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

(57) Proposed by the present invention are an air conditioner, a control method and a computer-readable storage medium. The air conditioner comprises: a refrigerant switching device, an indoor heat exchanger, an outdoor heat exchanger, a compressor, a memory, and a processor. The refrigerant switching device comprises a liquid pipe, a gas pipe, and a valve assembly. The processor executes a computer program so as to execute the following: obtaining switching information of a working mode of the air conditioner; and controlling the valve assembly according to the switching information so that the gas pipe and the liquid pipe are closed according to the sequence of the gas pipe first and then the liquid pipe, and then opened according to the sequence of the gas pipe first and then the liquid pipe. Therefore, during the switching process of the working mode, the refrigerant inside an indoor unit heat exchanger is limited by means of first closing the gas pipe and the liquid pipe, which reduces the amount of refrigerant to be balanced after the gas pipe connected to a target working mode is connected, and reduces the refrigerant noise caused by the impact of high pressure and low pressure refrigerant during the connection process. At the same time, the refrigerant flow may be switched without limiting the refrigerant

flow, which greatly shortens the duration of the switching process and ensures the operation stability of the compressor.

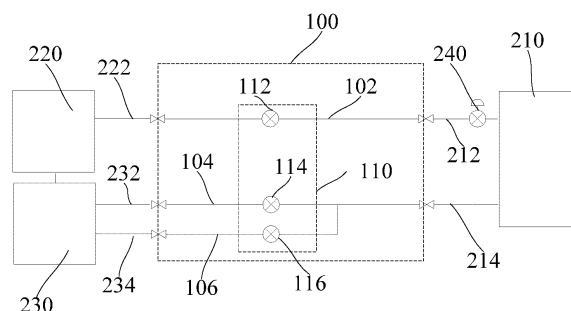


Fig. 1

Description

[0001] This application claims priority to Chinese Patent Application No. 202010998871.2 filed with China National Intellectual Property Administration on September 22, 2020 and entitled "Air Conditioner, Control Method and Computer-readable Storage Medium", the entire contents of which are herein incorporated by reference.

FIELD

[0002] The present invention relates to the technical field of air conditioners, and particularly relates to an air conditioner, a control method for an air conditioner, and a computer-readable storage medium.

BACKGROUND

[0003] In a three-pipe heat recovery multi-connected air conditioning system, the refrigerant flow direction needs to be changed at the time of mode switching for an indoor unit. The change in the refrigerant flow direction is often switching a gas pipe of the indoor unit between a high-pressure gas pipe and a low-pressure gas pipe, so as to connect the refrigerant in one of the states to the indoor unit, thereby forming a passage with a liquid pipe refrigerant. However, due to a relatively large difference in refrigerant pressure between the high-pressure gas pipe and the low-pressure gas pipe, when switching occurs, the refrigerant in the indoor unit and the refrigerant in the pipe to which the gas pipe of the indoor unit is switched are directly connected, i.e., a high-pressure refrigerant and a low-pressure refrigerant are directly connected, thus generating noticeable noises during switching.

SUMMARY

[0004] The present invention aims to solve at least one of the technical problems that exist in the prior art or the related art.

[0005] To this end, a first aspect of the present invention proposes an air conditioner.

[0006] A second aspect of the present invention proposes a control method for an air conditioner.

[0007] A third aspect of the present invention proposes a computer-readable storage medium.

[0008] In view of this, according to the first aspect of the present invention, there is proposed an air conditioner, comprising: a refrigerant switching device, comprising a liquid pipe, a gas pipe and a valve assembly, the valve assembly being arranged on the liquid pipe and the gas pipe and configured to open the liquid pipe and the gas pipe or close the liquid pipe and the gas pipe; an indoor heat exchanger, a first port of the indoor heat exchanger being connected to the liquid pipe and a second port of the indoor heat exchanger being connected to the gas pipe; an outdoor heat exchanger, a first port of the out-

door heat exchanger being connected to the liquid pipe; a compressor, a first port of the compressor being connected to the gas pipe and a second port of the compressor being connected to a second port of the outdoor heat exchanger; a memory, storing a computer program; and a processor, connected to the memory and the valve assembly, the processor executing the computer program so as to perform the following: obtaining switching information of a working mode of the air conditioner; and controlling the valve assembly according to the switching information so that the gas pipe and the liquid pipe are closed according to the sequence of first the gas pipe and then the liquid pipe, and then opened according to the sequence of first the gas pipe and then the liquid pipe.

[0009] The air conditioner provided in the present invention is provided with a refrigerant switching device, an indoor heat exchanger, an outdoor heat exchanger, a compressor, a memory, and a processor. The refrigerant switching device comprises a liquid pipe, a gas pipe and a valve assembly. The gas pipe is connected between the second port of the indoor heat exchanger and the first port of the compressor to deliver a gas refrigerant. The liquid pipe is connected between the first port of the indoor heat exchanger and the first port of the outdoor heat exchanger to deliver a liquid refrigerant. The valve assembly is arranged on the gas pipe and the liquid pipe for opening or closing the gas pipe and the liquid pipe.

[0010] When it is detected that the air conditioner needs to switch the working mode, the gas pipe opened in the current working mode is closed first according to the switching information, and then the liquid pipe is controlled to be closed, so that the pressure in the liquid pipe is restored to an initial value when the air conditioner is in a standby state, the refrigerant inside the indoor unit heat exchanger is limited, and after it is determined that the pressure in the liquid pipe is stable, i.e., after the liquid pipe is completely closed, the gas pipe corresponding to a target working mode is controlled to be opened according to the switching information, so that a pressure difference is formed in the pipe, and then the liquid pipe is controlled to be opened to restore the refrigerant flow, completing switching of the refrigerant flow direction. The working mode includes a cooling mode and a heating mode. Thus, during the switching process of the working mode, the refrigerant inside the indoor unit heat exchanger is limited through first closing the gas pipe and the liquid pipe, which reduces the amount of refrigerant to be balanced after the gas pipe connected to the target working mode is connected, and reduces the refrigerant noise caused by the impact of high-pressure and low-pressure refrigerants during the connection process. At the same time, the refrigerant flow may be switched without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

[0011] In addition, the air conditioner in the above em-

bodiment provided according to the present invention may further have the following additional technical features.

[0012] In the above embodiment, further, the first port of the compressor comprises an exhaust port and a gas suction port; the gas pipe comprises: a first pressure gas pipe, connected between the exhaust port and the second port of the indoor heat exchanger; and a second pressure gas pipe, connected between the gas suction port and the second port of the indoor heat exchanger; wherein a pressure on the first pressure gas pipe is greater than a pressure on the second pressure gas pipe.

[0013] In this embodiment, the gas pipe comprises a first pressure gas pipe and a second pressure gas pipe, the exhaust port of the compressor is in communication with the indoor heat exchanger through the first pressure gas pipe, and the gas suction port of the compressor is in communication with the indoor heat exchanger through the second pressure gas pipe. The pressure on the first pressure gas pipe is greater than the pressure on the second pressure gas pipe, i.e., one high-pressure gas pipe and one low-pressure gas pipe. Thus, by controlling the first pressure gas pipe and the second pressure gas pipe, one-way flow of the refrigerant is achieved, thereby achieving the cooling and heating functions of the air conditioner, which has a simple structure, and is easy to assemble and easy to control.

[0014] For example, when the air conditioner is in the heating mode, the first pressure gas pipe and the liquid pipe are controlled to be opened, the second pressure gas pipe is controlled to be closed, and the compressor pressurizes the gaseous refrigerant, so that the gaseous refrigerant becomes a high-temperature high-pressure refrigerant, which is delivered to the indoor heat exchanger through the first pressure gas pipe to be condensed and liquefied to release heat, so as to achieve the purpose of heating. The liquefied liquid refrigerant is depressurized and then enters the outdoor heat exchanger through the liquid pipe to absorb heat for gasification, and the gasified refrigerant enters the compressor again for the next cycle. When the air conditioner is in the cooling mode, the second pressure gas pipe and the liquid pipe are controlled to be opened, the first pressure gas pipe is controlled to be closed, and the compressor pressurizes the gaseous refrigerant, so that the gaseous refrigerant becomes a high-temperature high-pressure refrigerant, which is delivered to the outdoor heat exchanger to be liquefied to release heat, and the liquid refrigerant in the outdoor heat exchanger is depressurized and then enters the indoor heat exchanger through the liquid pipe to be gasified to absorb heat, so as to achieve the purpose of cooling. The gasified gaseous refrigerant is delivered to the compressor and pressurized again for the next cycle.

[0015] In any of the above embodiments, further, the valve assembly comprises: a first valve body, arranged in the liquid pipe and configured to open or close the liquid pipe; a second valve body, arranged in the first

pressure gas pipe and configured to open or close the first pressure gas pipe; and a third valve body, arranged in the second pressure gas pipe and configured to open or close the second pressure gas pipe.

[0016] In this embodiment, the valve assembly comprises: a first valve body, a second valve body and a third valve body, which are arranged in the liquid pipe, the first pressure gas pipe and the second pressure gas pipe, respectively, thus enabling independent control of the opening and closing of the liquid pipe and the two gas pipes, facilitating control.

[0017] Further, when the air conditioner is in the heating mode, the first valve body and the second valve body are opened and the third valve body is closed, so that the first pressure gas pipe and the liquid pipe are opened and the second pressure gas pipe is disconnected. When the air conditioner is in the cooling mode, the first valve body and the third valve body are opened and the second valve body is closed, so that the second pressure gas pipe and the liquid pipe are opened and the first pressure gas pipe is disconnected.

[0018] In any of the above embodiments, further, the step of the processor executing controlling the valve assembly according to the switching information when executing the computer program specifically comprises: controlling the third valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from the cooling mode to the heating mode; controlling the second valve body to open, based on a first time duration in which the first valve body is closed reaching a first time duration threshold; and controlling the first valve body to open, based on a second time duration in which the second valve body is opened reaching a second time duration threshold.

