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(71) Applicants:
- **GD Midea Heating & Ventilating Equipment Co., Ltd.**
  Foshan, Guangdong 528311 (CN)
- **Midea Group Co., Ltd.**
  Foshan, Guangdong 528311 (CN)

(72) Inventors:
- **BU, Qihui**
  Foshan
  Guangdong 528311 (CN)
- **XU, Yongfeng**
  Foshan
  Guangdong 528311 (CN)
- **LIANG, Boqi**
  Foshan
  Guangdong 528311 (CN)
- **LI, Hongwei**
  Foshan
  Guangdong 528311 (CN)
- **DONG, Shilong**
  Foshan
  Guangdong 528311 (CN)
- **WU, Xiaohong**
  Foshan
  Guangdong 528311 (CN)

(74) Representative: **Lam, Alvin et al**
Maucher Jenkins
26 Caxton Street
London SW1H 0RJ (GB)

(54) MULTI-CONNECTED SYSTEM AND CONTROL METHOD THEREFOR

(57) A multi-connected system and control method therefor. The control method comprises the following steps: obtaining outdoor ambient temperature when start instructions of indoor units are received (S110); determining whether the outdoor ambient temperature falls within a preset temperature range (S120); and determining an operation mode of a multi-connected system according to operations statuses of the started indoor units when the outdoor ambient temperature falls within the preset temperature range (S130).

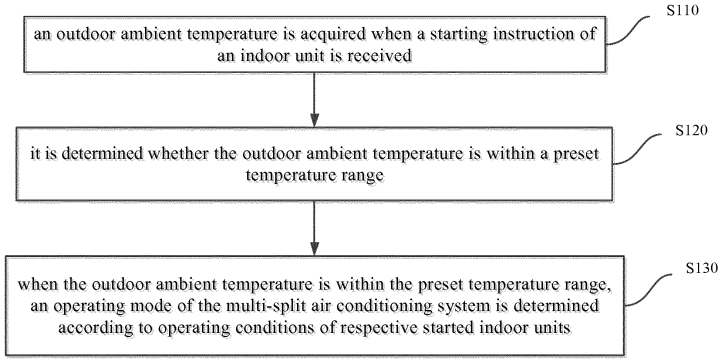

Fig. 2

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and benefits of Chinese Patent Application No. 201610840220.4, filed with the State Intellectual Property Office of P. R. China on September 21, 2016, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The present disclosure relates to air conditioner field, and more particularly, to a multi-split air conditioning system and a method for controlling a multi-split air conditioning system.

BACKGROUND

[0003] A multi-split air conditioning system is a system that uses a single or multiple outdoor units in parallel, and configures a plurality of air conditioning indoor units. The indoor units are independently controlled, and general operating modes include refrigerating, heating, air supply, etc. However, in the same system, the outdoor units can only operate in one mode, and cannot operate in refrigerating and heating mode at the same time. Since the body sense of each person may vary, in the transitional season, there may be cases that some people may want to start refrigerating and others may want to start heating. In this case, it is necessary to set a mode priority for the air conditioning system, and the system operates this mode first. At present, priority modes of each air conditioning manufacturer generally include a refrigerating priority or a heating priority. However, the priority modes have certain limitations, and cannot meet needs of most users, user experience is poor.

SUMMARY

[0004] An objective of the present disclosure is to provide a multi-split air conditioning system and a method for controlling thereof, which aims to avoid conflicts in operating modes of multi-split air conditioning systems.

[0005] To achieve the above objectives, the present disclosure provides a method for controlling a multi-split air conditioning system, including: acquiring an outdoor ambient temperature when receiving a starting instruction of an indoor unit; determining whether the outdoor ambient temperature is within a preset temperature range; and determining an operating mode of the multi-split air conditioning system according to operating conditions of respective started indoor units, when the outdoor ambient temperature is within the preset temperature range.

[0006] In at least one embodiment, determining the operating mode of the multi-split air conditioning system according to the operating conditions of respective started indoor units when the outdoor ambient temperature is within the preset temperature range comprises: determining whether there is a started indoor unit, when the outdoor ambient temperature is within the preset temperature range; determining whether the indoor unit sending the starting instruction has the highest priority level, when there is the started indoor unit; and determining the operating mode of the multi-split air conditioning system according to an operating mode set by the indoor unit sending the starting instruction when the indoor unit sending the starting instruction has the highest priority level, and determining the operating mode of the multi-split air conditioning system according to the operating mode of the started indoor unit when the indoor unit sending the starting instruction does not have the highest priority level.

[0007] In at least one embodiment, after determining whether there is a started indoor unit when the outdoor ambient temperature is within the preset temperature range, the method further comprises: determining whether there are at least two indoor units sending the starting instruction, when there is no started indoor unit; and when there are at least two indoor units sending the starting instruction, determining the operating mode of the multi-split air conditioning system through a priority level rule or a majority rule according to the number of indoor units and set operating modes thereof.

[0008] In at least one embodiment, the method further includes: when receiving a mode switching instruction sent by the indoor unit, determining whether the indoor unit sending the mode switching instruction has the highest priority level; when the indoor unit sending the mode switching instruction does not have the highest priority level, forwarding the mode switching instruction to the indoor unit having the highest priority level, and switching the operating mode of the multi-split air conditioning system when receiving confirmation from the indoor unit having the highest priority level; and when the indoor unit sending the mode switching instruction has the highest priority level, switching the current operating mode of the multi-split air conditioning system according to the mode switching instruction.

[0009] In at least one embodiment, the method further includes: stopping operating of the indoor unit for a preset time period and then starting the indoor unit again, when a current indoor temperature corresponding to the indoor unit reaches a target temperature.

[0010] In at least one embodiment, the method further includes: controlling the multi-split air conditioning system to operate in a heating mode when the outdoor ambient temperature is less than a lower limit of the preset temperature range; and controlling the multi-split air conditioning system to operate in a refrigerating mode when the outdoor ambient temperature is greater than an upper limit of the preset temperature range.

[0011] In addition, in order to achieve the above objectives, the present disclosure further provides a multi-split air conditioning system, including at least one outdoor unit and at least two indoor units. The at least two indoor units and the at least one outdoor unit form a refrigerant cycle loop and communicate with each other. The outdoor unit comprises a controller configured to receive a control signal from the indoor unit and control the outdoor unit according to the control signal. The controller comprises: a temperature acquiring module, configured to acquire an outdoor ambient temperature when receiving a starting instruction of the indoor unit; a temperature determining module, configured to determine whether the outdoor ambient temperature is within a preset temperature range; and a control module, configured to determine an operating mode of the multi-split air conditioning system according to operating conditions of respective started indoor units when the outdoor ambient temperature is within the preset temperature range.

[0012] In at least one embodiment, the control module is further configured to: determine whether there is a started indoor unit when the outdoor ambient temperature is within the preset temperature range; determine whether the indoor unit sending the starting instruction has a highest priority level when there is the started indoor unit; and determine the operating mode of the multi-split air conditioning system according to an operating mode set by the indoor unit sending the starting instruction when the indoor unit sending the starting instruction has the highest priority level, and determine the operating mode of the multi-split air conditioning system according to the operating mode of the started indoor unit when the indoor unit sending the starting instruction does not have the highest priority level.

[0013] In at least one embodiment, the control module is further configured to determine whether there are at least two indoor units sending the starting instruction when there is no started indoor unit; and when there are at least two indoor units sending the starting instruction, determine the operating mode of the multi-split air conditioning system through a priority level rule or a majority rule according to the number of indoor units and set operating modes thereof.

