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(54) MULTI-COUPLED HEAT PUMP AIR-CONDITIONING SYSTEM AND METHOD OF CONTROLLING MULTI-COUPLED HEAT PUMP AIR-CONDITIONING SYSTEM

(57) Disclosed are a multi-coupled heat pump air-conditioning system and a method of controlling a multi-coupled heat pump air-conditioning system. The method comprises: after a convergence unit performs gas-liquid separation and compression of coolant outputted by a third end of a switching unit, outputting same to a first end of the switching unit; under the operating modes of cooling and dehumidifying without a temperature drop, driving refrigerant outputted by a second end of the switching unit to successively flow through a first heat exchange unit and a second electronic expansion valve (11), a second heat exchanger (13), a third electronic expansion valve (17), and a third heat exchanger (14), flow back into a fourth end of the switching unit via a first shutoff valve (8), and then be outputted from the third end; under the operating mode of heating, driving refrigerant outputted by the fourth end of the switching unit to successively flow through the third heat exchanger (14), the third electronic expansion valve (17), the second heat exchanger (13), and the second electronic expansion valve (11), flow back to the second end of the switching unit via a second shutoff valve (9) and a first heat exchange unit, and then be outputted from the third end. System costs can be lowered and the control precision of a multi-coupled heat pump air-conditioning system can be improved by applying the present invention.

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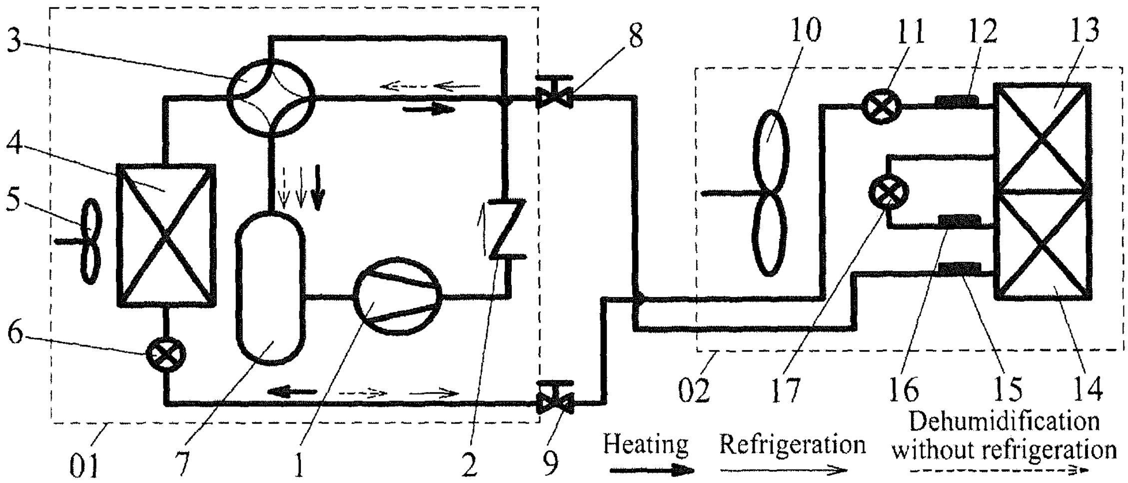
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Heating
Refrigeration
Dehumidification
without refrigeration

Fig.2

Description

Field

[0001] The present disclosure relates to the technology of multi-connected heat pump air conditioner system controlling technology, and particularly to a multi-connected heat pump air conditioner system and a method for controlling the multi-connected heat pump air conditioner system.

Background

[0002] Along with a constantly improved level of people's life, air conditioner systems have been installed in living and indoor working environments for more comfort in the living and working environments as a vital option of the people to accommodate a higher demand for comfort. Particularly a multi-connected air conditioner is a significant trend in the development of the central air conditioners due to its free control, efficient energy conservation, convenience to install and maintain, and other advantages.

[0003] Fig. 1 is a structural diagram of a current multi-connected heat pump air conditioner system. As shown in Fig. 1, the multi-connected heat pump air conditioner system generally includes one or more outdoor machines 01, one or more indoor machines 02, a central control network (CS-NET) 03, a refrigerant pipeline 04, a branch pipe 05 and communication lines 06. The multiple outdoor machines connect into an outdoor machine system; the CS-NET controls the outdoor machine system through the communication lines. The outdoor machines connect with the branch pipe through the refrigerant pipeline, and the branch pipe connects with indoor machines, herein:

[0004] The outdoor machine generally includes an outdoor heat exchanger, a compressor and other refrigerating accessories. The outdoor heat exchanger generally uses wind cooling or water cooling for heat exchange. The indoor machine includes a fan and a heat exchanger, and generally performs heat exchange by direct evaporation. As compared with multiple home air conditioners, the outdoor machines of the multi-connected air conditioner system can be shared to thereby lower effectively a cost of devices and manage centrally the respective indoor machines and outdoor machines, where a single compressor can be put into operation separately or multiple compressors can be put into operation concurrently for higher flexibility of control.

[0005] When the indoor air is processed by the indoor machine of the multi-connected heat pump air conditioner system, the temperature and humidity of the air needs to be adjusted and controlled. Herein the humidity control is more difficult. Current multi-connected heat pump air conditioner system performs dehumidification and cooling to control the humidity.. However, using such a method, on the one hand, excessively reducing the supply air temperature may increase energy consumption of the multi-connected heat pump air conditioner system, and reduction of the temperature of the evaporation, which will reduce of the energy efficiency ratio of the multi-connected heat pump air conditioner system, and on the other hand, lowering temperature and dehumidification during rainy season, will increase the cold feeling of the air. To avoid the uncomfortable feeling caused by the strong cold feeling, adding heating coil in the indoor machine is required to heat up the air, which additionally increases the energy consumption of the multi-connected heat pump air conditioner system.

[0006] To solve the problem that when using multi-connected heat pump air conditioner system to dehumidify, the system consumes too much energy and the refrigerating efficiency is low, an improvement method, which is adding a reheat heat exchanger in the indoor machine, is provided in the prior art, the reheat heat exchanger is a condenser in fact and the high temperature and high pressure refrigerant flowing from the outdoor heat exchanger flows through the reheat heat exchanger to release the heat into return air. The other part of the return air is refrigerated and dehumidified by the evaporator, and is mixed with the part of return air which is heated before sending into indoor. Thus cooling is avoided. Avoiding from cooling can also be realized by developing specialized dehumidification electromagnetic valve or adding multiple electromagnetic valves. However, such improvement on one hand requires adding additional reheat heat exchanger in the indoor machine, which adds cost to the system. On the other hand, using specialized dehumidification electromagnetic valve or multiple electromagnetic valves increases the difficulty in controlling the multi-connected heat pump air conditioner system, and the accuracy in control cannot be maintained.

Summary

[0007] The embodiments in this disclosure disclose a multi-connected heat pump air conditioner system, which lowers system costs and increases control accuracy of the multi-connected heat pump air conditioner system.

[0008] The embodiments in this disclosure further disclose a method to control multi-connected heat pump air conditioner system, which lowers system costs and increases control accuracy of the multi-connected heat pump air conditioner system.To achieve above purposes, some embodiments in this disclosure provide a multi-connected heat pump air conditioner system, including:

an outdoor machine and an indoor machine, wherein:

the outdoor machine comprises: a controlling component, a confluence component, a switching component, and a first heat exchange component;

the indoor machine comprises: an indoor side fan, a second electronic expansion valve, a second heat exchanger, a third electronic expansion valve and a third heat exchanger;

the controlling component is configured to control a first heat exchanger in the first exchange component to be condenser, and the second heat exchanger and the third heat exchanger in the indoor machine both to be evaporators, when the multi-connected heat pump air conditioner system is in a refrigerating mode; and to control the first heat exchanger in the first heat exchange component to be evaporator, and the second heat exchanger and third heat exchanger of the indoor machine both to be condensers, when the multi-connected heat pump air conditioner system is in a heating mode; and to control the first heat exchanger in the first heat exchange component and second heat exchanger of the indoor machine to be both condensers, and the third heat exchanger of the indoor machine to be evaporator, when the multi-connected heat pump air conditioner system is in dehumidification without refrigerating mode;

the switching component is configured to control the first terminal and the second terminal of the switching component to connect, and the third and the fourth terminal of the switching component to connect, wherein the first terminal of the switching component receives output from the confluence component, which is output to the first heat exchange component by the second terminal, the fourth terminal receives the output from the indoor machine which is output to the confluence component by the third terminal, when the multi-connected heat pump air conditioner system is in dehumidification without refrigerating mode; and the switching component is configured to control the first terminal and the fourth terminal of the switching component to connect, and the second and the third terminal of the switching component to connect, wherein the first terminal receives the output from the confluence component which is output to a first terminal of the indoor machine by the fourth terminal, the second terminal receives the output from the first heat exchange component which is output to the confluence component by the third terminal, when the multi-connected heat pump air conditioner system is in heating mode;

the confluence component is configured to output the refrigerant to the switching component after liquid-gas separating and compressing the refrigerant output by the switching component;

the first heat exchange component is configured to drive outdoor air to flow through the first exchanger in the first heat exchange component, the first terminal of the first heat exchange component connects with the second terminal of the switching component, and the other terminal of the first heat exchange component connects with the second terminal of the indoor machine;

one terminal of the second electronic expansion valve connects to other terminal of the second stop valve, and other terminal of the second electronic expansion valve connects with one terminal of the second heat exchanger;

other terminal of the second heat exchanger connects with one terminal of the third electronic expansion valve;

other terminal of the third electronic expansion valve connects with one terminal of the third heat exchanger;

other terminal of the third exchanger connects with other terminal of the first stop valve;

the indoor side fan is configured to drive indoor return air to flow through the second heat exchanger and the third heat exchanger.

[0009] Preferably, the switching component includes a four way reversing valve and a first stop valve, wherein:

a first terminal of the four way reversing valve connects with an output terminal of the confluence component, a second terminal of the four way reversing valve connects with an input terminal of the first heat exchange component, a third terminal of the four way reversing valve connects with an input terminal of the confluence component, and a fourth terminal of the four way reversing valve connects with one terminal of the first stop valve, other terminal of the first stop valve connects with a first terminal of the indoor machine.

[0010] Preferably, the confluence component includes: a compressor, a one way valve, and a gas liquid separator, wherein:

an output terminal of the compressor connects with an input terminal of the one way valve, an output terminal of the one way valve connects with one terminal of the four way reversing valve, an input terminal of the gas liquid separator connects with the third terminal of the four way reversing valve, an output terminal of gas liquid separator connects with the input terminal of the compressor.

