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(54) **AIR-CONDITIONER SYSTEM**

(57) Disclosed is an air-conditioner system, comprising a compressor (1), an indoor heat-exchanger (2), a first throttling device (3) and an outdoor heat-exchanger (4) connected in series to a main circuit, with a heat exchange device (5) being further provided in the main circuit. A pipe between the first throttling device (3) and the indoor heat-exchanger (2) serves as a first pipe M, a pipe between the first throttling device (3) and the outdoor heat-exchanger (4) serves as a second pipe N, one side of the heat exchange device (5) is connected to the first pipe M, and the other side of the heat exchange device (5) is connected to the second pipe N. The first pipe M

passes through one side of the heat exchange device (5), and the second pipe N passes through the other side of the heat exchange device (5). A refrigerant passing through the first pipe M and a refrigerant passing through the second pipe N can exchange heat in the heat exchange device (5). A first gas-liquid separator (6) is further provided in the main circuit, wherein the first gas-liquid separator (6) is located in a section of the second pipe N between the heat exchange device (5) and the outdoor heat-exchanger (4), and a bypass pipe L is provided between the first gas-liquid separator (6) and the compressor (1).

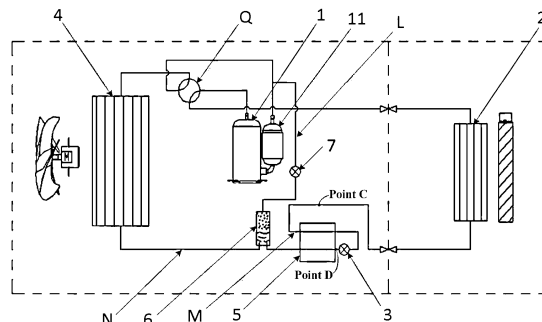


Fig. 1

Description

FIELD OF THE INVENTION

[0001] The present invention belongs to the technical field of air conditioners, and more particularly relates to an air conditioner system.

BACKGROUND OF THE INVENTION

[0002] An existing air conditioner system generally uses a condenser, a throttle device, an evaporator and a compressor to form a refrigeration/heating cycle circuit. A high-temperature high-pressure gaseous refrigerant discharged by the compressor is condensed into low-temperature high-pressure liquid in the condenser, is throttled into low-temperature low-pressure liquid through the throttle device, and then enters the evaporator to absorb heat and evaporate to finish a refrigeration/heating cycle.

[0003] During heating operation of the air conditioner, a low-temperature high-pressure liquid refrigerant is formed after the high-temperature high-pressure gaseous refrigerant exchanges heat through the condenser, and then, through throttling and pressure reduction by the throttle device, a low-temperature low-pressure gas-liquid two-phase region refrigerant is formed, and enters the evaporator for heat exchange. The greater the evaporation area is, the higher the relative evaporation capacity is. If the low-temperature high-pressure liquid refrigerant continues to release heat, the degree of supercooling will be increased, so that refrigerating and heating capacities of a system cycle are increased. When the refrigerant is exchanging heat, more than 95% heat exchange quantity comes from a vaporization latent heat quantity in its two-phase region. The isobaric specific heat capacity in a one-phase region (pure liquid or pure gas) is relatively small, and a proportion of the heat exchange quantity in the total system cycle is small. Additionally, the pressure drop of the gaseous refrigerant in a pipeline is great, is a main source of system refrigerant cycle pressure loss, and will increase the cycle work amount, that is, the energy consumption of the system cycle is increased.

[0004] Additionally, referring to Figure 3, Figure 3 is a schematic cycle diagram of a conventional air conditioner during heating operation. As shown in Figure 3, actual operation temperature points of the heating operation of the air conditioner are generally as follows: from a point A, a high-temperature gaseous refrigerant being 70°C enters an indoor heat exchanger and an indoor environment being 20°C for heat exchange to lower the temperature to 30°C, and enters the throttle device after flowing through an on-line pipe, wherein the temperature (about 30°C) between a point B and the throttle device is much higher than an outdoor environment temperature being 7°C, and afterheat is wasted. If the afterheat is absorbed and used, the degree of supercooling of the system re-

frigerant cycle can also be increased.