[0014] In at least one embodiment, the control module is further configured to: when receiving a mode switching instruction sent by the indoor unit, determine whether the indoor unit sending the mode switching instruction has the highest priority level; when the indoor unit sending the mode switching instruction does not have the highest priority level, forward the mode switching instruction to the indoor unit having the highest priority level, and switch the operating mode of the multi-split air conditioning system when receiving confirmation from the indoor unit having the highest priority level; and when the indoor unit sending the mode switching instruction has the highest priority level, switch the current operating mode of the multi-split air conditioning system according to the mode switching instruction.

[0015] In at least one embodiment, the control module is further configured to: stop operating of the indoor unit for a preset time period and then start the indoor unit again, when a current indoor temperature corresponding to the indoor unit reaches a target temperature.

[0016] In at least one embodiment, the control module is further configured to: control the multi-split air conditioning system to operate in a heating mode when the outdoor ambient temperature is less than a lower limit of the preset temperature range; and control the multi-split air conditioning system to operate in a refrigerating mode when the outdoor ambient temperature is greater than a upper limit of the preset temperature range.

[0017] In embodiments of the present disclosure, when the multi-split air conditioning system is operating, it is determined whether the outdoor ambient temperature is in a transitional season. When the outdoor ambient temperature is in the transitional season, operating conditions of respective indoor units are obtained, and the operating mode of the multi-split air conditioning system is determined based on the operating conditions of respective indoor units, thereby avoiding conflicts in operating modes of multi-split air conditioning systems.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In order to clearly illustrate technical solutions in embodiments of the present disclosure or in the related art, the drawings used in embodiments or the related art will be briefly described below. Obviously, the drawings in the following descriptions are only part embodiments of the present disclosure, and for those skilled in the art, other drawings can be obtained according to these drawings without creative labor.

Fig. 1 is a schematic diagram of a multi-split air conditioning system according to an embodiment of the present disclosure;

Fig. 2 is a flow chart of a first embodiment of a method for controlling a multi-split air conditioning system according to the present disclosure;

Fig. 3 is a flow chart of determining an operating mode of a multi-split air conditioning system in a method for controlling a multi-split air conditioning system according to the present disclosure;

Fig. 4 is a flow chart of a second embodiment of a method for controlling a multi-split air conditioning system according

to the present disclosure;

Fig. 5 is a flow chart of a third embodiment of a method for controlling a multi-split air conditioning system according to the present disclosure; and

Fig. 6 is a block diagram of function modules of a controller of a multi-split air conditioning system according to the present disclosure.

Description of reference numerals of drawings

Number	Name	Number	Name
1	compressor	2	four-way valve
3	outdoor heat exchanger	4	first throttling element
5a	first electronic expansion valve	5b	second electronic expansion valve
6a	first indoor heat exchange unit	6b	second indoor heat exchange unit
7	high-pressure valve	8	low-pressure valve
9	gas-liquid separator		

[0019] The implementation, function characteristics and advantages of the present disclosure will further be described with reference to the accompanying drawings in conjunction with embodiments.

DETAILED DESCRIPTION

[0020] Reference will be made clearly and completely technical solutions in the embodiments of the present disclosure with accompanying drawings. Obviously, the embodiments described herein are only part of the embodiments of the present disclosure but not all embodiments of the present disclosure. Based on the embodiments of the present disclosure, other embodiments obtained by those skilled in the art without creative labor are within scope of the present disclosure.

[0021] It should be noted that, if directional indications (such as up, down, left, right, front, rear, etc.) are involved in embodiments of the present disclosure, the directional indications are only used to explain relative positional relationships and movement between various components in a specific posture (as illustrated in the drawing). If the specific posture changes, the directional indications may also change accordingly.

[0022] In addition, terms such as "first" and "second" are used herein for purposes of description and are not intended to indicate or imply relative importance or significance or to imply the number of indicated technical features. Thus, the feature defined with "first" and "second" may comprise one or more of this feature. In addition, technical solutions between various embodiments can be combined with each other, but must be based on the implementation of those skilled in the art. When the combination of technical solutions appears contradictory or unachievable, it should be considered that the combination of such technical solutions does not exist, and is not within the protection scope claimed by the present disclosure.

[0023] The present disclosure provides a method for controlling a multi-split air conditioning system, which solves conflicts in operating modes of multi-split air conditioning systems that, when the multi-split air conditioning system is used in a transitional season, some people want the indoor unit to operate in a refrigerating mode, and others want the indoor unit to operate in a heating mode, the ambient temperature is divided, operations in the transitional season are separately controlled and conflicts of operating modes are avoided.

[0024] In detail, as illustrated in Fig. 1. Fig. 1 illustrates a structure of a multi-split air conditioning system according to an embodiment of the present disclosure. The multi-split air conditioning system includes a compressor 1, a four-way valve 2, an outdoor heat exchanger 3, a first throttling element 4, a second throttling element and an indoor heat exchanger. The indoor heat exchanger includes a plurality of indoor heat change units, such as a first indoor heat exchange unit 6a and a second indoor heat exchange unit 6b illustrated in Fig. 1. Correspondingly, the second throttling element includes a first electronic expansion valve 5a and a second electronic expansion valve 5b.

[0025] The four-way valve 2 includes four ports, i.e., a first port a, a second port b, a third port c and a fourth port d.

[0026] An exhaust port of the compressor 1 is connected with the first port a of the four-way valve 2 with a refrigerant line, and a one-way valve is provided at the exhaust port of the compressor to prevent refrigerant reflux. A gas returning port of the compressor 1 is connected with the third port c of the four-way valve 2 with a refrigerant line. It can be understood that, the multi-split air conditioning system may further include a gas-liquid separator 9, i.e., gas-liquid separation is performed on the refrigerant returned to the compressor 1, to prevent liquid refrigerant from flowing into the compressor 1. The third port c of the four-way valve 2 is connected with an inlet of the gas-liquid separator 9, and

an outlet of the gas-liquid separator 9 is connected with the gas returning port of the compressor 1 with the refrigerant line.

[0027] An end of the outdoor heat exchanger 3 is connected with the second port b of the four-way valve 2 with a refrigerant line, and the other end of the outdoor heat exchanger 3 is connected with an end of the first throttling element 4 with a refrigerant line. The other end of the first throttling element 4 is connected with an end of the indoor heat exchanger, i.e., is connected with an end of the first indoor exchange unit 6a and an end of the second indoor heat exchange unit 6b.

[0028] The other end of the indoor heat exchanger is connected with the four port d of the four-way valve 2 with a refrigerant line, i.e., the other end of the first indoor heat exchange unit 6a and the other end of the second indoor heat exchange unit 6b are connected with the four port d of the four-way valve 2 after joining with the refrigerant line.

[0029] A high-pressure valve 7 is provided on the refrigerant line that connects the first throttling element 4 and an end of the indoor heat exchanger. A low-pressure 8 is provided on the refrigerant line that connects with the other end of the indoor heat exchanger and the four-way valve 2.

[0030] Based on the above multi-split air conditioning system, the present disclosure provides a method for controlling a multi-split air conditioning system. As illustrated in Fig. 2, the method may include followings.

[0031] At block S110, an outdoor ambient temperature is acquired when a starting instruction of an indoor unit is received.