[0019] In this embodiment, at the time of switching from the cooling mode to the heating mode, the third valve body is controlled to close first to disconnect the second pressure gas pipe which is opened in the cooling mode. Then the first valve body is controlled to close so that the liquid pipe is closed, and timing of the first time duration in which the first valve body is closed is started. When the first time duration reaches the first time duration threshold, it indicates that the liquid pipe is completely closed and the pressure in the liquid pipe is stabilized. In such a case, the second valve body is controlled to open so that the first pressure gas pipe is opened, and timing of the second time duration in which the second valve body is opened is started. When the second time duration reaches the second time duration threshold, it indicates that a pressure difference between the gas pipe and the first pressure gas pipe is formed and the pressure difference is stable, then the liquid pipe is opened by controlling the first valve body to achieve switching of the refrigerant flow direction. In this way, the amount of refrigerant to be balanced after the first pressure gas pipe is connected is effectively reduced, and the refrigerant noise generated by the impact of high-pressure and low-

pressure refrigerants during the connection process is reduced. Moreover, switching of the refrigerant flow can be achieved without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

[0020] In any of the above embodiments, further, the step of the processor executing controlling the valve assembly according to the switching information when executing the computer program specifically comprises: controlling the second valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from the heating mode to the cooling mode; controlling the third valve body to open, based on a first time duration in which the first valve body is closed reaching a first time duration threshold; and controlling the first valve body to open, based on a third time duration in which the third valve body is opened reaching a third time duration threshold.

[0021] In this embodiment, at the time of switching from the heating mode to the cooling mode, the second valve body is controlled to close first to disconnect the first pressure gas pipe which is opened in the heating mode. Then the first valve body is controlled to close so that the liquid pipe is closed, and timing of the first time duration in which the first valve body is closed is started. When the first time duration reaches the first time duration threshold, it indicates that the liquid pipe is completely closed and the pressure in the liquid pipe is stabilized. In such a case, the third valve body is controlled to open so that the second pressure gas pipe is opened, and timing of the third time duration in which the third valve body is opened is started. When the third time duration reaches the third time duration threshold, it indicates that a pressure difference between the gas pipe and the second pressure gas pipe is formed and the pressure difference is stable, then the liquid pipe is opened by controlling the first valve body to achieve switching of the refrigerant flow direction. In this way, the amount of refrigerant to be balanced after the second pressure gas pipe is connected is effectively reduced, and the refrigerant noise generated by the impact of high-pressure and low-pressure refrigerants during the connection process is reduced. Moreover, switching of the refrigerant flow can be achieved without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

[0022] The first time duration threshold and the third time duration threshold can be set reasonably according to the parameters of the air conditioner and the requirements.

[0023] In any of the above embodiments, further, the first valve body, the second valve body and the third valve body are each a proportional control valve; and the step

of the processor executing the computer program to perform controlling the second valve body or the third valve body to open specifically comprises: adjusting an opening degree of the proportional control valve multiple times according to a preset opening degree, so that the opening degree of the proportional control valve reaches an opening degree threshold.

[0024] In this embodiment, in the process of opening the second valve body or the third valve body, the opening degree of the proportional control valve is adjusted multiple times according to the preset opening degree, so that the valve body slowly opens to the opening degree threshold, thereby improving the stability in the pressure transition process, further reducing the noise generated during the switching of the working mode, and enhancing the user's experience.

[0025] In addition, since the first valve body can control the flow rate of the liquid pipe by adjusting the opening degree, an expansion valve for throttling and pressure reduction between the indoor and outdoor heat exchangers can be omitted, simplifying the system structure and reducing the cost.

[0026] According to the second aspect of the present invention, there is proposed a control method for an air conditioner, comprising: obtaining switching information of a working mode of the air conditioner; and controlling the valve assembly according to the switching information so that a gas pipe and a liquid pipe are closed according to the sequence of first the gas pipe and then the liquid pipe, and then opened according to the sequence of first the gas pipe and then the liquid pipe.

[0027] In this embodiment, when it is detected that the air conditioner needs to switch the working mode, the gas pipe opened in the current working mode is closed first according to the switching information, and then the liquid pipe is controlled to be closed, so that the pressure in the liquid pipe is restored to an initial value when the air conditioner is in a standby state, the refrigerant inside the indoor unit heat exchanger is limited, and after it is determined that the pressure in the liquid pipe is stable, i.e., after the liquid pipe is completely closed, the gas pipe corresponding to a target working mode is controlled to be opened according to the switching information, so that a pressure difference is formed in the pipe, and then the liquid pipe is controlled to be opened to restore the refrigerant flow, completing switching of the refrigerant flow direction. The working mode includes a cooling mode and a heating mode. Thus, during the switching process of the working mode, the refrigerant inside the indoor unit heat exchanger is limited through first closing the gas pipe and the liquid pipe, which reduces the amount of refrigerant to be balanced after the gas pipe connected to the target working mode is connected, and reduces the refrigerant noise caused by the impact of high-pressure and low-pressure refrigerants during the connection process. At the same time, the refrigerant flow may be switched without limiting the refrigerant flow, which greatly shortens the duration of the switching process.

ess, ensures the operation stability of the compressor, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

[0028] In any of the above embodiments, further, the valve assembly comprises a first valve body, a second valve body and a third valve body; and the step of controlling the valve assembly according to the switching information specifically comprises: controlling the third valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from the cooling mode to the heating mode; controlling the second valve body to open, based on a first time duration in which the first valve body is closed reaching a first time duration threshold; and controlling the first valve body to open, based on a second time duration in which the second valve body is opened reaching a second time duration threshold.

[0029] In this embodiment, at the time of switching from the cooling mode to the heating mode, the third valve body is controlled to close first to disconnect the second pressure gas pipe which is opened in the cooling mode. Then the first valve body is controlled to close so that the liquid pipe is closed, and timing of the first time duration in which the first valve body is closed is started. When the first time duration reaches the first time duration threshold, it indicates that the liquid pipe is completely closed and the pressure in the liquid pipe is stabilized. In such a case, the second valve body is controlled to open so that the first pressure gas pipe is opened, and timing of the second time duration in which the second valve body is opened is started. When the second time duration reaches the second time duration threshold, it indicates that a pressure difference between the gas pipe and the first pressure gas pipe is formed and the pressure difference is stable, then the liquid pipe is opened by controlling the first valve body to achieve switching of the refrigerant flow direction. In this way, the amount of refrigerant to be balanced after the first pressure gas pipe is connected is effectively reduced, and the refrigerant noise generated by the impact of high-pressure and low-pressure refrigerants during the gas pipe and liquid pipe connection process is reduced. Moreover, switching of the refrigerant flow can be achieved without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

[0030] In any of the above embodiments, further, the valve assembly comprises a first valve body, a second valve body and a third valve body; and the step of controlling the valve assembly according to the switching information specifically comprises: controlling the second valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from the heating mode to the cooling mode; controlling the third valve body to open, based on a first time duration in which the first valve body

is closed reaching a first time duration threshold; and controlling the first valve body to open, based on a third time duration in which the third valve body is opened reaching a third time duration threshold.

[0031] In this embodiment, at the time of switching from the heating mode to the cooling mode, the second valve body is controlled to close first to disconnect the first pressure gas pipe which is opened in the heating mode. Then the first valve body is controlled to close so that the liquid pipe is closed, and timing of the first time duration in which the first valve body is closed is started. When the first time duration reaches the first time duration threshold, it indicates that the liquid pipe is completely closed and the pressure in the liquid pipe is stabilized. In such a case, the third valve body is controlled to open so that the second pressure gas pipe is opened, and timing of the third time duration in which the third valve body is opened is started. When the third time duration reaches the third time duration threshold, it indicates that a pressure difference between the gas pipe and the second pressure gas pipe is formed and the pressure difference is stable, then the liquid pipe is opened by controlling the first valve body to achieve switching of the refrigerant flow direction. In this way, the amount of refrigerant to be balanced after the second pressure gas pipe is connected is effectively reduced, and the refrigerant noise generated by the impact of high-pressure and low-pressure refrigerants during the connection process is reduced. Moreover, switching of the refrigerant flow can be achieved without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

[0032] According to the third aspect of the present invention, there is proposed a computer-readable storage medium on which a computer program is stored, wherein when the computer program is executed by a processor, the control method for an air conditioner proposed in the second aspect is implemented. Therefore, the computer-readable storage medium has all the beneficial effects of the control method for an air conditioner proposed in the second aspect.

[0033] Additional aspects and advantages of the present invention will become apparent in the following description, or are understood by the practice of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] In order to more clearly illustrate the embodiments of the present invention or in the prior art, a brief description will be made below on the drawings necessary in the description of the embodiments or the prior art. Obviously, the drawings in the following description are merely some of the embodiments of the present invention, and for a person of ordinary skills in the art, other drawings can be obtained according to the structures

shown in these drawings without any creative work.

Fig. 1 is a schematic structural diagram of an air conditioner according to an embodiment of the present invention;

Fig. 2 is a schematic structural diagram of an air conditioner according to another embodiment of the present invention;

Fig. 3 is a schematic structural diagram of an air conditioner according to a further embodiment of the present invention;

Fig. 4 is a schematic flowchart of a control method for an air conditioner according to an embodiment of the present invention;

Fig. 5 is a schematic flowchart of a control method for an air conditioner according to another embodiment of the present invention;

Fig. 6 is a schematic flowchart of a control method for an air conditioner according to a further embodiment of the present invention;

Fig. 7 is a schematic flowchart of a control method for an air conditioner according to a still further embodiment of the present invention; and

Fig. 8 is a schematic flowchart of a control method for an air conditioner according to a still further embodiment of the present invention.