[0005] Based on the above, the present invention is provided.

BRIEF DESCRIPTION OF THE INVENTION

[0006] In order to solve the problems in the prior art, i.e., in order to improve a heating cycle effect of an air conditioner, an air conditioner system provided by the present invention includes a compressor, an indoor heat exchanger, a first throttle device, and an outdoor heat exchanger connected in series in a main circuit. The main circuit is also provided with a heat exchanger and a first gas-liquid separator. One side of the heat exchanger is connected to a first pipeline between the first throttle device and the indoor heat exchanger, and the other side of the heat exchanger is connected to a second pipeline between the first throttle device and the outdoor heat exchanger. A refrigerant passing through the first pipeline and a refrigerant passing through the second pipeline can exchange heat in the heat exchanger. The first gas-liquid separator is positioned in a second pipeline section between the heat exchanger and the outdoor heat exchanger. A bypass pipeline is disposed between the first gas-liquid separator and the compressor.

[0007] In an exemplary implementation of the air conditioner system, a second throttle device is disposed in the bypass pipeline. During heating operation of the air conditioner system, the second throttle device is configured to control a flow rate of a gaseous refrigerant.

[0008] In an exemplary implementation of the air conditioner system, the first pipeline passes through one side of the heat exchanger, and/or the second pipeline passes through the other side of the heat exchanger.

[0009] In an exemplary implementation of the air conditioner system, a third throttle device is also disposed in the main circuit, and the third throttle device is positioned in a first pipeline section between the heat exchanger and the indoor heat exchanger.

[0010] In an exemplary implementation of the air conditioner system, during heating operation of the air conditioner system, the third throttle device is in a fully open state, and the first throttle device is configured to throttle the refrigerant.

[0011] In an exemplary implementation of the air conditioner system, during refrigeration operation of the air conditioner system, the first throttle device is in a fully open state, and the third throttle device is configured to throttle the refrigerant.

[0012] In an exemplary implementation of the air conditioner system, the compressor is provided with a second gas-liquid separator, and the refrigerant flows back into the compressor after passing through the second gas-liquid separator.

[0013] In an exemplary implementation of the air conditioner system, the bypass pipeline is connected to an upstream of the second gas-liquid separator.

[0014] In an exemplary implementation of the air con-

ditioner system, the air conditioner system also includes a mode switching device. The mode switching device is configured to switch the air conditioner system between a refrigeration mode and a heating mode.

[0015] In an exemplary implementation of the air conditioner system, the mode switching device is a four-way valve.

[0016] In the technical schemes of the present invention, the heat exchanger is added to the air conditioner system, and the two sides of the heat exchanger are respectively connected to the first pipeline and the second pipeline. Therefore, the refrigerant in the first pipeline and the refrigerant in the second pipeline can exchange heat in the heat exchanger. Not only is the degree of supercooling of the refrigerant in the first pipeline effectively increased, but also the evaporation of the refrigerant in the second pipeline can be promoted, so that a heating capacity of the system is improved. In addition, the bypass pipeline is disposed between the first gas-liquid separator and the compressor, and the gaseous refrigerant passing through the first gas-liquid separator can enter an air suction opening of the compressor through this bypass pipeline, so that the pressure loss of this part of the gaseous refrigerant in a heating cycle is reduced, which is equivalent to that the pressure of the air suction opening of the compressor is increased, the power consumption of the compressor is further reduced, the circulation volume of the refrigerant during the heating cycle of the air conditioner system is increased, and the purpose of improving the heating capacity is achieved. Additionally, the air conditioner of the present invention is also provided with the third throttle device, so that when the air conditioner is switched to the refrigeration mode, the third throttle device is used to replace the first throttle device (at the moment, the first throttle device is in the fully open state) to throttle the refrigerant. Therefore, the occurrence of a phenomenon that a refrigeration capacity is reduced in a refrigeration cycle is avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Figure 1 is a schematic structure diagram of an embodiment 1 of an air conditioner system of the present invention.