[0011] Preferably, the first heat exchange component includes: a first heat exchanger, an outdoor side fan, a first electronic expansion valve, and a second stop valve, wherein:

one terminal of the first heat exchanger connects with a second terminal of the four way reversing valve, and other terminal of the first heat exchanger connects with one terminal of the first electronic expansion valve;

other terminal of the first electronic expansion valve connects with one terminal of the second stop valve;

other terminal of the second operation valve connects with a second terminal of the indoor machine;

the outdoor side fan is configured to drive outdoor air through the first heat exchanger.

[0012] Preferably, the compressor consists of one or more constant speed compressors, or consists of variable speed compressors, or consisits of constant speed compressors and variable speed compressors.

[0013] Preferably, the outdoor side fan is an axial flow fan, and the indoor side fan is a centrifugal fan or a perfusion fan.

[0014] Preferably, the first heat exchanger, the second heat exchanger and the third heat exchanger are aluminum foil finned copper tube heat exchangers or aluminum finned micro-tube heat exchangers.

[0015] Preferably, the second heat exchanger is located above the third heat exchanger.

[0016] Preferably, the indoor machine further includes: a first temperature sensor, a second temperature sensor, and a third temperature sensor, wherein:

the first temperature sensor is located on a refrigerant pipeline, between the second electronic expansion valve and the second heat exchanger, and which is close to one terminal of the second heat exchanger;

the second temperature sensor is located on a refrigerant pipeline, between the third heat exchanger and the first stop valve, and which is close to one terminal of the third heat exchanger;

the third temperature sensor is located on a refrigerant pipeline, between the third electronic expansion valve and the third heat exchanger, and which is close to one terminal of the third heat exchanger.

[0017] Preferably, the refrigerant is output into the one way valve by the outlet of the compressor, and a high pressure refrigerant gas output by the one way valve enters into the first terminal of the four way reversing valve; when the multi-connected heat pump air conditioner system is in refrigerating mode and dehumidification without refrigerating mode:

the first terminal and the second terminal of the four way reversing valve connects, and the third terminal and the fourth terminal of the four way reversing valve connects, the refrigerant flows orderly through the second terminal of the four way reversing valve, the first heat exchanger, the first electronic expansion valve, the second stop valve, the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve, the third heat exchanger, the first stop valve, the fourth terminal of the four way reversing valve, and enters into an inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator;

when the multi-connected heat pump air conditioner system is in heating mode:

the first terminal and the fourth terminal of the four way reversing valve connects, and the second terminnal and the third terminal of the four way reversing valve connects. The refrigerant flows orderly through the fourth terminal of the four way reversing valve, the first stop valve, the third heat exchanger, the third electronic expansion valve, the second heat exchanger, the second electronic expansion valve, the second stop valve, the first electronic expansion valve, the first heat exchanger, the second terminal of the four way reversing valve, and enters into an inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator.

[0018] Preferably, in refrigerating mode, the first electronic expansion valve and the third electronic expansion valve are fully open, and the second electronic expansion valve throttles; the first heat exchanger works as a condenser, and the second heat exchanger and the third heat exchanger both work as evaporators, a low temperature air from the indoor machine cools down the indoor, the opening of the second electronic expansion valve is controlled by the difference between the temperatures acquired by the second temperature sensor and the first temperature sensor;
in dehumidification without refrigerating mode, the first electronic expansion valve and the second electronic expansion valve are fully open, and the third electronic expansion valve throttles, the first heat exchanger and the second heat exchanger both work as condensers, and the third heat exchanger work as the evaporator, part of the return air through the indoor machine is heated up by the second heat exchanger, and other part of the return air through the indoor component is dehumidified and refrigerated by the third heat exchanger, the processed hot and cold air is mixed and sent indoor, the opening of the third electronic expansion valve is controlled by the difference between the temperatures acquired by the second temperature sensor and the third temperature sensor;
in heating mode, the third electronic expansion valve is fully open, and the first electronic expansion valve and

the second electronic expansion valve throttle, the first heat exchanger works as evaporator, and the second heat exchanger and the third heat exchanger both work as condensers, a high temperature air from the indoor machine heats up the indoor; the opening of the second electronic expansion valve is controlled by the difference between the condensation temperature of the high pressure refrigerant and the temperature acquired by the first temperature sensor.

[0019] Preferably, the indoor machine further includes: a fourth heat exchanger and a fifth heat exchanger, wherein:

> the second heat exchanger and the third heat exchanger form a heat exchanger group, and the fourth heat exchanger and the fifth heat exchanger form another heat exchanger group, the two heat exchanger groups are connected by sheet metal component to form a V shape heat exchanger.

[0020] Preferably, other terminal of the second heat exchanger is connected with one terminal of the fourth heat exchanger;
other terminal of the fourth heat exchanger is connected with one terminal of the third electronic expansion valve;
other terminal of the third electronic expansion valve is connected with one terminal of the third heat exchanger;
other terminal of the third heat exchanger is connected with one terminal of the fifth heat exchanger;
other terminal of the fifth heat exchanger connects with other terminal of the stop valve, the second temperature sensor is located on a refrigerant pipeline, between the fifth heat exchanger and the first stop valve, and which is close to one terminal of the fifth heat exchanger.

[0021] Perferably, in dehumidification without refrigerating mode, the refrigerant flows orderly through the second electronic expansion valve, the second heat exchanger, the fourth heat exchanger, the third electronic expansion valve, the third heat exchanger and the fifth heat exchanger, the second electronic expansion valve is fully open and the third electronic expansion valve throttles, the second heat exchanger and the fourth heat exchanger both work as condensers, and third heat exchanger and the fifth heat exchanger both work as evaporators; the air from the second heat exchanger is hot air, from the third heat exchanger is cold air, from the fourth heat exchanger is hot air, from the fifth heat exchanger is cold air, and such hot and cold air are mixed and sent out.

[0022] Preferbly, the third electronic expansion valve is consisted of a heat expansion valve and a electromagnetic valve in parallel connection, the temperature sensor bundle of the heat expansion valve is located between the first stop valve and the third heat exchanger, and is close to the refrigerant pipeline to one terminal of the third heat exchanger, wherein:

> when the electromagnetic valve is open, the third electronic expansion valve is fully open, when the electromagnetic valve is closed and the heat expansion valve regulates, the third electronic expansion valve throttles, the opening of the heat expansion valve is controlled according to the temperature acquired by the temperature sensor bundle.

[0023] A method to control a multi-connected heat pump air conditioner system, incuding:

> A. A confluence component of an outdoor machine outputs a refrigerant to the first terminal of the switching component, after receiving the refrigerant output by the third terminal of the switching component and performing gas-liquid separation and compression to the refrigerant;
> Determining the current mode of the multi-connected heat pump air conditioner system;
>
> B. If the multi-connected heat pump air conditioner system is in refrigeration mode and dehumidification without refrigeration mode, the refrigerant output by the second terminal of the switching component connected with the first terminal is driven to flow orderly through the first heat exchange component, and the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve and the third heat exchanger of the indoor machine, and the refrigenant flows back to the fourth terminal of the switching component through the first stop valve and then is output out of the third terminal of the switching component;
>
> C. If the multi-connected heat pump air conditioner system is in heating mode, the refrigerant output by the fourth terminal of the switching component is driven to flow orderly through the third heat exchanger, the third electronic expansion valve, the second heat exchanger and the second electronic expansion valve of the indoor machine, and flows back to the second terminal of the switching component through a second stop valve and the first heat exchange component and then is output from the third terminal of the switching component.

[0024] Wherein the switching component includes a four way reversing valve and a first stop valve, wherein:

> a first terminal of the four way reversing valve connects with an output terminal of the confluence component, a second terminal of the four way reversing valve connects with an input terminal of the first hear exchange component, a third terminal of the four way reversing valve connects with the input terminal of the confluence component, and a fourth terminal of the four way reversing valve connects with one terminal of the first stop valve, the other terminal of the first stop valve connects with the first terminal of the

indoor machine;

the confluence component includes: a compressor, a one way valve, and a gas liquid separator, wherein:

an output terminal of the compressor connects with an input terminal of the one way valve, an output terminal of the one way valve connects with one terminal of the four way reversing valve, an input terminal of the gas liquid separator connects with the third terminal of the four way reversing valve, an output terminal of gas liquid separator connects with an input terminal of the compressor;

the first heat exchange component includes: a first heat exchanger, an outdoor side fan, a first electronic expansion valve, and a second stop valve, wherein:

one terminal of the first heat exchange component connects with the second terminal of the four way reversing valve, and the other terminal connects with one terminal of the first electronic expansion valve;

other terminal of the first electronic expansion valve connects with one terminal of the second stop valve;

other terminal of the second operation valve connects with the second terminal of the indoor machine;

the outdoor side fan is used to drive outdoor air through the first heat exchanger

the indoor machine further includes an indoor side fan used to drive indoor return air to flow through the second heat exchanger and the third heat exchanger.

[0025] Wherein the Operation B further includes:

the first terminal and the second terminal of the four way reversing valve connects, and the third and the fourth terminal of the four way reversing valve connects, the refrigerant flows orderly through the second terminal of the four way reversing valve, the first heat exchanger, the first electronic expansion valve, the second stop valve, the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve, the third heat exchanger, the first stop valve, the fourth terminal of the four way reversing valve, and enters into an inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator;

wherein, in refrigerating mode, the first electronic expansion valve and the third electronic expansion valve are fully open, and the second electronic expansion valve throttles, the first heat exchanger works as a condenser, and the second heat exchanger and the third heat exchanger both works as evaporators, the lower temperature air from the indoor machine cools down the indoor, the opening of the second electronic expansion valve is controlled according to the difference between the temperatures acquired by the second temperature sensor and the first temperature sensor;

in dehumidification without refrigerating mode, the first electronic expansion valve and the second electronic expansion valve are fully open, and the third electronic expansion valve throttles, the first heat exchanger and the second heat exchanger both work as condensers, and the third heat exchanger works as evaporator, part of the return air through the indoor machine is heated up by the second heat exchanger, and the other part is dehumidified and refrigerated by the third heat exchanger, the processed hot and cold air is mixed and sent indoor; the opening of the third electronic expansion valve is controlled according to the difference between the temperatures acquired by the second temperature sensor and the third temperature sensor.

