor unit 200, that is, the third temperature sensor 208 may detect the ambient temperature value of the indoor unit 200.

Third Embodiment:

[0239] As shown in FIG. 15, an air conditioner 1500 is provided in the third embodiment of the present application, the air conditioner 1500 includes: an indoor unit 1502 and the apparatus 1400 for controlling the air conditioner.

[0240] The apparatus 1400 for controlling the air conditioner, the apparatus 1400 for controlling the air conditioner is arranged in the indoor unit, and the apparatus 1400 for controlling the air conditioner is selected as the apparatus 1400 for controlling the air conditioner in the second embodiment.

[0241] The apparatus 1400 for controlling the air conditioner is configured to control the air conditioner, one or a plurality of indoor unit(s) and a plurality of temperature sensors are provided in the air conditioner. The plurality of temperature sensors are arranged at different positions of the indoor unit, and the plurality of temperature sensors may collect temperature parameter values at different positions respectively. A throttle valve and a draught fan are further provided in the indoor unit, and the throttle valve and the draught fan of the indoor unit are controlled according to the plurality of corresponding temperature parameter values collected by the plurality of temperature sensors. Thus, a control of the operation of the indoor unit is realized.

[0242] The indoor unit of the air conditioner collects the temperature parameter values continuously through the plurality of temperature sensors, collects the operating parameters of the air conditioner continuously, and controls the operation of the air conditioner according to the collected temperature parameter values and the operating parameters. Where, the throttle valve and the draught fan in the indoor unit are controlled through the temperature parameter values collected by the temperature sensor.

[0243] Whether there exists malfunctioned temperature sensor(s) arranged in the indoor unit is detected during the operation of the air conditioner. When detecting that at least two temperature sensors are in the fault state, a fault sensor in the plurality of temperature sensors is detected and located. Thus, the fault parameter value in the temperature parameter values collected by the plurality of temperature sensors may be determined, and the true value of the fault parameter value is estimated through other operating parameters of the air conditioner and the parameter substitution value is obtained. The plurality of collected temperature parameter values is updated by replacing the fault parameter value in the plurality of temperature parameter values with the parameter substitution value. The operation of the air conditioner is continued to be controlled through the parameter substitution value, such that the indoor unit of the air conditioner can still keep operation under the condition that the temperature sensor in the indoor unit of the air conditioner are in the fault state. It is ensured that the air conditioner can still be operated in a queueing process for maintenance, a downtime of the air conditioner in the queueing process for maintenance is shortened. Thus, a use experience of the user is improved.

[0244] In some embodiments, when one malfunctioned temperature sensor in the air conditioner is detected, the air conditioner outputs corresponding prompt information for prompting a fault of the temperature sensor.

[0245] In some embodiments, after the air conditioner detects that there exist one malfunctioned temperature sensor in the plurality of temperature sensors, after the air conditioner receives an operation instruction from the user, the air conditioner continues to perform the step of estimating the parameter substitution value and controlling the operation of the air conditioner according to the parameter substitution value.

[0246] In these embodiments, the air conditioner may determine whether continuous operation needs to performed according to the actual requirement of the user. If the air conditioner fails to receive the operation instruction from the user, the air conditioner is controlled to stop operation after outputting prompt information of "fault and halt". A controllability of the air conditioner is improved, and the air conditioner may select to continue to be operated or stop operation according to the requirement of the user when temperature sensor(s) is/are in the fault state.

[0247] In any one of the aforesaid embodiments, the air conditioner further includes an outdoor unit and a refrigerant pipeline, the outdoor unit is connected to the indoor unit through the refrigerant pipeline.

Fourth Embodiment:

[0248] As shown in FIG. 16, an air conditioner 1600 is provided in the fourth embodiment of the present application, the air conditioner 1600 includes at least two indoor units 200, a memory 1602, and a processor 1604.

[0249] As shown in FIG. 2, in the aforesaid embodiment, a heat exchanger is arranged in the indoor unit 200, and the temperature sensor includes a first temperature sensor, a second temperature sensor and a third temperature sensor. The first temperature sensor is arranged at a first end of the heat exchanger, the second temperature sensor is arranged at a second end of the heat exchanger, and the third temperature sensor is arranged at an air inlet of the indoor unit 200.

[0250] In the aforesaid embodiment, the indoor unit 200 is provided with the heat exchanger 202, the temperature sensor includes the first temperature sensor 204, the second temperature sensor 206 and the third temperature sensor 208. The first temperature sensor 204 is arranged at the first end of the heat exchanger 202, the second temperature sensor 206 is arranged at the second end of the heat exchanger 202, and the third temperature sensor 208 is arranged at the air inlet of the indoor unit 200.

[0251] In this embodiment, the indoor unit 200 of the air conditioner 1600 includes the heat exchanger 202. When the air conditioner 1600 is operated in the refrigeration mode, the refrigerant flows to the second end of the heat exchanger 202 through the first end of the heat exchanger 202. When the air conditioner 1600 is operated in the heating mode, the refrigerant flows to the first end of the heat exchanger 202 through the second end of the heat exchanger 202. A plurality of temperature sensors are further disposed in the indoor unit 200. The plurality of temperature sensors include a first temperature sensor 204 arranged at a first end of the heat exchanger 202. In the refrigeration mode, the first temperature sensor 204 may detect the temperature value at the refrigerant inlet of the indoor unit 200. In the heating mode, the first temperature sensor 204 may detect the temperature value at the refrigerant outlet of the indoor unit 200. The plurality of temperature sensors further includes a second temperature sensor 206 arranged at the second end of the heat exchanger 202. In the refrigeration mode, the second temperature sensor 206 may detect the temperature value at the refrigerant outlet of the indoor unit 200. In the heating mode, the second temperature sensor 206 may detect the temperature value at the refrigerant inlet of the indoor unit 200. The plurality of temperature sensors further include a third temperature sensor 208 arranged at the air inlet of the indoor unit 200, and the third temperature sensor 208 may detect the temperature of the air entering the indoor unit 200, that is, the third temperature sensor 208 may detect the ambient temperature value of the indoor unit 200.

[0252] A program or an instruction is stored in the memory 1602, and the processor 1604 is configured to execute the program or the instruction stored in the memory 1602 to implement the steps of the method for controlling the air conditioner 1600 in the first embodiment described above.

[0253] The method for controlling the air conditioner 1600 is used for controlling the air conditioner 1600. Indoor unit(s) 200 and a plurality of temperature sensors are arranged in the air conditioner 1600, the plurality of temperature sensors are arranged at different positions of the indoor unit 200, and the plurality of temperature sensors may collect temperature parameter values at different positions respectively. The indoor unit 200 is further provided with a throttle valve and a draught fan. The throttle valve and the draught fan of the indoor unit 200 are controlled according to the plurality of corresponding temperature parameter values collected by the plurality of temperature sensors. Thus, the control of the operation of the indoor unit 200 is realized.