Figure 2 is a schematic structure diagram of an embodiment 2 of the air conditioner system of the present invention.

Figure 3 is a schematic cycle diagram of a conventional air conditioner during heating operation.

DETAILED DESCRIPTION

[0018] For the purpose of making embodiments, technical schemes and advantages of the present invention more clear, clear and complete description will be made to the technical schemes of the present invention in con-

junction with drawings. Obviously, the described embodiments are merely a part of the embodiments of the present invention and not all the embodiments. It should be understood by those skilled in the art that these implementations are merely intended to explain the technical principles of the present invention and are not intended to limit the protection scope of the present invention.

[0019] Firstly, referring to Figure 1, Figure 1 is a schematic structure diagram of an embodiment 1 of the present invention. As shown in Figure 1, the air conditioner system of the present invention includes a compressor 1, an indoor heat exchanger 2, a first throttle device 3, and an outdoor heat exchanger 4 connected in series in a main circuit. The main circuit is also provided with a heat exchanger 5. For illustration purposes, a pipeline between the first throttle device 3 and the indoor heat exchanger 2 is used as a first pipeline M, and a pipeline between the first throttle device 3 and the outdoor heat exchanger 4 is used as a second pipeline N. One side of the heat exchanger 5 is connected to the first pipeline M, and the other side of the heat exchanger 5 is connected to the second pipeline N. According to a connection mode as shown in Figure 1, the first pipeline M passes through one side of the heat exchanger 5, and the second pipeline N passes through the other side of the heat exchanger N. In addition, a refrigerant passing through the first pipeline M and a refrigerant passing through the second pipeline N can exchange heat in the heat exchanger 5. Additionally, the main circuit is also provided with a first gas-liquid separator 6. The first gas-liquid separator 6 is positioned in a second pipeline N section between the heat exchanger 5 and the outdoor heat exchanger 4, and a bypass pipeline L is disposed between the first gas-liquid separator 6 and the compressor 1.

[0020] In the heating cycle process of the air conditioner, a high-temperature high-pressure gaseous refrigerant discharged by the compressor 1 flows to the indoor heat exchanger 2, and exchanges heat in the indoor heat exchanger 2 to become a low-temperature high-pressure liquid refrigerant. The refrigerant reaches a point C through the first pipeline M. At the moment, the temperature of the refrigerant is about 20°C (heat here is waste heat which is not sufficiently utilized). Then, the refrigerant enters the second pipeline N after being throttled by the first throttle device 3, and at the moment, the temperature of the refrigerant (throttled refrigerant) at a point D is about 5°C. The refrigerant in the first pipeline M and the refrigerant in the second pipeline N have temperature differences, and both pass through the heat exchanger 5, so that the refrigerant in the first pipeline M and the refrigerant in the second pipeline N exchange heat in the heat exchanger 5. Not only is the degree of supercooling of the refrigerant in the first pipeline M effectively increased (i.e., the part of refrigerant from the point C to the first throttle 3 continues to release heat to lower the temperature), but also the evaporation of the refrigerant in the second pipeline N can be promoted (i.e., the low-

temperature refrigerant at the point D can perform evaporation heat absorption on afterheat at the point C, which is equivalent to that the evaporation area is increased, and the heat exchange capability is effectively improved), so that a heating capacity is improved.