[0026] Wherein the Operation C further includes:

the first terminal and the fourth terminal of the four way reversing valve connects, and the second and the third terminal of the four way reversing valve connects, the refrigerant flows orderly through the fourth terminal of the four way reversing valve, the first stop valve, the third heat exchanger, the third electronic expansion valve, the second heat exchanger, the second electronic expansion valve, the second stop valve, the first electronic expansion valve, the first heat exchanger, the second terminal of the four way reversing valve, and enters into an inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator;

wherein, the third electronic expansion valve is fully open, and the first electronic expansion valve and the second electronic expansion valve throttle, the first heat exchanger works as an evaporator, and the second heat exchanger and the third heat exchanger both work as condensers, the high temperature air from the indoor machine heats up the indoor; the opening of the second electronic expansion valve is controlled according to the difference between the condensation temperature of the high pressure refrigerant and the temperature acquired by the first temperature sensor.

[0027] As shown in above technical schemes, the embodiments in this disclosure discloses a multi-connected heat pump air conditioner system and a method for controlling the multi-connected heat pump air conditioner system, wherein a confluence component of an outdoor machine performs gas-liquid separation and compression to refrigerant output by the third terminal of a switching component and outputs the refrigerant to the first terminal of the switching component; determines the working condition of the multi-connected heat pump air conditioner system; if the multi-connected heat pump air conditioner system is in refrigeration mode and dehumidification without refrigerating mode, a refrigerant output by the second terminal, connected with the first terminal of the switching component, of the switching component is driven to flow orderly through a first heat exchange component, and, a second electronic expansion valve, a second heat exchanger, a third electronic expansion valve, and a third heat exchanger, of the indoor machine, and flows back to the fourth terminal of the switching component through a first stop valve of the switching component, and then is output from the third terminal of the switching component; if the multi-connected heat pump air conditioner system is in heating mode, a refrigerant output by the fourth terminal, connected with the first terminal of the switching component, of the switching component is driven to flow orderly through the third heat exchanger, the third electronic expansion valve, the second heat exchanger and the second electronic expansion valve of the indoor machine, and flows back to the second terminal of the switching component through a second stop valve and the first heat exchange component of the outdoor machine, and then is output from the third terminal. Therefore, the indoor machine and the outdoor machine both use electronic expansion valve without developing specialized dehumidification electromagnetic valve or adding electromagnetic valves, thus the system cost can be reduced, and the control accuracy of the system can be improved and the difficulty in control can be reduced.

Brief Description of the Drawings

[0028] To better illustrate the technical features in the embodiments in this disclosure or in prior art, the following briefs describes the drawings required in the embodiments in this disclosure or in prior art. Obviously, the drawings in the following description are just for some embodiments in this disclosure. For person having ordinary skills in the art, they may infer other embodiments and drawings from the embodiments as shown in the following drawings.

Fig. 1 is a structural diagram of a current multi-connected heat pump air conditioner system.

Fig. 2 is a structural illustration of the multi-connected heat pump air conditioner system disclosed in the embodiments in this disclosure.

Fig. 3 is a working illustration of an indoor machine disclosed in the embodiments in this disclosure realizing dehumidification without refrigeration.

Fig. 4 is another structural illustration of the indoor machine disclosed in the embodiments in this disclosure.

Fig. 5 is another structural illustration of the indoor machine disclosed in the embodiments in this disclosure.

Fig. 6 is a flow chart of the method to control multi-connected heat pump air conditioner system disclosed in the embodiments in this disclosure.

Detailed Description

[0029] The following is a clear and comprehensive description of the technical schemes in the embodiments in this disclosure, using the drawings for the embodiments. Clearly, the embodiments described herein are just part of the embodiments of this disclosure, not all the embodiments. Based on the embodiments of this disclosure, persons with ordinary skills in this field may acquire other embodiments without inventive effort. Such embodiments shall be within the scope of the protection of this disclosure.

[0030] Current multi-connected heat pump air conditioner system releases heat into the return air by adding reheat heat exchanger to make high temperature and high pressure refrigerant from the outdoor side heat exchanger to flow through the reheat heat exchanger, the other part of the return air is mixed with the heated air, and sent into indoor after dehumidified and refrigerated by the evaporator, thus the multi-connected heat pump air conditioner system realizes dehumidification without refrigeration, however the cost of the system is added; or, the multi-connected heat pump air conditioner system realizes dehumidification without refrigerating fuction by developing specialized dehumidification electromagnetic valve or by adding electromagnetic valves, which not only adds cost, but also makes the multi-connected heat pump air conditioner system difficult to control and the accuracy of the multi-connected heat pump air conditioner system difficult to maintain.

[0031] The embodiments in this disclosure design, from economy and control perspectives, high efficient new indoor machine used for multi-connected heat pump air conditioner system, and provide a multi-connected heat pump air conditioner system having the feature of dehumidification without refrigeration, ensures the multi-connected heat pump air conditioner system to highly efficient operate while realizing refrigeration, heating and dehumidification without refrigeration, and satisfied the demand of customers with high expectations.

[0032] The multi-connected heat pump air conditioner system in the embodiments in this disclosure can refrigerate in summer, heat up in winter, and dehumidify without refrigeration in rainy season. From economy perspective, the multi-connected heat pump air conditioner system in the embodiments in this disclosure does not require additional heat exchanger. From increasing control accuracy and reducing control difficulty perspectives, the outdoor machine and the indoor machine in the embodiments in this disclosure both use electronic expansion valve, and do not require developing specialized dehumidification electromagnetic valve or adding electromagnetic valves.

[0033] Fig. 2 is a structural illustration of the multi-connected heat pump air conditioner system provided in the embodiments in this disclosure, including: an outdoor machine 01 and an indoor machine 02, wherein the outdoor machine 01 may be one or more, and the indoor machine 02 may be one or more.

[0034] Preferably, the indoor machine 02 may be the indoor machine provided in the embodiment in this disclosure which dehumidified without refrigeration; or the indoor machine 02 may be current indoor machine, i.e. indoor machine having only functions of heating and refrigeration.

[0035] The outdoor machine 01 includes: a controlling component, a confluence component, a switching component, and a first heat exchange component.

[0036] The controlling component is configured to control a first heat exchanger 4 in the first exchange component to be condenser, and the second heat exchanger 13 and the third heat exchanger 14 in the indoor machine 02 both to be evaporators, when the multi-connected heat pump air conditioner system is in a refrigerating mode; and to control the first heat exchanger 4 in the first heat exchange component to be evaporator, and the second heat exchanger 13 and third heat exchanger 14 of the indoor machine 02 both to be condensers, when the multi-connected heat pump air conditioner system is in a heating mode; and to control the first heat exchanger 4 in the first heat exchange component and second heat exchanger 13 of the indoor machine 02 to be both condensers, and the third heat exchanger 14 of the indoor machine 02 to be evaporator, when the multi-connected heat pump air conditioner system is in dehumidification without refrigerating mode;

the switching component is configured to control the first terminal and the second terminal of the switching component to connect, and the third and the fourth terminal of the switching component to connect, wherein the first terminal of the switching component receives output from the confluence component, which is output to the first heat exchange component by the second terminal, the fourth terminal receives the output from the indoor machine which is output to the confluence component by the third terminal, when the multi-connected heat pump air conditioner system is in dehumidification without refrigerating mode; to control the first terminal and the fourth terminal of the switching component to connect, and the second and the third terminal of the switching component to connect, wherein the first terminal receives the output from the confluence component which is output to the first terminal of the indoor machine by the fourth terminal, the second terminal receives the output from the first heat exchange component which is output to the confluence component by the third terminal, when the multi-connected heat pump air conditioner system is in heating mode;

the confluence component is configured to output the refrigerant to the switching component after liquid-gas separating and compressing the refrigerant output by the switching component;

the first heat exchange component is configured to drive outdoor air to flow through the first exchanger 4 in the first heat exchange component, the first terminal of the first heat exchange component connects with the second terminal of the switching component, and the other terminal of the first heat exchange component connects with the second terminal of the indoor machine.

[0037] Herein, the switching component includes a four way reversing valve 3 and a first stop valve 8, herein:

[0038] The first terminal of the four way reversing valve 3 connects with the output terminal of the confluence component, the second terminal connects with the input terminal of the first hear exchange component, the third terminal connects with the input terminal of the confluence component, and the fourth terminal connects with one terminal of the first stop valve 8, the other terminal of the first stop valve 8 connects with the first terminal of the indoor machine.

[0039] The confluence component includes: a compressor 1, a one way valve 2, and a gas liquid separator 7, herein:

> The output terminal of the compressor 1 connects with the input terminal of the one way valve 2, the output terminal of the one way valve 2 connects with the first terminal of the four way reversing valve 3, the input terminal of the gas liquid separator 7 connects with the third terminal of the four way reversing valve 3, the output terminal of the gas liquid separator 7 connects with the input terminal of the compressor 1.

[0040] In some embodiments, the compressor 1 may consist of one or more constant speed compressors, or consist of variable speed compressors, or consisit of constant speed compressors and variable speed compressors.

[0041] The first heat exchange component includes: a first heat exchanger 4, an outdoor side fan 5, a first electronic expansion valve 6, and a second stop valve 9, herein:

[0042] One terminal of the first heat exchange component 4 connects with the second terminal of the four way reversing valve 3, and the other terminal of the first heat exchange component 4 connects with one terminal of the first electronic expansion valve 6.

[0043] The other terminal of the first electronic expansion valve 6 connects with one terminal of the second stop valve 9.

[0044] The other terminal of the second operation valve 9 connects with the second terminal of the indoor machine.

[0045] The outdoor side fan 5 is configured to drive the outdoor air to flow through the first heat exchanger 4.

[0046] In some embodiments, the outdoor side fan 5 is an axial flow fan, and the outdoor side fan 5 rotates to drive the outdoor air to flow through the first heat exchanger 4.

[0047] Therefore, the outdoor machine 01 includes: a compressor 1, a one way valve 2, a four way reversing valve 3, a first heat exchanger 4, a outdoor side fan 5, a first electronic expansion valve 6, a gas liquid separator 7, a first stop valve 8 and a second stop valve 9, herein:

[0048] The output terminal of the compressor 1 connects with one terminal of the one way valve 2, and the input terminal connects with the output terminal of the gas liquid separator 7.

[0049] The other terminal of the one way valve 2 connects with the first terminal of the four way reversing valve 3.

[0050] The second terminal of the four way reversing valve 3 connects with one terminal of the first heat exchanger 4, the third terminal of the four way reversing valve 3 connects with the input terminal of the gas liquid separator 7, and the fourth terminal of the four way reversing valve 3 connects with one terminal of the first stop valve 8.

