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(54) AIR CONDITIONER AND HUMIDIFICATION METHOD THEREOF

(57) An air conditioner includes a fan (6), a humidification component, and a heat exchanger (7). The fan (6) is disposed at an air outlet of the heat exchanger (7). The humidification component includes a circulating water tank (4), a humidification module (1), and a water division tray (8). The circulating water tank (4) is configured to contain water. The humidification module (1) includes a wet film covering an air inlet of the heat exchanger (7), and further includes a manifold. The water division tray (8) is located below the humidification module (1), and is configured to recycle water dripping from the wet film. Water in the water division tray (8) flows into the circulating water tank (4) through a return pipe. A humidification method of an air conditioner is further disclosed.

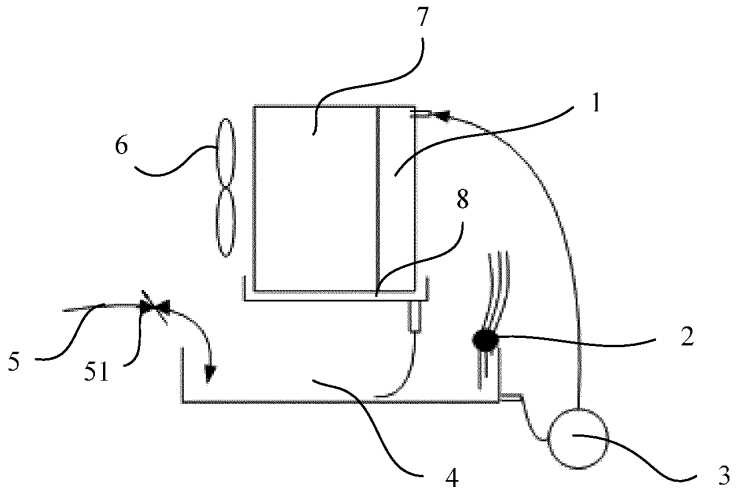

FIG. 1

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Description

[0001] This application claims priority to Chinese Patent Application No. 201610080117.4, filed with the Chinese Patent Office on February 4, 2016 and entitled "AIR CONDITIONER AND HUMIDIFICATION METHOD OF AIR CONDITIONER", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to the technical field of humidification devices, and in particular, to an air conditioner and a humidification method of an air conditioner.

BACKGROUND

[0003] For a place that has a relatively high requirement on a temperature and humidity environment, a dedicated precision air conditioner is used, so that not only a device can operate in a good and reliable working environment and a service life of the device is prolonged, but also operating costs are greatly reduced.

[0004] An in-row precision air conditioner and an equipment room server form enclosed space, and the in-row precision air conditioner provides a constant temperature and humidity operating environment for the nearby server by using refrigeration and humidification functions of the air conditioner, to ensure efficient and stable operation of a device.

[0005] In most in-row precision air conditioners, humidification operation is usually unstable, a requirement on water quality is relatively high, and a later maintenance workload is heavy. Therefore, it is urgent to propose a new humidification method to resolve a humidification problem of the in-row precision air conditioners.

[0006] A humidification manner used in the prior art is an electrode humidification method. A working principle of the electrode humidifier is: water is used as a conductor, alternating current is supplied to two electrodes, the electrodes form a current loop by using the water after the water contacts the electrodes, the water is heated and is made to boil, and evaporated water vapor is directly delivered by a draught fan to a channel through a pipe, to implement air humidification.

[0007] However, when the foregoing humidification manner is used, humidification efficiency is affected due to a conductivity of water, a requirement on water quality is relatively high, and power is large in a humidification process. Therefore, PUE of a machine set is relatively high. In addition, because high-temperature water vapor is mixed with cold wind, some water vapor condenses. Consequently, humidification efficiency decreases. Further, a water storage tank is liable to scale during long-time operation, stable system operation is affected, an overall service life is short, and a maintenance workload is heavy.

SUMMARY

[0008] The present invention provides an air conditioner and a humidification method of an air conditioner, to improve a humidification effect and increase a service life of a humidification component.

