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(54) MULTI-SPLIT AIR CONDITIONER CAPABLE OF REFRIGERATING AND HEATING SIMULTANEOUSLY

(57) Disclosed is a multi-split air conditioner capable of refrigerating and heating simultaneously. A heating circuit consists of a compressor(1), an oil-gas separator (2), a four-way valve(3), indoor heat exchanging systems (12,16,21,22), an outdoor heat exchanger(7), a four-way valve(3), and a gas-liquid separator(26) connected in series along the refrigerant flow direction. A refrigerating circuit consist of a compressor(1), an oil-gas separator (2), a four-way valve(3), an outdoor heat exchanger(7), indoor heat exchanging systems(12,16,21,22), and a gas-liquid separator(26) connected in series along the refrigerant flow direction. A parallel pipeline is arranged at a pipeline between the outdoor heat exchanger(7) and the indoor heat exchanging systems(12,16,21,22), and is utilized for connecting an second electronic expansion valve(8) with a second one-way valve(9) in parallel. A series pipeline is arranged with a third control valve(5) and a third one-way valve(6). An end of the series pipeline is connected to the pipeline between the four-way valve (3) and the outdoor heat exchanger(7), and another end of the series pipeline is connected to the pipeline between a first one-way valve(4) and the indoor exchanging systems(12,16,21,22). Five operation modes, i.e. single refrigerating, single heating, mainly refrigerating, mainly heating, simultaneous refrigerating and heating, can be realized in the multi-split air conditioner capable of refrigerating and heating simultaneously.

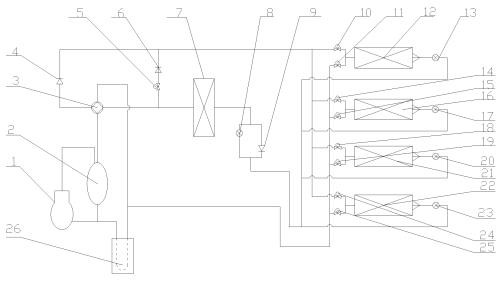

Figure 1

EP 2 589 889 A1

Description

[0001] The present application claims the priority of Chinese Patent Application No. 201010214957.8, titled "MULTI-SPLIT AIR CONDITIONER CAPABLE OF REFRIGERATING AND HEATING SIMULTANEOUSLY", filed with the Chinese State Intellectual Property Office on June 29, 2010, the entire disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present application relates to the field of air-conditioning equipment, and specifically to a multi-split air conditioner capable of refrigerating and heating simultaneously.

BACKGROUND OF THE INVENTION

[0003] An air conditioning device is referred to as an air conditioner. A wall-mounted air conditioner is a unit for providing conditioned air into a spatial region (generally being closed), and has a function of adjusting various parameters, such as temperature, humidity, purity and air flowing rate, of air in a room (or a closed space or region) so as to meet requirements for human comfort or manufacturing processes. The working principle of the air conditioner is as follows: gaseous refrigerant is compressed by a compressor into liquid refrigerant with high temperature and high pressure which is in turn transported to a condenser (an outdoor unit) for dissipating heat and then becomes liquid refrigerant with ambient temperature and high pressure, such that hot air is blown out from the outdoor unit; and due to a component referred to as a four-way valve, the flow direction of the refrigerant between the condenser and an evaporator in heating process is opposite to that in refrigerating process, such that in heating process, cold air is blown out from the outdoor unit and hot air is blown out from an indoor unit.

[0004] A multi-split air conditioner refers to an air conditioner having a plurality of indoor units and a single outdoor unit. At present, the conventional multi-split air conditioner can only provide cooling or heating solely at a time. However, in some special offices or hotels, the air conditioner may be also required to operate in refrigerating mode in winter. Thus, there is a need for developing a multi-split air conditioner capable of refrigerating and heating simultaneously in different offices.

SUMMARY OF THE INVENTION

[0005] In view of the above disadvantages, the technical problem to be solved by the present application is to provide a multi-split air conditioner capable of refrigerating and heating simultaneously, which may operate in five modes of refrigerating solely, heating solely, refrigerating mainly, heating mainly, and refrigerating-heating equally.