[0254] The indoor unit 200 of the air conditioner 1600 collects the temperature parameter values continuously through the plurality of temperature sensors, collects the operating parameters of the air conditioner 1600 continuously, and controls the operation of the air conditioner 1600 according to the collected temperature parameter values and the operating parameters. Where, the throttle valve and the draught fan in the indoor unit 200 are controlled according to the temperature parameter values collected by the temperature sensors.

[0255] Whether there exists malfunctioned temperature sensor(s) arranged in the indoor unit 200 is detected during the operation of the air conditioner 1600. When detecting that at least two temperature sensors are in the fault state, a fault sensor in the plurality of temperature sensors is detected and located. Thus, the fault parameter value in the temperature parameter values collected by the plurality of temperature sensors may be determined, and the true value of the fault parameter value is estimated through other operating parameters of the air conditioner 1600 and the parameter substitution value is obtained. The plurality of collected temperature parameter values is updated by replacing the fault parameter value in the plurality of temperature parameter values with the parameter substitution value. The operation of the air conditioner 1600 is continued to be controlled through the parameter substitution value, such that the indoor unit 200 of the air conditioner 1600 can still keep operation under the condition that the temperature sensor in the indoor unit 200 of the air conditioner 1600 are in the fault state. It is ensured that the air conditioner 1600 can still be operated in a queueing process for maintenance, a downtime of the air conditioner 1600 in the queueing process for maintenance is shortened. Thus, a use experience of the user is improved.

[0256] In some embodiments, when one malfunctioned temperature sensor in the air conditioner 1600 is detected, the air conditioner 1600 outputs corresponding prompt information for prompting a fault of the temperature sensor.

[0257] In some embodiments, after the air conditioner 1600 detects that there exists one malfunctioned temperature

sensor in the plurality of temperature sensors, the air conditioner 1600 continues to perform the step of the estimating the parameter substitution value, and controlling the operation of the air conditioner 1600 according to the parameter substitution value, after receiving an operation instruction from the user.

[0258] In these embodiments, the air conditioner 1600 may determine whether continuous operation needs to performed according to the actual requirement of the user. If the air conditioner 1600 fails to receive the operation instruction from the user, the air conditioner 1600 is controlled to stop operation after outputting prompt information of "fault and halt". A controllability of the air conditioner 1600 is improved, and the air conditioner 1600 may select to continue to be operated or stop operation according to the requirement of the user when temperature sensor(s) is/are in the fault state.

Fifth embodiment:

[0259] A readable storage medium is provided in the fifth embodiment of the present application. The storage medium stores a program, when the program is executed by a processor, the method for controlling the air conditioner in any one of the aforesaid embodiments is implemented. Thus, the storage medium has all beneficial technical effects of the method for controlling the air conditioner in any one of the aforesaid embodiments.

[0260] Where, the readable storage medium may be such as a read-only memory (Read-Only Memory, ROM), a random access memory (Random Access Memory, RAM), a magnetic disk, or an optical disc, etc.

[0261] It needs to be explained that, the term of "a plurality of" used in the claims, the description and the accompanying figures of the description refers to two or more than two, unless otherwise there is additional explicit definition. Terms such as "connect", "mount", "fix", etc., should be generalizedly interpreted. For example, "connect" may be interpreted as fixed connection, and may also be a detachable connection, or be an integral connection. "Connect" may be further interpreted as a direct connection or an indirect connection through intermediary. For the person of ordinary skill in the art, the specific meanings of the terms in the present application may be interpreted according to specific conditions of the terms.

[0262] In the description of the present application, the description of the reference terms such as "one embodiment", "some embodiments", "detailed description of embodiments" and the like means that the specific technical features, structures, materials or characteristics which are described with reference to the embodiments or the examples are included in at least one embodiment or example of the present application. In the description of the present application, schematic expressions of the terms mentioned above are not necessarily directed to the same embodiment or example. Furthermore, the specific technical features, structures, materials, or characteristics described above may be combined in any suitable manner in any of the one or plurality of embodiments or examples.

[0263] The foregoing embodiments are only some preferable embodiments of the present application, and these embodiments are not intended to limit the present application. It is obvious to the person of ordinary skill in the art that, various modifications and changes may be made in the present application. Any modification, equivalent replacement, improvement, and the like, which are made within the spirit and the principle of the present application, should all be included in the protection scope of the claims of the present application.

Claims

1. A method for controlling an air conditioner, wherein the air conditioner comprises indoor unit(s) and at least two temperature sensors, and the at least two temperature sensors are configured to obtain at least two corresponding temperature parameter values in the indoor unit, the method for controlling the air conditioner comprising: obtaining a fault parameter value in the at least two temperature parameter values on the basis that one of the at least two temperature sensors is in a fault state; obtaining a parameter substitution value corresponding to the fault parameter value according to operating parameters of the air conditioner; and controlling the air conditioner to be operated according to the parameter substitution value.

2. The method for controlling the air conditioner according to claim 1, wherein the indoor unit comprises a heat exchanger, the at least two temperature sensors comprise a first temperature sensor, a second temperature sensor and a third temperature sensor, the first temperature sensor and the second temperature sensor are arranged at two ends of the heat exchanger, the third temperature sensor is arranged at an air inlet of the indoor unit, and the step of obtaining the fault parameter value in the at least two temperature parameter values specifically comprises: determining a fault state of each of the first temperature sensor, the second temperature sensor, and the third temperature sensor; and determining the fault parameter value according to the fault state; wherein the fault parameter value includes a temperature value at a refrigerant inlet, a temperature value at a refrigerant outlet, and an ambient temperature value.

3. The method for controlling the air conditioner according to claim 2, wherein before the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner, the method further comprises: controlling the air conditioner to be operated in a preset operation mode; and obtaining the operating parameters of the air conditioner in the preset operation mode; wherein the preset operation mode comprises a refrigeration mode and a heating mode.

4. The method for controlling the air conditioner according to claim 3, wherein the first temperature sensor is in the fault state, a number of the indoor units is at least two, and the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically comprises: determining the fault parameter value as the temperature value at the refrigerant outlet and obtaining the number of the indoor units in an operation state in the air conditioner, based on an operation of the air conditioner in the heating mode; obtaining a high-pressure saturation temperature, a target subcooling degree, a pressure value at the refrigerant outlet, and a preset amount of heat output of each of the at least two said indoor units; and determining the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the number of the indoor units, the high-pressure saturation temperature, the target subcooling degree, the pressure value at the refrigerant outlet and the preset amount of heat output.

5. The method for controlling the air conditioner according to claim 4, wherein the step of determining the parameter substitution value corresponding to the temperature value at the refrigerant outlet specifically comprises: calculating the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the high-pressure saturation temperature and the target subcooling degree, when determining that the number of the indoor units is less than a preset number; and calculating the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the pressure value at the refrigerant outlet and the preset amount of heat output, when determining that the number of the indoor units is greater than or equal to the preset number.

