(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 February 2010 (11.02.2010)

PCT

(10) International Publication Number
WO 2010/015123 A1

(51) International Patent Classification:
F24F 3/14 (2006.01) *F24F 11/02* (2006.01)

(21) International Application Number:
PCT/CN2008/071897

(22) International Filing Date:
6 August 2008 (06.08.2008)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **ELECTROLUX (HANGZHOU) HOME APPLIANCES CO., LTD.** [CN/CN]; No.18 Road, Economical & Technical Development Area, Hangzhou, Zhejiang 310018 (CN).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **MA, Yingchao** [CN/CN]; No.18 Road, Economical & Technical Development Area, Hangzhou, Zhejiang 310018 (CN).

(74) Agent: **UNITALEN ATTORNEYS AT LAW**; 7th Floor, Scitech Place, No.22, Jian Guo Men Wai Ave., Chao Yang District, Beijing 100004 (CN).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: CONSTANT TEMPERATURE DEHUMIDIFYING AIR-CONDITIONER

(57) **Abstract**: A constant temperature dehumidifying air conditioner comprises an outdoor heat exchanger and a fan for improving heat-exchanging efficiency of the outdoor heat exchanger. The rotational speed of the fan is adjustable. Accordingly the heat-exchanging capacity of refrigerant in indoor evaporator and condenser can be balanced, thereby stabilizing the temperature of dehumidified air.

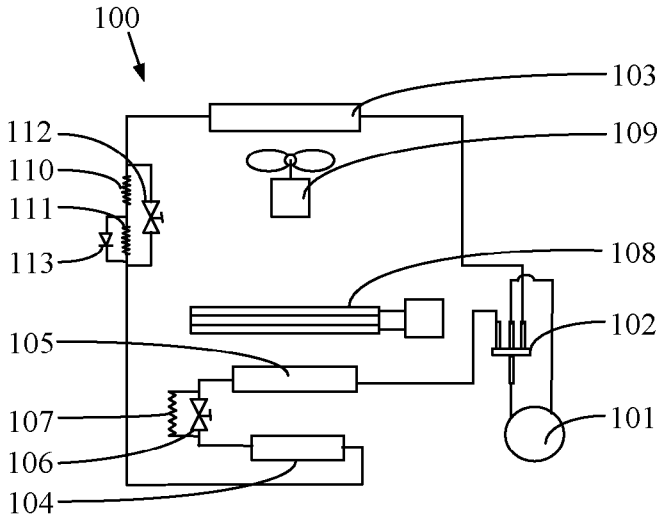

Figure 1

WO 2010/015123 A1

Constant Temperature Dehumidifying Air-conditioner

FIELD OF THE INVENTION

[0001] The present invention relates to an air-conditioner, particularly to a constant temperature dehumidifying air-conditioner.

BACKGROUND OF THE INVENTION

[0002] Existing air-conditioners usually have functions of cooling, heating and dehumidifying etc. The traditional means for air-conditioners to dehumidify is to lower the temperature of air flowing through the air-conditioners such that vapor in the air condense therein, and then the humidity of the air is accordingly lowered. Thus, when the air-conditioners continuously operate under dehumidifying mode, the indoor temperature will continue to decrease, leading to discomfort of human body which will become obvious during those weather of high humidity and low temperature, such as during rainy reasons when the temperature is lower. Although the effect of constant temperature dehumidifying can be achieved by existing integrated air-conditioners, noise pollution and discharge of condensed water become troublesome for users, therefore, they can not meet the requirements of customer in comfort aspect.

[0003] In prior art, the indoor heat-exchanger of air-conditioners is divided into two sub heat-exchangers, between which an expansion portion is connected in series, so that one sub heat-exchanger acts as a condenser and the other acts as an evaporator, accordingly, moistured air can be cooled to dehumidified and then be heated up, finally achieving the purpose of constant temperature dehumidifying. However, the temperature of dehumidified air can not be made stable.

[0004] Also, in prior art, electromagnetic expansion valve that is quite expensive is employed in expansion portion, which is disadvantageous for mass production.

SUMMARY OF THE INVENTION

[0005] In view of the drawbacks in prior art, the present invention aims at providing

a constant temperature dehumidifying air-conditioner, the heat-exchanging capacity of its outdoor heat-exchanger is adjustable, the heat-exchanging amount of refrigerant in indoor evaporator and condenser can thus be balanced during dehumidifying operation, thereby the temperature of dehumidified air can be made stable.