[0051] The other terminal of the first heat exchanger 4 connects with one terminal of the first electronic expansion valve 6.

[0052] The other terminal of the first electronic expansion valve 6 connects with one terminal of the second stop valve 9.

[0053] The other terminal of the first stop valve 8 outputs to the first terminal of the indoor machine 02, and the other terminal of the second stop valve 9 outputs to the second terminal of the indoor machine 02.

[0054] The indoor machine 02 includes: an indoor side fan 10, a second electronic expansion valve 11, a second heat exchanger 13, a third electronic expansion valve 17 and a third heat exchanger 14, herein:

One terminal of the second electronic expansion valve 11 connects to the other terminal of the second stop valve 9, and the other terminal connects with one terminal of the second heat exchanger 13.

[0055] The other terminal of the second heat exchanger 13 connects with one terminal of the third electronic expansion valve 17.

[0056] The other terminal of the third electronic expansion valve 17 connects with one terminal of the third heat exchanger 14.

[0057] The other terminal of the third heat exchanger 14 connects with the other terminal of the first stop valve 8.

[0058] The indoor side fan 10 is configured to drive the indoor return air to flow through the second heat changer 13 and the third heat changer 14.

[0059] In some embodiments, the indoor side fan 10 is a centrifugal fan or a perfusion fan. The indoor side fan 0 rotates to drive the indoor return air to flow through the second heat exchanger 13 and the third heat exchanger 14.

[0060] The first heat exchanger 4, the second heat exchanger 13 and the third heat exchanger 14 are aluminum foil finned copper tube heat exchangers or aluminum finned micro-tube heat exchangers.

[0061] Preferably, the second heat exchanger 13 is located above the third heat exchanger 14 (in height).

[0062] In practice, a single heat exchanger can be separated into an upper part and a lower part by connecting and welding curve tubes on the terminal face of the heat exchanger, for example, by connecting and welding curve tubes on the terminal face of the heat exchanger, the heat exchanger inside the indoor component can be separated into a upper part and a lower part to form a second heat exchanger 13 and a third heat exchanger 14. In other words, a second heat exchanger 13 and a third heat exchanger 14 can be formed by connecting and welding curve tubes on the terminal face of the heat exchanger.

[0063] Preferably, the indoor machine further includes: a first temperature sensor 12, a second temperature sensor 15, and a third temperature sensor 16, herein:

The first temperature sensor 12 is located on the refrigerant pipeline between the second electronic expansion valve 11 and the second heat exchanger 13, and the refrigerant pipeline is close to one terminal of the second heat exchanger 13.

[0064] The second temperature sensor 15 is located on the refrigerant pipeline between the third heat exchanger 14 and the first stop valve 8, and the refrigerant pipeline is close to one terminal of the third heat exchanger 14.

[0065] The third temperature sensor 16 is located on the refrigerant pipeline between the third electronic expansion valve 17 and the third heat exchanger 14, and the refrigerant pipeline is close to one terminal of the third heat exchanger 14.

[0066] In some embodiments, the temperature sensor 12, the second temperature sensor 15, and the third temperature sensor 16 are respectively configured to sense the temperatures of the refrigerant pipelines which they are respectively located on, thus allowing the electronic expansion valves on respective refrigerant pipelines to adjust the openings of the electronic expansion valves, to realize refrigeration, heating and dehumidification without refrigeration according to temperatures sensed by the temperature sensors.

[0067] Therefore, the indoor machine 02 includes: an indoor side fan 10, a second electronic expansion valve 11, a first temperature sensor 12, a second heat exchanger 13, a third heat exchanger 14, a second temperature sensor 15, a third temperature sensor 16 and a third electronic expansion valve 17, herein:

One terminal of the second electronic expansion valve 11 connects with one terminal of the second heat exchanger 13, the first temperature sensor 12 is located on the refrigerant pipeline between the second electronic expansion valve 11 and the second heat exchanger 13, and the refrigerant pipeline is close to one terminal of the second heat exchanger 13, the other terminal of the second electronic expansion valve 11 connects with the other terminal of the second stop valve 9.

[0068] The other terminal of the second heat exchanger 13 connects with one terminal of the third electronic expansion valve 17.

[0069] The other terminal of the third electronic expansion valve 17 connects with one terminal of the third heat exchanger 14, the third temperature sensor 16 is located on the refrigerant pipeline between the third electronic expansion valve 17 and the third heat exchanger 14, and the refrigerant pipeline is close to one terminal of the third heat exchanger 14.

[0070] The other terminal of the third heat exchanger 14 connects with the other terminal of the first stop valve 8, the second temperature sensor 15 is located on the refrigerant pipeline between the third heat exchanger 14 and the first stop valve 8, and the refrigerant pipeline is close to one terminal of the third heat exchanger 14.

[0071] The indoor side fan 10 can be configured to drive indoor return air to flow through the second heat exchanger 13 and the third heat exchanger 14.

[0072] The following is a detailed description of the work process of the multi-connected heat pump air conditioner system in the embodiment of this disclosure.

[0073] The refrigerant is output into the one way valve 2 by the outlet (output terminal) of the compressor 1, and the high pressure refrigerant output by the one way valve 2 enters into the first terminal of the four way reversing valve 3.

[0074] When the multi-connected heat pump air conditioner system is in refrigerating mode and dehumidification without refrigerating mode:

The first terminal of the four way reversing valve 3 connects with the second terminal of the four way reversing valve 3, and the third of the four way reversing valve 3 connects with the fourth terminal of the four way reversing valve 3. The refrigerant flows orderly through the second terminal of the four way reversing valve 3, the first heat exchanger 4, the first electronic expansion valve 6, the second stop valve 9, the second electronic expansion valve 11, the second heat exchanger 13, the third electronic expansion valve 17, the third heat exchanger 14, the first stop valve 8, the fourth terminal of the four way reversing valve 3, and enters into the inlet (input terminal) of the compressor 1 from the third terminal of the four way reversing valve 3 through the gas liquid separator 7.

[0075] When the multi-connected heat pump air conditioner system is in heating mode:

The first terminal and the fourth terminal of the four way reversing valve 3 connects, and the second and the third terminal connects. The refrigerant flows orderly through the fourth terminal of the four way reversing valve 3, the first stop valve 8, the third heat exchanger 14, the third electronic expansion valve 17, the second heat exchanger 13, the second electronic expansion valve 11, the second stop valve 9, the first electronic expansion valve 6, the first heat exchanger 4, the second terminal of the four way reversing valve 3, and enters into the inlet of the compressor 1 from the third terminal of the four way reversing valve 3 through the gas liquid separator 7

[0076] To realize refrigeration, heating and dehumidification without refrigeration, the methods to control each electronic expansion valve in different modes and the work processes of each heat exchanger in different modes are as following:

In refrigerating mode, the first electronic expansion valve 6 and the third electronic expansion valve 17 are fully open, and the second electronic expansion valve 11 throttles to adjust the flow of the refrigerant flowing through the second electronic expansion valve 11. In the refrigerating mode, the first heat exchanger 4 is condenser, and the second heat exchanger 13 and the third heat exchanger 14 are both evaporators, the lower temperature air from the indoor machine 02 cools down the indoor. The opening of the second electronic expansion valve 11 is controlled according to the difference between the temperatures acquired by the second temperature sensor 15 and the first temperature sensor 12, i.e. the evaporation overheating degree. Herein:

$$SH = T_{15} - T_{12}$$

Where,

SH is evaporation overheating degree. The opening of the valve is controlled by calculating the evaporation overheating degree:

T_{15} is a temperature acquired by the second temperature sensor 15.

T_{12} is a temperature acquired by the first temperature sensor 12.

[0077] In heating mode, the third electronic expansion valve 17 is fully open, and the first electronic expansion valve 6 and the second electronic expansion valve 11 throttle to adjust flows of the refrigerants flowing through the first electronic expansion valve 6 and the second electronic expansion valve 11 respectively. In the heating mode, the first heat exchanger 4 is evaporator, and the second heat exchanger 13 and the third heat exchanger 14 are both condensers. The higher temperature air from the indoor machine 02 heats up the indoor. The opening of the second electronic expansion valve 11 is controlled according to the difference between the condensation temperature of the high pressure refrigerant and the temperature acquired by the first temperature sensor 12, i.e. the condensation overcooling degree. Herein:

$$SC = T_c - T_{12}$$

Where,

SC is condensation overcooling degree.

T_C is the condensation temperature of the refrigerant.

T_{12} is the temperature acquired by the first temperature sensor 12.

[0078] In dehumidification without refrigerating mode, the first electronic expansion valve 6 and the second electronic expansion valve 11 are fully open, and the third electronic expansion valve 17 throttles. The first heat exchanger 4 and the second heat exchanger 13 are both condensers, and the third heat exchanger 14 is evaporator. Part of the return air which flows through the indoor machine 02 is heated up by the second heat exchanger 13, and the other part is dehumidified and refrigerated by the third heat exchanger 14. The processed hot and cold air is mixed and sent indoor to realize the dehumidification without refrigerating. The opening of the third electronic expansion valve 17 is controlled according to the difference between the temperatures acquired by the second temperature sensor 15 and the third temperature sensor 16, i.e. the evaporation overheating degree. Herein:

$$SH' = T_{15} - T_{16}$$

Where,

SH' is the evaporation overheating degree.

T_{15} is the temperatures acquired by the second temperature sensor 15.

T_{16} is the temperatures acquired by the first temperature sensor 16.

[0079] Fig. 3 is an illustration of the way the indoor machine of the embodiments in this disclosure realizing dehumidification without refrigeration. As shown in Fig. 3, the second heat exchanger 13 is a condenser, and third heat exchanger 14 is an evaporator. The indoor side fan 10 is started up to drive the indoor return air to flow through the second heat exchanger 13 and the third heat exchanger 14, to enable the return air flowing through the indoor machine 02 to be divided into two parts. One part of the return air is heated up by the second heat exchanger 13 to become warm air, and the other part is refrigerated and dehumidified by the third heat exchanger 14. Then, the warm air heated up by the second heat exchanger 13 and the cold air refrigerated and dehumidified by the third heat exchanger 14 is mixed and sent indoor, therefore realizing dehumidification the indoor without refrigeration.