6. The method for controlling the air conditioner according to claim 3, wherein the first temperature sensor is in a fault state, and the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically comprises: determining that the fault parameter value is the temperature value at the refrigerant inlet based on an operation of the air conditioner in the refrigeration mode; obtaining the temperature value at the refrigerant outlet of the indoor unit every first preset time duration; and calculating the parameter substitution value corresponding to the temperature value at the refrigerant inlet according to the temperature value at the refrigerant outlet.

7. The method for controlling the air conditioner according to claim 6, wherein the indoor unit comprises a draught fan, and before the step of obtaining the temperature value at the refrigerant outlet of the indoor unit, the method further comprises: controlling the draught fan to stop operation for a second preset time duration.

8. The method for controlling the air conditioner according to claim 3, wherein the second temperature sensor is in a fault state, and the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically comprises: determining the fault parameter value as the temperature value at the refrigerant inlet based on an operation of the air conditioner in the heating mode, and obtaining the high-voltage saturation temperature of the indoor unit; and calculating the parameter substitution value corresponding to the temperature value at the refrigerant inlet according to the high-pressure saturation temperature.

9. The method for controlling the air conditioner according to claim 3, wherein the second temperature sensor is in a fault state, a number of the indoor units is at least two, and the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically comprises: determining the fault parameter value as the temperature value at the refrigerant outlet based on an operation of the air conditioner in the refrigeration mode, and obtaining the number of the indoor units in an operation state in the air conditioner; obtaining a temperature value at the refrigerant inlet, a target superheat degree, a preset amount of heat output, a temperature of an exhaust air and a target superheat degree of the exhaust air of a compressor of each of at least two said indoor units; and determining the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the number of the indoor units, the temperature value at the refrigerant inlet, the target superheat degree, the preset amount of heat output, the temperature value of the exhaust air, and the target superheat degree of the exhaust air.

10. The method for controlling the air conditioner according to claim 9, wherein the step of determining the parameter substitution value corresponding to the temperature value at the refrigerant outlet specifically comprises: calculating the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the temperature value at the refrigerant inlet and the target superheat degree, when determining that the number of the indoor units is less than a preset number; and calculating the parameter substitution value corresponding to the temperature value at the refrigerant outlet according to the superheat degree of the exhaust air, the temperature of the exhaust air, a temperature value at the refrigerant inlet and the target superheat degree, when determining that the number of the indoor units is greater than or equal to the preset number.

11. The method for controlling the air conditioner according to claim 3, wherein the third temperature sensor is in a fault state, and the step of obtaining the parameter substitution value corresponding to the fault parameter value according to the operating parameters of the air conditioner specifically comprises: determining the fault parameter value as the ambient temperature value; obtaining the temperature value at the refrigerant outlet every third preset time duration; and calculating the parameter substitution value corresponding to the ambient temperature value according to the temperature value at the refrigerant outlet.

12. The method for controlling the air conditioner according to claim 11, wherein before the step of obtaining the temperature value at the refrigerant outlet, the method further comprises: controlling a throttle valve to disable a fourth preset time duration.

13. The method for controlling the air conditioner according to any one of claims 2-11, wherein the step of determining fault states of the first temperature sensor, the second temperature sensor and the third temperature sensor specifically comprises: obtaining a numerical relationship between the temperature value at the refrigerant inlet, the temperature value at the refrigerant outlet and the ambient temperature value; and determining the fault state of the first temperature sensor, the fault state of the second temperature sensor, and the fault state of the third temperature sensor respectively according to the numerical relationship.

14. The method for controlling the air conditioner according to any one of claims 1 to 11, further comprising: counting a time duration of an operation of the air conditioner which is controlled according to the parameter substitution value; and controlling the air conditioner to stop operation when determining that the time duration reaches a fourth preset time duration.

15. An apparatus for controlling an air conditioner, wherein the apparatus comprises: a fault parameter acquisition unit configured to obtain a fault parameter value in at least two temperature parameter values on the basis that any one of the at least two temperature sensors is in a fault state; a parameter determination unit configured to obtain a parameter substitution value corresponding to the fault parameter value according to operating parameters of the air conditioner; and an operation control unit configured to control the air conditioner to be operated according to the parameter substitution value.

16. An air conditioner, wherein the air conditioner comprises: an indoor unit; and the apparatus for controlling the air conditioner according to claim 15, wherein the apparatus for controlling the air conditioner is arranged in the indoor unit.

17. An air conditioner, wherein the air conditioner comprises: at least two indoor units; a memory which stores a program or an instruction; a processor configured to execute the program or the instruction stored in the memory to implement steps of the method for controlling the air conditioner according to any one of claims 1-14.

18. A readable storage medium, wherein the readable storage medium stores a program or an instruction, when the program or the instruction is executed by a processor, steps of the method for controlling the air conditioner according to any one of claims 1-14 are implemented.

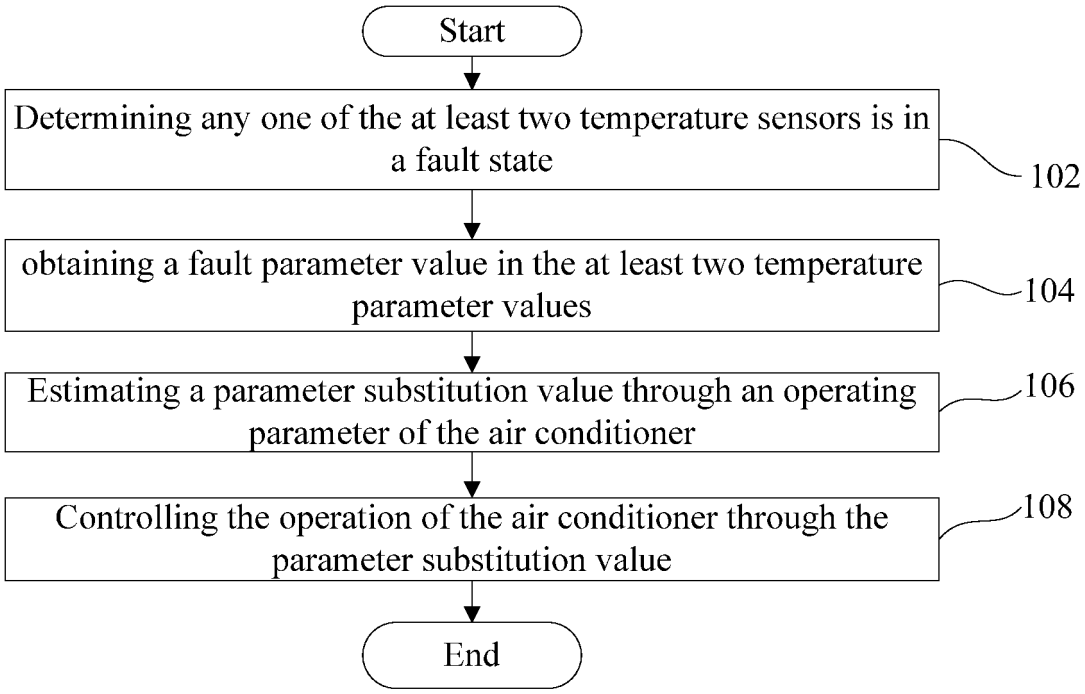
Start
Determining any one of the at least two temperature sensors is in a fault state
102
obtaining a fault parameter value in the at least two temperature parameter values
104
Estimating a parameter substitution value through an operating parameter of the air conditioner
106
Controlling the operation of the air conditioner through the parameter substitution value
108
End