[0006] To solve the aforementioned problems, the present invention provides a constant temperature dehumidifying air-conditioner, which comprises an outdoor heat-exchanger and a fan for improving heat-exchanging efficiency of said outdoor heat-exchanger, the rotational speed of said fan is adjustable.

[0007] Preferably, the dehumidifying air-conditioner further comprises a voltage controller which controls the input voltage of said fan.

[0008] Preferably, the motor of said fan is a tapping speed-adjustable motor or a chopping speed-adjustable motor or a DC (direct current) motor.

[0009] Preferably, the method for adjusting the rotational speed of said fan includes the method of regulating speed by additionally providing a PTC resistance in a circuit.

[0010] Preferably, the air-conditioner further comprises a first indoor heat-exchanger, a second indoor heat-exchanger and a dehumidifying expansion portion, said first indoor heat-exchanger, said dehumidifying expansion portion as well as said second indoor heat-exchanger are sequently connected with each other in series.

[0011] Preferably, the heat-exchanging area of said first indoor heat-exchanger is 40% to 60% of the total heat-exchanging area of said two indoor heat-exchangers.

[0012] Preferably, said heat-exchanging expansion portion is consisted of throttling means and dehumidifying control valves connected in parallel with said throttling means.

[0013] Preferably, the dehumidifying air-conditioner further comprises a heat-exchanging expansion portion which is respectively in communication with said first indoor heat-exchanger and said outdoor heat-exchanger and a heat-exchanging control valve which bypasses said heat-exchanging expansion portion, said heat-exchanging expansion portion is formed by connecting a first heat-exchange throttling means in series with a second heat-exchange throttling means, said first heat-exchange throttling means is in communication with said outdoor heat-exchanger at one end thereof and said second heat-exchange throttling means is in communication

with said indoor heat-exchangers at one end thereof, said heat-exchanging expansion portion further includes a check valve which bypasses said second heat-exchange throttling means, said check valve only allows refrigerant flowing toward said indoor heat-exchangers to pass through.

[0014] Preferably, the dehumidifying air-conditioner further comprises a compressor, and said compressor includes a compressor with constant-speed or a compressor with variable frequency.

[0015] Preferably, said outdoor heat-exchanger is consisted of a plurality of sub heat-exchangers connected in series with each other, each of which is in parallel connection with a corresponding bypass valve.

[0016] Compared with prior art, in the constant temperature dehumidifying air-conditioner, the fan for improving heat-exchanging efficiency of the outdoor heat-exchanger is adjustable in respect of rotational speed, the heat-exchanging capacity of the outdoor heat-exchanger can therefore be adjusted by controlling the rotational speed of the fan, then the heat-exchanging amount of refrigerant in indoor evaporator and condenser can be balanced, thereby the temperature of dehumidified air can be stabilized.

[0017] In addition, the constant temperature dehumidifying air-conditioner further comprises a first indoor heat-exchanger, a second indoor heat-exchanger and a dehumidifying expansion portion, said first indoor heat-exchanger, said dehumidifying expansion portion as well as said second indoor heat-exchanger are sequently connected with each other in series, such that one of said indoor heat-exchangers functions as a condenser, and the other functions as an evaporator, accordingly, the moistured air can be firstly cooled down and dehumidified, then be heated up, achieving the purpose of constant temperature dehumidifying finally.

[0018] The outdoor heat-exchanger are communicated in series with the first heat-exchange throttling means , the second heat-exchange throttling means , the first indoor heat-exchanger, the dehumidification throttling means and the second indoor heat-exchanger, whereas the compressor is communicated with the outdoor heat-exchanger and the second indoor heat-exchanger via a four-way valve, thereby forming a circuit.

[0019] The second heat-exchange throttling means is connected in parallel with the

check valve which only allows the refrigerant flowing toward the indoor heat-exchangers to pass through; the heat-exchanging control valve is connected in parallel with the first heat-exchange throttling means and the second heat-exchange throttling means. When the heat-exchanging control valve is opened, the refrigerant will only flow through the heat-exchanging control valve due to the greater resistance of the first heat-exchange throttling means. Likewise, the dehumidifying expansion control valve is connected in parallel with the dehumidification throttling means, and the refrigerant will not flow through the dehumidification throttling means when the dehumidifying expansion control valve is opened.

[0020] In addition, the dehumidifying expansion portion, the dehumidifying control valve, the heat-exchanging expansion portion and the heat-exchanging control valve as arranged and configured above can replace electromagnetic expansion valves, thereby reducing manufacturing cost.