[0006] In order to solve the above technical problem, a multi-split air conditioner capable of refrigerating and heating simultaneously according to the present application includes a compressor, an oil-gas separator, a four-way valve, an outdoor heat exchanger, at least two indoor heat exchanging mechanisms and a gas-liquid separator, wherein:

the oil-gas separator and the compressor are connected via an oil return pipeline;

each of the indoor heat exchanging mechanisms includes an indoor heat exchanger and a first electronic expansion valve, and the indoor heat exchanger and the first electronic expansion valve are connected in serial;

the indoor heat exchanging mechanisms are connected in parallel to form an indoor heat exchanging system;

a heating loop is formed by connecting the compressor, the oil-gas separator, the four-way valve, the indoor heat exchanging system, the outdoor heat exchanger, the four-way valve and the gas-liquid separator in sequence in a refrigerant flowing direction, and a first control valve is provided on a connecting pipeline between the four-way valve and each of the indoor heat exchangers;

a heating loop is formed by connecting the compressor, the oil-gas separator, the four-way valve, the outdoor heat exchanger, the indoor heat exchanging system and the gas-liquid separator in sequence in a refrigerant flowing direction, and a second control valve is provided on a connecting pipeline between the gas-liquid separator and each of the indoor heat exchangers;

a first one-way valve is provided on a connecting pipeline between the four-way valve and the indoor heat exchanging system;

a parallel pipeline is provided between the outdoor heat exchanger and the indoor heat exchanging system, and the parallel pipeline is formed by connecting a second electronic expansion valve and a second one-way valve in parallel; and

in addition to the parallel pipeline, a serial pipeline is further included and is provided with a third control valve and a third one-way valve, and the serial pipeline includes one end connected to a pipeline between the four-way valve and the outdoor heat exchanger, and the other end connected to a pipeline between the first one-way valve and the indoor heat exchanging system.

[0007] Preferably, the first control valve, the second control valve and the third control valve each are an electromagnetic valve.

[0008] Preferably, the compressor is an inverter compressor.

[0009] Compared with the prior art, the multi-split air conditioner capable of refrigerating and heating simultaneously according to the present application may be operated in five modes, i.e., solely refrigerating mode, solely heating mode, mainly refrigerating mode, mainly heating mode, and equally refrigerating-heating mode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a structural schematic view of a multi-split air conditioner capable of refrigerating and heating simultaneously according to a preferred embodiment of the present application.

DETAILED DESCRIPTION

[0011] In order that those skilled in the art can understand technical solutions of the present application better, the present application will be described below in conjunction with specific embodiments.

[0012] A multi-split air conditioner capable of refrigerating and heating simultaneously according to the present application includes an inverter compressor, an oil-gas separator, a four-way valve, an outdoor heat exchanger, four indoor heat exchanging mechanisms and a gas-liquid separator, wherein:

the oil-gas separator and the inverter compressor are connected via an oil return pipeline;

each of the indoor heat exchanging mechanisms includes an indoor heat exchanger and a first electronic expansion valve, and the indoor heat exchanger and the first electronic expansion valve are connected in serial;

the indoor heat exchanging mechanisms are connected in parallel to form an indoor heat exchanging system;

a heating loop is formed by connecting the inverter compressor, the oil-gas separator, the four-way valve, the indoor heat exchanging system, the outdoor heat exchanger, the four-way valve and the gas-liquid separator in sequence in a refrigerant flowing direction, and a first electromagnetic valve is provided on a connecting pipeline between the four-way valve and each of the indoor heat exchangers;

a heating loop is formed by connecting the inverter compressor, the oil-gas separator, the four-way valve, the outdoor heat exchanger, the indoor heat exchanging system and the gas-liquid separator in sequence in a refrigerant flowing direction, and a second electromagnetic valve is provided on a connecting pipeline between the gas-liquid separator and each of the indoor heat exchangers;

a first one-way valve is provided on a connecting pipeline between the four-way valve and the indoor heat exchanging system;

a parallel pipeline is provided between the outdoor heat exchanger and the indoor heat exchanging system, and the parallel pipeline is formed by connecting a second electronic expansion valve and a second one-way valve in parallel; and

in addition to the parallel pipeline, a serial pipeline is further included and is provided with a third electromagnetic valve and a third one-way valve, and the serial pipeline includes one end connected to a pipeline between the four-way valve and the outdoor heat exchanger, and the other end connected to a pipeline between the first one-way valve and the indoor heat exchanging system.

[0013] Referring to Fig. 1, a structural schematic view of a multi-split air conditioner capable of refrigerating and heating simultaneously according to a preferred embodiment of the present application is shown.

[0014] The embodiment is described by taking the four indoor heat exchanging mechanisms as an example.