[0035] The corresponding relationship between the reference signs and component names in Fig. 1 to Fig. 3 is as follows:

100: refrigerant switching device, 102: liquid pipe, 104: first pressure gas pipe, 106: second pressure gas pipe, 110: valve assembly, 112: first valve body, 114: second valve body, 116: third valve body, 210: indoor heat exchanger, 212: first port of indoor heat exchanger, 214: second port of indoor heat exchanger, 220: outdoor heat exchanger, 222: first port of outdoor heat exchanger, 230: compressor, 232: exhaust port, 234: gas suction port, and 240: expansion valve.

[0036] The realization of the object, functional characteristics and advantages of the present invention will be further described with reference to the drawings in conjunction with the embodiments.

DETAILED DESCRIPTION OF THE INVENTION

[0037] In order that the above-mentioned objectives, features and advantages of the present invention can be understood more clearly, a further detailed description of the present invention will be given below in connection with the accompanying drawings and specific embodi-

ments. It should be noted that the embodiments of the present invention and the features in the embodiments can be combined with each other if there is no conflict.

[0038] In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, the present invention can also be implemented in other manners than those described herein. Therefore, the protection scope of the present invention is not limited to the specific embodiments disclosed below.

[0039] An air conditioner, a control method for an air conditioner, and a computer-readable storage medium according to some embodiments of the present invention are described below with reference to Fig. 1 to Fig. 8.

Embodiment 1:

[0040] As shown in Fig. 1 to Fig. 3, according to an embodiment of the present invention, there is proposed an air conditioner, comprising: a refrigerant switching device 100, an indoor heat exchanger 210, an outdoor heat exchanger 220, a compressor 230, a memory (not shown), and a processor (not shown).

[0041] For example, the refrigerant switching device 100 comprises a liquid pipe 102, a gas pipe (a first pressure gas pipe 104 and a second pressure gas pipe 106), and a valve assembly 110. The valve assembly 110 is disposed on the liquid pipe 102 and the gas pipe and configured to open the liquid pipe 102 and the gas pipe, or close the liquid pipe 102 and the gas pipe. A first port 212 of the indoor heat exchanger is connected to the liquid pipe 102 and a second port 214 of the indoor heat exchanger is connected to the gas pipe. A first port 222 of the outdoor heat exchanger is connected to the liquid pipe 102. A first port (a gas suction port 234 and an exhaust port 232) of the compressor is connected to the gas pipe and a second port of the compressor is connected to a second port of the outdoor heat exchanger. That is, the gas pipe is connected between the second port 214 of the indoor heat exchanger and the first port of the compressor, and the liquid pipe 102 is connected between the first port 212 of the indoor heat exchanger and the first port 222 of the outdoor heat exchanger. The processor is connected to the memory and the valve assembly 110, and the processor executes a computer program so as to perform the following: obtaining switching information of a working mode of the air conditioner; and controlling the valve assembly 110 according to the switching information so that the gas pipe and the liquid pipe 102 are closed according to the sequence of first the gas pipe and then the liquid pipe 102, and then opened according to the sequence of first the gas pipe and then the liquid pipe 102.

[0042] In this embodiment, the air conditioner is provided with a refrigerant switching device 100, an indoor heat exchanger 210, an outdoor heat exchanger 220, a compressor 230, a memory, and a processor. The refrigerant switching device 100 comprises a liquid pipe 102,

a gas pipe and a valve assembly 110. The gas pipe is connected between the second port 214 of the indoor heat exchanger and the first port of the compressor to deliver a gas refrigerant. The liquid pipe 102 is connected between the first port 212 of the indoor heat exchanger and the first port 222 of the outdoor heat exchanger to deliver a liquid refrigerant. The valve assembly 110 is arranged on the gas pipe and the liquid pipe 102 for opening or closing the gas pipe and the liquid pipe 102.

[0043] When it is detected that the air conditioner needs to switch the working mode, the gas pipe opened in the current working mode is closed first according to the switching information, and then the liquid pipe 102 is controlled to be closed, so that the pressure in the liquid pipe 102 is restored to an initial value when the air conditioner is in a standby state, the refrigerant inside the indoor unit heat exchanger is limited, and after it is determined that the pressure in the liquid pipe 102 is stable, i.e., after the liquid pipe 102 is completely closed, the gas pipe corresponding to a target working mode is controlled to be opened according to the switching information, so that a pressure difference is formed in the pipe, and then the liquid pipe 102 is controlled to be opened to restore the refrigerant flow, completing switching of the refrigerant flow direction. The working mode includes a cooling mode and a heating mode. Thus, during the switching process of the working mode, the refrigerant inside the indoor unit heat exchanger is limited through first closing the gas pipe and the liquid pipe 102, which reduces the amount of refrigerant to be balanced after the gas pipe connected to the target working mode is connected, and reduces the refrigerant noise caused by the impact of high-pressure and low-pressure refrigerants during the gas pipe and liquid pipe connection process. At the same time, the refrigerant flow may be switched without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor 230, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

Embodiment 2:

[0044] As shown in Fig. 1 to Fig. 3, in an embodiment according to the present invention, the features defined in the above embodiment are included, and further, the first port of the compressor comprises an exhaust port 232 and a gas suction port 234; and the gas pipe comprises a first pressure gas pipe 104 and a second pressure gas pipe 106.

[0045] For example, the first pressure gas pipe 104 is connected between the exhaust port 232 and the second port 214 of the indoor heat exchanger; and the second pressure gas pipe 106 is connected between the gas suction port 234 and the second port 214 of the indoor heat exchanger; wherein a pressure on the first pressure gas pipe 104 is greater than a pressure on the second pressure gas pipe 106.

[0046] In this embodiment, the gas pipe comprises a first pressure gas pipe 104 and a second pressure gas pipe 106, the exhaust port 232 of the compressor 230 is in communication with the indoor heat exchanger 210 through the first pressure gas pipe 104, and the gas suction port 234 of the compressor 230 is in communication with the indoor heat exchanger 210 through the second pressure gas pipe 106. The pressure on the first pressure gas pipe 104 is greater than the pressure on the second pressure gas pipe 106, i.e., one high-pressure gas pipe and one low-pressure gas pipe. Thus, by controlling the first pressure gas pipe 104 and the second pressure gas pipe 106, one-way flow of the refrigerant is achieved, thereby achieving the cooling and heating functions of the air conditioner, which has a simple structure, and is easy to assemble and easy to control.

[0047] For example, when the air conditioner is in the heating mode, the first pressure gas pipe 104 and the liquid pipe 102 are controlled to be opened, the second pressure gas pipe 106 is controlled to be closed, and the compressor 230 pressurizes the gaseous refrigerant, so that the gaseous refrigerant becomes a high-temperature high-pressure refrigerant, which is delivered, under the effect of the pressure difference, to the indoor heat exchanger 210 through the first pressure gas pipe 104 to be condensed and liquefied to release heat, so as to achieve the purpose of heating. The liquefied liquid refrigerant is depressurized and then enters the outdoor heat exchanger 220 through the liquid pipe 102 to absorb heat for gasification, and the gasified refrigerant enters the compressor 230 again for the next cycle. When the air conditioner is in the cooling mode, the second pressure gas pipe 106 and the liquid pipe 102 are controlled to be opened, the first pressure gas pipe 104 is controlled to be closed, and the compressor 230 pressurizes the gaseous refrigerant, so that the gaseous refrigerant becomes a high-temperature high-pressure refrigerant, which is delivered to the outdoor heat exchanger 220 to be liquefied to release heat, and the liquid refrigerant in the outdoor heat exchanger 220 is depressurized and then enters the indoor heat exchanger 210 through the liquid pipe 102 to be gasified to absorb heat, so as to achieve the purpose of cooling. The gasified gaseous refrigerant is delivered to the compressor 230 and pressurized again for the next cycle.

Embodiment 3:

[0048] As shown in Fig. 1 and Fig. 2, in an embodiment according to the present invention, the features defined in any of the above embodiments are included, and further, the valve assembly 110 comprises: a first valve body 112, a second valve body 114 and a third valve body 116.

[0049] For example, the first valve body 112 is disposed in the liquid pipe 102 and used for opening or closing the liquid pipe 102; the second valve body 114 is disposed in the first pressure gas pipe 104 and used for opening or closing the first pressure gas pipe 104; and

the third valve body 116 is disposed in the second pressure gas pipe 106 and used for opening or closing the second pressure gas pipe 106.

[0050] In this embodiment, the valve assembly 110 comprises: a first valve body 112, a second valve body 114 and a third valve body 116, which are disposed in the liquid pipe 102, the first pressure gas pipe 104 and the second pressure gas pipe 106, respectively, thus enabling independent control of the opening and closing of the liquid pipe 102 and the two gas pipes, facilitating control.

[0051] Further, when the air conditioner is in the heating mode, the first valve body 112 and the second valve body 114 are opened and the third valve body 116 is closed, so that the first pressure gas pipe 104 and the liquid pipe 102 are opened and the second pressure gas pipe 106 is disconnected. When the air conditioner is in the cooling mode, the first valve body 112 and the third valve body 116 are opened and the second valve body 114 is closed, so that the second pressure gas pipe 106 and the liquid pipe 102 are opened and the first pressure gas pipe 104 is disconnected.

[0052] It may be understood that the first valve body 112, the second valve body 114 and the third valve body 116 may be ordinary on-off valve bodies, may also be proportional control valves whose opening degree can be adjusted, such as electric ball valves, electronic expansion valves, etc., and may further be a combination of multiple on-off valve bodies (e.g., solenoid valves) of different calibers in parallel. In addition, since both the first pressure gas pipe 104 and the second pressure gas pipe 106 are connected to the second port 214 of the indoor heat exchanger, the second valve body 114 and the third valve body 116 may be replaced with a three-way valve.

[0053] Further, the step of the processor executing controlling the valve assembly 110 according to the switching information when executing the computer program specifically comprises: controlling the third valve body 116 to close and then controlling the first valve body 112 to close, according to the switching information of the air conditioner switching from the cooling mode to the heating mode; controlling the second valve body 114 to open, based on a first time duration in which the first valve body 112 is closed reaching a first time duration threshold; and controlling the first valve body 112 to open, based on a second time duration in which the second valve body 114 is opened reaching a second time duration threshold.