[0021] Furthermore, with a compressor with variable frequency being employed, the heat-exchanging amount of refrigerant in evaporator and condenser can be adjusted by adjusting its operating frequency, accordingly ensuring the uniformity between the temperature of output air and input air of the air-conditioner, thereby realizing the purpose of constant temperature dehumidifying.

[0022] The outdoor heat-exchanger is consisted of a plurality of sub heat-exchangers connected in series with each other, each of which is in parallel connection with a corresponding bypass valve, accordingly, the heat-exchanging capacity of the outdoor heat-exchanger can be adjusted in a stepped manner, thereby further improving the adjustability of heat-exchanging capacity of the outdoor heat-exchanger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Fig. 1 is a schematic view showing an embodiment of the constant temperature dehumidifying air-conditioner according to the present invention;

[0024] Fig. 2 is a schematic view showing another embodiment of the constant temperature dehumidifying air-conditioner according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0025] The detailed description herein primarily aims at providing a constant temperature dehumidifying air-conditioner, the outdoor heat-exchanger of which is adjustable in respect of heat-exchanging capacity, accordingly, the heat-exchanging amount of refrigerant in indoor evaporator and condenser can thus be balanced during dehumidifying operation, thereby the temperature of dehumidified air can be made stable.

[0026] Inventors of the present invention found that, for the conventional method in which the indoor heat-exchanger of air-conditioners is divided into two sub heat-exchangers, between which an expansion portion is connected in series, so that one sub heat-exchanger acts as a condenser and the other acts as an evaporator, thereby realizing the effect of constant temperature dehumidifying, not only one of the sub heat-exchangers but also the outdoor heat-exchanger act as condensers. The condensing temperature will become lower due to increase of condensing area and decrease of evaporating area, and then the heat transferred from the outdoor heat-exchanger will be insufficient to heat up the air of low temperature flowing through the evaporator while a constant dehumidifying amount is maintained. Therefore, it is necessary to decrease the heat-exchanging capacity of the outdoor condenser and increase condensing temperature, and accordingly balance the heat-exchanging capacities of the two indoor heat-exchangers, thereby ensuring the temperature of air after being dehumidified is substantially the same as that before being dehumidified. In the present invention, the rotational speed of outdoor fan is changed from the one at which the heat-exchanging amount of outdoor heat-exchanger and indoor heat-exchanger is balanced under cooling/heating mode into the one at which the heat-exchanging amount of condenser and evaporator is balanced under dehumidifying mode, in order that the condensing temperature is increased so as to ensure the uniformity between the temperature of dehumidified air blown from indoor equipment and room temperature, thereby achieving the purpose of constant temperature dehumidifying.

[0027] To this end, a constant temperature dehumidifying air-conditioner is provided in the following embodiments, which comprises an outdoor heat-exchanger and a fan for improving heat-exchanging efficiency of said outdoor heat-exchanger, the rotational speed of said fan is adjustable. Preferably, the air-conditioner further comprises a

voltage controller which controls the input voltage of said fan. Preferably, the motor of said fan is a tapping speed-adjustable motor or a chopping speed-adjustable motor or a DC (direct current) motor. Preferably, the method for adjusting the rotational speed of said fan includes the method of regulating speed by additionally providing a PTC resistance in a circuit. Preferably, the dehumidifying air-conditioner further comprises a first indoor heat-exchanger, a second indoor heat-exchanger and a dehumidifying expansion portion, said first indoor heat-exchanger, said dehumidifying expansion portion as well as said second indoor heat-exchanger are sequently connected with each other in series. Preferably, the heat-exchanging area of said first indoor heat-exchanger is 40% to 60% the total heat-exchanging area of said two indoor heat-exchangers. Preferably, said heat-exchanging expansion portion is consisted of throttling means and dehumidifying control valves connected in parallel with said throttling means. Preferably, the air-conditioner further comprises a heat-exchanging expansion portion which is respectively in communication with said first indoor heat-exchanger and said outdoor heat-exchanger and a heat-exchanging control valve which bypasses said heat-exchanging expansion portion, said heat-exchanging expansion portion is formed by connecting a first heat-exchange throttling means in series with a second heat-exchange throttling means , said first heat-exchange throttling means is in communication with said outdoor heat-exchanger at one end thereof and said second heat-exchange throttling means is in communication with said indoor heat-exchangers at one end thereof, said heat-exchanging expansion portion further includes a check valve which bypasses said second heat-exchange throttling means, said check valve only allows refrigerant flowing toward said indoor heat-exchangers to pass through. Preferably, the air-conditioner further comprises a compressor, said compressor includes a compressor with constant-speed or a compressor with variable frequency. Preferably, said outdoor heat-exchanger is consisted of a plurality of sub heat-exchangers connected in series with each other, each of which is in parallel connection with a corresponding bypass valve.