[0032] When the user wants to start the indoor unit to adjust the temperature (such as increase temperature or decrease temperature) in the area where the indoor unit is located, the user may send a starting instruction, and set a target indoor temperature and an operating mode (such as a refrigerating mode, a heating mode, etc.). The indoor unit receives the starting instruction sent by the user, and sends the starting instruction to the outdoor unit. The outdoor unit acquires the outdoor ambient temperature based on the starting instruction of the indoor unit.

[0033] At block S120, it is determined whether the outdoor ambient temperature is within a preset temperature range.

[0034] In the embodiment, a temperature range (i.e., a temperature range of the transitional season (such as 22°C to 28°C)) may be preset, when the outdoor ambient temperature is within the temperature range, it is indicated that it is in the transitional season. When the outdoor ambient temperature is less than 22°C, the air conditioning system is controlled to operate in the heating mode. When the outdoor ambient temperature is greater than 28°C, the air conditioning system is controlled to operate in the refrigerating mode.

[0035] At block S130, when the outdoor ambient temperature is within the preset temperature range, an operating mode of the multi-split air conditioning system is determined according to operating conditions of respective started indoor units.

[0036] When the outdoor ambient temperature is within the preset temperature range, operating conditions of respective indoor units are obtained, and the operating mode of the multi-split air conditioning system is determined through a preset rule according to the operating conditions of respective indoor units. In other words, the multi-split air conditioning system may operate in a refrigerating mode, or may operate in a heating mode. The operating condition may include an operating state (such as on or off) of the indoor unit, and an operating mode (such as a refrigerating mode, a heating mode, etc.) of the indoor unit.

[0037] In embodiments of the present disclosure, when the multi-split air conditioning system is operating, it is determined whether the outdoor ambient temperature is in the transitional season, when the outdoor ambient temperature is in the transitional season, operating conditions of respective indoor units are obtained, and the operating mode of the multi-split air conditioning system is determined based on the operating conditions of respective indoor units, thereby avoiding conflicts in operating modes of multi-split air conditioning systems.

[0038] Furthermore, as illustrated in Fig. 3, block S130 may include followings.

[0039] At block S131, when the outdoor ambient temperature is within the preset temperature range, it is determined whether there is a started indoor unit.

[0040] In the operating process of the multi-split air conditioning system, the outdoor unit may communicate with the indoor unit to inform its respective operating state. In other words, when the outdoor ambient temperature is within the preset temperature range, the operating condition of the indoor unit can be obtained by querying the outdoor unit, such that it can be determined whether there is the started indoor unit.

[0041] At block S132, when there is the started indoor unit, it is determined whether the indoor unit sending the starting instruction has a highest priority level.

[0042] In embodiments of the present disclosure, the indoor units may be numbered in advance, such as indoor unit 1, indoor unit 2, indoor unit 3, etc. A priority level may be set for each indoor unit, and a priority level table can be defined. Therefore, based on the preset priority level table, when it is determined that there is the started indoor unit, the priority level of the started indoor unit may be compared with that of the indoor unit sending the starting instruction, to determine whether the indoor unit sending the starting instruction has the highest priority level.

[0043] At block S133, when the indoor unit sending the starting instruction has the highest priority level, the operating mode of the multi-split air conditioning system is determined according to an operating mode set by the indoor unit sending the starting instruction, and otherwise the operating mode of the multi-split air conditioning system is determined

according to the operating mode of the started indoor unit.

[0044] When the indoor unit sending the starting instruction has the highest priority level, the operating mode of the multi-split air conditioning system is determined according to the operating mode set by the starting instruction. For example, when the indoor unit sending the starting instruction is in the refrigerating mode, the multi-split air conditioning system is currently operating in the heating mode, and then the current heating mode is switched to the refrigerating mode.

[0045] When the indoor unit sending the starting instruction does not have the highest priority level, i.e., one of the started indoor units has the highest priority level, no operation is performed, and the multi-split air conditioning system operates in the current operating mode.

[0046] At block S134, when there is no started indoor unit, it is determined whether there are at least two indoor units sending the starting instruction.

[0047] When there is no started indoor unit, it is indicated that the multi-split air conditioning system is not in the operating state. It is determined whether there is one or more indoor units sending the starting instruction. When there is only one indoor unit sending the starting instruction, the operation of the multi-split air conditioning system is controlled based on the operating mode set by the starting instruction. When there are more than two indoor units sending the starting instruction, the operating mode of the multi-split air conditioning system is determined through a priority level rule or a majority rule based on set operating modes of respective indoor units.

[0048] At block S135, when there are at least two indoor units sending the starting instruction, the operating mode of the multi-split air conditioning system is determined through a priority level rule or a majority rule according to the number of indoor units and set operating modes thereof.

[0049] For the operating mode of the multi-split air conditioning system is determined according to the priority level rule, reference may be made to the above. The majority rule refers to that, according to the number of indoor units sending the same starting instruction and the same operating modes set by respective indoor units, the operating mode of the multi-split air conditioning system is determined by the operating mode set by most of the indoor units. For example, the indoor units sending the starting instruction include an indoor unit 1, an indoor unit 2 and an indoor unit 4, the operating mode set by the indoor unit 1 is the refrigerating mode, the operating mode set by the indoor unit 2 is the heating mode, and the operating mode set by the indoor unit 4 is the refrigerating mode, and then the final operating mode of the multi-split air conditioning system is the refrigerating mode according to the majority rule.

[0050] Furthermore, as illustrated in Fig. 4, the method further includes followings.

[0051] At block S140, after the operating mode of multi-split air conditioning system is determined, when a mode switching instruction sent by the indoor unit is received, it is determined whether the indoor unit sending the mode switching instruction has the highest priority level.

[0052] At block S150, when the indoor unit sending the mode switching instruction does not have the highest priority level, the mode switching instruction is forwarded to the indoor unit having the highest priority level, and the operating mode of the multi-split air conditioning system is switched when confirmation from the indoor unit having the highest priority level is received.

[0053] At block S160, when the indoor unit sending the mode switching instruction has the highest priority level, the current operating mode of the multi-split air conditioning system is switched according to the mode switching instruction.

[0054] After the operating mode of the multi-split air conditioning system is determined, the user may want to switch the current operating mode (for example, switch the refrigerating mode to the heating mode), after the indoor unit receives the mode switching instruction, the indoor unit can send it to the outdoor unit. The outdoor unit may first determine whether the indoor unit sending the mode switching instruction has the highest priority level. When the indoor unit sending the mode switching instruction has the highest priority level, the current operating mode of the multi-split air conditioning system is switched according to the mode switching instruction. When the indoor unit sending the mode switching instruction does not have the highest priority level, the mode switching instruction is forwarded to the indoor unit having the highest priority level to confirm. It should be noted that, the above comparison of the priority level is to compare the priority level of the indoor unit sending the mode switching instruction to that of the started indoor unit.

[0055] Furthermore, as illustrated in Fig. 5, the method further includes followings.

[0056] At block S170, after the operating mode of multi-split air conditioning system is determined, a current indoor temperature corresponding to the indoor unit is obtained.

[0057] At block S180, when a current indoor temperature corresponding to the indoor unit reaches a target temperature, the indoor unit is stopped for a preset time period and then the indoor unit is started again.