[0054] For example, at the time of switching from the cooling mode to the heating mode, the third valve body 116 is controlled to close first to disconnect the second pressure gas pipe 106 which is opened in the cooling mode. Then the first valve body 112 is controlled to close so that the liquid pipe 102 is closed, and timing of the first time duration in which the first valve body 112 is closed is started. When the first time duration reaches the first time duration threshold, it indicates that the liquid

pipe 102 is completely closed and the pressure in the liquid pipe 102 is stabilized. In such a case, the second valve body 114 is controlled to open so that the first pressure gas pipe 104 is opened, and timing of the second time duration in which the second valve body 114 is opened is started. When the second time duration reaches the second time duration threshold, it indicates that a pressure difference between the gas pipe and the first pressure gas pipe 104 is formed and the pressure difference is stable, then the liquid pipe 102 is opened by controlling the first valve body 112 to achieve switching of the refrigerant flow direction. In this way, the amount of refrigerant to be balanced after the first pressure gas pipe 104 is connected is effectively reduced, and the refrigerant noise generated by the impact of high-pressure and low-pressure refrigerants during the connection process is reduced. Moreover, switching of the refrigerant flow can be achieved without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor 230, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

[0055] Still further, the step of the processor executing controlling the valve assembly 110 according to the switching information when executing the computer program specifically comprises: controlling the second valve body 114 to close and then controlling the first valve body 112 to close, according to the switching information of the air conditioner switching from the heating mode to the cooling mode; controlling the third valve body 116 to open, based on a first time duration in which the first valve body 112 is closed reaching a first time duration threshold; and controlling the first valve body 112 to open, based on a third time duration in which the third valve body 116 is opened reaching a third time duration threshold.

[0056] For example, at the time of switching from the heating mode to the cooling mode, the second valve body 114 is controlled to close first to disconnect the first pressure gas pipe 104 which is opened in the heating mode. Then the first valve body 112 is controlled to close so that the liquid pipe 102 is closed, and timing of the first time duration in which the first valve body 112 is closed is started. When the first time duration reaches the first time duration threshold, it indicates that the liquid pipe 102 is completely closed and the pressure in the liquid pipe 102 is stabilized. In such a case, the third valve body 116 is controlled to open so that the second pressure gas pipe 106 is opened, and timing of the third time duration in which the third valve body 116 is opened is started. When the third time duration reaches the third time duration threshold, it indicates that a pressure difference between the gas pipe and the second pressure gas pipe 106 is formed and the pressure difference is stable, then the liquid pipe 102 is opened by controlling the first valve body 112 to achieve switching of the refrigerant flow direction. In this way, the amount of refrigerant to be bal-

anced after the second pressure gas pipe 106 is connected is effectively reduced, and the refrigerant noise generated by the impact of high-pressure and low-pressure refrigerants during the connection process is reduced. Moreover, switching of the refrigerant flow can be achieved without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor 230, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

[0057] The first time duration threshold, the second time duration threshold and the third time duration threshold may be set reasonably according to the parameters of the air conditioner and the requirements. The first time duration threshold may be set in the range of 0 to 3 min, for example, 0.1s, 0.5s, 1s, 60s, etc.

Embodiment 4:

[0058] In an embodiment according to the present invention, the features defined in any of the above embodiments are included, and further, the first valve body, the second valve body and the third valve body are each a proportional control valve.

[0059] For example, the step of the processor executing the computer program to perform controlling the second valve body or the third valve body to open specifically comprises: adjusting an opening degree of the proportional control valve multiple times according to a preset opening degree, so that the opening degree of the proportional control valve reaches an opening degree threshold.

[0060] In this embodiment, in the process of opening the second valve body or the third valve body, the opening degree of the proportional control valve is adjusted multiple times according to the preset opening degree, so that the valve body slowly opens to the opening degree threshold, thereby improving the stability in the pressure transition process, further reducing the noise generated during the switching of the working mode, and enhancing the user's experience.

[0061] For example, in the case of switching the indoor unit from the cooling mode to the heating mode, at the time of opening the first pressure gas pipe, the second valve body is controlled to open to a preset opening degree first, and maintained for a maintenance time. After the maintenance time reaches the second time duration threshold, the second valve body is fully opened; and then the first valve body of the liquid pipe is opened, completing the switching from the cooling mode to the heating mode. Of course, there may be multiple preset opening degrees in the opening process, the multiple preset opening degrees may be the same or different, the maintenance time corresponding to each preset opening degree may also be the same or different, and the sum of the maintenance time corresponding to the multiple preset opening degrees is reasonably set according to the second time duration threshold.

[0062] In addition, as shown in Fig. 2, since the first valve body 112 can control the flow rate of the liquid pipe 102 by adjusting the opening degree, an expansion valve for throttling and pressure reduction between the indoor and outdoor heat exchangers can be omitted, simplifying the system structure and reducing the cost. Similarly, an expansion valve 240 for throttling and pressure reduction between the indoor and outdoor heat exchangers is also utilized to replace the first valve body, as shown in Fig. 3.

Embodiment 5:

[0063] As shown in Fig. 4, according to an embodiment of the second aspect of the present invention, there is proposed a control method for an air conditioner, comprising:

step 302, obtaining switching information of a working mode of the air conditioner; and

step 304, controlling the valve assembly according to the switching information so that a gas pipe and a liquid pipe are closed according to the sequence of first the gas pipe and then the liquid pipe, and then opened according to the sequence of first the gas pipe and then the liquid pipe.

[0064] In this embodiment, when it is detected that the air conditioner needs to switch the working mode, the gas pipe opened in the current working mode is closed first according to the switching information, and then the liquid pipe is controlled to be closed, so that the pressure in the liquid pipe is restored to an initial value when the air conditioner is in a standby state, the refrigerant inside the indoor unit heat exchanger is limited, and after it is determined that the pressure in the liquid pipe is stable, i.e., after the liquid pipe is completely closed, the gas pipe corresponding to a target working mode is controlled to be opened according to the switching information, so that a pressure difference is formed in the pipe, and then the liquid pipe is controlled to be opened to restore the refrigerant flow, completing switching of the refrigerant flow direction. The working mode includes a cooling mode and a heating mode. Thus, during the switching process of the working mode, the refrigerant inside the indoor unit heat exchanger is limited through first closing the gas pipe and the liquid pipe, which reduces the amount of refrigerant to be balanced after the gas pipe connected to the target working mode is connected, and reduces the refrigerant noise caused by the impact of high-pressure and low-pressure refrigerants during the gas pipe and liquid pipe connection process. At the same time, the refrigerant flow may be switched without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

Embodiment 6:

[0065] As shown in Fig. 5, according to an embodiment of the present invention, there is proposed a control method for an air conditioner, comprising:

step 402, obtaining switching information of a working mode of the air conditioner;

step 404, controlling the third valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from the cooling mode to the heating mode;

step 406, timing a first time duration in which the first valve body is closed;

step 408, determining whether the first time duration reaches a first time duration threshold, if yes, proceeding to step 410, otherwise, proceeding to step 406;

step 410, controlling the second valve body to open, and timing a second time duration in which the second valve body is opened;

step 412, determining whether the second time duration reaches a second time duration threshold, if yes, proceeding to step 414, otherwise, proceeding to step 410; and

step 414, controlling the first valve body to open.

[0066] In this embodiment, at the time of switching from the cooling mode to the heating mode, the third valve body is controlled to close first to disconnect the second pressure gas pipe which is opened in the cooling mode. Then the first valve body is controlled to close so that the liquid pipe is closed, and timing of the first time duration in which the first valve body is closed is started. When the first time duration reaches the first time duration threshold, it indicates that the liquid pipe is completely closed and the pressure in the liquid pipe is stabilized. In such a case, the second valve body is controlled to open so that the first pressure gas pipe is opened, and timing of the second time duration in which the second valve body is opened is started. When the second time duration reaches the second time duration threshold, it indicates that a pressure difference between the gas pipe and the first pressure gas pipe is formed and the pressure difference is stable, then the liquid pipe is opened by controlling the first valve body to achieve switching of the refrigerant flow direction. In this way, the amount of refrigerant to be balanced after the first pressure gas pipe is connected is effectively reduced, and the refrigerant noise generated by the impact of high-pressure and low-pressure refrigerants during the connection process is

reduced. Moreover, switching of the refrigerant flow can be achieved without limiting the refrigerant flow, which greatly shortens the duration of the switching process, ensures the operation stability of the compressor, improves the cooling or heating effect of the air conditioner, and enhances the reliability of the air conditioner.

Embodiment 7:

[0067] As shown in Fig. 6, according to an embodiment of the present invention, there is proposed a control method for an air conditioner, comprising:

step 502, obtaining switching information of a working mode of the air conditioner;

step 504, controlling the second valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from the heating mode to the cooling mode;

step 506, timing a first time duration in which the first valve body is closed;

step 508, determining whether the first time duration reaches a first time duration threshold, if yes, proceeding to step 510, otherwise, proceeding to step 506;

step 510, controlling the third valve body to open, and timing a third time duration in which the third valve body is opened;

step 512, determining whether the third time duration reaches a third time duration threshold, if yes, proceeding to step 514, otherwise, proceeding to step 510; and

step 514, controlling the first valve body to open.