[0080] Fig. 4 is another structural schematic of indoor machine of the embodiments in this disclosure. As shown in Fig. 4, this embodiment is a preferred embodiment, which includes two groups of heat exchangers. The second heat exchanger 13 and the third heat exchanger 14 form one heat exchanger group, and the fourth heat exchanger 13' and the fifth heat exchanger 14' form another heat exchanger group. The two heat exchanger groups are connected by sheet metal component 20 to form a V shape heat exchanger. Thus increasing heat exchange surface within the limited space inside the indoor machine, enhancing the refrigeration volume, heating volume and dehumidification volume of the multi-connected heat pump air conditioner system.

[0081] Herein, the other terminal of the second heat exchanger 13 is connected with one terminal of the fourth heat exchanger 13'.

[0082] The other terminal of the fourth heat exchanger 13' is connected with one terminal of the third electronic expansion valve 17.

[0083] The other terminal of the third electronic expansion valve 17 is connected with one terminal of the third heat exchanger 14. The third temperature sensor 16 is located on the refrigerant pipeline between the third electronic expansion valve 17 and the third heat exchanger 14, and the refrigerant pipeline is close to one terminal of the third heat exchanger 14.

[0084] The other terminal of the third heat exchanger 14 is connected with one terminal of the fifth heat exchanger 14'.

[0085] The other terminal of the fifth heat exchanger 14' connects with the other terminal of the first stop valve 8. The second temperature sensor 15 is located on the refrigerant pipeline between the fifth heat exchanger 14' and the first stop valve 8, and the refrigerant pipeline is close to one terminal of the fifth heat exchanger 14'.

[0086] In the embodiments, the second heat exchanger 13 and the fourth heat exchanger 13' have the same function, and the third heat exchanger 14 and the fifth heat exchanger 14' have the same function, by connecting the refrigerant pipeline. In other words, the second heat exchanger 13 and the fourth heat exchanger 13' are both condensers or are both evaporators, and the third heat exchanger 14 and the fifth heat exchanger 14' are both condensers or are both evaporators.

[0087] For example, in the dehumidification without refrigerating mode, as shown in Fig. 4, the refrigerant flows orderly through the second electronic expansion valve 11, the second heat exchanger 13, the fourth heat exchanger13', the third electronic expansion valve 17, the third heat exchanger 14 and the fifth heat exchanger 14'. In such mode, the second electronic expansion valve 11 is fully open and the third electronic expansion valve 17 throttles. The second heat exchanger 13 and the fourth heat exchanger 13' are both condensers, and third heat exchanger 14 and the fifth heat exchanger 14' are both evaporators. The return air after processed is hot air, cold air, hot air, cold air respectively from top to bottom. That is, the air flowing from the second heat exchanger 13 is hot, flowing from the third heat exchanger 14 is cold, flowing from the fourth heat exchanger 13' is hot, flowing from the fifth heat exchanger 14' is cold, and the hot and cold air are mixed and sent out. Therefore, the air of different temperatures can be mixed, and thus the comfort of the air sent out from the multi-connected heat pump air conditioner system and the thermal performance of the multi-connected heat pump air conditioner system are improved.

[0088] In this embodiment, as shown in Figs. 3 and 4, the rules of controlling each electronic expansion valve are same as the rules of controlling each electronic expansion valve in Fig. 2. In Fig. 4, the second temperature sensor 15 is located on the refrigerant pipeline between the fifth heat exchanger 14' and the first stop valve 8, and the refrigerant pipeline is close to one terminal of the fifth heat exchanger 14'. The locations of other electronic expansion valves remain the same.

[0089] Fig. 5 is another structural illustration of indoor machine of the embodiments in this disclosure. As shown in Fig. 5, differing from Fig. 3, the third electronic expansion valve 17 is replaced by a heat expansion valve 18 and an electromagnetic valve 19 which are in parallel connection, i.e. one terminal of the heat expansion valve 18 connects with one terminal of the electromagnetic valve 19, and also connects with the other terminal of the second heat exchanger 13; the other terminal of the heat expansion valve 18 connects with the other terminal of the electromagnetic valve 19, and also connects with the other terminal of the third heat exchanger 14. The temperature sensor bundle 15' of the heat expansion valve is located on the refrigerant pipeline between the first stop valve 8 and the third heat exchanger 14, and the refrigerant pipeline is close to one terminal of the third heat exchanger 14.

[0090] In some embodiments, in different modes the function of each heat exchanger is the same as the corresponding heat exchanger in Fig. 2. In two embodiments (in Figs. 2 and 5), the rules of controlling the first electronic expansion valve 6 is same with the corresponding rules of controlling the function of the second electronic expansion valve 11. This embodiment is differs from the embodiment of Fig.2 in that, the third electronic expansion valve 17 is replaced by a heat expansion valve 18 and an electromagnetic valve 19 which are in parallel connection, the heat expansion valve 18 and the electromagnetic valve 19 which are in parallel connection work in the following manner: the electromagnetic valve 19 is open, corresponds to the third electronic expansion valve 17 is fully open; the electromagnetic valve 19 is closed and the heat expansion valve 18 throttles, corresponds to the third electronic expansion valve 17 throttles; the opening of the heat expansion valve 18 is controlled according to the temperature acquired by the temperature sensor bundle 15'.

[0091] Above all, the multi-connected heat pump air conditioner system in the embodiments in this disclosure can share an outdoor machine, and doesn't require additional heat exchanger in the indoor machines. By connecting and welding the curved tubes on the terminal face of the heat exchanger in the indoor machines, one heat exchanger can be separated into an upper part and a lower part, thus enhancing economy and lowers costs, also achieving collective control of each of the indoor machine, and thus not only achieving only one indoor machine's s start-up, but also achieving several indoor components' start-up at the same time, which improve the flexibility in control. The indoor machines can refrigerate in summer, heat up in winter, and dehumidify without refrigeration in rainy season, thus making the air sent out by the indoor components more comfortable. Additionally, the outdoor machine and the indoor machine in the embodiments in this disclosure both use electronic expansion valve, and do not require developing specialized dehumidification electromagnetic valve or adding electromagnetic valves; therefore lowing control difficulty and reducing control accuracy.

[0092] Fig. 6 is a flow chart of the method to control multi-connected heat pump air conditioner system disclosed in the embodiments in this disclosure. As shown in Fig. 6, the method includes:

S601. The confluence component of the outdoor machine outputs a refrigerant to the first terminal of the switching component, after receiving the refrigerant output by the third terminal of the switching component and performing gas-liquid separation and compression to the refrigerant.

[0093] Herein, the switching component includes a four way reversing valve and a first stop valve, herein:

The first terminal of the four way reversing valve connects with an output terminal of the confluence component, the second terminal of the four way reversing valve connects with an input terminal of the first hear exchange component, the third terminal of the four way reversing valve connects with the input terminal of the confluence component, and the fourth terminal of the four way reversing valve connects with one terminal of the first stop valve, the other terminal of the first stop valve connects with the first terminal of the indoor machine.

[0094] The confluence component includes: a compressor, a one way valve, and a gas liquid separator, herein:

The output terminal of the compressor connects with the input terminal of the one way valve. The output terminal of the one way valve connects with one terminal of the four way reversing valve. The input terminal of the gas liquid separator connects with the third terminal of the four way reversing valve. The output terminal of gas liquid separator connects with the input terminal of the compressor.S602. Determining the current mode of the multi-connected heat pump air conditioner system, if the mode is refrigeration mode or dehumidification without refrigeration mode, performing S603; if the mode is heating mode, performing S604.

[0095] S603. The refrigerant output by the second terminal of the switching component connected with the first terminal of the switching component is driven to flow orderly through the first heat exchange component, and the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve and the third heat exchanger of the indoor machine, and flow back to the fourth terminal of the switching component through the first stop valve and then is output from the third terminal of the switching component.

[0096] Herein, the first heat exchange component includes: a first heat exchanger, an outdoor side fan, a first electronic expansion valve, and a second stop valve, herein:

One terminal of the first heat exchanger connects with the second terminal of the four way reversing valve, and the other terminal of the first heat exchanger connects with one terminal of the first electronic expansion valve.

[0097] The other terminal of the first electronic expansion valve connects with one terminal of the second stop valve.

[0098] The other terminal of the second operation valve connects with the second terminal of the indoor machine.

[0099] The outdoor side fan is configured to drive the outdoor air to flow through the first heat exchanger.

[0100] The indoor machine further includes an indoor side fan used to drive indoor return air to flow through the second heat exchanger and the third heat exchanger.

[0101] Herein the S603 includes:

The first terminal and the second terminal of the four way reversing valve connects, and the third and the fourth terminal of the four way reversing valve connects. The refrigerant flows orderly through the second terminal of the four way reversing valve, the first heat exchanger, the first electronic expansion valve, the second stop valve, the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve, the third heat exchanger, the first stop valve, the fourth terminal of the four way reversing valve, and enters into the inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator.

[0102] Herein, in refrigerating mode, the first electronic expansion valve and the third electronic expansion valve are fully open, and the second electronic expansion valve throttles. The first heat exchanger is a condenser, and the second heat exchanger and the third heat exchanger are both evaporators. The lower temperature air from the indoor machine cools down the indoor. The opening of the second electronic expansion valve is controlled according to the difference between the temperatures acquired by the second temperature sensor and the first temperature sensor.

[0103] In dehumidification without refrigerating mode, the first electronic expansion valve and the second electronic expansion valve are fully open, and the third electronic expansion valve throttles. The first heat exchanger and the second heat exchanger are both condensers, and the third heat exchanger is an evaporator. Part of the return air through the indoor machine is heated up by the second heat exchanger, and the other part is dehumidified and refrigerated by the third heat exchanger. The processed hot and cold air is mixed and sent indoor. The opening of the third electronic expansion valve is controlled according to the difference between the temperatures acquired by the second temperature sensor and the third temperature sensor.

[0104] S604. Refrigerant output by the fourth terminal of the switching component connected with the first terminal is driven to flow orderly through the third heat exchanger, the third electronic expansion valve, the second heat exchanger and the second electronic expansion valve, flows back to the second terminal of the switching component through a second stop valve and the first heat exchange component and then is output from the third terminal of the switching component.

[0105] Herein, S604 includes:

The first terminal and the fourth terminal of the four way reversing valve connects, and the second and the third terminals connects. The refrigerant flows orderly through the fourth terminal of the four way reversing valve, the first stop valve, the third heat exchanger, the third electronic expansion valve, the second heat exchanger, the second electronic expansion valve, the second stop valve, the first electronic expansion valve, the first heat exchanger, the second terminal of the four way reversing valve, and enters into the inlet of the compressor from the third terminal of the four way reversing valve, through the gas liquid separator.