[0058] After the operating mode of multi-split air conditioning system is determined, the indoor unit may further detect the current indoor temperature corresponding to the indoor unit. In the embodiment, the indoor temperature may be detected by a temperature sensor provided at a return air inlet of the indoor unit. When the indoor temperature corresponding to the indoor unit reaches the target temperature, the indoor unit is controlled to stop operating for a time period, and then the indoor unit is started again. After the indoor unit stops operating, the multi-split air conditioning system may obtain operating conditions of remaining indoor units to re-determine the operating mode of the multi-split air conditioning system.

[0059] Accordingly, embodiments of the present disclosure further provide a multi-split air conditioning system for performing the above method. The multi-split air conditioning system includes the structure illustrated in Fig. 1, and further includes a controller. The controller is configured to receive a control signal from the indoor unit and control the outdoor unit according to the control signal. In detail, as illustrated in Fig. 6, the controller includes a temperature acquiring module 110, a temperature determining module 120 and a control module 130.

[0060] The temperature acquiring module 110 is configured to acquire an outdoor ambient temperature when receiving a starting instruction of the indoor unit.

[0061] The temperature determining module 120 is configured to determine whether the outdoor ambient temperature is within a preset temperature range.

[0062] The control module 130 is configured to determine an operating mode of the multi-split air conditioning system according to operating conditions of respective started indoor units when the outdoor ambient temperature is within the preset temperature range.

[0063] When the user wants to start the indoor unit to adjust the temperature (such as increase temperature or decrease temperature) in the area where the indoor unit is located, the user can may a starting instruction, and set a target indoor temperature and an operating mode (such as a refrigerating mode, a heating mode, etc.). The indoor unit receives the starting instruction sent by the user, and sends the starting instruction to the outdoor unit. The temperature acquiring module 110 acquires the outdoor ambient temperature based on the starting instruction of the indoor unit.

[0064] In the embodiment, a temperature range (i.e., a temperature range of the transitional season (such as 22°C to 28°C)) may be preset, when the outdoor ambient temperature is within the temperature range, it is indicated that it is in the transitional season. When the outdoor ambient temperature is less than 22°C, the air conditioning system is controlled to operate in the heating mode. When the outdoor ambient temperature is greater than 28°C, the air conditioning system is controlled to operate in the refrigerating mode.

[0065] When the outdoor ambient temperature is within the preset temperature range, operating conditions of respective indoor units are obtained, and the operating mode of the multi-split air conditioning system is determined through a preset rule according to the operating conditions of respective indoor units. In other words, the multi-split air conditioning system may operate in a refrigerating mode, or may operate in a heating mode. The operating condition may include an operating state (such as on or off) of the indoor unit, and an operating mode (such as a refrigerating mode, a heating mode, etc.) of the indoor unit.

[0066] In embodiments of the present disclosure, it is determined whether the outdoor ambient temperature is in the transitional season, when the outdoor ambient temperature is in the transitional season, operating conditions of respective indoor units are obtained, and the operating mode of the multi-split air conditioning system is determined based on the operating conditions of respective indoor units, thereby avoiding conflicts in operating modes of multi-split air conditioning systems.

[0067] Furthermore, the control module 130 in the controller is further configured to determine whether there is a started indoor unit when the outdoor ambient temperature is within the preset temperature range; determine whether the indoor unit sending the starting instruction has a highest priority level when there is the started indoor unit; and determine the operating mode of the multi-split air conditioning system according to an operating mode set by the indoor unit sending the starting instruction when the indoor unit sending the starting instruction has the highest priority level, and determine the operating mode of the multi-split air conditioning system according to the operating mode of the started indoor unit when the indoor unit sending the starting instruction does not have the highest priority level.

[0068] In the operating process of the multi-split air conditioning system, the outdoor unit may communicate with the indoor unit to inform its respective operating state. In other words, when the outdoor ambient temperature is within the preset temperature range, the operating condition of the indoor unit can be obtained by querying the outdoor unit, such that it can be determined whether there is the started indoor unit.

[0069] In embodiments of the present disclosure, the indoor units may be numbered in advance, such as indoor unit 1, indoor unit 2, indoor unit 3, etc. A priority level may be set for each indoor unit, and a priority level table can be defined. Therefore, based on the preset priority level table, when it is determined that there is the started indoor unit, the priority level of the started indoor unit may be compared with that of the indoor unit sending the starting instruction, to determine whether the indoor unit sending the starting instruction has the highest priority level.

[0070] When the indoor unit sending the starting instruction has the highest priority level, the operating mode of the multi-split air conditioning system is determined according to the operating mode set by the starting instruction. For example, when the indoor unit sending the starting instruction is in the refrigerating mode, the multi-split air conditioning system is currently operating in the heating mode, and then the current heating mode is switched to the refrigerating mode.

[0071] When the indoor unit sending the starting instruction does not have the highest priority level, i.e., one of the started indoor units has the highest priority level, no operation is performed, and the multi-split air conditioning system operates in the current operating mode.

[0072] Furthermore, the control module 130 is further configured to determine whether there are at least two indoor units sending the starting instruction when there is no started indoor unit; and when there are at least two indoor units

sending the starting instruction, determine the operating mode of the multi-split air conditioning system through a priority level rule or a majority rule according to the number of indoor units and set operating modes thereof.

[0073] When there is no started indoor unit, it is indicated that the multi-split air conditioning system is not in the operating state. It is determined whether there is one or more indoor units sending the starting instruction. When there is only one indoor unit sending the starting instruction, the operation of the multi-split air conditioning system is controlled based on the operating mode set by the starting instruction. When there are more than two indoor units sending the starting instruction, the operating mode of the multi-split air conditioning system is determined through a priority level rule or a majority rule based on set operating modes of respective indoor units.

[0074] For the operating mode of the multi-split air conditioning system is determined according to the priority level rule, reference may be made to the above. The majority rule refers to that, according to the number of indoor units sending the same starting instruction and the same operating modes set by respective indoor units, the operating mode of the multi-split air conditioning system is determined by the operating mode set by most of the indoor units. For example, the indoor units sending the starting instruction include an indoor unit 1, an indoor unit 2 and an indoor unit 4, the operating mode set by the indoor unit 1 is the refrigerating mode, the operating mode set by the indoor unit 2 is the heating mode, and the operating mode set by the indoor unit 4 is the refrigerating mode, and then the final operating mode of the multi-split air conditioning system is the refrigerating mode according to the majority rule.

[0075] Furthermore, the control module 130 is further configured to, when receiving a mode switching instruction sent by the indoor unit, determine whether the indoor unit sending the mode switching instruction has the highest priority level; when the indoor unit sending the mode switching instruction does not have the highest priority level, forward the mode switching instruction to the indoor unit having the highest priority level, and switch the operating mode of the multi-split air conditioning system when receiving confirmation from the indoor unit having the highest priority level; and when the indoor unit sending the mode switching instruction has the highest priority level, switch the current operating mode of the multi-split air conditioning system according to the mode switching instruction.

[0076] After the operating mode of the multi-split air conditioning system is determined, the user may want to switch the current operating mode (for example, switch the refrigerating mode to the heating mode), after the indoor unit receives the mode switching instruction, the indoor unit can send it to the outdoor unit. The outdoor unit may first determine whether the indoor unit sending the mode switching instruction has the highest priority level. When the indoor unit sending the mode switching instruction has the highest priority level, the current operating mode of the multi-split air conditioning system is switched according to the mode switching instruction. When the indoor unit sending the mode switching instruction does not have the highest priority level, the mode switching instruction is forwarded to the indoor unit having the highest priority level to confirm. It should be noted that, the above comparison of the priority level is to compare the priority level of the indoor unit sending the mode switching instruction to that of the started indoor unit.