[0068] In this embodiment, at the time of switching from the heating mode to the cooling mode, the second valve body is controlled to close first to disconnect the first pressure gas pipe which is opened in the heating mode. Then the first valve body is controlled to close so that the liquid pipe is closed, and timing of the first time duration in which the first valve body is closed is started. When the first time duration reaches the first time duration threshold, it indicates that the liquid pipe is completely closed and the pressure in the liquid pipe is stabilized. In such a case, the third valve body is controlled to open so that the second pressure gas pipe is opened, and timing of the third time duration in which the third valve body is opened is started. When the third time duration reaches the third time duration threshold, it indicates that a pressure difference between the gas pipe and the second pressure gas pipe is formed and the pressure difference is stable,

then the liquid pipe is opened by controlling the first valve body to achieve switching of the refrigerant flow direction. In this way, the amount of refrigerant to be balanced after the second pressure gas pipe is connected is effectively reduced, and the refrigerant noise generated by the impact of high-pressure and low-pressure refrigerants during the connection process is reduced.

Embodiment 8:

[0069] As shown in Fig. 7, according to an embodiment of the present invention, there is proposed a control method for an air conditioner, a third valve body of the air conditioner being a proportional control valve, the control method comprising:

step 602, obtaining switching information of a working mode of the air conditioner;

step 604, controlling a second valve body to close and then controlling a first valve body to close, according to the switching information of the air conditioner switching from the heating mode to the cooling mode;

step 606, timing a first time duration in which the first valve body is closed;

step 608, determining whether the first time duration reaches a first time duration threshold, if yes, proceeding to step 610, otherwise, proceeding to step 606;

step 610, controlling the third valve body to open, and adjusting an opening degree of the third valve body multiple times according to a preset opening degree;

step 612, timing a third time duration in which the third valve body is opened;

step 614, determining whether the third time duration reaches a third time duration threshold, if yes, proceeding to step 616, otherwise, proceeding to step 612; and

step 616, controlling the first valve body to open.

[0070] In this embodiment, the indoor unit is switched from the heating mode to the cooling mode. At the time of opening the second pressure gas pipe, i.e., in the process of opening the third valve body, the opening degree of the second valve body is adjusted multiple times according to the preset opening degree. For example, the third valve body is controlled to open to a first preset opening degree first. After the maintenance time in which the third valve body is maintained open according to the first preset opening degree reaches a time threshold cor-

responding to the first preset opening degree, the opening degree of the third valve body continues to be increased according to a next preset opening degree, and this process is repeated until the third valve body slowly opens to the opening degree threshold. Then the first valve body of the liquid pipe is opened, completing the switching from the heating mode to the cooling mode. In this way, the stability in the pressure transition process is improved, the noise generated during the switching of the working mode is further reduced, and the user's experience is enhanced.

[0071] It may be understood that there may be multiple preset opening degrees in the opening process, the multiple preset opening degrees may be the same or different, the maintenance time corresponding to each preset opening degree may also be the same or different, and the sum of the maintenance time corresponding to the multiple preset opening degrees is reasonably set according to the third time duration threshold.

Embodiment 9:

[0072] As shown in Fig. 8, according to an embodiment of the present invention, there is proposed a control method for an air conditioner, a second valve body of the air conditioner being a proportional control valve, the control method comprising:

step 702, obtaining switching information of a working mode of the air conditioner;

step 704, controlling the third valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from the cooling mode to the heating mode;

step 706, timing a first time duration in which the first valve body is closed;

step 708, determining whether the first time duration reaches a first time duration threshold, if yes, proceeding to step 710, otherwise, proceeding to step 706;

step 710, controlling the second valve body to open, and adjusting an opening degree of the second valve body multiple times according to a preset opening degree;

step 712, timing a second time duration in which the second valve body is opened;

step 714, determining whether the second time duration reaches a second time duration threshold, if yes, proceeding to step 716, otherwise, proceeding to step 712; and

step 716, controlling the first valve body to open.

[0073] In this embodiment, the indoor unit is switched from the cooling mode to the heating mode. At the time of opening the first pressure gas pipe, i.e., in the process of opening the second valve body, the opening degree of the second valve body is adjusted multiple times according to the preset opening degree. For example, the second valve body is controlled to open to a first preset opening degree first. After the maintenance time in which the second valve body is maintained open according to the first preset opening degree reaches a time threshold corresponding to the first preset opening degree, the opening degree of the second valve body continues to be increased according to a next preset opening degree, and this process is repeated until the second valve body slowly opens to the opening degree threshold. Then the first valve body of the liquid pipe is opened, completing the switching from the cooling mode to the heating mode. In this way, the stability in the pressure transition process is improved, the noise generated during the switching of the working mode is further reduced, and the user's experience is enhanced.

[0074] It needs to be noted that the sum of the maintenance time corresponding to the multiple preset opening degrees is reasonably set according to the second time duration threshold.

Embodiment 10:

[0075] According to a specific embodiment of the present invention, there is proposed a control method for an air conditioner.

[0076] For example, as shown in Fig. 2, the gas pipe (the first port 212 of the indoor heat exchanger) and the liquid pipe (the second port 214 of the indoor heat exchanger) of the heat exchanger of the indoor unit are connected to the indoor side gas pipe (the first pressure gas pipe 104 and the second pressure gas pipe 106) and liquid pipe 102 of the switching device (the refrigerant switching device 100), respectively; and the outdoor side medium-pressure liquid pipe 102, high-pressure gas pipe (the first pressure gas pipe 104) and low-pressure gas pipe (the second pressure gas pipe 106) of the switching device are connected to the liquid pipe (the first port 222 of the outdoor heat exchanger) of the heat exchanger of the outdoor unit, and the high-pressure gas pipe (the exhaust port 232) and the low-pressure gas pipe (the gas suction port 234) of the compressor of the outdoor unit, respectively. The outdoor side medium-pressure liquid pipe 102 of the switching device is connected to the indoor side liquid pipe through an electric ball valve (the first valve body 112), and after connected to an electric ball valve (the second valve body 114, the third valve body 116) respectively, the outdoor side high-pressure gas pipe and low-pressure gas pipe are connected to the indoor side gas pipe at the same time.

[0077] When the indoor unit heat exchanger runs in

the cooling mode, the switching device makes the electric ball valve on the outdoor side medium-pressure liquid pipe 102 open, the indoor side and outdoor side liquid pipes 102 of the switching device are in communication, the electric ball valve on the outdoor side low-pressure gas pipe is opened, the electric ball valve on the high-pressure gas pipe is closed, and the indoor side gas pipe of the switching device is in communication with the outdoor side low-pressure gas pipe. The refrigerant flows from the medium-pressure liquid pipe 102 into the indoor unit heat exchanger, and then flows out from the low-pressure gas pipe.

[0078] When the indoor unit heat exchanger runs in the heating mode, the switching device makes the electric ball valve on the indoor side liquid pipe 102 open, the indoor side and outdoor side liquid pipes 102 of the switching device are in communication, the electric ball valve on the outdoor side high-pressure gas pipe is opened, the electric ball valve on the outdoor side low-pressure gas pipe is closed, and the indoor side gas pipe is in communication with the outdoor side high-pressure gas pipe. The refrigerant flows from the high-pressure gas pipe into the indoor unit heat exchanger and then flows out from the outdoor side liquid pipe 102.

[0079] When the indoor unit is switched from the cooling mode to the heating mode, the indoor unit gas pipe needs to be switched from the originally connected outdoor side low-pressure gas pipe to the outdoor side high-pressure gas pipe. Under the effect of a pressure difference, the refrigerant flow direction of the indoor unit is changed from the original direction of from the liquid pipe 102 to the gas pipe to the direction of from the gas pipe to the liquid pipe 102. When the switching device performs switching, the electric ball valve of the outdoor side low-pressure gas pipe is closed first, then the electric ball valve on the liquid pipe 102 is closed, then the valve body on the outdoor side high-pressure gas pipe is opened to an opening degree A and maintained for time t_a , and then is fully opened, and finally the valve body of the liquid pipe 102 is opened, completing the switching from the cooling mode to the heating mode.

[0080] When the indoor unit is switched from the heating mode to the cooling mode, the indoor unit gas pipe needs to be switched from the originally connected outdoor side high-pressure gas pipe to the outdoor side low-pressure gas pipe. Under the effect of a pressure difference, the refrigerant flow direction of the indoor unit is changed from the original direction of from the gas pipe to the liquid pipe 102 to the direction of from the liquid pipe 102 to the gas pipe. When the switching device performs switching, the electric ball valve of the outdoor side high-pressure gas pipe is closed first, then the electric ball valve on the outdoor side liquid pipe 102 is closed, then the valve body on the outdoor side low-pressure gas pipe is opened to an opening degree B and maintained for time t_b , and then is fully opened, and finally the valve body of the liquid pipe 102 is opened, completing the switching from the heating mode to the cooling

mode.

[0081] As shown in Fig. 3, the control of the electric ball valve may also be achieved by the expansion valve 240 (a throttling electronic expansion valve in a heating or cooling system) on the liquid pipe of the indoor unit.

[0082] Further, the air conditioner may be a household type air conditioner, or an air conditioning unit consisting of an outdoor unit and multiple indoor units. It may be understood that there may be a single switching device, or multiple switching devices connected in parallel, i.e., in the air conditioning unit, each indoor unit is connected with a corresponding switching device.

[0083] The valve bodies used for the high-pressure gas pipe and the low-pressure gas pipe of the switching device may be valve bodies whose opening degree can be adjusted, including electric ball valves, electronic expansion valves, etc. It is also feasible to replace the above valve bodies with multiple on-off valve bodies (e.g., solenoid valves) having different calibers in parallel combination, wherein the valve bodies having small calibers are opened at the time of balancing, and the valve bodies having large calibers are opened after the balancing. As shown in Fig. 3, the valve body that shuts off the liquid pipe 102 of the switching device can be placed in the switching device, or can be replaced by an electronic expansion valve on the indoor unit liquid pipe (the second port 214 of the indoor heat exchanger).

[0084] In this embodiment, in the switching process, the gas pipe connected before switching is shut off first, then the liquid pipe 102 is shut off, then the gas pipe required to be connected after switching is slowly connected, and finally the liquid pipe 102 is opened to resume refrigerant flow, completing the switching of the refrigerant flow direction. Thus, by limiting the refrigerant inside the heat exchanger of the indoor unit, the amount of refrigerant to be balanced after the gas pipe connected in a next mode is connected is reduced, the refrigerant noise generated by the connecting process is reduced, and the duration of the switching process can also be shortened.