[0028] The present embodiment will be described in detail with reference to the accompanied drawings in the following.

[0029] As shown in Fig. 1, the constant temperature dehumidifying air-conditioner 100 according to the present embodiment comprises a compressor 101, an outdoor heat-exchanger 103, an outdoor fan 109, a first indoor heat-exchanger 104, a second

indoor heat-exchanger 105, an indoor fan 108, a four-way valve 102, a dehumidification throttling means 107, a dehumidifying expansion control valve 106, a first heat-exchange throttling means 110, a second heat-exchange throttling means 111, a heat-exchanging control valve 112 and a check valve 113.

[0030] The aforementioned components are connected with each other as follows: the outdoor heat-exchanger 103 are communicated in series with the first heat-exchange throttling means 110, the second heat-exchange throttling means 111, the first indoor heat-exchanger 104, the dehumidification throttling means 107 and the second indoor heat-exchanger 105, while the compressor 101 is communicated with the outdoor heat-exchanger 103 and the second indoor heat-exchanger 105 via the four-way valve 102, thereby forming a circuit.

[0031] The first heat-exchange throttling means 110, the second heat-exchange throttling means 111, the heat-exchanging control valve 112 and the check valve 113 together constitute a heat-exchanging expansion portion, wherein the first heat-exchange throttling means 110 is connected in series with the second heat-exchange throttling means 111 and the second heat-exchange throttling means 111 is connected in parallel with the check valve 113 which only allows the refrigerant flowing toward the first indoor heat-exchanger 104 to pass through; the heat-exchanging control valve 112 is connected in parallel with the first heat-exchange throttling means 110 and the second heat-exchange throttling means 111. When the heat-exchanging control valve 112 is opened, the refrigerant will only flow through the heat-exchanging control valve 112 due to the greater resistance of the first heat-exchange throttling means 110. Likewise, the dehumidifying expansion control valve 106 is connected in parallel with the dehumidification throttling means 107, and the refrigerant will not flow through the dehumidification throttling means 107 when the dehumidifying expansion control valve 106 is opened.

[0032] When the air-conditioner operates under cooling or heating mode, the heat-exchanging control valve 112 is closed and the dehumidifying expansion control valve 106 is fully opened, the refrigerant flows through the fully opened dehumidifying expansion control valve 106, the dehumidification throttling means 107 is out of function at the moment, and the air-conditioner functions like a conventional one. When the air-conditioner operates under dehumidifying mode of constant output temperature, the heat-exchanging control valve 112 is fully opened while the dehumidifying

expansion control valve 106 is closed, then the first indoor heat-exchanger 104 functioning as a condenser will use the heat transferred via the outdoor heat-exchanger 103 to heat the air of low temperature dehumidified by the second indoor heat-exchanger 105 functioning as an evaporator, the total area of the condenser, which is constituted by the outdoor heat-exchanger 103 and the first indoor heat-exchanger 104 instead of by the single outdoor heat-exchanger 103, will be increased; while the total area of the evaporator, which is constituted by the single second indoor heat-exchanger 105 instead of by the first indoor heat-exchanger 104 and the second indoor heat-exchanger 105, will be decreased, the condensing temperature will decrease accordingly. With the premise that dehumidifying amount is ensured, it is insufficient to heat the air of low temperature flowing through the evaporator only by the heat discharged from the first indoor heat-exchanger 104. Therefore, the heat-exchanging efficiency of the outdoor heat-exchanger 103 is reduced by means of lowering the rotational speed of the outdoor fan 109, i.e., the rotational speed of the outdoor fan 109 is changed from the one under cooling/heating mode which aims at balancing the indoor and outdoor heat-exchanging amount into the one under dehumidifying mode which aims at balancing the heat-exchanging amount of the condenser and the evaporator, increasing the condensing temperature so as to ensure uniformity between the temperature of the dehumidified air blown away from the indoor equipment and the indoor temperature, thereby realizing the purpose of outputting dehumidified air of constant temperature.

[0033] The dehumidification throttling means 107 may be a single capillary tube or capillary tubes connected in parallel, or it may be throttling means of other structures. Similarly, the first heat-exchange throttling means 110 and the second heat-exchange throttling means 111 may employ similar structure.