[0077] Furthermore, the control module 130 is further configured to stop operating of the indoor unit for a preset time period and then start the indoor unit again, when a current indoor temperature corresponding to the indoor unit reaches a target temperature.

[0078] After the operating mode of multi-split air conditioning system is determined, the indoor unit may further detect the current indoor temperature corresponding to the indoor unit. In the embodiment, the indoor temperature may be detected by a temperature sensor provided at a return air inlet of the indoor unit. When the indoor temperature corresponding to the indoor unit reaches the target temperature, the indoor unit is controlled to stop operating for a time period, and then the indoor unit is started again. After the indoor unit stops operating, the multi-split air conditioning system may obtain operating conditions of remaining indoor units to re-determine the operating mode of the multi-split air conditioning system.

[0079] Although explanatory embodiments have been shown and described, it would be appreciated that the above embodiments are exemplary and cannot be construed to limit the present disclosure, and changes, amendments, alternatives and modifications can be made in the embodiments by those skilled in the art without departing from spirit, principles and scope of the present disclosure.

Claims

1. A method for controlling a multi-split air conditioning system, comprising:

acquiring an outdoor ambient temperature when receiving a starting instruction of an indoor unit;
determining whether the outdoor ambient temperature is within a preset temperature range; and
determining an operating mode of the multi-split air conditioning system according to operating conditions of respective started indoor units, when the outdoor ambient temperature is within the preset temperature range.

2. The method according to claim 1, wherein determining the operating mode of the multi-split air conditioning system

according to the operating conditions of respective started indoor units when the outdoor ambient temperature is within the preset temperature range comprises:

determining whether there is a started indoor unit, when the outdoor ambient temperature is within the preset temperature range;
determining whether the indoor unit sending the starting instruction has a highest priority level, when there is the started indoor unit; and
determining the operating mode of the multi-split air conditioning system according to an operating mode set by the indoor unit sending the starting instruction when the indoor unit sending the starting instruction has the highest priority level, and determining the operating mode of the multi-split air conditioning system according to the operating mode of the started indoor unit when the indoor unit sending the starting instruction does not have the highest priority level.

3. The method according to claim 2, wherein, after determining whether there is a started indoor unit when the outdoor ambient temperature is within the preset temperature range, the method further comprises:

determining whether there are at least two indoor units sending the starting instruction, when there is no started indoor unit; and
when there are at least two indoor units sending the starting instruction, determining the operating mode of the multi-split air conditioning system through a priority level rule or a majority rule according to the number of indoor units and set operating modes thereof.

4. The method according to claim 2, further comprising:

when receiving a mode switching instruction sent by the indoor unit, determining whether the indoor unit sending the mode switching instruction has the highest priority level;
when the indoor unit sending the mode switching instruction does not have the highest priority level, forwarding the mode switching instruction to the indoor unit having the highest priority level, and switching the operating mode of the multi-split air conditioning system when receiving confirmation from the indoor unit having the highest priority level; and
when the indoor unit sending the mode switching instruction has the highest priority level, switching the current operating mode of the multi-split air conditioning system according to the mode switching instruction.

5. The method according to any one of claims 1 to 4, further comprising:
stopping operating of the indoor unit for a preset time period and then starting the indoor unit again, when a current indoor temperature corresponding to the indoor unit reaches a target temperature.

6. The method according to claim 1, further comprising:

controlling the multi-split air conditioning system to operate in a heating mode when the outdoor ambient temperature is less than a lower limit of the preset temperature range; and
controlling the multi-split air conditioning system to operate in a cooling mode when the outdoor ambient temperature is greater than an upper limit of the preset temperature range.

7. A multi-split air conditioning system, comprising at least one outdoor unit and at least two indoor units, wherein the at least two indoor units and the at least one outdoor unit form a refrigerant cycle loop and communicate with each other, the outdoor unit comprises a controller configured to receive a control signal from the indoor unit and control the outdoor unit according to the control signal; the controller comprises:

a temperature acquiring module, configured to acquire an outdoor ambient temperature when receiving a starting instruction of the indoor unit;
a temperature determining module, configured to determine whether the outdoor ambient temperature is within a preset temperature range; and
a control module, configured to determine an operating mode of the multi-split air conditioning system according to operating conditions of respective started indoor units when the outdoor ambient temperature is within the preset temperature range.

8. The multi-split air conditioning system according to claim 7, wherein the control module is further configured to:

determine whether there is a started indoor unit when the outdoor ambient temperature is within the preset temperature range;
determine whether the indoor unit sending the starting instruction has a highest priority level when there is the started indoor unit; and
determine the operating mode of the multi-split air conditioning system according to an operating mode set by the indoor unit sending the starting instruction when the indoor unit sending the starting instruction has the highest priority level, and determine the operating mode of the multi-split air conditioning system according to the operating mode of the started indoor unit when the indoor unit sending the starting instruction does not have the highest priority level.

9. The multi-split air conditioning system according to claim 8, wherein the control module is further configured to:

determine whether there are at least two indoor units sending the starting instruction when there is no started indoor unit; and
when there are at least two indoor units sending the starting instruction, determine the operating mode of the multi-split air conditioning system through a priority level rule or a majority rule according to the number of indoor units and set operating modes thereof.

10. The multi-split air conditioning system according to claim 8, wherein the control module is further configured to:

when receiving a mode switching instruction sent by the indoor unit, determine whether the indoor unit sending the mode switching instruction has the highest priority level;
when the indoor unit sending the mode switching instruction does not have the highest priority level, forward the mode switching instruction to the indoor unit having the highest priority level, and switch the operating mode of the multi-split air conditioning system when receiving confirmation from the indoor unit having the highest priority level; and
when the indoor unit sending the mode switching instruction has the highest priority level, switch the current operating mode of the multi-split air conditioning system according to the mode switching instruction.

11. The multi-split air conditioning system according to any one of claims 7 to 10, wherein the control module is further configured to:
stop operating of the indoor unit for a preset time period and then start the indoor unit again, when a current indoor temperature corresponding to the indoor unit reaches a target temperature.

12. The multi-split air conditioning system according to claim 7, wherein the control module is further configured to:

control the multi-split air conditioning system to operate in a heating mode when the outdoor ambient temperature is less than a lower limit of the preset temperature range; and
control the multi-split air conditioning system to operate in a cooling mode when the outdoor ambient temperature is greater than a upper limit of the preset temperature range.