[0009] According to a first aspect, an air conditioner is provided, where the air conditioner includes a fan, a humidification component, and a heat exchanger, where

the fan is disposed at an air outlet of the heat exchanger;

the humidification component includes a circulating water tank, where the circulating water tank is configured to contain water;

a humidification module, including a wet film covering an air inlet of the heat exchanger, and further including a manifold, where a water outlet of the manifold faces the wet film, a water inlet of the manifold communicates with the circulating water tank by using a pipe, and a circulating water pump that pumps water inside the circulating water tank into the manifold is disposed on the pipe; and

a water division tray, located below the humidification module, and configured to recycle water dripping from the wet film, where the water division tray is connected to a return pipe that communicates with the circulating water tank, and water in the water division tray flows into the circulating water tank through the return pipe.

[0010] With reference to the first aspect, in a first possible implementation, the water division tray is disposed in a lower part of the wet film, and a width of the water division tray is greater than or equal to a width of the wet film; or the water division tray is disposed in a lower part of the heat exchanger and the wet film, and a width of the water division tray is greater than or equal to a sum of a width of the heat exchanger and a width of the wet film.

[0011] With reference to the first possible implementation of the first aspect, in a second possible implementation, the water outlet of the manifold faces the wet film and is connected to an upper part of the wet film, so that water flowing from the water outlet of the manifold flows from the upper part of the wet film to the lower part, and water is evenly distributed on the wet film.

[0012] With reference to the first aspect and the second possible implementation, in a third possible implementation, a water inlet of the circulating water tank is connected to a water inlet pipe, and a switch valve is disposed on the water inlet pipe.

[0013] With reference to the third possible implementation of the first aspect, in a fourth possible implementation, the switch valve is a solenoid valve;

a liquid level detection apparatus is disposed inside the circulating water tank; and

the air conditioner further includes a control apparatus, where when a water level detected by the liquid level detection apparatus is lower than a specified water level, the control apparatus controls the solenoid valve to be opened until the detected water level of the circulating water tank reaches the specified water level.

[0014] With reference to the first aspect, in a fifth possible implementation, the water division tray is located below the heat exchanger and the humidification module, and is configured to collect condensate water of the heat exchanger and water dripping from the humidification module.

[0015] With reference to the first aspect to the fifth possible implementation of the first aspect, in a sixth possible implementation, a thickness of the wet film is between 20 mm and 200 mm.

[0016] According to a second aspect, a humidification method of an air conditioner is provided, where the air conditioner is the foregoing air conditioner, and the humidification method includes the following step:

when humidification is required, first humidifying, by using a wet film, air that is drawn by a fan in the air conditioner, and then delivering humidified air into a heat exchanger.

[0017] With reference to the second aspect, in a first possible implementation, the humidification method further includes: when humidification is initiated, detecting a water level of a circulating water tank, and directly starting humidification when the water level of the circulating water tank reaches a specified water level; or when the water level of the circulating water tank does not reach a specified water level, controlling the solenoid valve to be opened to inject water into the circulating water tank until water reaches a specified position, and then starting humidification.

[0018] According to the air conditioner provided in the first aspect and the humidification method provided in the second aspect, during specific humidification, water pumped from the circulating water tank to the humidification module forms an even water film on the wet film. When dry wind passes through a wet film material, dry air contacts a surface of the humid wet film on a relatively large area, thereby achieving a relatively large moisture vaporization amount. The heat exchanger heats the water film on the wet film, and a large quantity of water molecules are delivered, with wind, into space that needs humidification, so that air humidity is increased, thereby achieving an objective of humidification. A humidification effect is achieved through cooperation of the humidification module and the heat exchanger. Compared with a humidification manner in the prior art, in this humidification manner, the humidification component provided in the embodiments is disposed at the air inlet of the heat exchanger, so that condensation of water vapor is avoided. Further, the foregoing humidification manner has a relatively low requirement on water quality, and water scale is prevented from forming inside the circulating water tank, thereby improving stability of the humidification component, and increasing a service life of the humidification component.

BRIEF DESCRIPTION OF DRAWINGS

[0019]

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

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

FIG. 3 is a control block diagram of a humidification component according to an embodiment of the present invention.

[0020] Reference numerals in the drawings are as follows:

1: humidification module; 2: liquid level detection apparatus; 3: circulating water pump; 4: circulating water tank; 5: water inlet pipe; 51: solenoid valve; 6: fan; 7: heat exchanger; and 8: water division tray

DESCRIPTION OF EMBODIMENTS

[0021] The following describes the specific embodiments of the present invention in detail with reference to the accompanying drawings. It should be understood that the specific embodiments described herein are merely used to explain the present invention but are not intended to limit the present invention.