[0034] During dehumidifying operation of constant temperature, the second indoor heat-exchanger 105 functions as an evaporator to dehumidify the moistured air and lower the temperature of the same, while the first indoor heat-exchanger 104 functions as an condenser to heat the dehumidified air. Accordingly, the second indoor heat-exchanger 105 is positioned in the front section of the indoor air passage of the constant temperature dehumidifying air-conditioner 100, while the first indoor heat-exchanger 104 is positioned in the rear section of said air passage, so that the first indoor heat-exchanger 104 and the second indoor heat-exchanger 105 can function

independently of each other.

[0035] The heat-exchanging area of the first indoor heat-exchanger 104 is 40% to 60% of the total heat-exchanging area of the two indoor heat-exchangers, and the heat-exchanging area of each indoor heat-exchanger can be substantially the same as each other.

[0036] In the case that the temperature of outdoor air is constant, the minimum heat-exchanging capacity of the outdoor heat-exchanger 103 is determined by the heat-exchanging area thereof, while the maximum heat-exchanging capacity of the outdoor heat-exchanger 103 is determined by the maximum speed of air flowing between the fins, that is to say, how much heat-exchanging capacity the outdoor heat-exchanger 103 may have in addition to the minimum heat-exchanging capacity thereof depends on rotational speed of the outdoor fan 109 creating air flow between the fins. Therefore, the outdoor fan 109 is configured to be adjustable in respect of rotational speed, making the outdoor heat-exchanger 103 have an adjustable heat-exchanging capacity. Configuring an adjustable outdoor fan 109 may be realized for example by providing an additional voltage controller which controls the input voltage of the outdoor fan 109, or by means of regulating speed by providing an additional PTC resistance in a circuit, or by using tapping speed-adjustable motor or chopping speed-adjustable motor or DC (direct current) motor.

[0037] The four-way valve 102 which is switchable between two states is a means with variable passageway. In one state of the four-way valve 102, the input port of the compressor 101 is in communication with the second indoor heat-exchanger 105 and the output port of the compressor 101 is in communication with the outdoor heat-exchanger 103; in the other state thereof, the output port of the compressor 101 is in communication with the second indoor heat-exchanger 105 while the input port of the compressor 101 is in communication with the outdoor heat-exchanger 103. Therefore, the flowing direction of the refrigerant in the circuit can be changed by switching the four-way valve 102 between different states, thereby making it possible to switch among the functions of cooling, heating and constant temperature dehumidifying.

[0038] The compressor 101 can be a conventional compressor with constant-speed, or a compressor with variable frequency. The advantage originating from utilizing a compressor with variable frequency lies in that the compressor with variable frequency can automatically change its operating frequency according to different outdoor and

indoor environment so as to adjust evaporating temperature and condensing temperature, thereby ensuring the uniformity between the temperature of output air and input air of the air-conditioner in more accurate manner and realizing the purpose of constant temperature dehumidifying.

[0039] In addition, as shown in Fig. 2, the heat-exchanging capacity of the outdoor heat-exchanger 103 can be controlled by means of separating the outdoor heat-exchanger 103'. Specifically, the outdoor heat-exchanger 103' can be separated by connecting several bypass valves 114 in parallel manner with corresponding outdoor heat-exchanger 103' along the pipe line thereof, each bypass valve 114 upon being opened forms a bypass of the pipe section of the corresponding outdoor heat-exchanger 103'. Thus, the heat-exchanging area of the outdoor heat-exchanger 103' when playing the function of outdoor heat-exchanging and thereby the heat-exchanging capacity of the outdoor heat-exchanger 103' can be controlled by controlling the number of the bypass valve 114 being opened. By separating the outdoor heat-exchanger 103', the heat-exchanging capacity of the outdoor heat-exchanger 103' can be roughly regulated in a discontinuous manner, however, by controlling the rotational speed of the outdoor fan 109, the heat-exchanging capacity of the outdoor heat-exchanger 103' can be precisely regulated in a continuous manner. In the present embodiment, the method of separating the outdoor heat-exchanger 103' is employed in conjunction with the method of controlling the rotational speed of the outdoor fan 109, thereby realizing accurate adjustment of the heat-exchanging capacity of the outdoor heat-exchanger 103'. However, it is appreciated by those having ordinary skill in the art that the object of the present invention can be achieved by only separating the outdoor heat-exchanger 103'.