FIG. 1

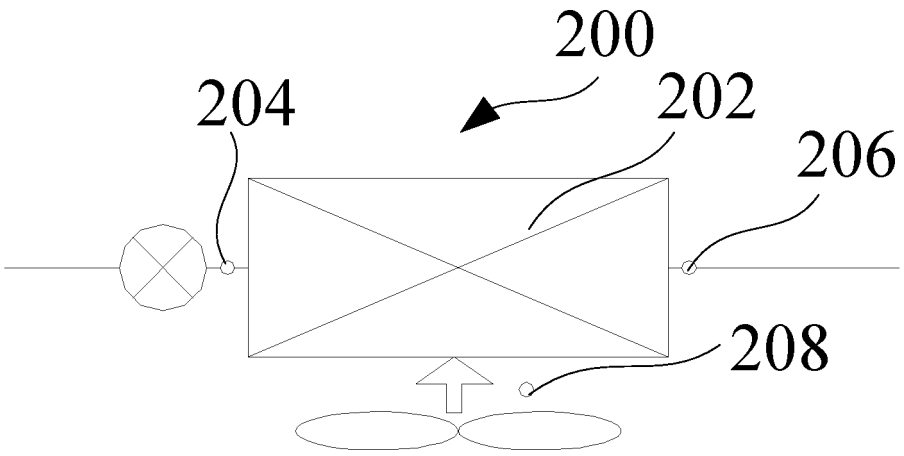
200
204
202
206
208

FIG. 2

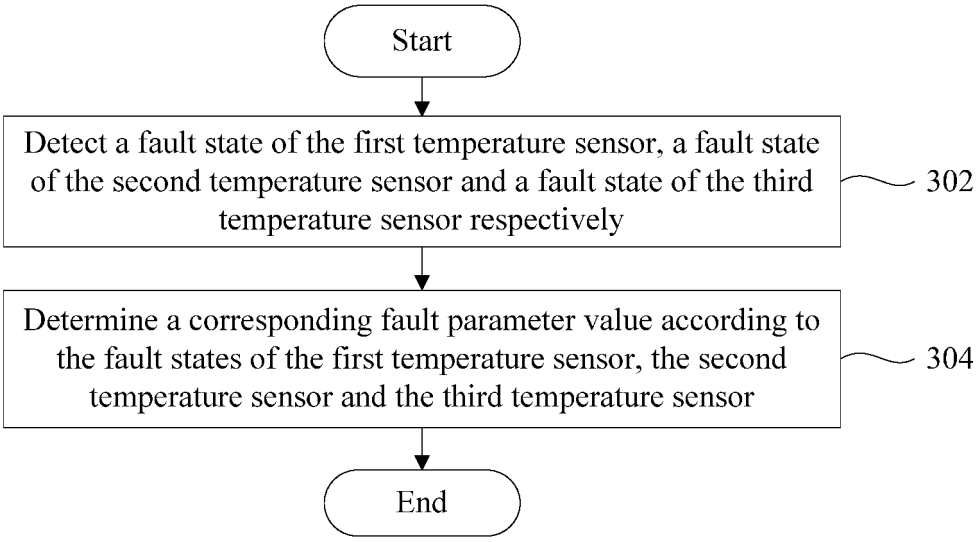
Start
Detect a fault state of the first temperature sensor, a fault state of the second temperature sensor and a fault state of the third temperature sensor respectively
302
Determine a corresponding fault parameter value according to the fault states of the first temperature sensor, the second temperature sensor and the third temperature sensor
304
End

FIG. 3

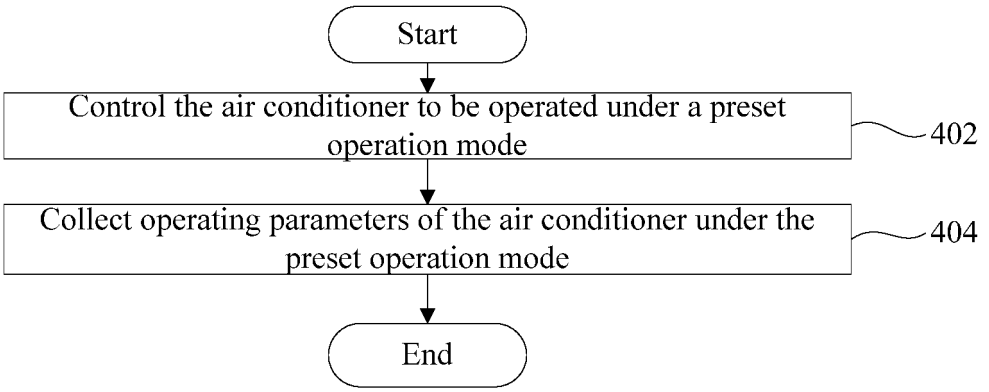
Start
Control the air conditioner to be operated under a preset operation mode
402
Collect operating parameters of the air conditioner under the preset operation mode
404
End