[0022] An embodiment of the present invention provides a humidification component used for an air conditioner. The humidification component includes:

a circulating water tank, where the circulating water tank is configured to contain water;

a humidification module, including a wet film covering an air inlet of a heat exchanger, and further including a manifold, where a water outlet of the manifold faces the wet film, a water inlet of the manifold communicates with the circulating water tank by using a pipe, and a circulating water pump that pumps water inside the circulating water tank into the manifold is disposed on the pipe; and

a water division tray, located below the humidification module, and configured to recycle water dripping from the wet film, where the water division tray is connected to a return pipe that communicates with the circulating water tank, and water in the water division tray flows into the circulating water tank through the return pipe.

[0023] During specific humidification, water pumped from the circulating water tank to the humidification module forms an even water film on the wet film. When a fan draws wind, the heat exchanger heats the water film on the wet film, dry wind passes through a wet film material, and dry air contacts a surface of the humid wet film on a relatively large area, thereby achieving a relatively large moisture vaporization amount. A large quantity of water molecules are delivered, with wind, into space that needs humidification, so that air humidity is increased, thereby

achieving an objective of humidification. A humidification effect is achieved through cooperation of the humidification module and the heat exchanger. Compared with a humidification manner in the prior art, in this humidification manner, the humidification component provided in this embodiment is disposed at the air inlet of the heat exchanger, so that condensation of water vapor is avoided. Further, the foregoing humidification manner has a relatively low requirement on water quality, and water scale is prevented from forming inside the circulating water tank, thereby improving stability of the humidification component, and increasing a service life of the humidification component.

[0024] In addition, as shown in FIG. 1, FIG. 1 shows a schematic structural diagram of an air conditioner according to an embodiment of the present invention.

[0025] An embodiment of the present invention further provides an air conditioner. The air conditioner includes a fan 6, a humidification component, and a heat exchanger 7.

[0026] The fan 6 is disposed at an air outlet of the heat exchanger 7.

[0027] The humidification component includes a circulating water tank 4, where the circulating water tank 4 is configured to contain water;

a humidification module 1, including a wet film covering an air inlet of the heat exchanger 7, and further including a manifold, where a water outlet of the manifold faces the wet film, a water inlet of the manifold communicates with the circulating water tank 4 by using a pipe, and a circulating water pump 3 that pumps water inside the circulating water tank 4 into the manifold is disposed on the pipe; and

a water division tray 8, located below the humidification module 1, and configured to recycle water dripping from the wet film, where the water division tray 8 is connected to a return pipe that communicates with the circulating water tank 4, and water in the water division tray 8 flows into the circulating water tank 4 through the return pipe.

[0028] During specific humidification, water pumped from the circulating water tank 4 to the humidification module 1 forms an even water film on the wet film. When the fan draws wind, the heat exchanger 7 heats the water film on the wet film, dry wind passes through a wet film material, and dry air contacts a surface of the humid wet film on a relatively large area, thereby achieving a relatively large moisture vaporization amount. A large quantity of water molecules are delivered, with wind, into space that needs humidification, so that air humidity is increased, thereby achieving an objective of humidification. A humidification effect is achieved through cooperation of the humidification module 1 and the heat exchanger 7. Compared with a humidification manner in the prior art, in this humidification manner, the humidification component provided in this embodiment is disposed at the air inlet of the heat exchanger 7, so that condensation of water vapor is avoided. Further, the foregoing humidification manner has a relatively low requirement on water quality, and water scale is prevented from forming inside the circulating water tank 4, thereby improving stability of the humidification component, and increasing a service life of the humidification component. Further, the humidification module 1 is disposed inside an enclosure of the heat exchanger 7, so that a spatial area occupied by the entire air conditioner is reduced, thereby facilitating miniaturization.

[0029] Further, the water division tray is disposed in a lower part of the wet film, and a width of the water division tray is greater than or equal to a width of the wet film; or the water division tray is disposed in a lower part of the heat exchanger and the wet film, and a width of the water division tray is greater than or equal to a sum of a width of the heat exchanger and a width of the wet film.

[0030] Further, the water outlet of the manifold faces the wet film and is connected to an upper part of the wet film, so that water flowing from the water outlet of the manifold flows from the upper part of the wet film to the lower part, and water is evenly distributed on the wet film.