[0040] In the aforementioned embodiment, the purpose for providing the heat-exchanging expansion portion which is constituted by the check valve 113, the heat-exchanging control valve 112, the first heat-exchange throttling means 110 and the second heat-exchange throttling means 111, is to reduce manufacturing cost. In view of this, said heat-exchanging expansion portion can be replaced by an electromagnetic expansion valve. Similarly, the dehumidifying expansion portion constituting by the dehumidifying expansion control valve 106 and the dehumidification throttling means 107 which are connected in parallel with each other, can be replaced by a valve specially designed for dehumidifying which is switchable between the states of "fully open" and "throttling".

[0041] The operating principle of the constant temperature dehumidifying air-conditioner 100 will be described with reference to Fig. 1 in the following.

[0042] When the constant temperature dehumidifying air-conditioner 100 is operating under the state of constant temperature dehumidifying, the four-way valve 102 is under a state in which the input port of the compressor 101 is in communication with the second indoor heat-exchanger 105 while the output port thereof is in communication with the outdoor heat-exchanger 103, the dehumidifying expansion control valve 106 is closed, the heat-exchanging control valve 112 is opened and the outdoor fan 109 is arranged at the speed corresponding to dehumidification. The gaseous refrigerant of high temperature and pressure compressed by the compressor 101 is firstly cooled down through heat-exchanging with outdoor air in the outdoor heat-exchanger 103, and the gaseous refrigerant is then cooled down again through heat-exchanging with indoor air and changed into liquid of relatively high temperature and pressure after flowing into the first indoor heat-exchanger 104 via the heat-exchanging control valve 112. Then, the refrigerant becomes into a mixture of gas and liquid with low temperature and pressure after being expanded through the effect of throttling when flowing through the dehumidification throttling means 107, after that, the refrigerant subsequently enters into the second indoor heat-exchanger 105 and becomes into gas with low temperature and pressure through evaporation heat-exchanging with indoor air, finally it enters into the compressor 101 and is compressed, thereby finishing a complete dehumidifying cycle. The indoor air flows in such a way that it is firstly cooled down through heat-exchanging with the second indoor heat-exchanger 105, at this time, the vapor contained in the indoor air is condensed on the outer surface of the second indoor heat-exchanger such that the temperature and humidity of air flowing through the second indoor heat-exchanger 105 is lowered, the dehumidified indoor air is then heated up through heat-exchanging with the first indoor heat-exchanger 104 and reaches the temperature before dehumidification, accordingly achieving the effect of constant temperature dehumidifying.

[0043] When the constant temperature dehumidifying air-conditioner 100 is operating under cooling state, the four-way valve 102 is under a state in which the input port of the compressor 101 is in communication with the second indoor heat-exchanger 105 while the output port thereof is in communication with the outdoor heat-exchanger 103, the dehumidifying expansion control valve 106 is opened, the heat-exchanging

control valve 112 is closed and the outdoor fan 109 is arranged at the speed corresponding to cooling. The gaseous refrigerant of high temperature and pressure compressed by the compressor 101 is cooled down through heat-exchanging with outdoor air in the outdoor heat-exchanger 103 and then becomes into a mixture of gas and liquid with low temperature and pressure after being expanded through the effect of throttling when flowing through the first heat-exchange throttling means 110, and the refrigerant then enters into the first indoor heat-exchanger 104 via the check valve 113 and performs heat-exchange with the indoor air for the first time, then the refrigerant enters into the second indoor heat-exchanger 105 to evaporate via the dehumidifying expansion control valve 106 and becomes into gas with low temperature and pressure after heat-exchanging with the indoor air for the second time, finally it enters into the compressor 101 and is compressed, thereby finishing a complete cooling circle. The indoor air flows in such a way that it is cooled down for the first time through heat-exchanging with the second indoor heat-exchanger 105 and then cooled down for the second time through heat-exchanging with the first indoor heat-exchanger 104, consequently reaching a predetermined temperature lower than the indoor temperature.

[0044] When the constant temperature dehumidifying air-conditioner 100 is operating under heating state, the four-way valve 102 is under a state in which the output port of the compressor 101 is in communication with the second indoor heat-exchanger 105 while the input port thereof is in communication with the outdoor heat-exchanger 103, the dehumidifying expansion control valve 106 is opened, the heat-exchanging control valve 112 is closed and the outdoor fan 109 is arranged at the speed corresponding to heating. The gaseous refrigerant of high temperature and pressure compressed by the compressor 101 is condensed in the second indoor heat-exchanger 105 and is cooled down through heat-exchanging with indoor air for the first time, then the refrigerant is condensed in the first indoor heat-exchanger 104 after entering into the first indoor heat-exchanger 104 via the dehumidifying expansion control valve 106 and is cooled down through heat-exchanging with indoor air for the second time, and then the refrigerant becomes into a mixture of gas and liquid with low temperature and pressure after sequently passing through the second heat-exchange throttling means 111 and the first heat-exchange throttling means 110, after that, the refrigerant enters into the outdoor heat-exchanger 103 to evaporate and becomes into gas with high temperature but low pressure through heat-exchanging with outdoor air,