FIG. 4

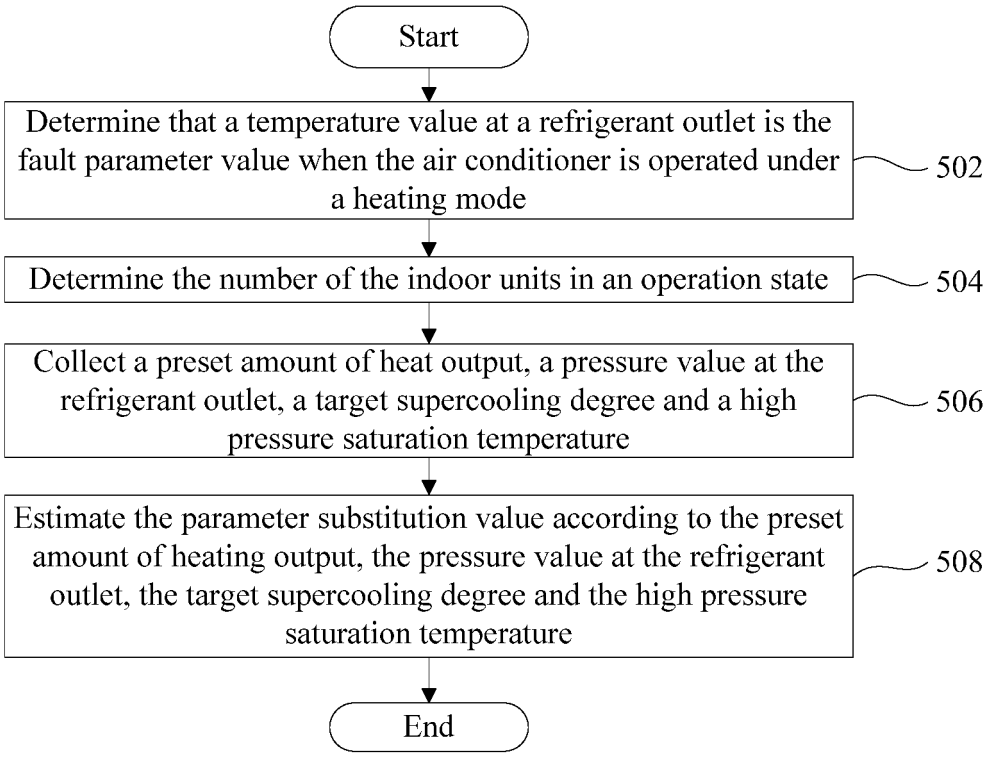
Start
Determine that a temperature value at a refrigerant outlet is the fault parameter value when the air conditioner is operated under a heating mode
502
Determine the number of the indoor units in an operation state
504
Collect a preset amount of heat output, a pressure value at the refrigerant outlet, a target supercooling degree and a high pressure saturation temperature
506
Estimate the parameter substitution value according to the preset amount of heating output, the pressure value at the refrigerant outlet, the target supercooling degree and the high pressure saturation temperature
508
End

FIG. 5

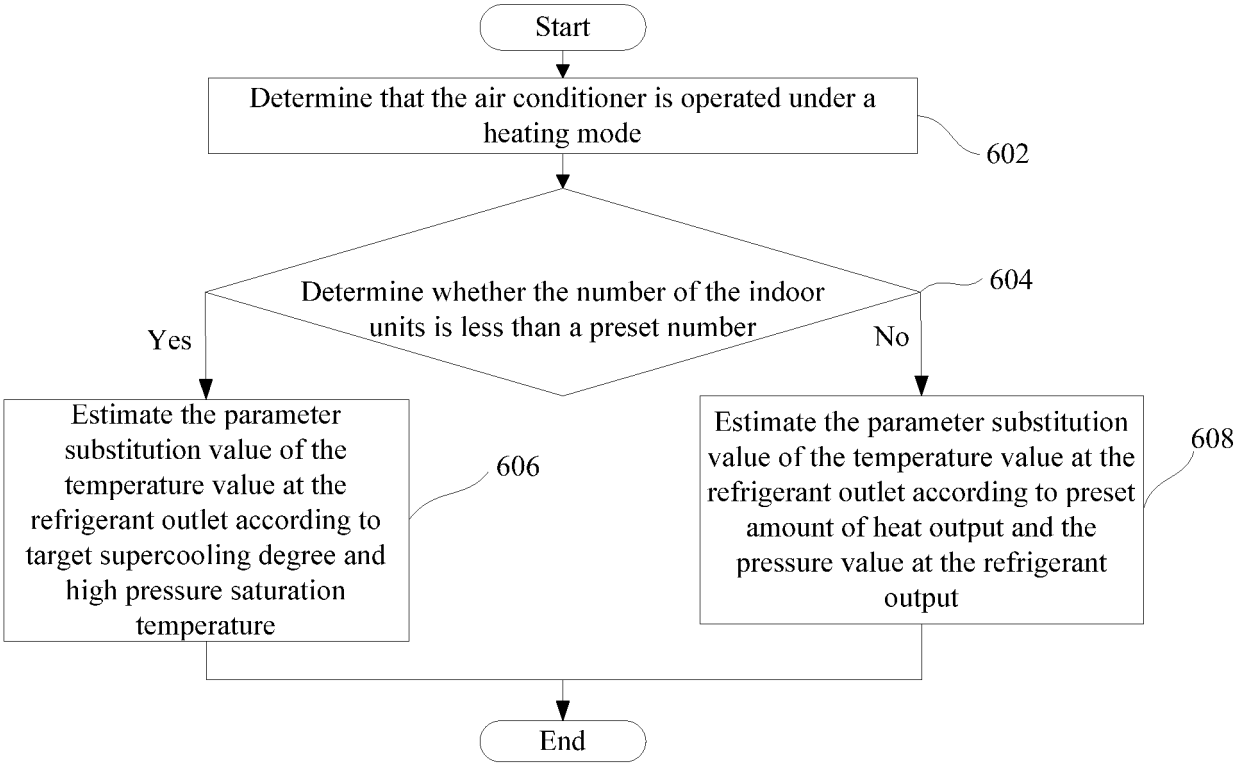
Start
Determine that the air conditioner is operated under a heating mode
602
Determine whether the number of the indoor units is less than a preset number
604
Yes
No
Estimate the parameter substitution value of the temperature value at the refrigerant outlet according to target supercooling degree and high pressure saturation temperature
606
Estimate the parameter substitution value of the temperature value at the refrigerant outlet according to preset amount of heat output and the pressure value at the refrigerant output
608
End

FIG. 6

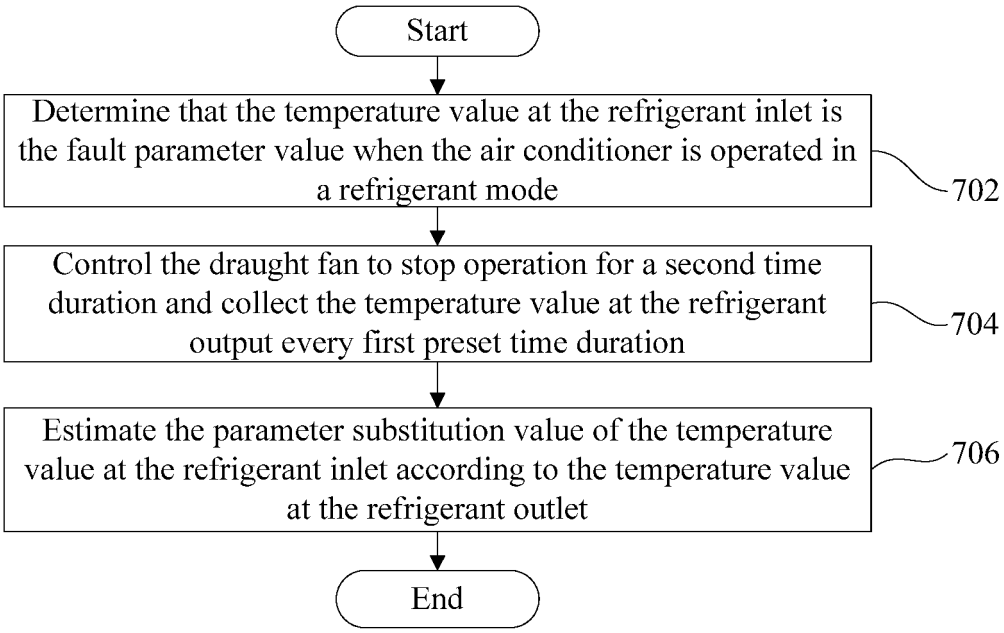
Start
Determine that the temperature value at the refrigerant inlet is the fault parameter value when the air conditioner is operated in a refrigerant mode
702
Control the draught fan to stop operation for a second time duration and collect the temperature value at the refrigerant output every first preset time duration
704
Estimate the parameter substitution value of the temperature value at the refrigerant inlet according to the temperature value at the refrigerant outlet
706
End