[0106] Herein, the third electronic expansion valve is fully open, and the first electronic expansion valve and the second electronic expansion valve throttles. The first heat exchanger is an evaporator, and the second heat exchanger and the third heat exchanger are both condensers. The higher temperature air from the indoor machine heats up the indoor. The opening of the second electronic expansion valve is controlled by the difference between the condensation temperature of the high pressure refrigerant and the temperature acquired by the first temperature sensor.

[0107] Obviously, those skilled in this art can make any changes and modifications to the embodiments herein of this disclosure without altering the spirit or falling out of the scope. If so, such changes or modifications to this disclosure shall be within the scope of the claims herein or be equivalent thereto, and this disclosure shall include such changes or modifications.

Claims

1. A multi-connected heat pump air conditioner system, wherein the system comprises: an outdoor machine and an indoor machine, wherein:

the outdoor machine comprises: a controlling component, a confluence component, a switching component, and a first heat exchange component;

the indoor machine comprises: an indoor side fan, a second electronic expansion valve, a second heat exchanger, a third electronic expansion valve and a third heat exchanger;

the controlling component is configured to control a first heat exchanger in the first exchange component to be condenser, and the second heat exchanger and the third heat exchanger in the indoor machine both to be evaporators, when the multi-connected heat pump air conditioner system is in a refrigerating mode; and to control the first heat exchanger in the first heat exchange component to be evaporator, and the second heat exchanger and third heat exchanger of the indoor machine both to be condensers, when the multi-connected heat pump air conditioner system is in a heating mode; and to control the first heat exchanger in the first heat exchange component and second heat exchanger of the indoor machine to be both condensers, and the third heat exchanger of the indoor machine to be evaporator, when the multi-connected heat pump air conditioner system is in dehumidification without refrigerating mode;

the switching component is configured to control the first terminal and the second terminal of the switching component to connect, and the third and the fourth terminal of the switching component to connect, wherein the first terminal of the switching component receives output from the confluence component, which is output to the first heat exchange component by the second terminal, the fourth terminal receives the output from the indoor machine which is output to the confluence component by the third terminal, when the multi-connected heat pump air conditioner system is in dehumidification without refrigerating mode; and the switching component is configured to control the first terminal and the fourth terminal of the switching component to connect, and the second and the third terminal of the switching component to connect, wherein the first terminal receives the output from the confluence component which is output to a first terminal of the indoor machine by the fourth terminal, the second terminal receives the output from the first heat exchange component which is output to the confluence component by the third terminal, when the multi-connected heat pump air conditioner system is in heating mode;

the confluence component is configured to output the refrigerant to the switching component after liquid-gas separating and compressing the refrigerant output by the switching component;

the first heat exchange component is configured to drive outdoor air to flow through the first exchanger in the first heat exchange component, the first terminal of the first heat exchange component connects with the second terminal of the switching component, and the other terminal of the first heat exchange component connects with the second terminal of the indoor machine;

one terminal of the second electronic expansion valve connects to other terminal of the second stop valve, and other terminal of the second electronic expansion valve connects with one terminal of the second heat exchanger;

other terminal of the second heat exchanger connects with one terminal of the third electronic expansion valve;

other terminal of the third electronic expansion valve connects with one terminal of the third heat exchanger;

other terminal of the third exchanger connects with other terminal of the first stop valve;

the indoor side fan is configured to drive indoor return air to flow through the second heat exchanger and the third heat exchanger.

2. The system of claim 1, wherein the switching component comprises a four way reversing valve and a first stop valve, wherein:

a first terminal of the four way reversing valve connects with an output terminal of the confluence component, a second terminal of the four way reversing valve connects with an input terminal of the first heat exchange component, a third terminal of the four way reversing valve connects with an input terminal of the confluence component, and a fourth terminal of the four way reversing valve connects with one terminal of the first stop valve, other terminal of the first stop valve connects with a first terminal of the indoor machine.

3. The system of claim 2, wherein the confluence component comprises: a compressor, a one way valve, and a gas liquid separator, wherein:

an output terminal of the compressor connects with an input terminal of the one way valve, an output terminal of the one way valve connects with one terminal of the four way reversing valve, an input terminal of the gas liquid separator connects with the third terminal of the four way reversing valve, an output terminal of gas liquid separator connects with the input terminal of the compressor.

4. The system of claim 3, wherein the first heat exchange component comprises: a first heat exchanger, an outdoor side fan, a first electronic expansion valve, and a second stop valve, wherein:

one terminal of the first heat exchanger connects with a second terminal of the four way reversing valve, and other terminal of the first heat exchanger connects with one terminal of the first electronic expansion valve;
other terminal of the first electronic expansion valve connects with one terminal of the second stop valve;
other terminal of the second operation valve connects with a second terminal of the indoor machine;
the outdoor side fan is configured to drive outdoor air through the first heat exchanger.

5. The system of claim 4, wherein the compressor consists of one or more constant speed compressors, or consists of variable speed compressors, or consisits of constant speed compressors and variable speed compressors.

6. The system of claim 4, wherein:

the outdoor side fan is an axial flow fan, and the indoor side fan is a centrifugal fan or a perfusion fan.

7. The system of claim 4, wherein the first heat exchanger, the second heat exchanger and the third heat exchanger are aluminum foil finned copper tube heat exchangers or aluminum finned micro-tube heat exchangers.

8. The system of claim 4, wherein the second heat exchanger is located above the third heat exchanger.

9. The system of any one of claims 1 to 8, wherein the indoor machine further comprises: a first temperature sensor, a second temperature sensor, and a third temperature sensor, wherein:

the first temperature sensor is located on a refrigerant pipeline, between the second electronic expansion valve and the second heat exchanger, and which is close to one terminal of the second heat exchanger;
the second temperature sensor is located on a refrigerant pipeline, between the third heat exchanger and the first stop valve, and which is close to one terminal of the third heat exchanger;
the third temperature sensor is located on a refrigerant pipeline, between the third electronic expansion valve and the third heat exchanger, and which is close to one terminal of the third heat exchanger.

10. The system of claim 9, wherein the refrigerant is output into the one way valve by the outlet of the compressor, and a high pressure refrigerant gas output by the one way valve enters into the first terminal of the four way reversing valve;
when the multi-connected heat pump air conditioner system is in refrigerating mode and dehumidification without refrigerating mode:

the first terminal and the second terminal of the four way reversing valve connects, and the third terminal and the fourth terminal of the four way reversing valve connects, the refrigerant flows orderly through the second terminal of the four way reversing valve, the first heat exchanger, the first electronic expansion valve, the second stop valve, the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve, the third heat exchanger, the first stop valve, the fourth terminal of the four way reversing valve, and enters into an inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator;

when the multi-connected heat pump air conditioner system is in heating mode:

the first terminal and the fourth terminal of the four way reversing valve connects, and the second terminnal and the third terminal of the four way reversing valve connects. The refrigerant flows orderly through the fourth terminal of the four way reversing valve, the first stop valve, the third heat exchanger, the third electronic expansion valve, the second heat exchanger, the second electronic expansion valve, the second stop valve, the first electronic expansion valve, the first heat exchanger, the second terminal of the four way reversing valve, and enters into an inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator.

11. The system of claim 10, wherein:

in refrigerating mode, the first electronic expansion valve and the third electronic expansion valve are fully open, and the second electronic expansion valve throttles; the first heat exchanger works as a condenser, and the second heat exchanger and the third heat exchanger both work as evaporators, a low temperature air from the indoor machine cools down the indoor,the opening of the second electronic expansion valve is controlled by the difference between the temperatures acquired by the second temperature sensor and the first temperature sensor;

in dehumidification without refrigerating mode, the first electronic expansion valve and the second electronic expansion valve are fully open, and the third electronic expansion valve throttles, the first heat exchanger and the second heat exchanger both work as condensers, and the third heat exchanger work as the evaporator, part of the return air through the indoor machine is heated up by the second heat exchanger, and other part of the return air through the indoor component is dehumidified and refrigerated by the third heat exchanger, the processed hot and cold air is mixed and sent indoor, the opening of the third electronic expansion valve is controlled by the difference between the temperatures acquired by the second temperature sensor and the third temperature sensor;

in heating mode, the third electronic expansion valve is fully open, and the first electronic expansion valve and the second electronic expansion valve throttle, the first heat exchanger works as evaporator, and the second heat exchanger and the third heat exchanger both work as condensers, a high temperature air from the indoor machine heats up the indoor; the opening of the second electronic expansion valve is controlled by the difference between the condensation temperature of the high pressure refrigerant and the temperature acquired by the first temperature sensor.

12. The system of claim 9, wherein the indoor machine further comprises: a fourth heat exchanger and a fifth heat exchanger, wherein:

the second heat exchanger and the third heat exchanger form a heat exchanger group, and the fourth heat exchanger and the fifth heat exchanger form another heat exchanger group, the two heat exchanger groups are connected by sheet metal component to form a V shape heat exchanger.

13. The system of claim 12, wherein other terminal of the second heat exchanger is connected with one terminal of the fourth heat exchanger;

other terminal of the fourth heat exchanger is connected with one terminal of the third electronic expansion valve;

other terminal of the third electronic expansion valve is connected with one terminal of the third heat exchanger;

other terminal of the third heat exchanger is connected with one terminal of the fifth heat exchanger;

other terminal of the fifth heat exchanger connects with other terminal of the stop valve, the second temperature sensor is located on a refrigerant pipeline, between the fifth heat exchanger and the first stop valve, and which is close to one terminal of the fifth heat exchanger.

14. The system of claim 13, wherein in dehumidification without refrigerating mode, the refrigerant flows orderly through the second electronic expansion valve, the second heat exchanger, the fourth heat exchanger, the third electronic expansion valve, the third heat exchanger and the fifth heat exchanger, the second electronic expansion valve is fully open and the third electronic expansion valve throttles, the second heat exchanger and the fourth heat exchanger both work as condensers, and third heat exchanger and the fifth heat exchanger both work as evaporators; the air from the second heat exchanger is hot air, from the third heat exchanger is cold air, from the fourth heat exchanger is hot air, from the fifth heat exchanger is cold air, and such hot and cold air are mixed and sent out.