[0015] The multi-split air conditioner capable of refrigerating and heating simultaneously according to the present application may operates in five modes, i.e., solely refrigerating mode, solely heating mode, mainly refrigerating mode, mainly heating mode, and equally refrigerating-heating mode. The specific operating principle and process of the air conditioner according to the present application will be described below.

SOLELY REFRIGERATING MODE

[0016] When refrigerating solely, a third electromagnetic valve 5 and first electromagnetic valves 10, 14, 18 and 24 are closed, while second electromagnetic valves 11, 15, 19 and 25 are opened. Refrigerant is compressed by an inverter compressor 1, and then refrigerant gas with high temperature and high pressure enters into an oil-gas separator 2, passes through a four-way reversing valve 3 into an outdoor heat exchanger 7, and then passes through a second one-way valve 9 and first electronic expansion valves 13, 17, 20 and 23, such that the refrigerant with high temperature and high pressure is throttled and the pressure thereof is reduced. Then refrigerant liquid with low pressure flows into indoor heat exchangers 12, 16, 21 and 22, such that refrigerant liquid is vaporized and the heat thereof is absorbed, then refrigerant passes through the second electromagnetic valves 11, 15, 19

and 25 into a gas-liquid separator 26, and then returns to the inverter compressor 1.

MAINLY REFRIGERATING MODE

[0017] When refrigerating mainly, a number of the indoor heat exchangers operating in the refrigerating mode is larger than a number of the indoor heat exchangers operating in the heating mode. The second electromagnetic valve 11 (if one of the second electromagnetic valves 11, 15, 19 and 25 is closed, the corresponding one of the second electromagnetic valves 10, 14, 18 and 24 shall be opened) and the second electromagnetic valves 14, 18 and 24 are closed, while the third electromagnetic valve 5, the first electromagnetic valve 10 and the second electromagnetic valves 15, 19 and 25 are opened. Refrigerant is compressed by the inverter compressor 1, and then refrigerant gas with high temperature and high pressure enters into the oil-gas separator 2, and passes through the four-way reversing valve 3; then a part of the refrigerant gas with high temperature and high pressure passes through the third electromagnetic valve 5, a third one-way valve 6 and the first electromagnetic valve 10, and then radiates heat indoors via the indoor heat exchanger 12, thereby achieving the heating purpose. Then refrigerant liquid with reduced temperature flows through the first electric expansion valve 13 opened fully and then joins refrigerant liquid with lowered temperature that is formed by the other part of the refrigerant gas with high temperature and high pressure flowing through the outdoor heat exchanger 7. The joined refrigerant liquid flows through the first electric expansion valves 17, 20 and 23, such that the refrigerant liquid is throttled and the pressure thereof is reduced; then the refrigerant liquid with low pressure flows into the indoor heat exchangers 16, 21 and 22, such that the refrigerant liquid is vaporized and the heat thereof is absorbed, then the refrigerant passes through the second electromagnetic valves 15, 19 and 25 into the gas-liquid separator 26, and then returns to the inverter compressor 1.

SOLELY HEATING MODE

[0018] When heating solely, the first electromagnetic valves 10, 14, 18 and 24 are opened, while the third electromagnetic valve 5 and the second electromagnetic valves 11, 15, 19 and 25 are closed. Refrigerant is compressed by the inverter compressor 1, and then refrigerant gas with high temperature and high pressure enters into the oil-gas separator 2, flows through the four-way reversing valve 3 and the first one-way valve 4, and then passes through the first electromagnetic valves 10, 14, 18 and 24 and enters into the indoor heat exchangers 12, 16, 21 and 22 correspondingly, so as to radiate heat indoors, thereby achieving the heating purpose. Then refrigerant liquid with reduced temperature flows through the first electronic expansion valves 13, 17, 20 and 23 and the second electronic expansion valve 8, such that the refrigerant liquid is throttled and the pressure thereof is reduced; then the refrigerant liquid with low pressure flows into the outdoor heat exchanger 7, such that the refrigerant liquid is vaporized and the heat thereof is absorbed, then the refrigerant passes through the four-way reversing valve 3 and the gas-liquid separator 26, and then returns to the inverter compressor 1.