[0021] Then, the refrigerant exchanging heat through the heat exchanger 5 enters the first gas-liquid separator 6. The gaseous refrigerant separated by the first gas-liquid separator 6 directly flows back into the compressor 1 along the bypass pipeline L, so that the pressure loss of this part of the gaseous refrigerant in a heating cycle is reduced, which is equivalent to that the pressure of an air suction opening of the compressor 1 is increased, the power consumption of the compressor 1 is further reduced, the circulation volume of the refrigerant during the heating cycle of the air conditioner system is increased, and the purpose of improving the heating capacity is achieved. The liquid refrigerant passing through the first gas-liquid separator 6 flows back into the compressor 1 through the outdoor heat exchanger 4. Through the design, in a heating operation process of the air conditioner, not only can the waste heat be reused, but also the power consumption of the system may be reduced, and the circulation volume of the refrigerant during the heating cycle of the air conditioner system is increased, so that the heating capacity of the whole system is improved.

[0022] As an example, a second throttle device 7 is disposed on the bypass pipeline L. During heating operation of the air conditioner, the second throttle device 7 is configured to control the flow rate of the gaseous refrigerant, that is, an open degree of the second throttle device 7 may be regulated according to the actual operation work conditions so as to flexibly control the passing quantity of the gaseous refrigerant. During a refrigeration cycle of the air conditioner, the second throttle device 7 may be closed, so that the bypass pipeline L does not participate in the refrigeration cycle.

[0023] It should be noted that the above-mentioned heat exchanger 5 may be a water tank containing water or may be in any other suitable form, provided that the refrigerants at the upstream and downstream of the first throttle device 3 can exchange heat. Additionally, the design can effectively improve the heating capacity for the heating cycle and reduce a refrigeration capacity for the refrigeration cycle.

[0024] As an example, the air conditioner system of the present invention further includes a mode switching device (e.g., a four-way valve Q in Figure 1). The mode switching device is configured to switch the air conditioner system between a refrigeration mode and a heating mode.

[0025] As an example, referring to Figure 2, Figure 2 is a schematic structure diagram of an embodiment 2 of the air conditioner system of the present invention. As shown in Figure 2, a third throttle device 8 is also disposed in the main circuit of the air conditioner system of the present invention. The third throttle device 8 is positioned

in a first pipeline M section between the heat exchanger 5 and the indoor heat exchanger 2. During the heating operation of the air conditioner, the third throttle device 8 is in a fully open state. The first throttle device 3 is configured to throttle the refrigerant. At the moment, a principle is identical to that of the air conditioner system in the embodiment 1. When the air conditioner system is switched to refrigeration operation through the four-way valve Q, the first throttle device 3 is in a fully open state, the third throttle device 8 is configured to throttle the refrigerant, and meanwhile, the second throttle device 7 is closed. At the moment, the refrigerants at the two sides of the heat exchanger 5 basically have no temperature difference, that is, the heat exchanger 5 does not function in a process of the refrigeration cycle, and the whole refrigeration cycle is a conventional refrigeration cycle. Therefore, the reducing of refrigeration capacity during the refrigeration operation is avoided.

[0026] Preferably, referring to Figure 1 and Figure 2, the compressor 1 is provided with a second gas-liquid separator 11, the gaseous refrigerant entering the compressor 1 firstly passes through the second gas-liquid separator 11 and is then sucked in by the compressor 1, so that a next cycle is started. The bypass pipeline L is connected to the upstream of the second gas-liquid separator 11.

[0027] Based on the above, the heat exchanger is added to the air conditioner system of the present invention, and the two sides of the heat exchanger are respectively connected to the first pipeline and the second pipeline. Therefore, the refrigerant in the first pipeline and the refrigerant in the second pipeline can exchange heat in the heat exchanger. Not only is the degree of supercooling of the refrigerant in the first pipeline effectively increased, but also the evaporation of the refrigerant in the second pipeline can be promoted, so that the heating capacity of the system is improved. In addition, the bypass pipeline is disposed between the first gas-liquid separator and the compressor, and the gaseous refrigerant passing through the first gas-liquid separator can enter the air suction opening of the compressor through this bypass pipeline, so that the pressure loss of this part of the gaseous refrigerant in the heating cycle is reduced, which is equivalent to that the pressure of the air suction opening of the compressor is increased, the power consumption of the compressor is further reduced, the circulation volume of the refrigerant during the heating cycle of the air conditioner system is increased, and the purpose of increasing the heating capacity is achieved. Additionally, the air conditioner of the present invention is also provided with the third throttle device, so that when the air conditioner is switched to the refrigeration mode, the third throttle device is used to replace the first throttle device (at the moment, the first throttle device is in the fully open state) to throttle the refrigerant. Therefore, the occurrence of a phenomenon that the refrigeration capacity is reduced in the refrigeration cycle is avoided.