15. The system of claim 9, wherein the third electronic expansion valve is consisted of a heat expansion valve and a electromagnetic valve in parallel connection, the temperature sensor bundle of the heat expansion valve is located between the first stop valve and the third heat exchanger, and is close to the refrigerant pipeline to one terminal of the third heat exchanger, wherein:

when the electromagnetic valve is open, the third electronic expansion valve is fully open, when the electromagnetic valve is closed and the heat expansion valve regulates, the third electronic expansion valve throttles, the opening of the heat expansion valve is controlled according to the temperature acquired by the temperature sensor bundle.

16. A method to control a multi-connected heat pump air conditioner system, comprising:

A. A confluence component of an outdoor machine outputs a refrigerant to a first terminal of the switching component, after receiving the refrigerant output by the third terminal of the switching component and performing a gas-liquid separation and compression to the refrigerant;
Determining the current mode of the multi-connected heat pump air conditioner system;
B. If the multi-connected heat pump air conditioner system is in refrigeration mode and dehumidification without refrigeration mode, the refrigerant output by the second terminal of the switching component connected with the first terminal is driven to flow orderly through the first heat exchange component, and the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve and the third heat exchanger of the indoor machine, and the refrigenant flow back to the fourth terminal of the switching component through the first stop valve and then is output from the third terminal of the switching component;
C. If the multi-connected heat pump air conditioner system is in heating mode, the refrigerant output by the fourth terminal of the switching component is driven to flow orderly through the third heat exchanger, the third electronic expansion valve, the second heat exchanger and the second electronic expansion valve of the indoor machine, and flows back to the second terminal of the switching component through a second stop valve and the first heat exchange component and then is output from the third terminal of the switching component.

17. The method of claim 16, wherein the switching component comprises a four way reversing valve and a first stop valve, wherein:

a first terminal of the four way reversing valve connects with an output terminal of the confluence component, a second terminal of the four way reversing valve connects with an input terminal of the first hear exchange component, a third terminal of the four way reversing valve connects with the input terminal of the confluence component, and a fourth terminal of the four way reversing valve connects with one terminal of the first stop valve, the other terminal of the first stop valve connects with the first terminal of the indoor machine;
the confluence component comprises: a compressor, a one way valve, and a gas liquid separator, wherein:

an output terminal of the compressor connects with an input terminal of the one way valve, an output terminal of the one way valve connects with one terminal of the four way reversing valve, an input terminal of the gas liquid separator connects with the third terminal of the four way reversing valve, an output terminal of gas liquid separator connects with an input terminal of the compressor;
the first heat exchange component comprises: a first heat exchanger, an outdoor side fan, a first electronic expansion valve, and a second stop valve, wherein:

one terminal of the first heat exchange component connects with the second terminal of the four way reversing valve, and the other terminal connects with one terminal of the first electronic expansion valve;
other terminal of the first electronic expansion valve connects with one terminal of the second stop valve;
other terminal of the second operation valve connects with the second terminal of the indoor machine;
the outdoor side fan is used to drive outdoor air through the first heat exchanger
the indoor machine further comprises an indoor side fan used to drive indoor return air through the second heat exchanger and the third heat exchanger.

18. The method of claim 17, wherein the Operation B further comprises:

the first terminal and the second terminal of the four way reversing valve connects, and the third and the fourth terminal of the four way reversing valve connects, the refrigerant flows orderly through the second terminal of the four way reversing valve, the first heat exchanger, the first electronic expansion valve, the second stop valve, the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve, the third heat exchanger, the first stop valve, the fourth terminal of the four way reversing valve, and enters into an inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator;

wherein, in refrigerating mode, the first electronic expansion valve and the third electronic expansion valve are fully open, and the second electronic expansion valve throttles, the first heat exchanger works as a condenser, and the second heat exchanger and the third heat exchanger both works as evaporators, the lower temperature air from the indoor machine cools down the indoor, the opening of the second electronic expansion valve is controlled according to the difference between the temperatures acquired by the second temperature sensor and the first temperature sensor;

in dehumidification without refrigerating mode, the first electronic expansion valve and the second electronic expansion valve are fully open, and the third electronic expansion valve throttles, the first heat exchanger and the second heat exchanger both work as condensers, and the third heat exchanger works as evaporator, part of the return air through the indoor machine is heated up by the second heat exchanger, and the other part is dehumidified and refrigerated by the third heat exchanger, the processed hot and cold air is mixed and sent indoor; the opening of the third electronic expansion valve is controlled according to the difference between the temperatures acquired by the second temperature sensor and the third temperature sensor.

19. The method of claim 17, wherein the Operation C further comprises:

the first terminal and the fourth terminal of the four way reversing valve connects, and the second and the third terminal of the four way reversing valve connects, the refrigerant flows orderly through the fourth terminal of the four way reversing valve, the first stop valve, the third heat exchanger, the third electronic expansion valve, the second heat exchanger, the second electronic expansion valve, the second stop valve, the first electronic expansion valve, the first heat exchanger, the second terminal of the four way reversing valve, and enters into an inlet of the compressor from the third terminal of the four way reversing valve through the gas liquid separator;

wherein, the third electronic expansion valve is fully open, and the first electronic expansion valve and the second electronic expansion valve throttle, the first heat exchanger works as an evaporator, and the second heat exchanger and the third heat exchanger both work as condensers, the high temperature air from the indoor machine heats up the indoor; the opening of the second electronic expansion valve is controlled according to the difference between the condensation temperature of the high pressure refrigerant and the temperature acquired by the first temperature sensor.

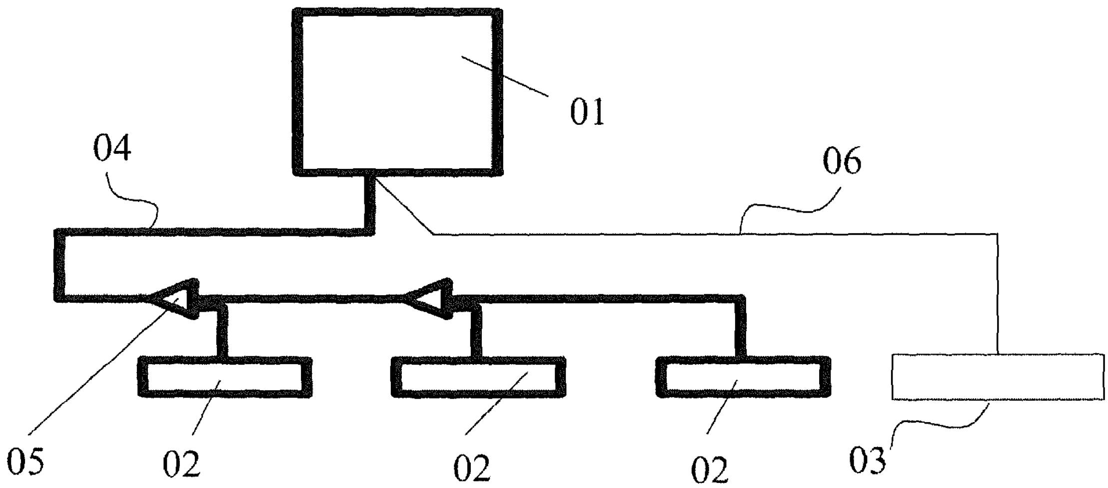

01
04
06
05
02
02
02
03

Fig.1

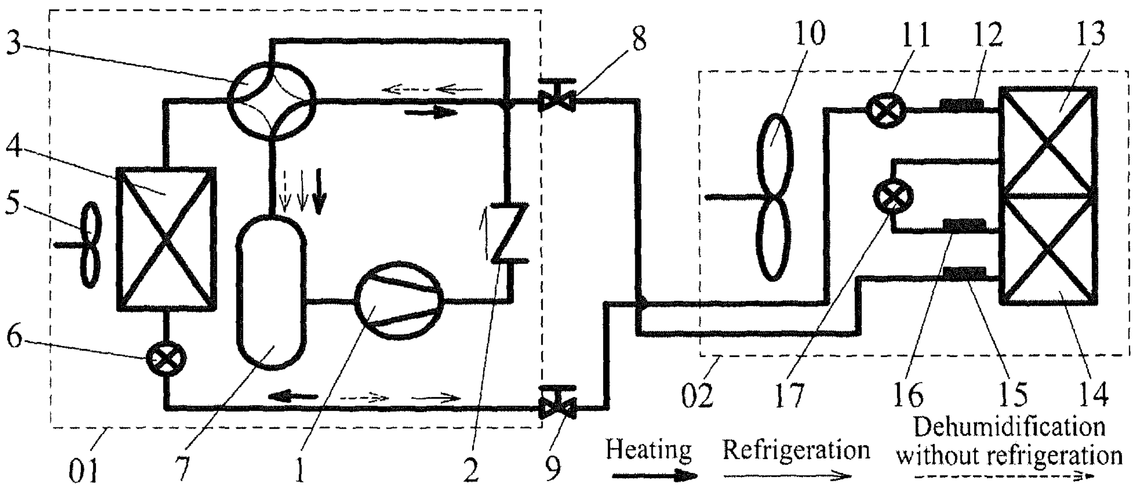
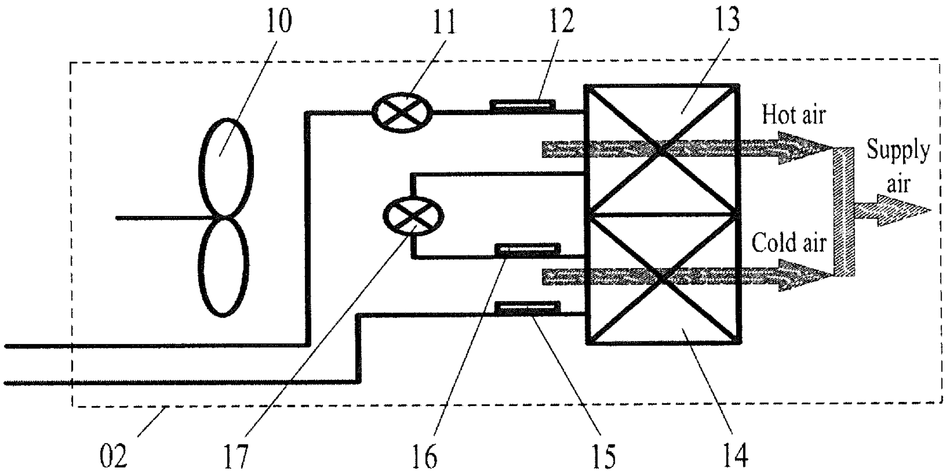

3
4
5
6
8
10
11
12
13
01
7
1
2
9
02
17
16
15
14
Heating
Refrigeration
Dehumidification without refrigeration