MAINLY HEATING MODE

[0019] When heating mainly, the number of the indoor heat exchangers operating in the heating mode is larger than the number of the indoor heat exchangers operating in the refrigerating mode. The second electromagnetic valve 11 (if one of the second electromagnetic valves 11, 15, 19 and 25 is opened, the corresponding one of the first electromagnetic valves 10, 14, 18 and 24 shall be closed) and the first electromagnetic valves 14, 18 and 24 are opened, while the third electromagnetic valve 5, the first electromagnetic valve 10 and the second electromagnetic valves 15, 19 and 25 are closed. Refrigerant is compressed by the inverter compressor 1, and then refrigerant gas with high temperature and high pressure enters into the oil-gas separator 2, flows through the four-way reversing valve 3 and the first one-way valve 4, and then passes through the second electromagnetic valves 14, 18 and 24 and enters into the indoor heat exchangers 16, 21 and 22 correspondingly, so as to radiate heat indoors, thereby achieving the heating purpose. Then Refrigerant liquid with reduced temperature flows through the first electronic expansion valves 17, 20 and 23, then a part of the refrigerant liquid enters into the indoor heat exchanger 12, such that the refrigerant liquid is vaporized and the heat thereof is absorbed, and then the refrigerant flows through the second electromagnetic valve 11 into the gas-liquid separator 26, and then returns to the inverter compressor 1. The other part of the remaining refrigerant liquid flows through the second electronic expansion valve 8 into the outdoor heat exchanger 7, such that the refrigerant liquid is vaporized and the heat thereof is absorbed, and then the refrigerant passes through the four-way reversing valve 3 and the gas-liquid separator 26, and then returns to the inverter compressor 1.

EQUALLY REFRIGERATING-HEATING MODE

[0020] When refrigerating and heating equally, the number of the indoor heat exchangers operating in the heating mode is equal to the number of the indoor heat exchangers operating in the refrigerating mode. The second electromagnetic valves 11 and 15 (if two of the second electromagnetic valves 11, 15, 19 and 25 are opened, the corresponding two of the first electromagnetic valves 10, 14, 18 and 24 shall be closed) and the first electromagnetic valves 18 and 24 are opened, while the third electromagnetic valve 5, the first electromagnetic valves 10 and 14, and the second electromagnetic valves 19 and 25 are closed. Refrigerant is compressed

by the inverter compressor 1, and then refrigerant gas with high temperature and high pressure enters into the oil-gas separator 2, flows through the four-way reversing valve 3 and the one-way valve 4, and then passes through the second electromagnetic valves 18 and 24 and enters into the indoor heat exchangers 21 and 22 correspondingly, so as to radiate heat indoors, thereby achieving the heating purpose. Then refrigerant liquid with reduced temperature flows through the first electronic expansion valves 20 and 23 and enters into the indoor heat exchangers 12 and 16 correspondingly, such that the refrigerant liquid is vaporized and the heat thereof is absorbed, and then the refrigerant flows through the second electromagnetic valves 11 and 15 into the gas-liquid separator 26; and then returns to the inverter compressor 1.

[0021] Compared with the prior art, the multi-split air conditioner capable of refrigerating and heating simultaneously according to the present application may be operated in five modes, i.e., solely refrigerating mode, solely heating mode, mainly refrigerating mode, mainly heating mode, and equally refrigerating-heating mode.

[0022] Certainly, the foregoing description is only directed to the preferred embodiments of the present application. It should be noted that, many improvements and modifications may be made by those skilled in the art without departing from the principle of the present application, and these improvements and modifications should be deemed to fall into the protection scope of the present application.

Claims

1. A multi-split air conditioner capable of refrigerating and heating simultaneously comprising a compressor, an oil-gas separator, a four-way valve, an outdoor heat exchanger, at least two indoor heat exchanging mechanisms and a gas-liquid separator, wherein:

   the oil-gas separator and the compressor are connected via an oil return pipeline;
   each of the indoor heat exchanging mechanisms comprises an indoor heat exchanger and a first electronic expansion valve which are connected in serial;
   the indoor heat exchanging mechanisms are connected in parallel to form an indoor heat exchanging system;
   a heating loop is formed by connecting the compressor, the oil-gas separator, the four-way valve, the indoor heat exchanging system, the outdoor heat exchanger, the four-way valve and the gas-liquid separator in sequence in a refrigerant flowing direction, and a first control valve is provided on a connecting pipeline between the four-way valve and each of the indoor heat exchangers;
   a heating loop is formed by connecting the compressor, the oil-gas separator, the four-way valve, the outdoor heat exchanger, the indoor heat exchanging system and the gas-liquid separator in sequence in a refrigerant flowing direction, and a second control valve is provided on a connecting pipeline between the gas-liquid separator and each of the indoor heat exchangers;
   a first one-way valve is provided on a connecting pipeline between the four-way valve and the indoor heat exchanging system;
   a parallel pipeline is provided between the outdoor heat exchanger and the indoor heat exchanging system, and the parallel pipeline is formed by connecting a second electronic expansion valve and a second one-way valve in parallel; and
   in addition to the parallel pipeline, a serial pipeline is further comprised and is provided with a third control valve and a third one-way valve, and the serial pipeline comprises one end connected to a pipeline between the four-way valve and the outdoor heat exchanger, and the other end connected to a pipeline between the first one-way valve and the indoor heat exchanging system.