[0031] For ease of understanding a structure and a working principle of the air conditioner provided in this embodiment of the present invention, the following describes the air conditioner in detail with reference to the accompanying drawings.

[0032] Still referring to FIG. 1, the air conditioner provided in this embodiment mainly includes structures such as a fan 6, a humidification component, and a heat exchanger 7, and a placement direction shown in FIG. 1 is a reference direction. The humidification module 1 is placed at the air inlet of the heat exchanger 7, and the circulating water tank 4 is placed below the humidification module 1.

[0033] The humidification component provided in this embodiment is configured to form a water film. During usage, the fan 6 in the air conditioner draws wind, air is first humidified by passing through the humidification module 1, and then is heated by passing through the heat exchanger 7. The humidification module 1 includes the wet film that is disposed at the air inlet of the heat exchanger 7 of the air conditioner and the manifold. The water outlet of the manifold faces the wet film, and the water inlet of the manifold is connected to the circulating water tank 4 by using a pipe that has the circulating water pump 3. Specifically, a physical principle of wet film humidification is isoenthalpy humidification, and a material of the wet film is a polymeric composite material with interleaved and overlapped corrugated sheets. When water in the circulating water tank 4 is conveyed to the manifold that is on a top of the humidification module 1, the manifold evenly sprays the water to a top of the wet film. The manifold ensures that the water is evenly distributed to a wet film material. Water percolates downwards along the wet film material and wets all layers inside the wet film, and is absorbed by the wet film material at the same time, to form an even water film. When dry wind passes through the wet film material, dry air contacts a surface of the humid wet film on a relatively large area,

thereby achieving a relatively large moisture vaporization amount. A large quantity of water molecules are delivered, with wind, into space that needs humidification, so that air humidity is increased, thereby achieving an objective of humidification. By using the foregoing humidification manner, problems that current electrode humidification has a relatively high requirement on water quality and it is liable to scale are resolved, a maximum consumption power of wet film humidification is 10 W, the power is reduced by more than 95% compared with consumption of electrode humidification, and a PUE value of a machine set is reduced. In addition, a service life of wet film humidification is generally two years, and later maintenance costs of the machine set are reduced by nearly 80%. Further, the heat exchanger in the air conditioner is configured to blow wind, a maximum consumption power of wet film humidification is 10 W, the power is reduced by more than 95% compared with consumption of electrode humidification, and a PUE value of the machine set is reduced.

[0034] The wet film may have different thicknesses, and a thickness of the wet film may be specifically set according to space inside the enclosure of the heat exchanger 7, to ensure that the humidification module 1 can be placed into a structure of the heat exchanger 7. As a preferred embodiment, the thickness of the wet film provided in this embodiment of the present invention is between 20 mm and 200 mm, and is specifically any thickness between 20 mm and 200 mm, for example, 20 mm, 50 mm, 100 mm, 150 mm, or 200 mm. The thickness of the wet film is decreased, and a mesh diameter of the wet film is reduced, so that a contact area of the wet film is unchanged, and humidification efficiency is the same. Further, hindrance of a same humidification amount is decreased, and this facilitates an overall refrigeration capability of the heat exchanger 7.

[0035] For ease of supplying water to the humidification module 1, the circulating water tank 4 is disposed in a heater in this embodiment, and the circulating water tank 4 is connected to the humidification module 1 by using the pipe that has the circulating water pump 3. When humidification is required, water inside the circulating water tank 4 is drawn into the humidification module 1 by using the circulating water pump 3. Further, when water in the circulating water tank 4 provided in this embodiment is used up, water may be added manually. As a preferred embodiment, a water inlet of the circulating water tank 4 provided in this embodiment is connected to a water inlet pipe 5, and a switch valve is disposed on the water inlet pipe 5. Specifically, the water inlet pipe 5 is connected to a pump or a water supply system, where the water supply system is a commonly seen water supply system in the prior art. When it is required to add water, water is supplied to the circulating water tank 4 by using the water supply system or the pump, thereby improving water supply efficiency.