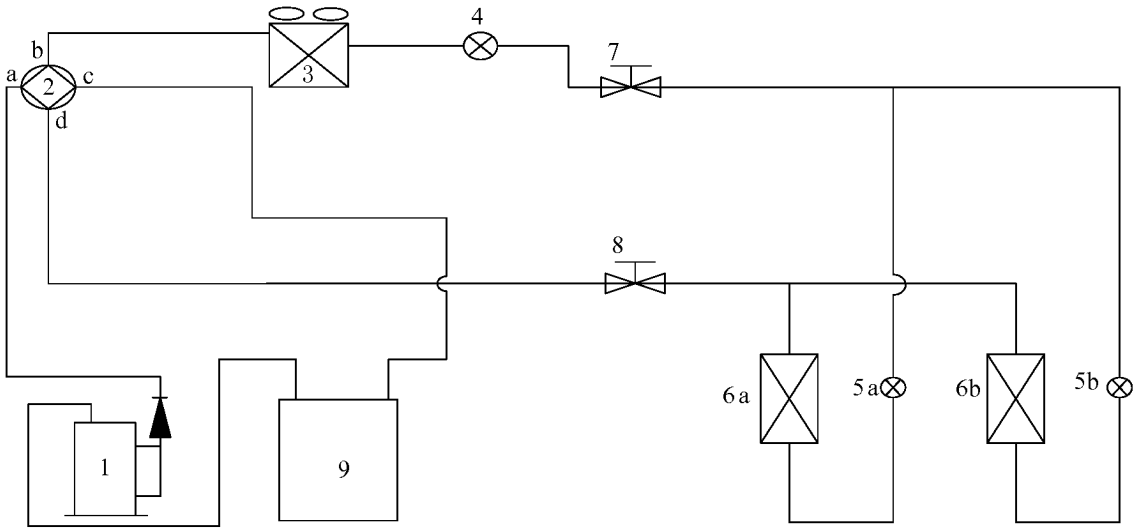
4
b
7
a
2
c
3
d
8
6a
5a
6b
5b
1
9

Fig. 1

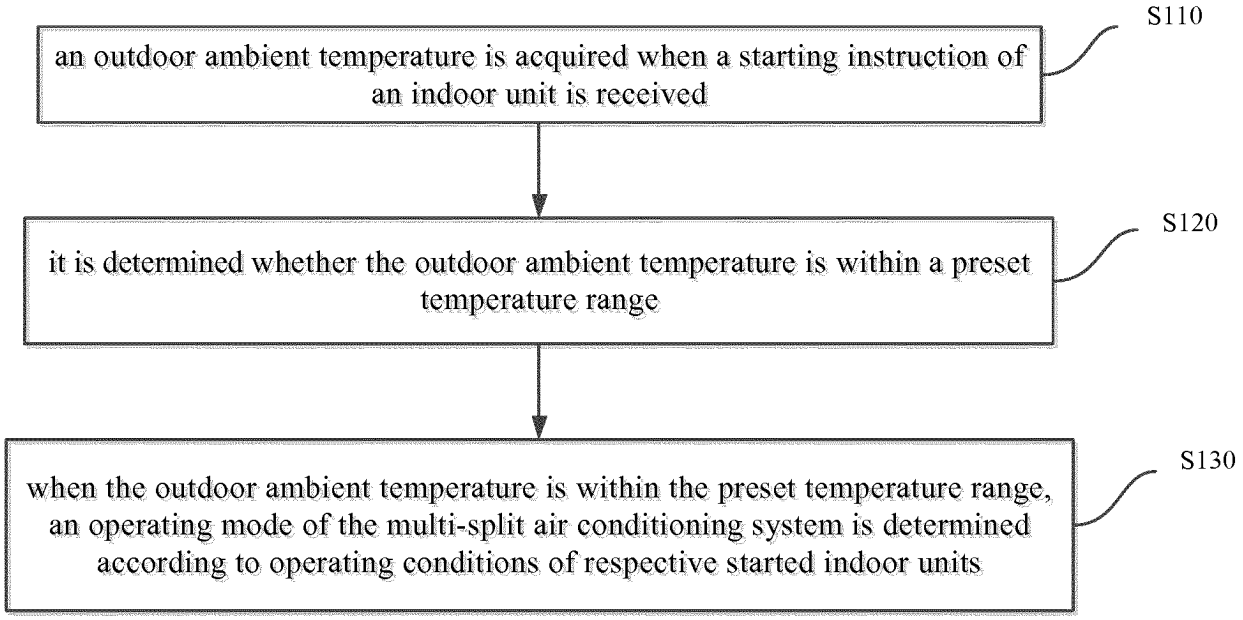
S110
an outdoor ambient temperature is acquired when a starting instruction of an indoor unit is received
S120
it is determined whether the outdoor ambient temperature is within a preset temperature range
S130
when the outdoor ambient temperature is within the preset temperature range, an operating mode of the multi-split air conditioning system is determined according to operating conditions of respective started indoor units

Fig. 2

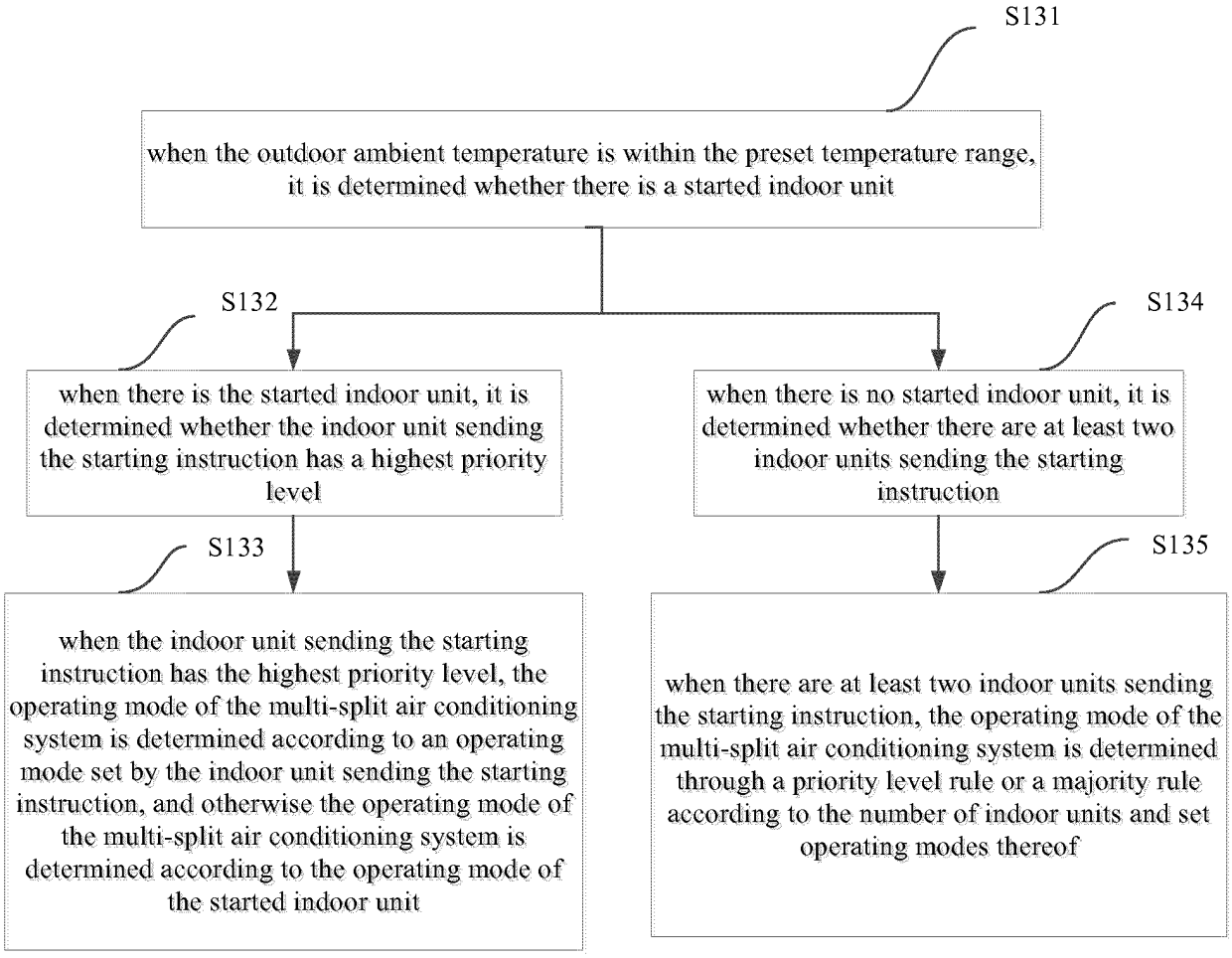
S131
when the outdoor ambient temperature is within the preset temperature range, it is determined whether there is a started indoor unit
S132
when there is the started indoor unit, it is determined whether the indoor unit sending the starting instruction has a highest priority level
S133
when the indoor unit sending the starting instruction has the highest priority level, the operating mode of the multi-split air conditioning system is determined according to an operating mode set by the indoor unit sending the starting instruction, and otherwise the operating mode of the multi-split air conditioning system is determined according to the operating mode of the started indoor unit
S134
when there is no started indoor unit, it is determined whether there are at least two indoor units sending the starting instruction
S135
when there are at least two indoor units sending the starting instruction, the operating mode of the multi-split air conditioning system is determined through a priority level rule or a majority rule according to the number of indoor units and set operating modes thereof