FIG. 7

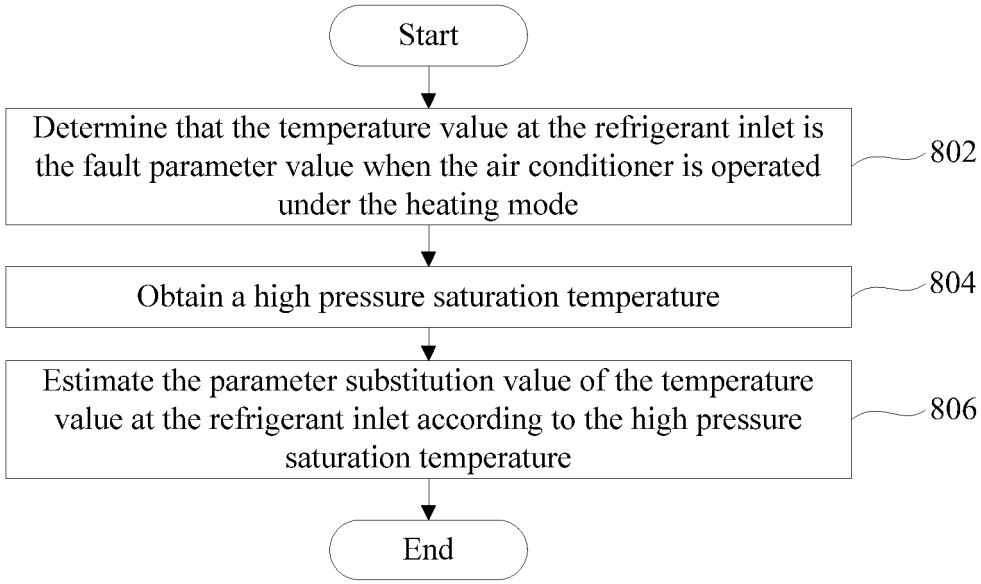
Start
Determine that the temperature value at the refrigerant inlet is the fault parameter value when the air conditioner is operated under the heating mode
802
Obtain a high pressure saturation temperature
804
Estimate the parameter substitution value of the temperature value at the refrigerant inlet according to the high pressure saturation temperature
806
End

FIG. 8

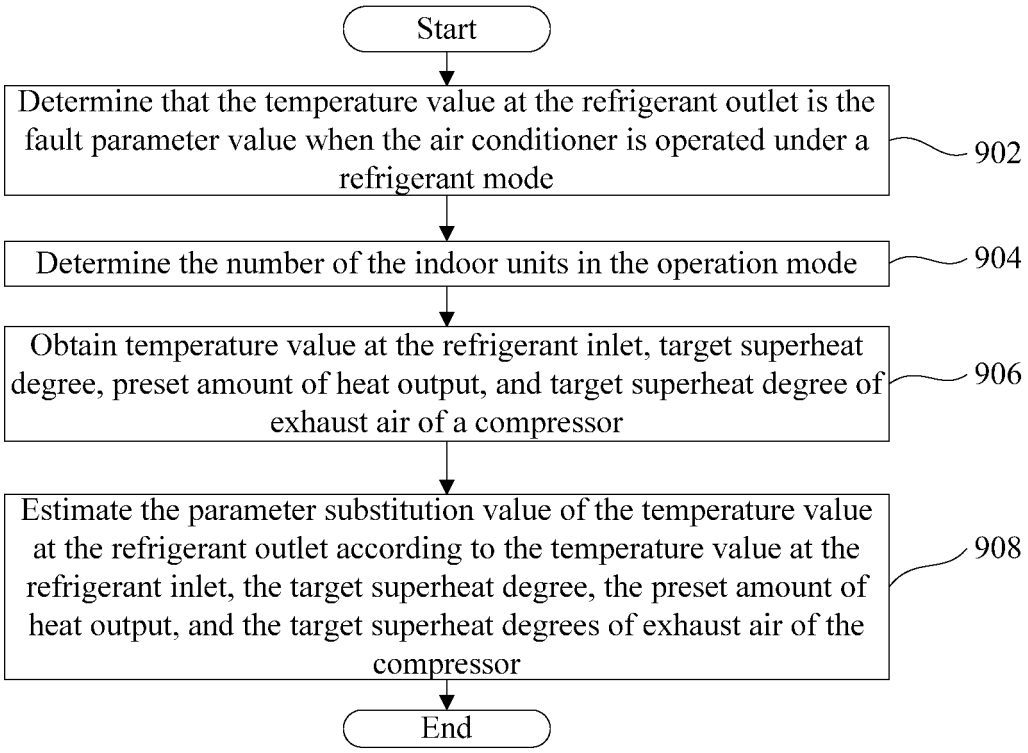
Start
Determine that the temperature value at the refrigerant outlet is the fault parameter value when the air conditioner is operated under a refrigerant mode
902
Determine the number of the indoor units in the operation mode
904
Obtain temperature value at the refrigerant inlet, target superheat degree, preset amount of heat output, and target superheat degree of exhaust air of a compressor
906
Estimate the parameter substitution value of the temperature value at the refrigerant outlet according to the temperature value at the refrigerant inlet, the target superheat degree, the preset amount of heat output, and the target superheat degrees of exhaust air of the compressor
908
End