finally it enters into the compressor 101 and is compressed, thereby finishing a complete heating circle. The indoor air flows in such a way that it is heated up for the first time through heat-exchanging with the second indoor heat-exchanger 105 and then heated up for the second time through heat-exchanging with the first indoor heat-exchanger 104, consequently reaching a predetermined temperature higher than the indoor temperature.

[0045] Although the present invention has been disclosed with reference to preferred embodiments described above, it is not limited to those embodiments. Those having ordinary skills in the art can make various changes and modifications without departing from the spirit and scope thereof. Therefore, the protecting scope of the present invention is to be defined by the accompanied claims.

CLAIMS

What is claimed is:

1. A constant temperature dehumidifying air-conditioner comprising an outdoor heat-exchanger and a fan for improving heat-exchanging efficiency of said outdoor heat-exchanger, characterized in that the rotational speed of said fan is adjustable.

2. The constant temperature dehumidifying air-conditioner as claimed in Claim 1, characterized in that it further comprises a voltage controller which controls the input voltage of said fan.

3. The constant temperature dehumidifying air-conditioner as claimed in Claim 1, characterized in that the motor of said fan is a tapping speed-adjustable motor or a chopping speed-adjustable motor or a DC (direct current) motor.

4. The constant temperature dehumidifying air-conditioner as claimed in Claim 1, characterized in that the method for adjusting the rotational speed of said fan includes the method of regulating speed by additionally providing a PTC resistance in a circuit.

5. The constant temperature dehumidifying air-conditioner as claimed in Claim 1, characterized in that it further comprises a first indoor heat-exchanger, a second indoor heat-exchanger and a dehumidifying expansion portion, said first indoor heat-exchanger, said dehumidifying expansion portion as well as said second indoor heat-exchanger being sequently connected with each other in series.

6. The constant temperature dehumidifying air-conditioner as claimed in Claim 5, characterized in that the heat-exchanging area of said first indoor heat-exchanger is 40% to 60% of the total heat-exchanging area of said two indoor heat-exchangers.

7. The constant temperature dehumidifying air-conditioner as claimed in Claim 5, characterized in that said heat-exchanging expansion portion is consisted of throttling

means and dehumidifying control valves connected in parallel with said throttling means.

8. The constant temperature dehumidifying air-conditioner as claimed in Claim 5, characterized in that it further comprises a heat-exchanging expansion portion which is respectively in communication with said first indoor heat-exchanger and said outdoor heat-exchanger and a heat-exchanging control valve which bypasses said heat-exchanging expansion portion, said heat-exchanging expansion portion being formed by connecting a first heat-exchange throttling means in series with a second heat-exchange throttling means, said first heat-exchange throttling means being in communication with said outdoor heat-exchanger at one end thereof and said second heat-exchange throttling means being in communication with said indoor heat-exchangers at one end thereof, said heat-exchanging expansion portion further including a check valve which bypasses said second heat-exchange throttling means, said check valve only allowing refrigerant flowing toward said indoor heat-exchangers to pass through.

9. The constant temperature dehumidifying air-conditioner as claimed in Claim 1, characterized in that it further comprises a compressor, said compressor including a compressor with constant-speed or a compressor with variable frequency.

10. The constant temperature dehumidifying air-conditioner as claimed in Claim 1, characterized in that said outdoor heat-exchanger is consisted of a plurality of sub heat-exchangers connected in series with each other, each of which is in parallel connection with a corresponding bypass valve.