Fig. 3

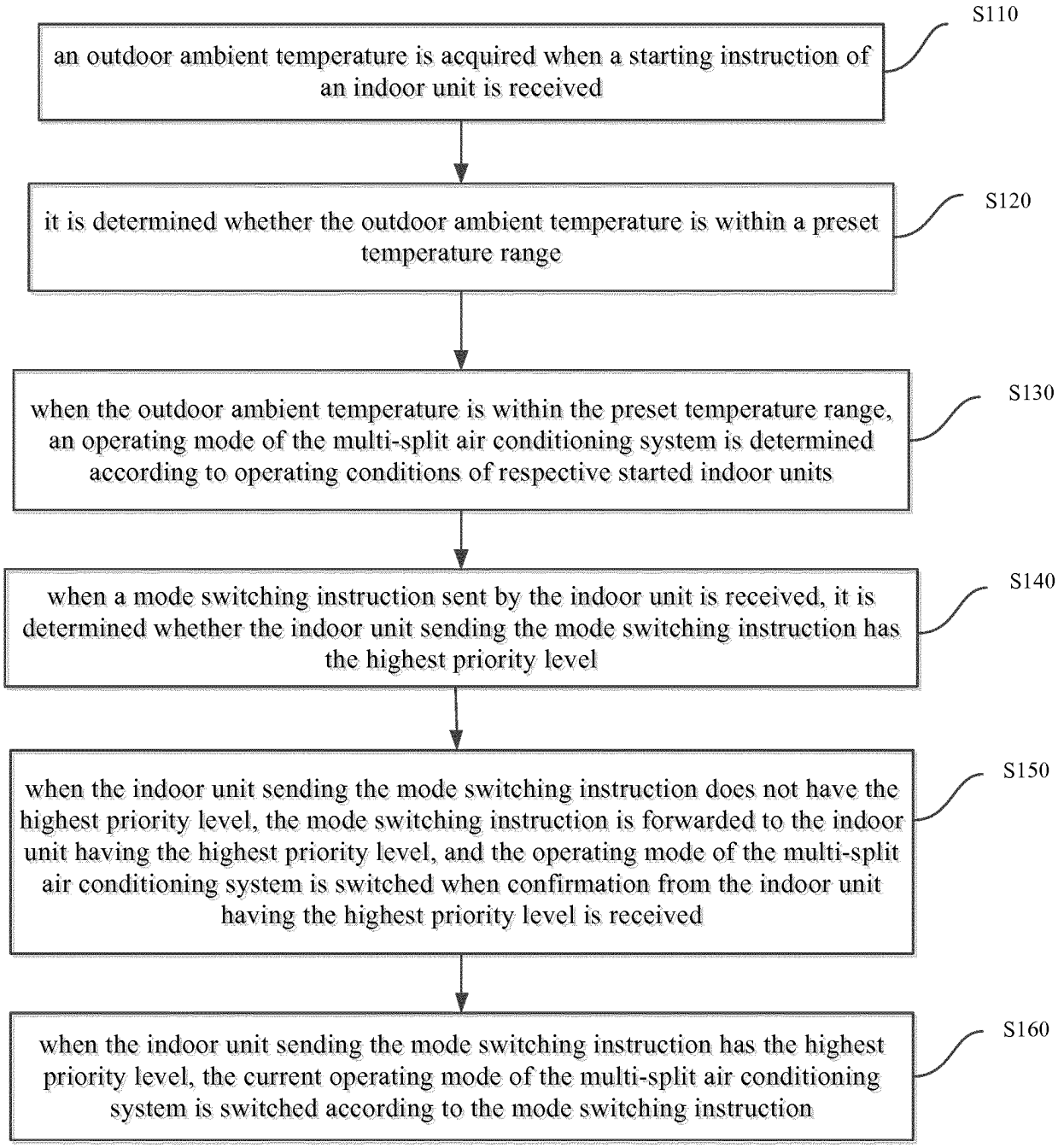
S110
an outdoor ambient temperature is acquired when a starting instruction of an indoor unit is received
S120
it is determined whether the outdoor ambient temperature is within a preset temperature range
S130
when the outdoor ambient temperature is within the preset temperature range, an operating mode of the multi-split air conditioning system is determined according to operating conditions of respective started indoor units
S140
when a mode switching instruction sent by the indoor unit is received, it is determined whether the indoor unit sending the mode switching instruction has the highest priority level
S150
when the indoor unit sending the mode switching instruction does not have the highest priority level, the mode switching instruction is forwarded to the indoor unit having the highest priority level, and the operating mode of the multi-split air conditioning system is switched when confirmation from the indoor unit having the highest priority level is received
S160
when the indoor unit sending the mode switching instruction has the highest priority level, the current operating mode of the multi-split air conditioning system is switched according to the mode switching instruction