FIG. 9

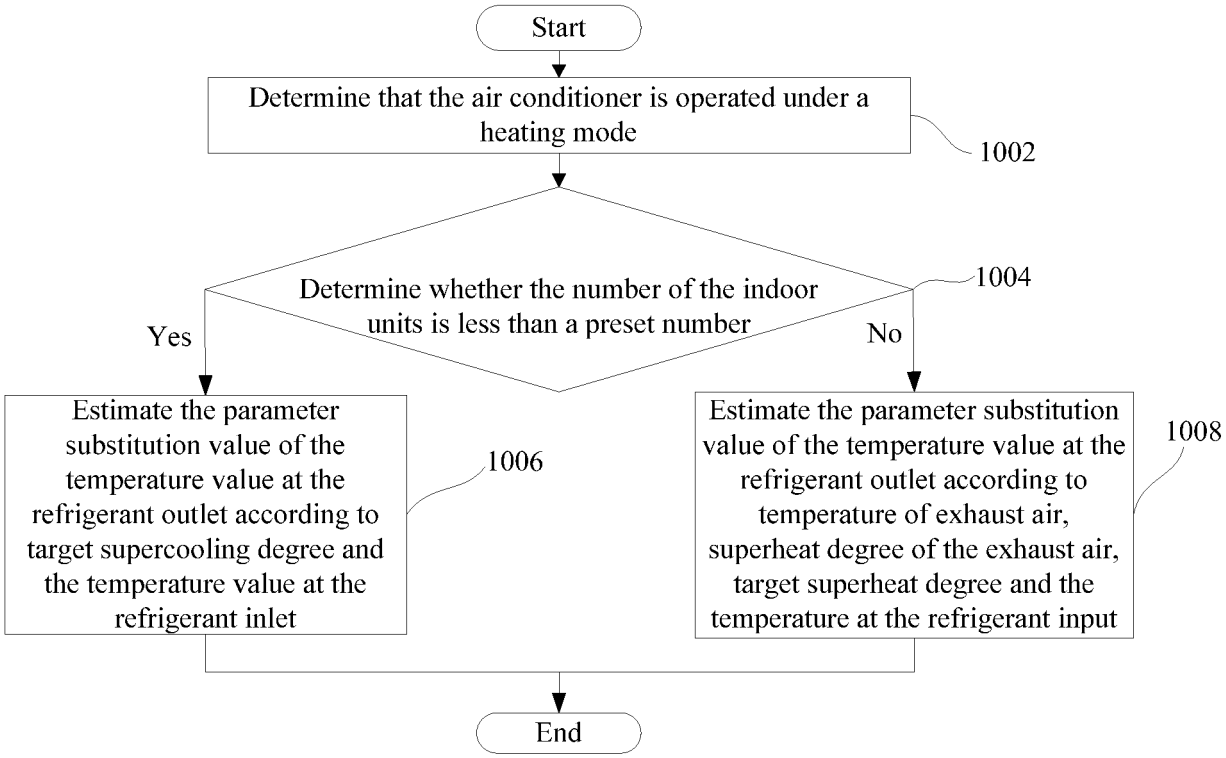
Start
Determine that the air conditioner is operated under a heating mode
1002
Determine whether the number of the indoor units is less than a preset number
1004
Yes
No
Estimate the parameter substitution value of the temperature value at the refrigerant outlet according to target supercooling degree and the temperature value at the refrigerant inlet
1006
Estimate the parameter substitution value of the temperature value at the refrigerant outlet according to temperature of exhaust air, superheat degree of the exhaust air, target superheat degree and the temperature at the refrigerant input
1008
End