[0036] In the air conditioner provided in this embodiment, to reduce a waste of water resources, the water division tray 8 is disposed in the air conditioner in this embodiment. The water division tray 8 is disposed below the humidification module 1, and is configured to recycle water dripping from the humidification module 1. Specifically, when the manifold sprays water onto the wet film, water cannot totally enter the wet film. To prevent a waste of water resources, in this embodiment, the water division tray 8 that recycles dripping water is disposed below the humidification module 1, and the water division tray 8 is configured to contain dripping water. Further, a water outlet is disposed at the bottom of the water division tray 8, and the water outlet is connected to a return pipe that extends into the circulating water tank 4, so that collected water can flow back into the circulating water tank 4, thereby implementing recycling of water.

[0037] As a preferred technical solution, the water division tray 8 is located below the heat exchanger 7 and the humidification module 1, and is configured to collect condensate water of the heat exchanger 7 and water dripping from the humidification module 1. That is, the water division tray 8 can also recycle condensate water formed on the heat exchanger 7, so that condensate water formed on the heat exchanger 7 in the air conditioner may be used for humidification, thereby improving utilization of the water resources. In addition, condensate water of an air conditioner set is recycled, and a sensible heat ratio of refrigeration is improved up to 100%.

[0038] In addition, to improve automated operation efficiency of an entire device, a system for automatically supplying water is disposed in the humidification component provided in this embodiment. Specifically, the switch valve on the water inlet pipe 5 is a solenoid valve 51, and a liquid level detection apparatus 2 is disposed inside the circulating water tank 4. In addition, a control apparatus is further disposed. When a water level detected by the liquid level detection apparatus 2 is lower than a specified water level, the control apparatus controls the solenoid valve 51 to be opened until the detected water level of the circulating water tank 4 reaches the specified water level.

[0039] During specific operation, when an air conditioner operation parameter is less than a specified value, the air conditioner initiates a "humidification" working condition. After an instruction is accepted, and when it is detected that a high liquid level has no output signal, the solenoid valve 51 is opened, to add water to the circulating water tank 4. When a liquid level rises to the high liquid level, the solenoid valve 51 is closed, and the circulating water pump 3 is turned on, to pump water in the circulating water tank 4 into the manifold. Humidification is performed by using the wet film, and water that is not evaporated flows back into the circulating water tank 4 for a next cycle. After a humidification parameter reaches the specified value, the circulating water pump 3 is turned off, and the humidification working condition is finished.

[0040] When an air conditioner operation parameter is less than a specified value, the air conditioner initiates a "humidification" working condition. After an instruction is

accepted, and when it is detected that a high liquid level has an output signal, the circulating water pump 3 is turned on, to pump water in the circulating water tank 4 into the manifold. Humidification is performed by using the wet film, and water that is not evaporated flows back into the circulating water tank 4 for a next cycle. After a humidification parameter reaches the specified value, the circulating water pump 3 is turned off, and the humidification working condition is finished.

[0041] Further, as shown in FIG. 2, the water division tray is disposed in a lower part of the wet film, and a width of the water division tray is greater than or equal to a width of the wet film. A side wall of the water division tray is disposed between the heat exchanger and the wet film. Alternatively, the water division tray is disposed at the bottom of the heat exchanger, and extends to space containing the bottom of the wet film.

[0042] In addition, an embodiment further provides a humidification method of an air conditioner. The air conditioner is the foregoing air conditioner. The humidification method includes the following step:

when humidification is required, first humidifying, by using a wet film, air that is drawn by a fan 6 in the air conditioner, and then delivering humidified air into a heat exchanger 7.

[0043] In the foregoing embodiment, wind that is drawn by the fan 6 during rotation is first humidified by using the wet film on which a water film forms, and then humidified air enters the heat exchanger, so that air humidity is increased. Compared with a humidification manner in the prior art, in this humidification manner, the humidification component provided in this embodiment is disposed at an air inlet of the heat exchanger 7, so that condensation of water vapor is avoided. Further, the foregoing humidification manner has a relatively low requirement on water quality, and water scale is prevented from forming inside the circulating water tank 4, thereby improving stability of the humidification component, and increasing a service life of the humidification component. Further, the humidification module 1 is disposed inside an enclosure of the heat exchanger 7, so that a spatial area occupied by the entire air conditioner is reduced, thereby facilitating miniaturization.