Fig. 4

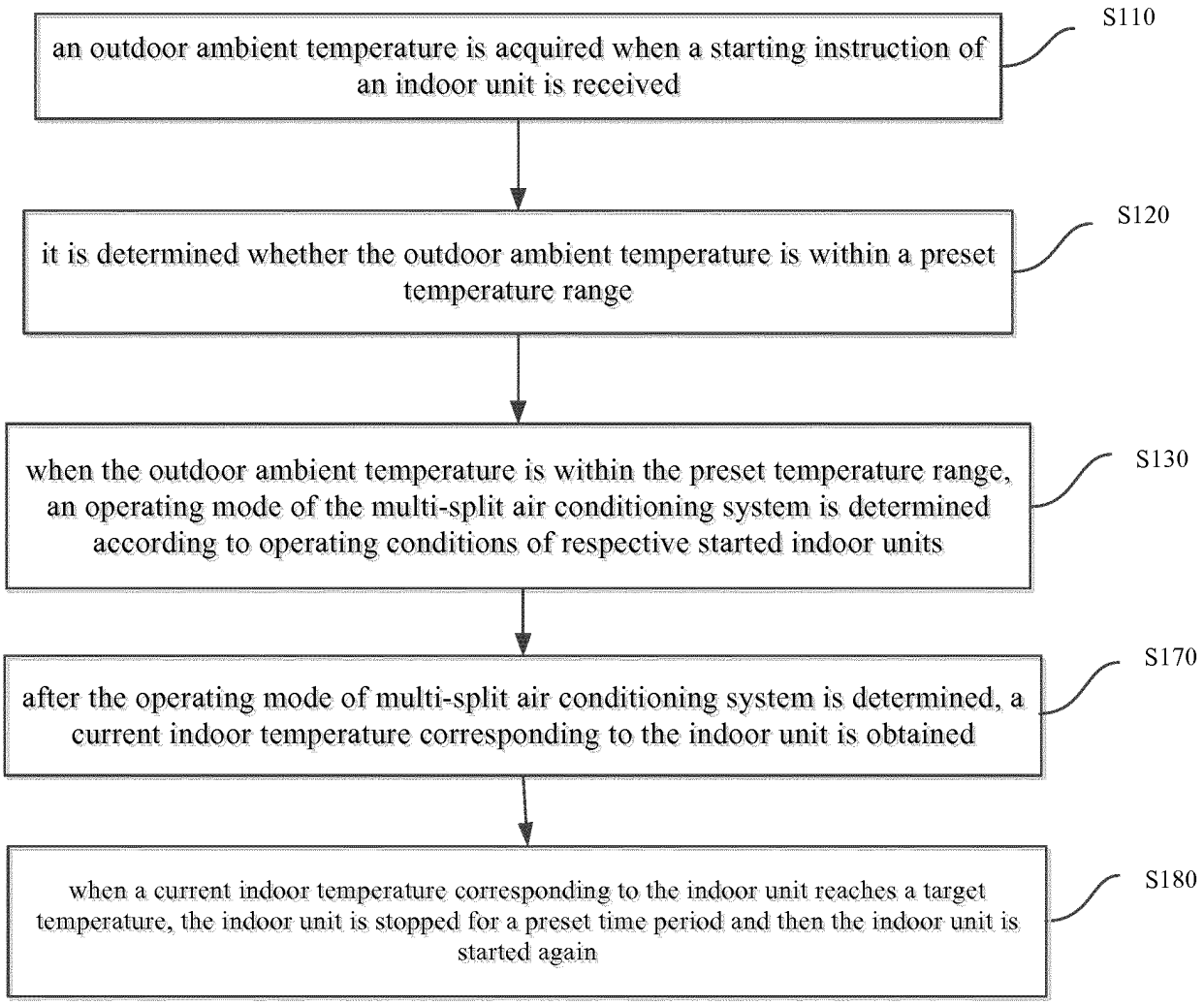
an outdoor ambient temperature is acquired when a starting instruction of an indoor unit is received
S110
it is determined whether the outdoor ambient temperature is within a preset temperature range
S120
when the outdoor ambient temperature is within the preset temperature range, an operating mode of the multi-split air conditioning system is determined according to operating conditions of respective started indoor units
S130
after the operating mode of multi-split air conditioning system is determined, a current indoor temperature corresponding to the indoor unit is obtained
S170
when a current indoor temperature corresponding to the indoor unit reaches a target temperature, the indoor unit is stopped for a preset time period and then the indoor unit is started again
S180

Fig. 5

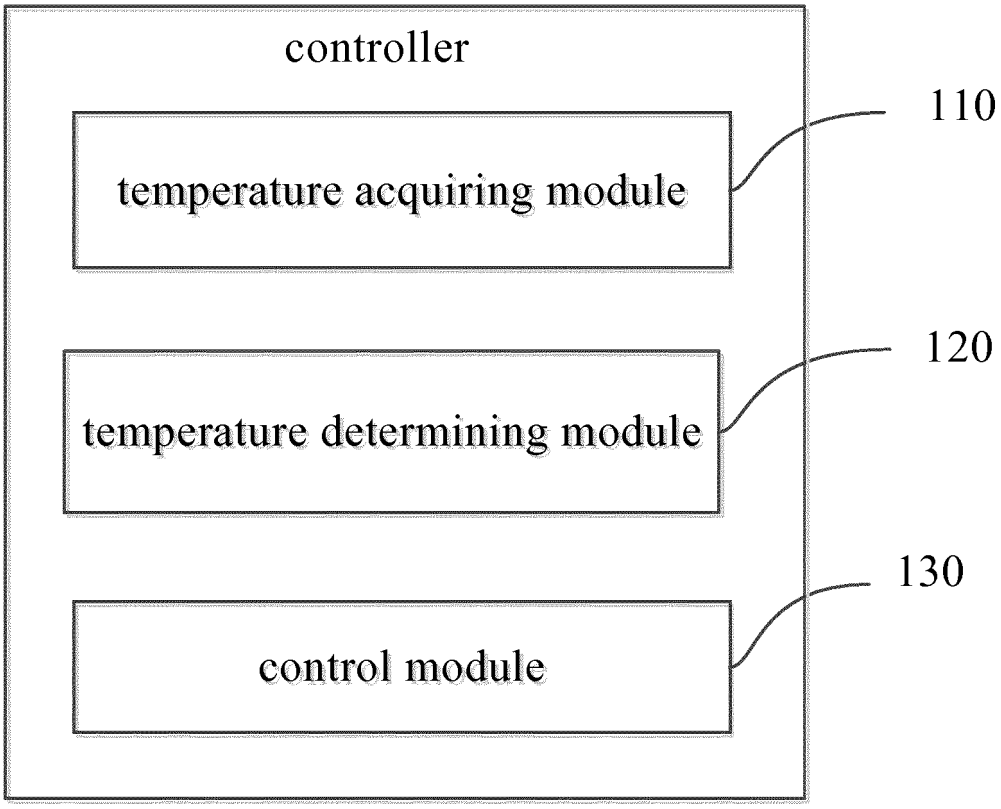
controller
temperature acquiring module
110
temperature determining module
120
control module
130

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2017/099277

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/00 (2006.01) 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)

WPI, EPODOC, CNKI, CNPAT; (air, indoor, outdoor, mode, control, calculate, environment, temperature, multi-connected; 空气, 室内, 室外, 模式, 控制, 计算, 环境, 温度, 多联机)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 106403183 A (GUANGDONG MIDEA HEATING & VENTILATION EQUIPMENT CO., LTD. et al.), 15 February 2017 (15.02.2017), description, paragraphs [0003]-[0095]	1-12
X	CN 104676836 A (SICHUAN CHANGHONG ELECTRIC CO., LTD.), 03 June 2015 (03.06.2015), description, paragraphs [0008]-[0027]	1-12
A	CN 103216909 A (NINGBO AUX ELECTRICAL CO., LTD.), 24 July 2013 (24.07.2013), entire document	1-12
A	CN 104566830 A (MITSUBISHI HEAVY INDUSTRIES-HAIER (QINGDAO) AIR-CONDITIONERS CO., LTD.), 29 April 2015 (29.04.2015), entire document	1-12
A	EP 2530394 A1 (MITSUBISHI HEAVY IND LTD.), 05 December 2012 (05.12.2012), entire document	1-12

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 November 2017	28 November 2017

Name and mailing address of the ISA	Authorized officer
State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	ZHANG, Yang Telephone No. (86-10) 62084045

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2017/099277

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 106403183 A	15 February 2017	None	
CN 104676836 A	03 June 2015	CN 104676836 B	19 April 2017
CN 103216909 A	24 July 2013	CN 103216909 B	22 July 2015
CN 104566830 A	29 April 2015	None	
EP 2530394 A1	05 December 2012	JP 2011153756 A	11 August 2011
		JP 5631012 B2	26 November 2014
		WO 2011093212 A1	04 August 2011
		EP 2530394 A4	19 July 2017

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201610840220 **[0001]**