FIG. 10

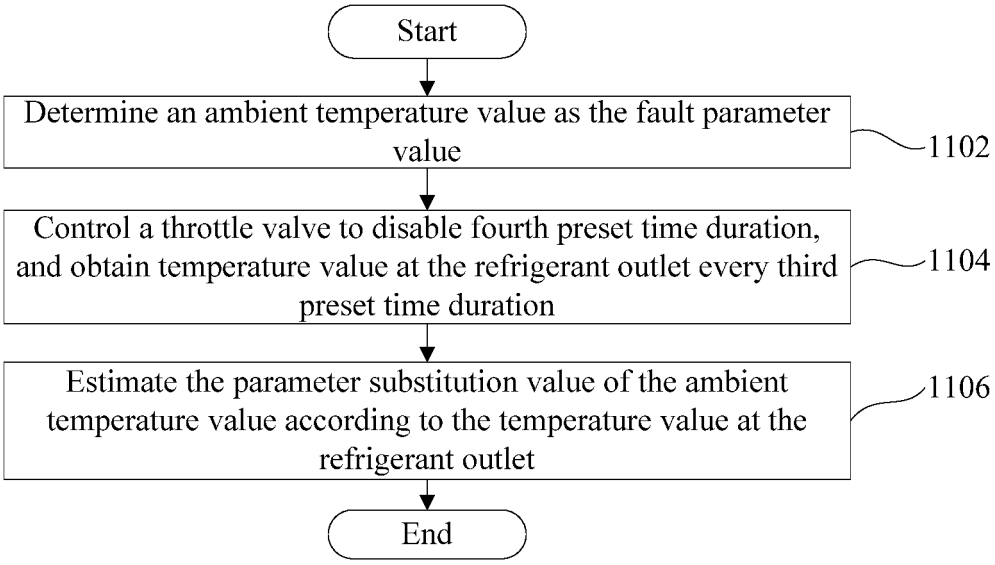

FIG. 11

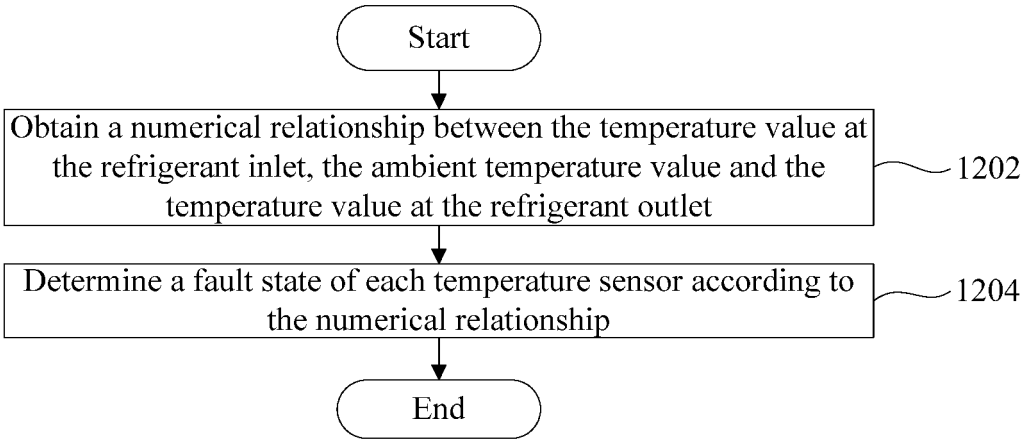

FIG. 12

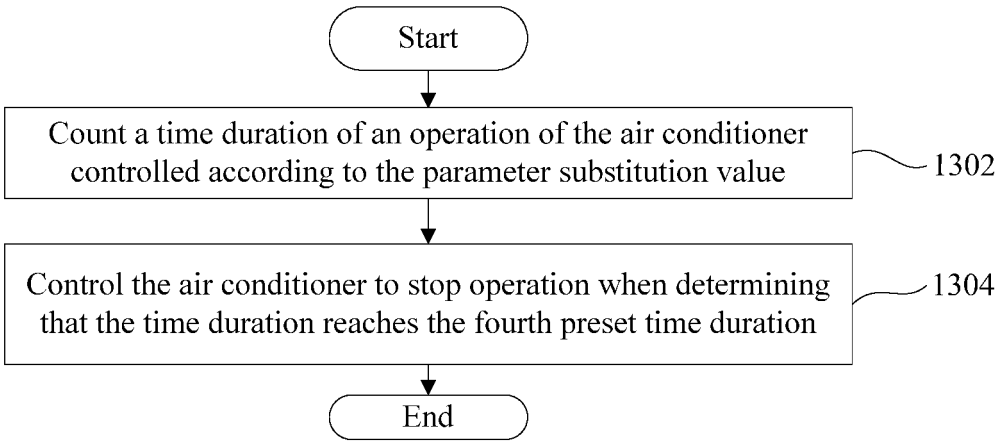

FIG. 13

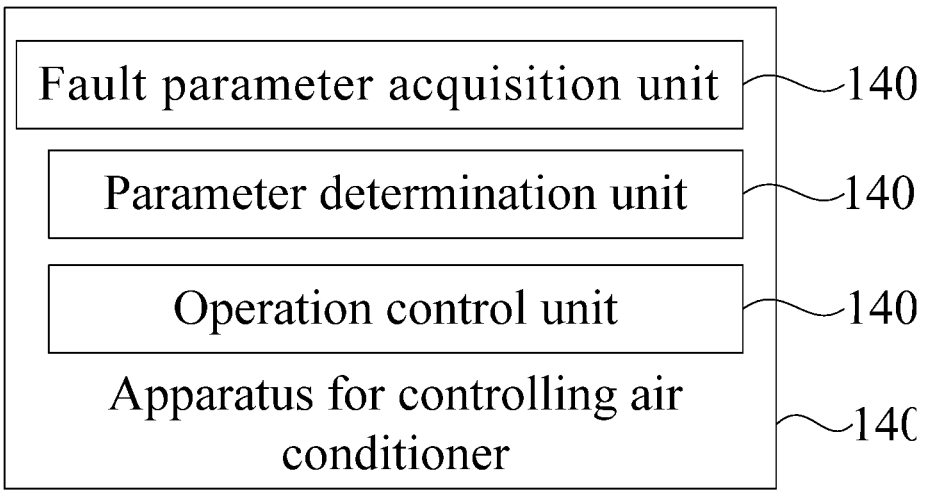

FIG. 14

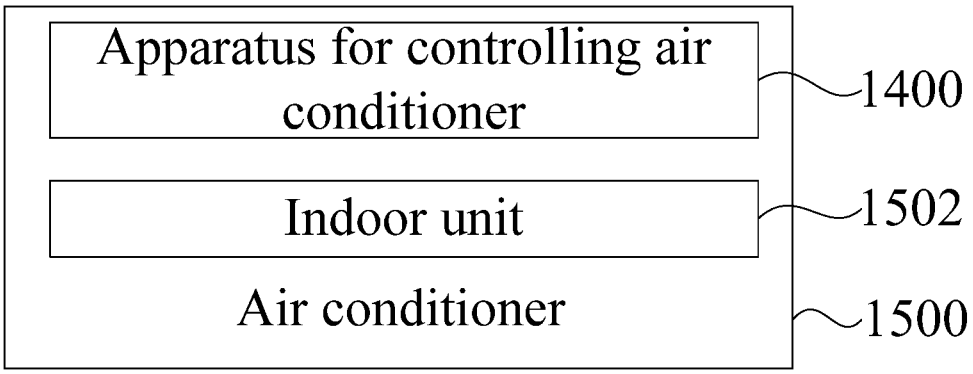

FIG. 15

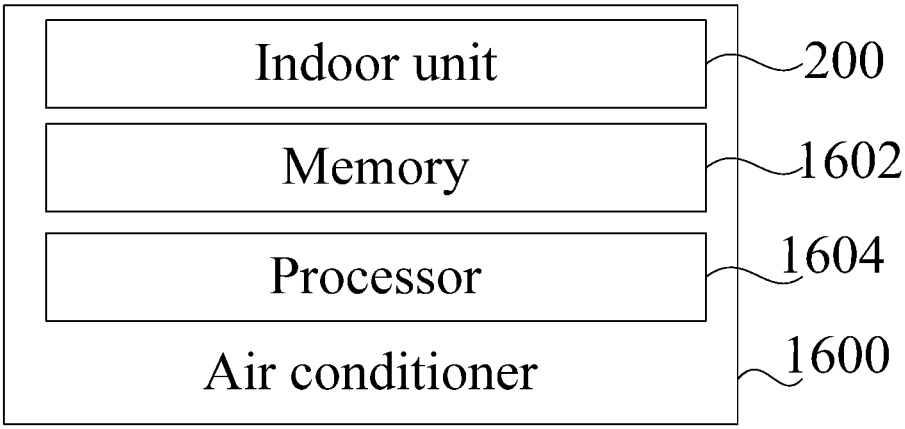

FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/082777

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/38(2018.01)i; F24F 11/43(2018.01)i; F24F 11/61(2018.01)i; F24F 11/64(2018.01)i; F24F 110/10(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: 空调, 室内机, 温度传感器, 故障, 替代, 冷媒入口温度, 冷媒出口温度, 环境温度, air conditioner, indoor unit, temperature sensor, fault, replace, refrigerant inlet temperature, refrigerant outlet temperature, ambient temperature

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 110260458 A (ZHUHAI GREE ELECTRIC APPLIANCES INC.) 20 September 2019 (2019-09-20) description, paragraphs [0061]-[0166]	1-18
Y	CN 111425987 A (GUANDONG MIDEA HVAC EQUIPMENT CO., LTD. et al.) 17 July 2020 (2020-07-17) description, paragraphs [0051]-[0126], and figures 1-4	1-18
Y	CN 110953779 A (WEICHAI POWER CO., LTD.) 03 April 2020 (2020-04-03) description, paragraphs [0071]-[0147]	4-5
A	CN 108759035 A (GUANDONG MIDEA HVAC EQUIPMENT CO., LTD. et al.) 06 November 2018 (2018-11-06) entire document	1-18
A	CN 109140688 A (GUANGDONG MIDEA REFRIGERATION EQUIPMENT CO., LTD. et al.) 04 January 2019 (2019-01-04) entire document	1-18

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

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"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
16 June 2022	**23 June 2022**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/082777

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 108361912 A (QINGDAO HAIER AIR CONDITIONER GENERAL CO., LTD.) 03 August 2018 (2018-08-03) entire document	1-18

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/082777

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 110260458 A	20 September 2019	None	
CN 111425987 A	17 July 2020	None	
CN 110953779 A	03 April 2020	None	
CN 108759035 A	06 November 2018	None	
CN 109140688 A	04 January 2019	None	
CN 108361912 A	03 August 2018	None	

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 202110780857X **[0001]**