Embodiment 11:

[0085] In an embodiment according to the third aspect of the present invention, there is proposed a computer-readable storage medium on which a computer program is stored, wherein when the computer program is executed by a processor, the control method for an air conditioner proposed in the second aspect is implemented. Therefore, the computer-readable storage medium has all the beneficial effects of the control method for an air conditioner proposed in the second aspect, which will not be described further here.

[0086] In the description of the present specification, the terms "first" and "second" are used for the purpose of description only, and cannot be understood as indicating or implying relative importance, unless otherwise explicitly specified or defined; and the terms "connection",

"mounting", "fixing" and the like should be understood in a broad sense, for example, "connection" may be a fixed connection, and may also be a removable connection, or an integral connection; and may be direct connection and may also be indirect connection through an intermediary. A person of ordinary skills in the art could understand the specific meaning of the terms in the present invention according to specific situations.

[0087] In the description of the present specification, the descriptions of the terms "one embodiment", "some embodiments" and "specific embodiments" and the like mean that specific features, structures, materials or characteristics described in conjunction with the embodiment(s) or example(s) are included in at least one embodiment or example of the present invention. In the specification, the schematic representation of the above terms does not necessarily refer to the same embodiment or example. Moreover, the particular features, structures, materials or characteristics described may be combined in a suitable manner in any one or more embodiments or examples.

[0088] The descriptions above are only preferred embodiments of the present invention, which are not used to limit the present invention. For a person skilled in the art, the present invention may have various changes and variations. Any modifications, equivalent substitutions, improvements etc. within the spirit and principle of the present invention shall all be included in the protection scope of the present invention.

Claims

1. An air conditioner, comprising:

a refrigerant switching device, comprising a liquid pipe, a gas pipe and a valve assembly, the valve assembly being arranged on the liquid pipe and the gas pipe and configured to open the liquid pipe and the gas pipe or close the liquid pipe and the gas pipe;
an indoor heat exchanger, a first port of the indoor heat exchanger being connected to the liquid pipe and a second port of the indoor heat exchanger being connected to the gas pipe;
an outdoor heat exchanger, a first port of the outdoor heat exchanger being connected to the liquid pipe;
a compressor, a first port of the compressor being connected to the gas pipe and a second port of the compressor being connected to a second port of the outdoor heat exchanger;
a memory, storing a computer program; and
a processor, connected to the memory and the valve assembly, the processor executing the computer program so as to perform the following:

- obtaining switching information of a working mode of the air conditioner; and
controlling the valve assembly according to the switching information so that the gas pipe and the liquid pipe are closed according to the sequence of first the gas pipe and then the liquid pipe, and then opened according to the sequence of first the gas pipe and then the liquid pipe.
2. The air conditioner according to claim 1, wherein the first port of the compressor comprises an exhaust port and a gas suction port; and the gas pipe comprises:
- a first pressure gas pipe, connected between the exhaust port and the second port of the indoor heat exchanger; and
a second pressure gas pipe, connected between the gas suction port and the second port of the indoor heat exchanger;
wherein a pressure on the first pressure gas pipe is greater than a pressure on the second pressure gas pipe.
3. The air conditioner according to claim 2, wherein the valve assembly comprises:
- a first valve body, arranged in the liquid pipe and configured to open or close the liquid pipe;
a second valve body, arranged in the first pressure gas pipe and configured to open or close the first pressure gas pipe; and
a third valve body, arranged in the second pressure gas pipe and configured to open or close the second pressure gas pipe.
4. The air conditioner according to claim 3, wherein the step of the processor executing controlling the valve assembly according to the switching information when executing the computer program specifically comprises:
- controlling the third valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from a cooling mode to a heating mode;
controlling the second valve body to open, based on a first time duration in which the first valve body is closed reaching a first time duration threshold; and
controlling the first valve body to open, based on a second time duration in which the second valve body is opened reaching a second time duration threshold.
5. The air conditioner according to claim 3, wherein the
- step of the processor executing controlling the valve assembly according to the switching information when executing the computer program specifically comprises:
- controlling the second valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from a heating mode to a cooling mode;
controlling the third valve body to open, based on a first time duration in which the first valve body is closed reaching a first time duration threshold; and
controlling the first valve body to open, based on a third time duration in which the third valve body is opened reaching a third time duration threshold.
6. The air conditioner according to any one of claims 3-5, wherein
- the first valve body, the second valve body and the third valve body are each a proportional control valve; and
the step of the processor executing the computer program to perform controlling the second valve body or the third valve body to open specifically comprises:
adjusting an opening degree of the proportional control valve multiple times according to a preset opening degree, so that the opening degree of the proportional control valve reaches an opening degree threshold.
7. A control method for an air conditioner, applied to the air conditioner according to any one of claims 1-6, the control method comprising:
- obtaining switching information of a working mode of the air conditioner; and
controlling the valve assembly according to the switching information so that a gas pipe and a liquid pipe are closed according to the sequence of first the gas pipe and then the liquid pipe, and then opened according to the sequence of first the gas pipe and then the liquid pipe.
8. The control method for an air conditioner according to claim 7, wherein the valve assembly comprises a first valve body, a second valve body and a third valve body; and the step of controlling the valve assembly according to the switching information specifically comprises:
- controlling the third valve body to close and then controlling the first valve body to close, according to the switching information of the air condi-

tioner switching from a cooling mode to a heating mode;

controlling the second valve body to open, based on a first time duration in which the first valve body is closed reaching a first time duration threshold; and 5

controlling the first valve body to open, based on a second time duration in which the second valve body is opened reaching a second time duration threshold. 10

9. The control method for an air conditioner according to claim 7, wherein the valve assembly comprises a first valve body, a second valve body and a third valve body; and the step of controlling the valve assembly according to the switching information specifically comprises: 15

controlling the second valve body to close and then controlling the first valve body to close, according to the switching information of the air conditioner switching from a heating mode to a cooling mode; 20

controlling the third valve body to open, based on a first time duration in which the first valve body is closed reaching a first time duration threshold; and 25

controlling the first valve body to open, based on a third time duration in which the third valve body is opened reaching a third time duration threshold. 30

10. A computer-readable storage medium on which a computer program is stored, wherein when the computer program is executed by a processor, the control method for an air conditioner according to any one of claims 7-9 is implemented. 35

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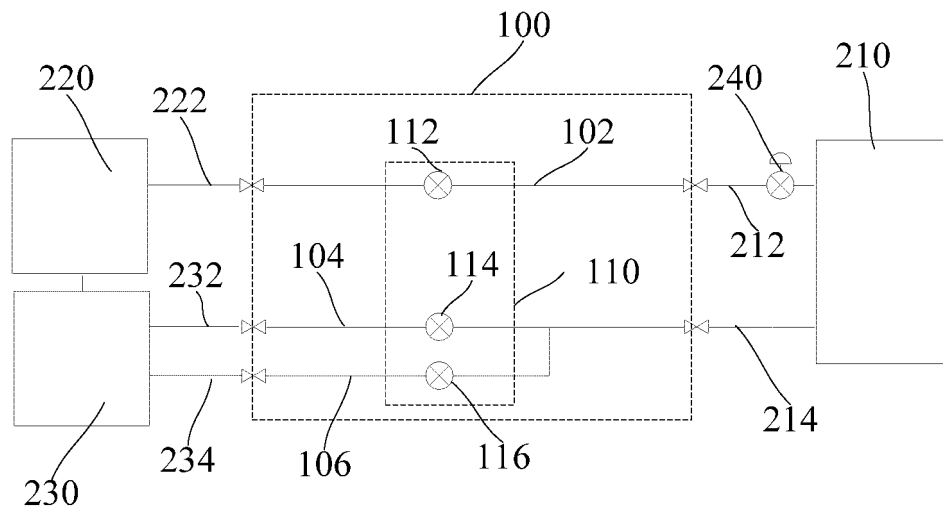