[0028] So far, the technical schemes of the present

invention have been described in conjunction with the exemplary implementations shown in the drawings, but it will be readily understood by those skilled in the art that the protection scope of the present invention is obviously not limited to these specific implementations. Those skilled in the art can make equivalent alterations or substitutions to the relevant technical features without departing from the principles of the present invention, and the technical schemes after these alterations or substitutions will all fall within the protection scope of the present invention.

Claims

1. An air conditioner system, comprising a compressor, an indoor heat exchanger, a first throttle device, and an outdoor heat exchanger connected in series in a main circuit, wherein the main circuit is also provided with a heat exchanger and a first gas-liquid separator; one side of the heat exchanger is connected to a first pipeline between the first throttle device and the indoor heat exchanger, and the other side of the heat exchanger is connected to a second pipeline between the first throttle device and the outdoor heat exchanger, so that a refrigerant passing through the first pipeline and a refrigerant passing through the second pipeline can exchange heat in the heat exchanger; and the first gas-liquid separator is positioned in a second pipeline section between the heat exchanger and the outdoor heat exchanger, and a bypass pipeline is disposed between the first gas-liquid separator and the compressor. 35
2. The air conditioner system according to claim 1, wherein a second throttle device is disposed in the bypass pipeline, and during heating operation of the air conditioner system, the second throttle device is configured to control a flow rate of a gaseous refrigerant. 40
3. The air conditioner system according to claim 1, wherein the first pipeline passes through one side of the heat exchanger, and/or the second pipeline passes through the other side of the heat exchanger. 45
4. The air conditioner system according to claim 3, wherein a third throttle device is also disposed in the main circuit, and the third throttle device is positioned in a first pipeline section between the heat exchanger and the indoor heat exchanger. 50
5. The air conditioner system according to claim 4, wherein during heating operation of the air conditioner system, the third throttle device is in a fully open state, and the first throttle device is configured to 55

throttle the refrigerant.

6. The air conditioner system according to claim 4, wherein during refrigeration operation of the air conditioner system, the first throttle device is in a fully open state, and the third throttle device is configured to throttle the refrigerant. 5
7. The air conditioner system according to any one of claims 1 to 6, wherein the compressor is provided with a second gas-liquid separator, and the refrigerant flows back into the compressor after passing through the second gas-liquid separator. 10
8. The air conditioner system according to claim 7, wherein the bypass pipeline is connected to an upstream of the second gas-liquid separator. 15
9. The air conditioner system according to any one of claims 1 to 6, wherein the air conditioner system also comprises a mode switching device, and the mode switching device is configured to switch the air conditioner system between a refrigeration mode and a heating mode. 20
10. The air conditioner system according to claim 9, wherein the mode switching device is a four-way valve. 25