[0044] As shown in FIG. 3, FIG. 3 shows control logic of the foregoing humidification manner. When the foregoing humidification manner is used, when there is a humidification requirement, that is, when an air conditioner operation parameter is less than a specified value, the air conditioner initiates a "humidification" working condition. Before humidification is initiated, a water level of a circulating water tank 4 is detected. Humidification is directly started when the water level of the circulating water tank 4 reaches a specified water level; or when the water level of the circulating water tank 4 does not reach a specified water level, a solenoid valve 51 is controlled to be opened to inject water into the circulating water tank 4 until water reaches a specified position, and then humidification is started. After humidification is started, air humidity is detected, and when the air humidity reaches the standard, a circulating water pump 3 is controlled to stop humidification, and an entire humidification process is finished.

[0045] A person skilled in the art can make various modifications and variations to the present invention without departing from the spirit and scope of the present invention. The present invention is intended to cover these modifications and variations provided that they fall within the scope of protection defined by the following claims and their equivalent technologies.

Claims

1. An air conditioner, comprising a fan, a humidification component, and a heat exchanger, wherein
   the fan is disposed at an air outlet of the heat exchanger;
   the humidification component comprises a circulating water tank, wherein the circulating water tank is configured to contain water;
   a humidification module, comprising a wet film covering an air inlet of the heat exchanger, and further comprising a manifold, wherein a water outlet of the manifold faces the wet film and is connected to an upper part of the wet film, a water inlet of the manifold communicates with the circulating water tank by using a pipe, and a circulating water pump that pumps water inside the circulating water tank into the manifold is disposed on the pipe; and
   a water division tray, located below the humidification module, and configured to recycle water dripping from the wet film, wherein the water division tray is connected to a return pipe that communicates with the circulating water tank, and water in the water division tray flows into the circulating water tank through the return pipe.

2. The air conditioner according to claim 1, wherein the water division tray is disposed in a lower part of the wet film, and a width of the water division tray is greater than or equal to a width of the wet film; or the water division tray is disposed in a lower part of the heat exchanger and the wet film, and a width of the water division tray is greater than or equal to a sum of a width of the heat exchanger and a width of the wet film.

3. The air conditioner according to claim 1 or 2, wherein the water outlet of the manifold faces the wet film and is connected to the upper part of the wet film, so that water flowing from the water outlet of the manifold flows from the upper part of the wet film to the lower part, and water is evenly distributed on the wet film.

4. The air conditioner according to claim 3, wherein a

water inlet of the circulating water tank is connected to a water inlet pipe, and a switch valve is disposed on the water inlet pipe.

5. The air conditioner according to claim 3, wherein the switch valve is a solenoid valve; and
a liquid level detection apparatus is disposed inside the circulating water tank; and
the air conditioner further comprises a control apparatus, wherein when a water level detected by the liquid level detection apparatus is lower than a specified water level, the control apparatus controls the solenoid valve to be opened until the detected water level of the circulating water tank reaches the specified water level.

6. The air conditioner according to claim 3, wherein the water division tray is located below the heat exchanger and the humidification module, and is configured to collect condensate water of the heat exchanger and water dripping from the humidification module.

7. The air conditioner according to any one of claims 3 to 6, wherein a thickness of the wet film is between 20 mm and 200 mm.

8. A humidification method of an air conditioner, wherein the air conditioner is the air conditioner according to claim 2, and the humidification method comprises the following step:

when humidification is required, first humidifying, by using a wet film, air that is drawn by a fan in the air conditioner, and then delivering humidified air into a heat exchanger.

9. The humidification method according to claim 8, further comprising: when humidification is initiated, detecting a water level of a circulating water tank, and directly starting humidification when the water level of the circulating water tank reaches a specified water level; or when the water level of the circulating water tank does not reach a specified water level, controlling the solenoid valve to be opened to inject water into the circulating water tank until water reaches a specified position, and then starting humidification.