Fig. 1

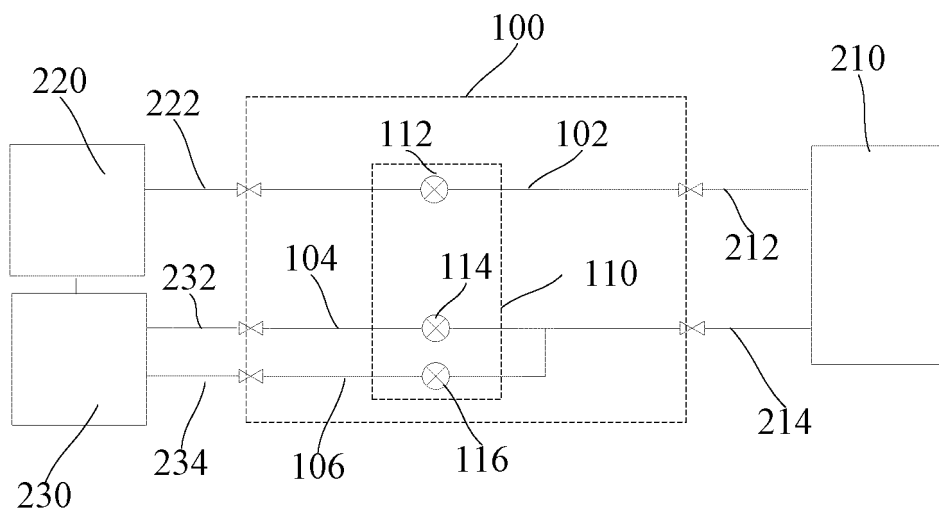


Fig. 2

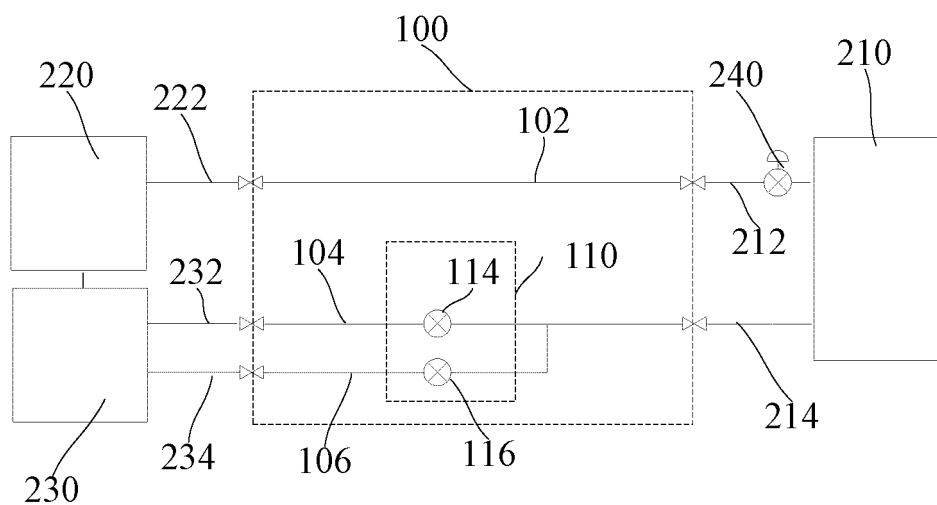


Fig. 3

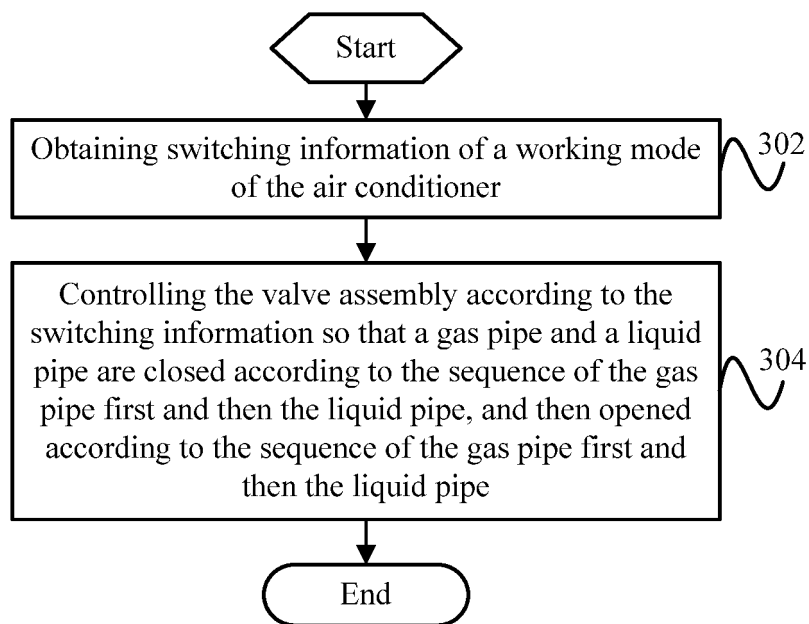


Fig. 4

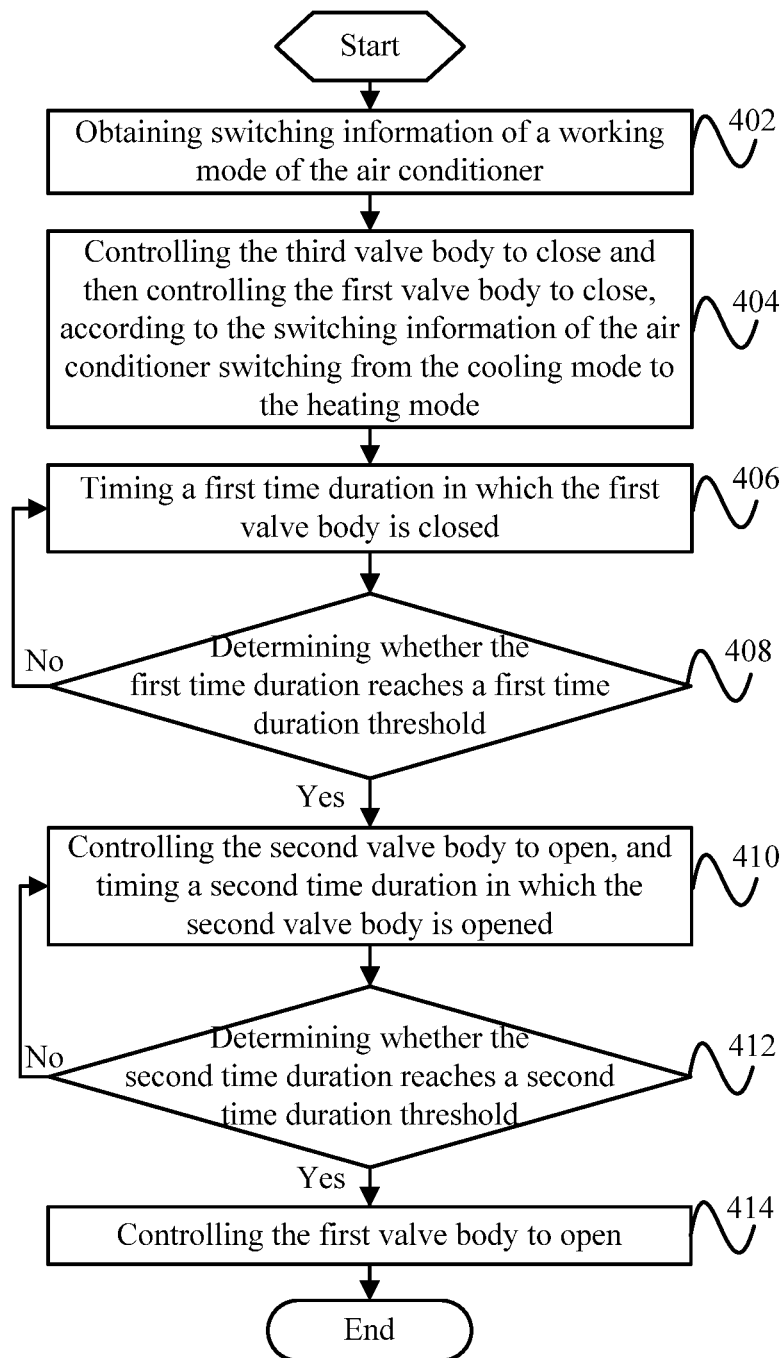


Fig. 5

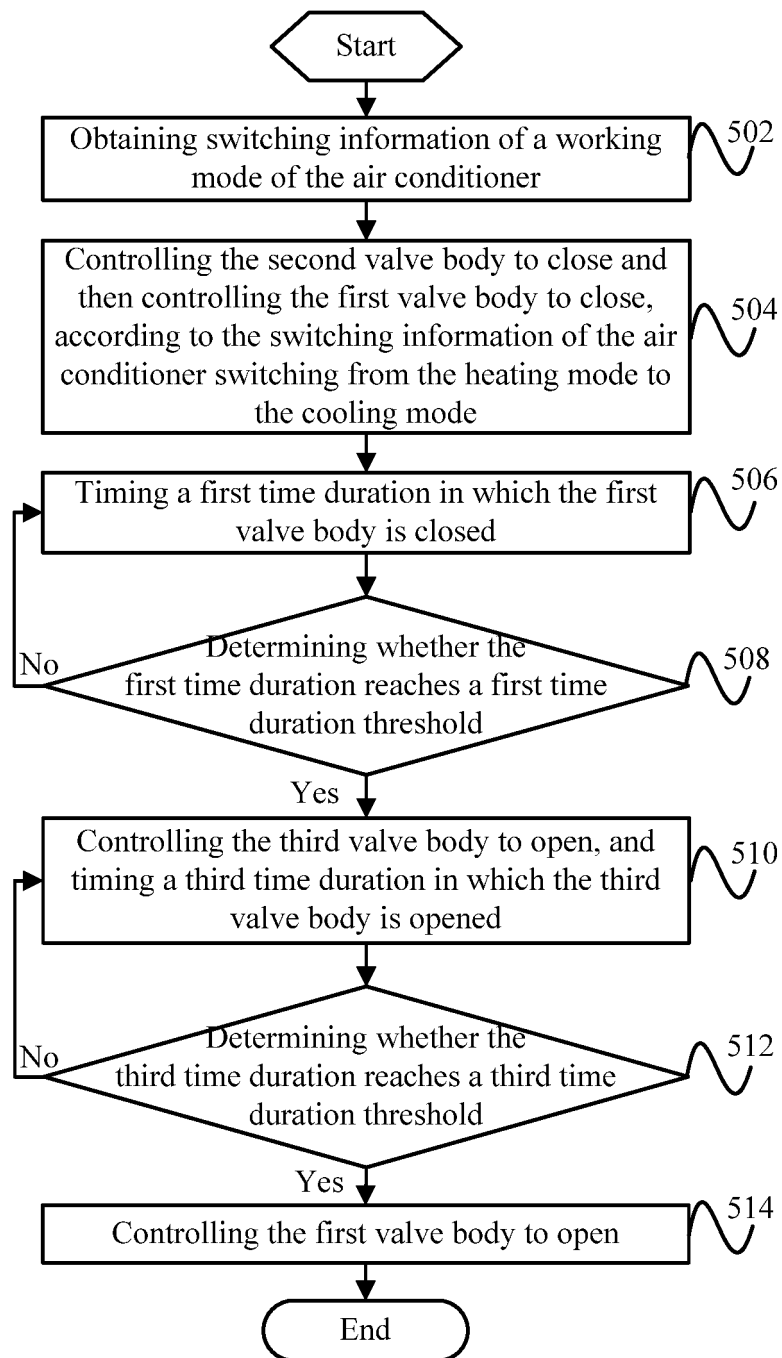


Fig. 6

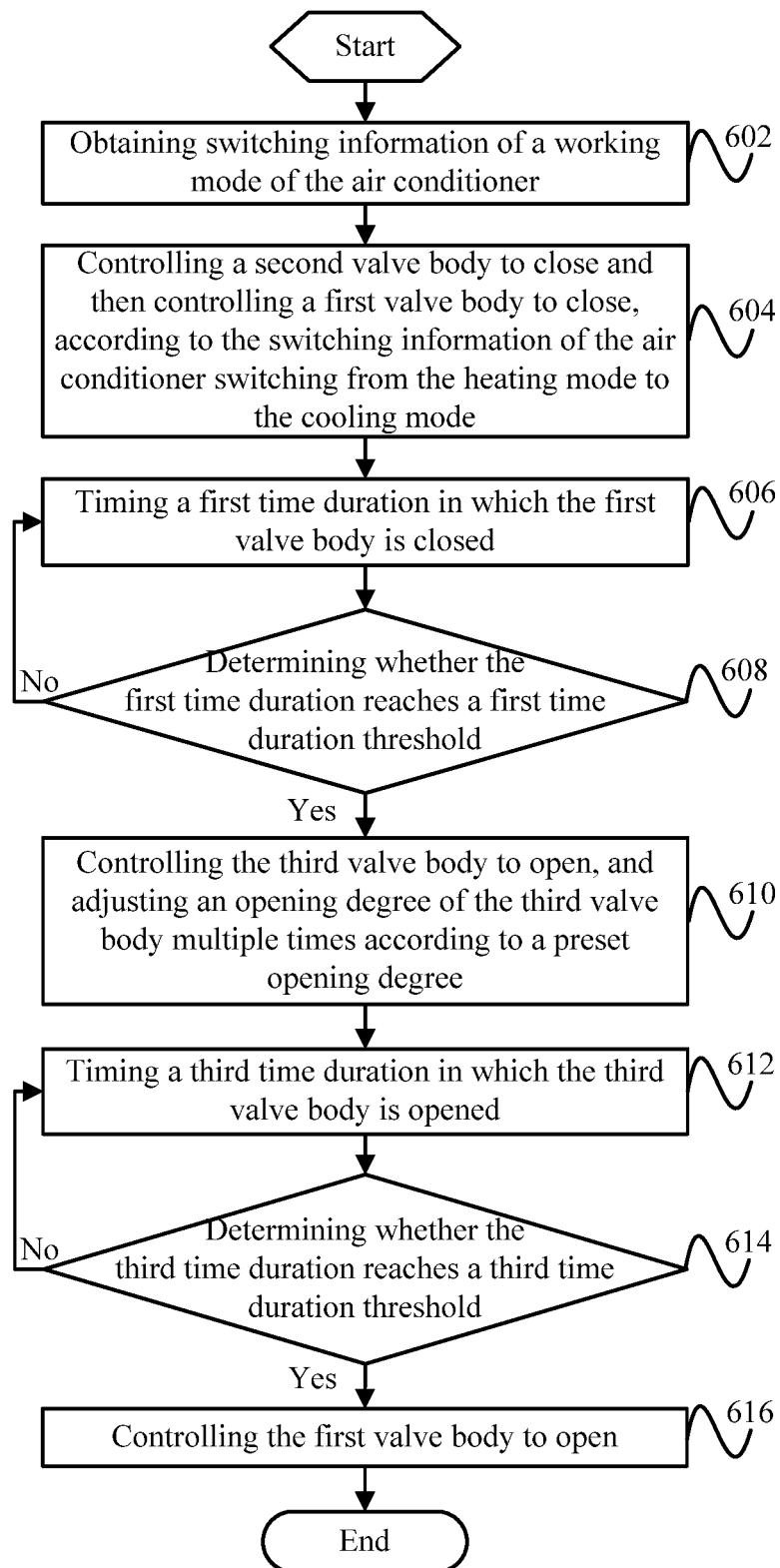


Fig. 7

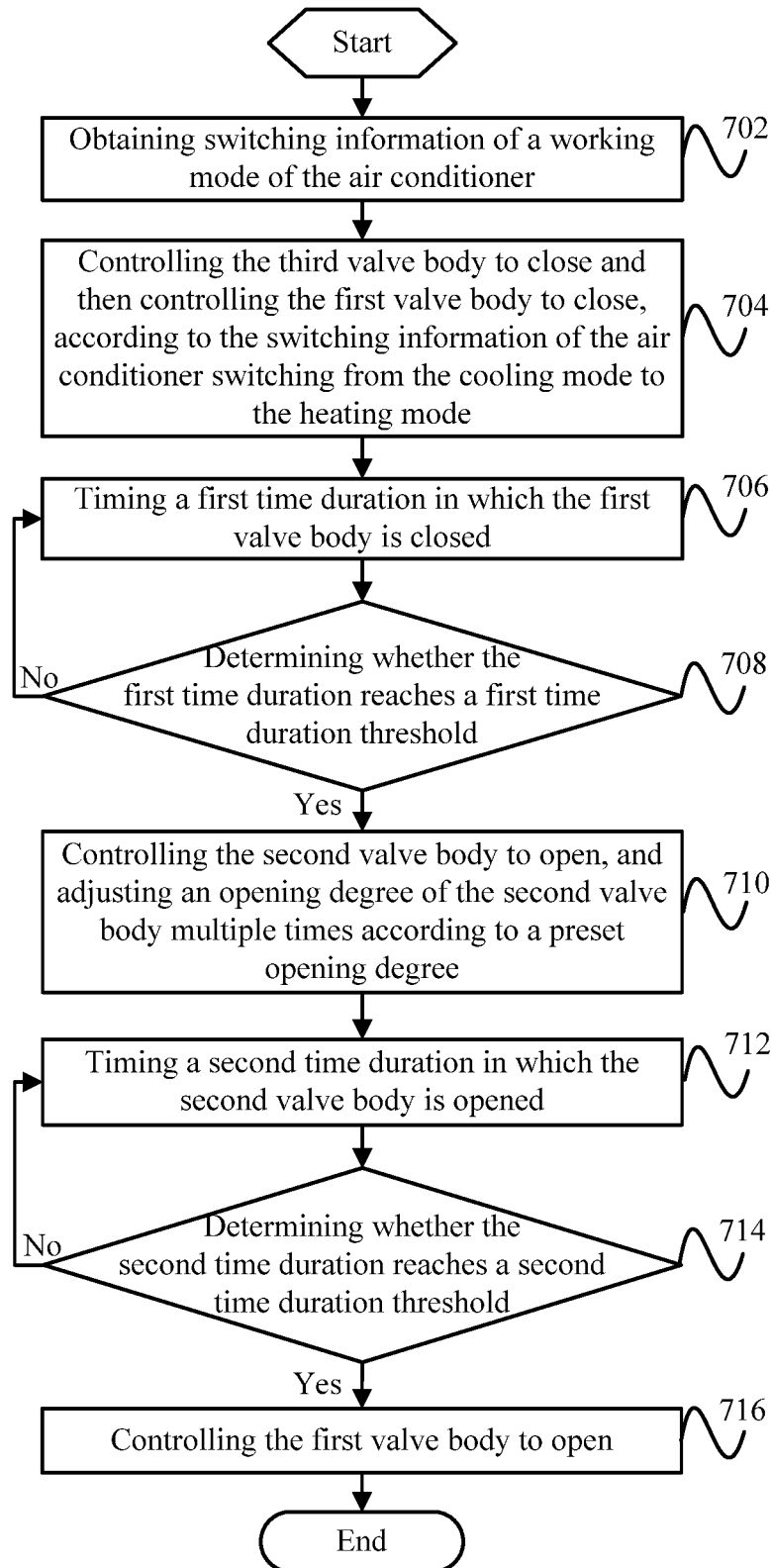


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/135836

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/89(2018.01)i; F24F 11/64(2018.01)i; F24F 11/67(2018.01)i; F24F 13/24(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,F25B

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, CNTXT, CNKI, VEN, USTXT, WOTXT, EPTXT, DWPI, SIPOABS, JPTXT, 美的, 马熙华, 庄子宝, 王命仁, 谭志军, 冷媒, 制冷剂, 模式, 冷热, 切换, 高压, 低压, 气管, 液管, 噪音, 压力, 三管, refrigerant, mode, pattern, switch+, chang+, transfer+, high pressure, low pressure, gas, liquid, noise

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 107238161 A (GUANDONG MIDEA HVAC EQUIPMENT CO., LTD. et al.) 10 October 2017 (2017-10-10) description paragraphs 30-65, figures 1-4d	1-10
Y	CN 102192583 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 21 September 2011 (2011-09-21) description, paragraphs 27-43, and figures 2-5	1-10
Y	CN 106152406 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 23 November 2016 (2016-11-23) description, paragraphs 31-55, and figures 1-3	1-10
A	CN 108489134 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 04 September 2018 (2018-09-04) entire document	1-10
A	JP 2018141587 A (DAIKIN INDUSTRIES, LTD.) 13 September 2018 (2018-09-13) entire document	1-10

☐ 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

18 May 2021

Date of mailing of the international search report

23 June 2021

Name and mailing address of the ISA/CN

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Facsimile No. (86-10)62019451

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2020/135836

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	107238161	A	10 October 2017	CN	107238161	B	08 May 2020
CN	102192583	A	21 September 2011	CN	102192583	B	03 April 2013
				CN	201615578	U	27 October 2010
CN	106152406	A	23 November 2016	CN	106152406	B	25 June 2019
CN	108489134	A	04 September 2018	EP	3779327	A1	17 February 2021
				WO	2019196311	A1	17 October 2019
				CN	208536432	U	22 February 2019
				US	2021080137	A1	18 March 2021
JP	2018141587	A	13 September 2018	JP	6551437	B2	31 July 2019

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

REFERENCES CITED IN THE DESCRIPTION

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- CN 202010998871 [0001]