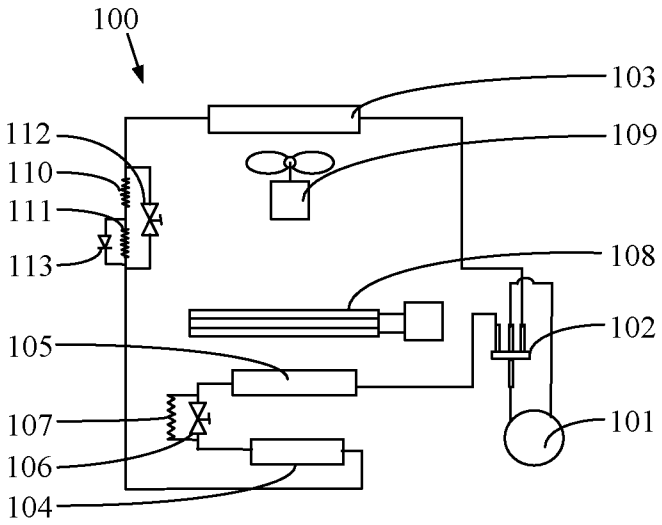

Figure 1

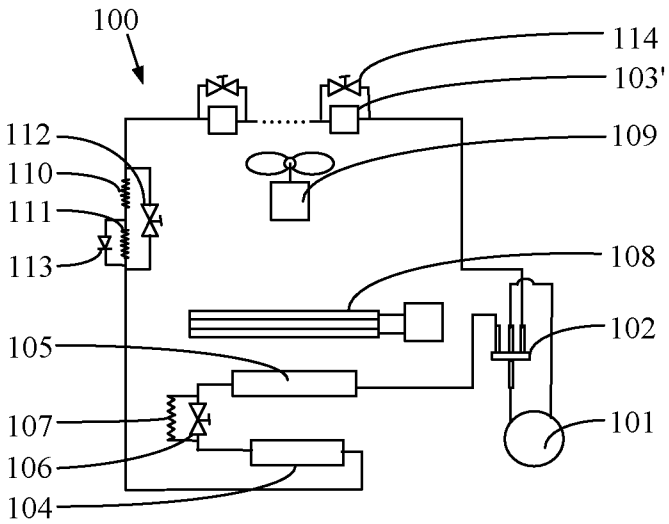

Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2008/071897

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 3/14; F24F11/02; F24F 3/147; F24F 3/153; F24F11/04; F24F11/00

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; PAJ; CNPAT; dehumidify+, air condition+, constant, fan?, blower?, speed, number, adjust+, variable

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN1111681C (HITACHI SEISAKUSHO KK) 18 Jun. 2003 (18.06.2003) page 51, last paragraph to page 54 of description, figures 26-29	1-9
X	JP2003-232554A (DAIKIN KOGYO KK) 22 Aug. 2003 (22.08.2003) paragraphs 0023-0039, figure 1	1-7,9,10
X	CN1232772C (LG ELECTRONICS INC) 21 Dec. 2005 (21.12.2005) whole document	1-7,9
X	CN1566831A (LG ELECTRONICS TIANJIN APPLIANCES CO LTD) 19 Jan. 2005 (19.01.2005) whole document	1-7,9
X	CN1062949C (MITSUBISHI JUKOGYO KK) 07 Mar. 2001 (07.03.2001) whole document	1-7,9

☐ 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
13 Apr. 2009 (13.04.2009)	**14 May 2009 (14.05.2009)**
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 ZHANG Yu Telephone No. (86-10)62413260

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2008/071897

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN1111681C	18.06.2003	TW265404A	11.12.1995
		CN1101412A	12.04.1995
		JP2001208398A	03.08.2001
		JP2001208401A	03.08.2001
		JP2002333186A	22.11.2002
		JP2002333191A	22.11.2002
		JP2002340437A	27.11.2002
		JP3397413B2	14.04.2003
		JP2003097842A	03.04.2003
		CN1430023A	16.07.2003
		CN1434254A	06.08.2003
		JP3515071B2	05.04.2004
		JP3634818B2	30.03.2005
		JP3645231B2	11.05.2005
		JP3653261B2	25.05.2005
		JP3703440B2	05.10.2005
		JP2005283120A	13.10.2005
		JP2005321191A	17.11.2005
		CN1198091C	20.04.2005
		CN1740672A	01.03.2006
		CN1740673A	01.03.2006
		CN1226575C	09.11.2005
		JP2007127406A	24.05.2007
		JP2007240146A	20.09.2007
		JP3993616B2	17.10.2007
		JP3993617B2	17.10.2007
JP2003-232554A	22.08.2003	NONE	
CN1232772C	21.12.2005	JP2004069287A	04.03.2004
		CN1472480A	04.02.2004
		KR20040012158A	11.02.2004
		KR100488015B	06.05.2005

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2008/071897

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN1566831A	19.01.2005	NONE	
CN1062949C	07.03.2001	CN1109156A	27.09.1995

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2008/071897

Continuation of: Box A in second sheet

CLASSIFICATION OF SUBJECT MATTER

F24F3/14(2006.01)i
F24F11/02(2006.01)i

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