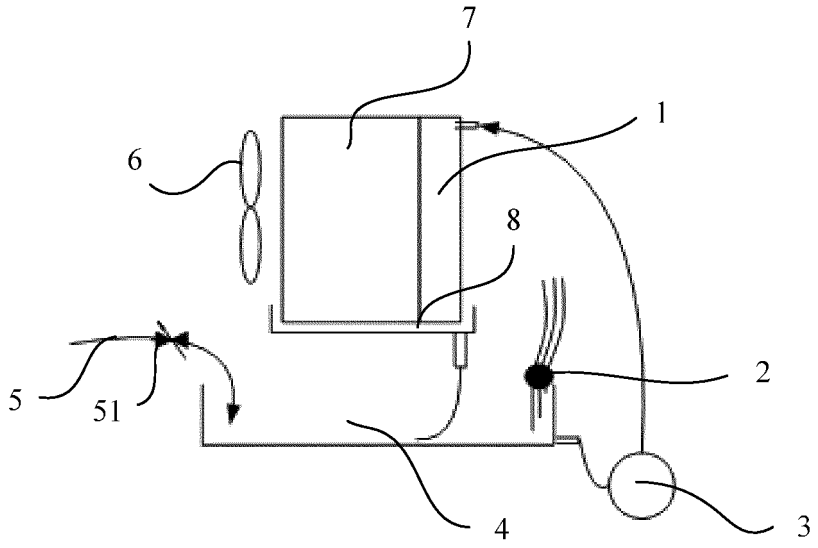

FIG. 1

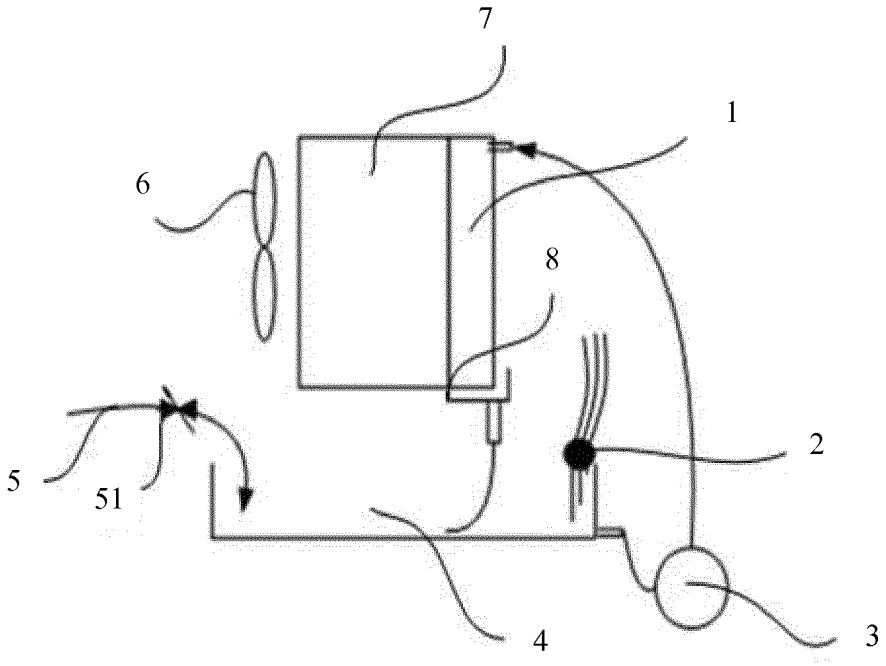

FIG. 2

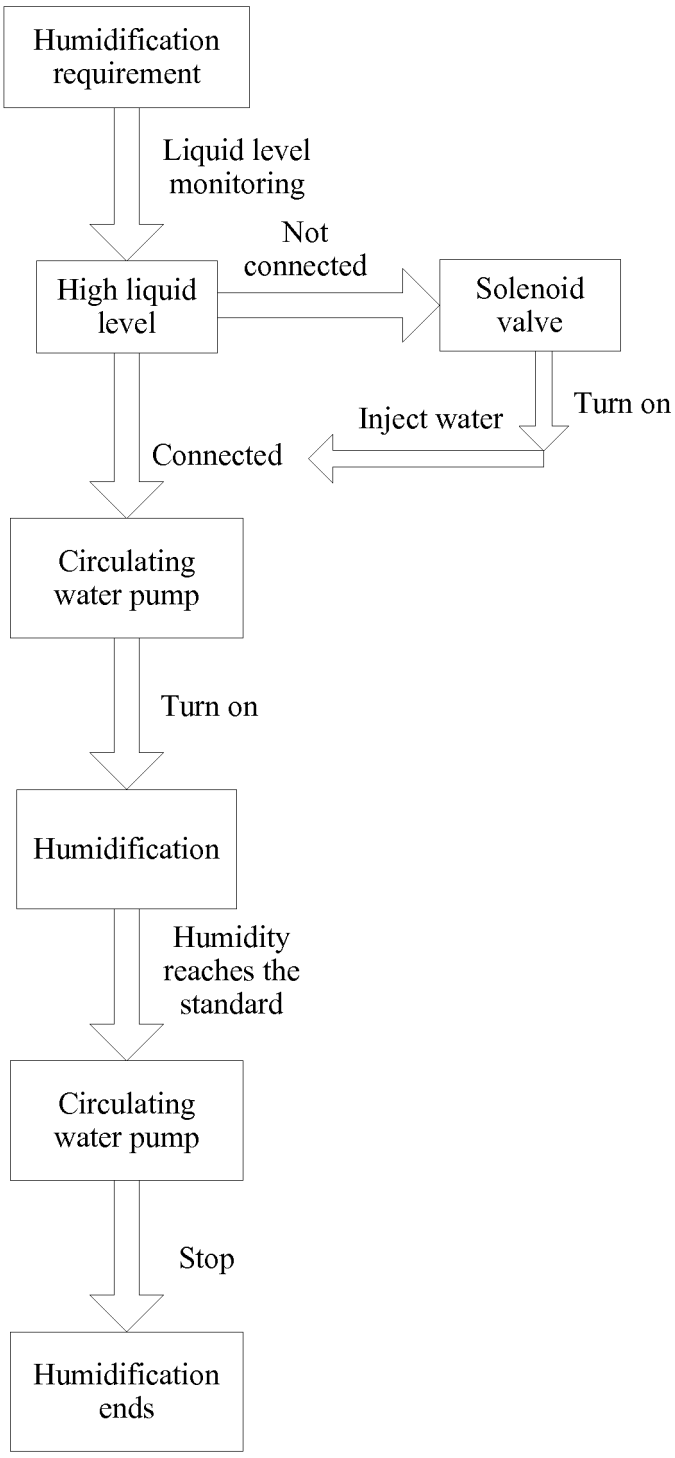
Humidification requirement
Liquid level monitoring
Not connected
High liquid level
Solenoid valve
Turn on
Inject water
Connected
Circulating water pump
Turn on
Humidification
Humidity reaches the standard
Circulating water pump
Stop
Humidification ends

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/109539

A. CLASSIFICATION OF SUBJECT MATTER

F24F 6/04 (2006.01) i; F24F 3/14 (2006.01) i; F24F 13/30 (2006.01) i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F

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)
CPRSABS, CNKI, VEN: air inlet, air condition, humidify, damping, humidity, moisture, film, membrane, heat exchange, heat transfer, evaporator, condensator, condenser, inlet, intake, air, water tank, water box

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 204438361 U (SICHUAN SUP-INFO INFORMATION TECHNOLOGY CO., LTD.), 01 July 2015 (01.07.2015), abstract, description, paragraphs [0014]-[0017], and figures 1-2	1-9
A	CN 201285120 Y (JIANG, Guoliang), 05 August 2009 (05.08.2009), the whole document	1-9
A	CN 202501590 U (ZHEJIANG NORMAL UNIVERSITY), 24 October 2012 (24.10.2012), the whole document	1-9
A	CN 103743016 A (BAOJI XINGYE AIR CONDITIONING EQUIPMENT GROUP CO., LTD.), 23 April 2014 (23.04.2014), the whole document	1-9
A	CN 104896639 A (CHANGSHA MAXXOM HIGH-TECH CO., LTD.), 09 September 2015 (09.09.2015), the whole document	1-9
A	JP H05332586 A (MITSUBISHI ELECTRIC CORP.), 14 December 1993 (14.12.1993), the whole document	1-9
A	SU 1375909 A1 (SANITARY ENG RES), 23 February 1988 (23.02.1988), the whole document	1-9

☒ 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

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Date of the actual completion of the international search	Date of mailing of the international search report
27 February 2017 (27.02.2017)	**16 March 2017 (13.03.2017)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **ZHONG, Dehui** Telephone No.: (86-10) **62084834**

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/109539

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 105716188 A (SANITARY ENG RES), 23 February 1988 (23.02.1988), description, paragraphs [0033]-[0061], and figures 1-3	1-9

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/109539

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 204438361 U	01 July 2015	None	
CN 201285120 Y	05 August 2009	None	
CN 202501590 U	24 October 2012	None	
CN 103743016 A	23 April 2014	None	
CN 104896639 A	09 September 2015	None	
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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