Fig.2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13
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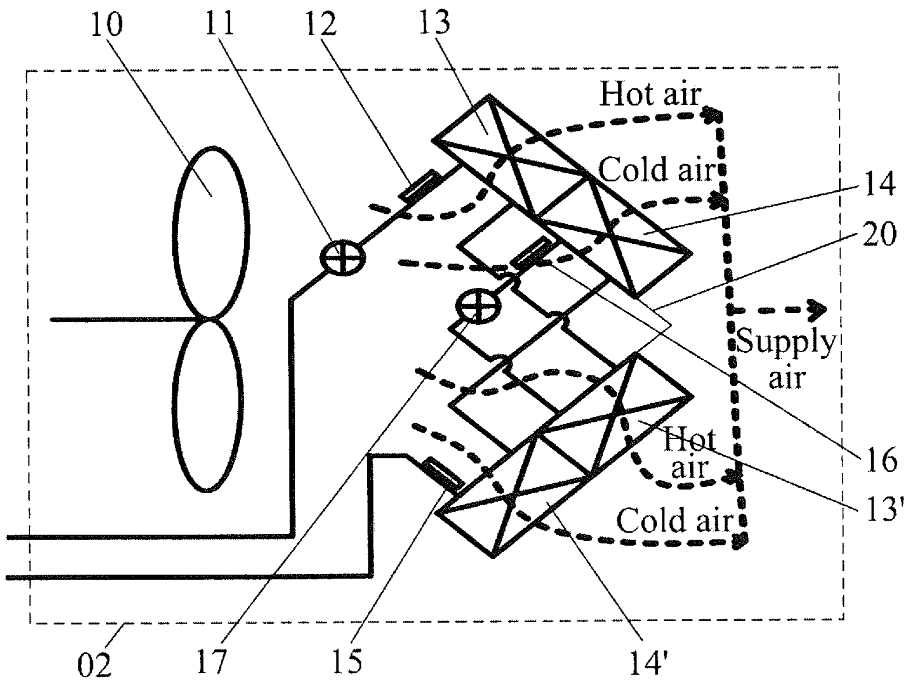
Supply
air
Cold air
02
17
16
15
14

Fig.3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11
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Cold air
14
20
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air
Hot
air
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13'
Cold air
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15
14'

Fig.4

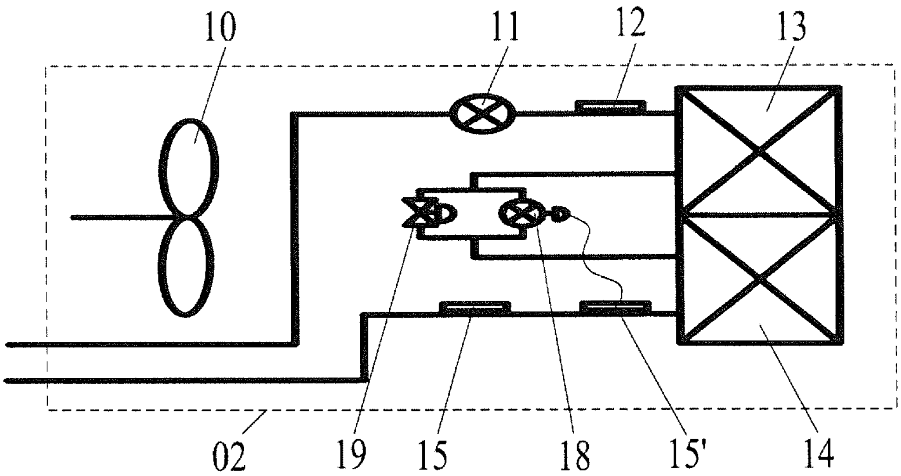

Fig.5

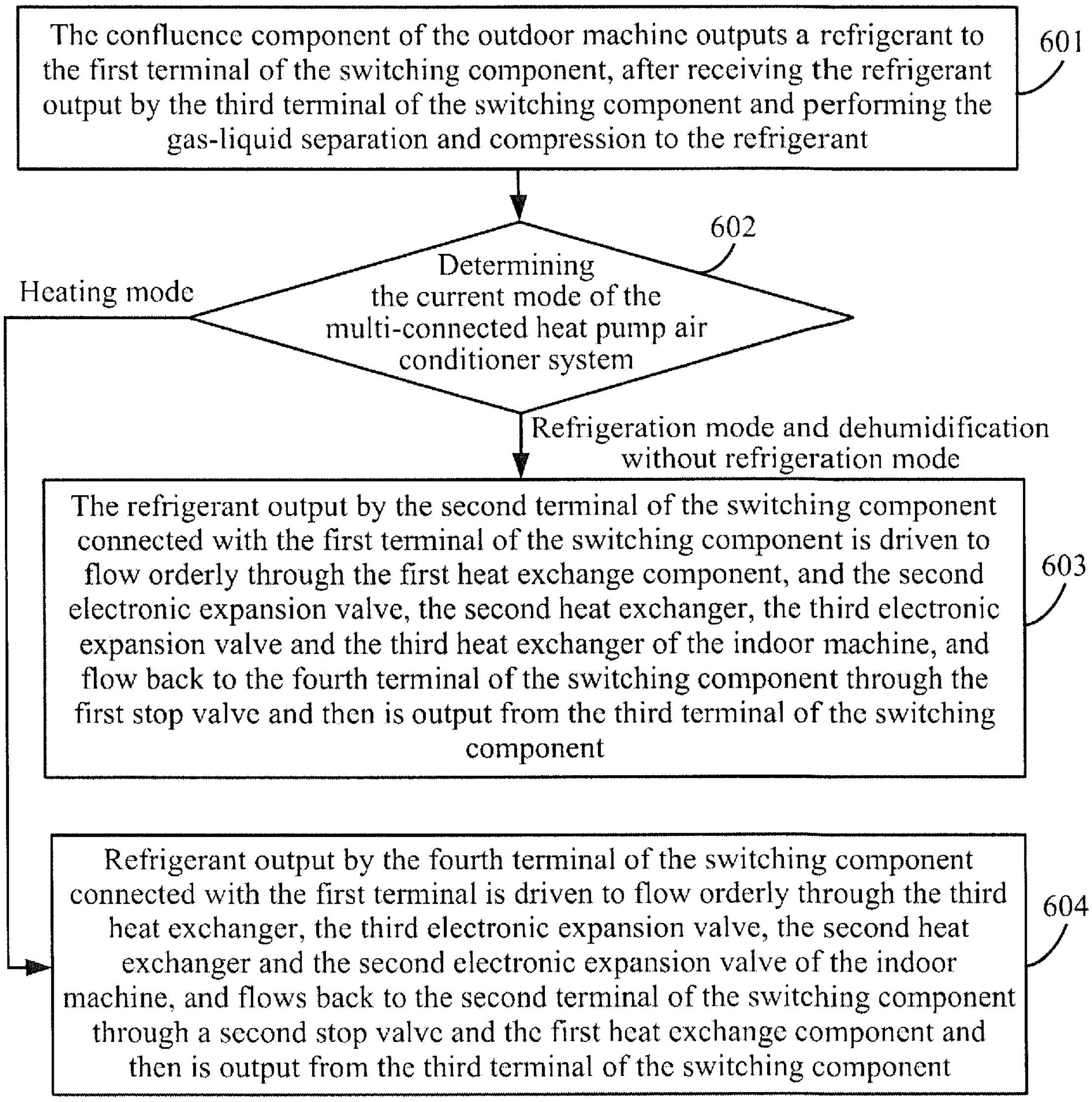
The confluence component of the outdoor machine outputs a refrigerant to the first terminal of the switching component, after receiving the refrigerant output by the third terminal of the switching component and performing the gas-liquid separation and compression to the refrigerant
601
Determining the current mode of the multi-connected heat pump air conditioner system
602
Heating mode
Refrigeration mode and dehumidification without refrigeration mode
The refrigerant output by the second terminal of the switching component connected with the first terminal of the switching component is driven to flow orderly through the first heat exchange component, and the second electronic expansion valve, the second heat exchanger, the third electronic expansion valve and the third heat exchanger of the indoor machine, and flow back to the fourth terminal of the switching component through the first stop valve and then is output from the third terminal of the switching component
603
Refrigerant output by the fourth terminal of the switching component connected with the first terminal is driven to flow orderly through the third heat exchanger, the third electronic expansion valve, the second heat exchanger and the second electronic expansion valve of the indoor machine, and flows back to the second terminal of the switching component through a second stop valve and the first heat exchange component and then is output from the third terminal of the switching component
604

Fig.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/083981

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F24F 3, F24F 11

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)

CNPAT, CNKI, WPI, EPODOC: non-cooling, interior heat transfer, air condition+, constant temperature, dehumidif+, evaporator, indoor, interior, heat exchang+, heat transfer+, two, several, multiple

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 1286376 A (HAIER GROUP CORP. et al.), 07 March 2001 (07.03.2001), description, page 1, lines 18-26, and page 2, line 5 to page 3, line 11, and figure 1	1-19
X	CN 1109156 A (MITSUBISHI HEAVY INDUSTRIES, LTD.), 27 September 1995 (27.09.1995), the whole document	1-19
X	CN 1427216 A (LG ELECTRONICS (TIANJIN) APPLIANCE CO., LTD.), 02 July 2003 (02.07.2003), the whole document	1-19
X	JP 11304285 A (HITACHILTD), 05 November 1999 (05.11.1999), the whole document	1-19
X	JP 2203172 A (MATSUSHITA ELECTRIC IND CO., LTD.), 13 August 1990 (13.08.1990), the whole document	1-19
A	JP 2004163052 A (DAIKIN KOGYO KK), 10 June 2004 (10.06.2004), the whole document	1-19

☐ 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
26 March 2013 (26.03.2013)	**18 July 2013 (18.07.2013)**

Name and mailing address of the ISA/CN	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	**ZHONG, Dehui** Telephone No.: (86-10) **62084834**

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/083981

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 1286376 A	07.03.2001	CN 1125277 C	22.10.2003
CN 1109156 A	27.09.1995	CN 1062949 C	07.03.2001
CN 1427216 A	02.07.2003	CN 1189705 C	16.02.2005
JP 11304285 A	05.11.1999	None	
JP 2203172 A	13.08.1990	None	
JP 2004163052 A	10.06.2004	JP 4288934 B2	01.07.2009

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/083981

CLASSIFICATION OF SUBJECT MATTER

F24F 3/14 (2006.01) i

F24F 11/00 (2006.01) i

F25B 5/02 (2006.01) i

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