2. The multi-split air conditioner capable of refrigerating and heating simultaneously according to claim 1, wherein the first control valve, the second control valve and the third control valve each are an electromagnetic valve.

3. The multi-split air conditioner capable of refrigerating and heating simultaneously according to claim 1, wherein the compressor is an inverter compressor.

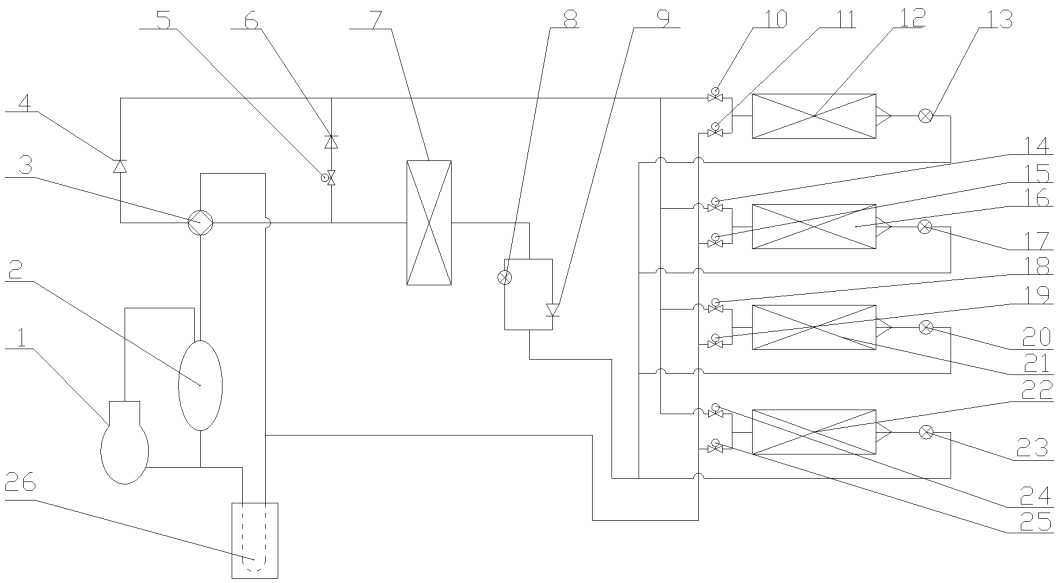

Figure 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/071673

A. CLASSIFICATION OF SUBJECT MATTER

See 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, F25B

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

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

WPI, EPODOC, CPRS, CNKI:

AIR, CONDITION+, HVAC, COOL+, HEAT+, COMPRESSOR+, VALVE, EXCHANG+, INDOOR, OUTDOOR, REFRIGERA+, PARALLEL+, MULTI+, FOUR?PORT, FOUR?WAY, GAS+, OIL, LIQUID, EXPAN+, SEPARATOR

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN1495390A (LG ELECTRONICS INC) 12 May 2004 (12.05.2004) Description page 6,line 2 to page 12, line 26 and figures 1-3B	1-3
X	US7124595B2 (KINSEISHA KK ET-AL) 24 October 2006 (24.10.2006) Description column 4,line 62 to column 11, line 67 and figures 1-6	1-3

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

* Special categories of cited documents:

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"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
10 May 2011 (10.05.2011)	**09 Jun. 2011 (09.06.2011)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer XIE, Zhun Telephone No. (86-10)62084829

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/071673

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CA2097165A1（MITSUBISHI DENKI KK ET-AL） 29 November 1993（29.11.1993） Description page 26,line 5 to page 46, line 4 and figures 1-6	1-3
PX	CN101865555A（GUANGDONG CHIGO AIR CONDITIONER CO LTD ET-AL） 20 October 2010（20.10.2010） Description paragraph 0018 to paragraph 0036 and figure 1	1-3

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2011/071673

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/071673

CLASSIFICATION OF SUBJECT MATTER:

F24F3/06 (2006.01)i
F25B13/00 (2006.01)i

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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