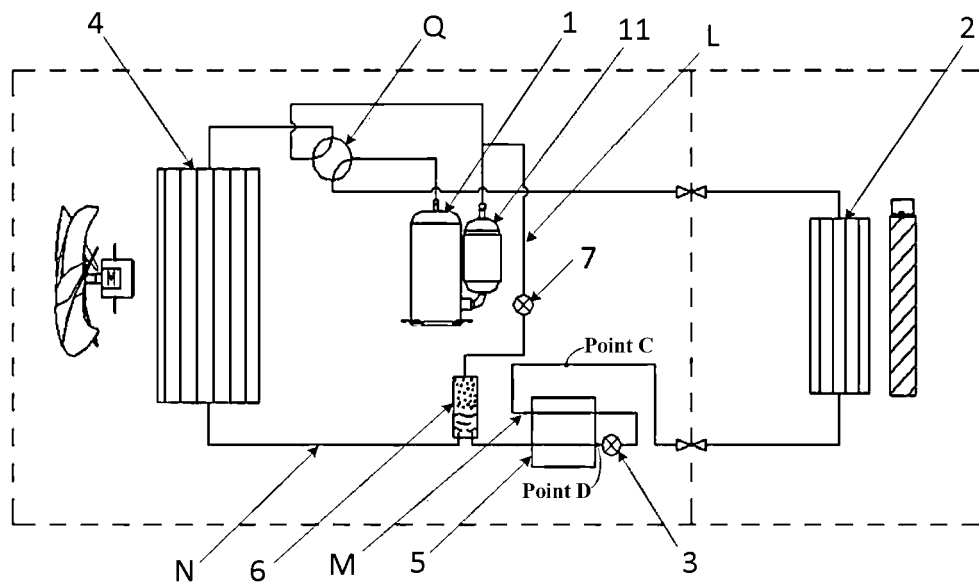


Fig. 1

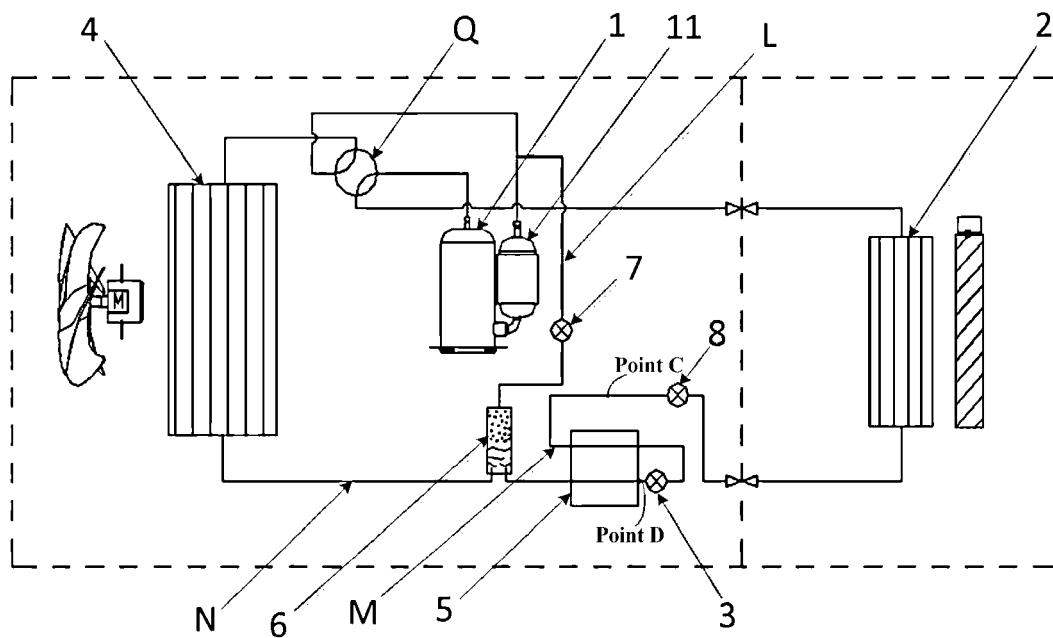


Fig. 2

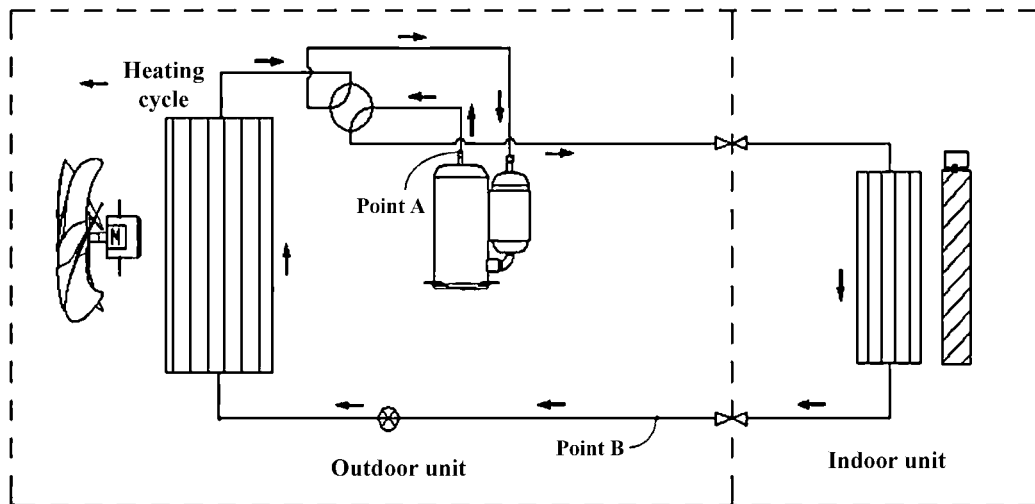


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/115748

A. CLASSIFICATION OF SUBJECT MATTER F25B 47/02(2006.01)i; F25B 41/00(2006.01)i; F25B 40/02(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																					
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F25B Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																					
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS; DWPI; SIPOABS; CNKI: 辅助, 换热器, 热交换器, 旁通, 过冷度, 节流, 气液, 分离, auxiliary, subsidiary, heat exchang+, bypass, supercooling, undercooling, subcooling, throttl+, expansion, liquid vapor, gas liquid, separat+																					
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>CN 203132222 U (GD MIDEA AIR-CONDITIONING EQUIPMENT CO., LTD. ET AL.) 14 August 2013 (2013-08-14) description, paragraphs [0007]-[0022], and figure 1</td> <td>1-10</td> </tr> <tr> <td>Y</td> <td>CN 106403347 A (GUANGDONG MIDEA HEATING & VENTILATION EQUIPMENT CO., LTD. ET AL.) 15 February 2017 (2017-02-15) description, paragraphs [0007]-[0061], and figures 1 and 2</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 206739693 U (SHENZHEN SKYWORTH AIR CONDITIONING TECHNOLOGY CO., LTD.) 12 December 2017 (2017-12-12) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 101776308 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 14 July 2010 (2010-07-14) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 206310607 U (MIDEA GROUP CO., LTD. ET AL.) 07 July 2017 (2017-07-07) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>WO 2004013549 X (DAIKIN IND. LTD. ET AL.) 27 July 2006 (2006-07-27) entire document</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	CN 203132222 U (GD MIDEA AIR-CONDITIONING EQUIPMENT CO., LTD. ET AL.) 14 August 2013 (2013-08-14) description, paragraphs [0007]-[0022], and figure 1	1-10	Y	CN 106403347 A (GUANGDONG MIDEA HEATING & VENTILATION EQUIPMENT CO., LTD. ET AL.) 15 February 2017 (2017-02-15) description, paragraphs [0007]-[0061], and figures 1 and 2	1-10	A	CN 206739693 U (SHENZHEN SKYWORTH AIR CONDITIONING TECHNOLOGY CO., LTD.) 12 December 2017 (2017-12-12) entire document	1-10	A	CN 101776308 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 14 July 2010 (2010-07-14) entire document	1-10	A	CN 206310607 U (MIDEA GROUP CO., LTD. ET AL.) 07 July 2017 (2017-07-07) entire document	1-10	A	WO 2004013549 X (DAIKIN IND. LTD. ET AL.) 27 July 2006 (2006-07-27) entire document	1-10
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☒ 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 18 January 2019	Date of mailing of the international search report 25 January 2019																				
Name and mailing address of the ISA/CN National Intellectual Property Administration, PRC (ISA/CN) No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																				

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/115748

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2018/115748

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