(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 357 685 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
24.04.2024 Bulletin 2024/17

(21) Application number: **23765963.6**

(22) Date of filing: **07.03.2023**

(51) International Patent Classification (IPC):
F24F 1/14 *(2011.01)* ***F24F 11/61*** *(2018.01)*
F24F 11/64 *(2018.01)* ***F24F 11/65*** *(2018.01)*
F24F 11/84 *(2018.01)* ***F24F 11/85*** *(2018.01)*
F25B 39/04 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F24F 1/14; F24F 1/16; F24F 11/61; F24F 11/84; F24F 11/85; F25B 39/04; F28F 25/06;
F24F 2110/64; F24F 2110/65

(86) International application number:
PCT/CN2023/079957

(87) International publication number:
WO 2023/169385 (14.09.2023 Gazette 2023/37)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **11.03.2022 CN 202210239348**

(71) Applicants:
- **GD Midea Heating & Ventilating Equipment Co., Ltd.**
  Foshan Guangdong 528311 (CN)
- **Midea Group Co., Ltd.**
  Foshan, Guangdong 528311 (CN)

(72) Inventors:
- **YAN, Libo**
  Foshan, Guangdong 528311 (CN)
- **ZENG, Haiyuan**
  Foshan, Guangdong 528311 (CN)
- **ZHANG, Feng**
  Foshan, Guangdong 528311 (CN)
- **WANG, Feng**
  Foshan, Guangdong 528311 (CN)

(74) Representative: **Ran, Handong et al**
Maucher Jenkins
Seventh Floor Offices
Artillery House
11-19 Artillery Row
London SW1P 1RT (GB)

(54) SPRAYING SYSTEM AND CONTROL METHOD AND APPARATUS THEREFOR, ELECTRONIC DEVICE, AND READABLE STORAGE MEDIUM

(57) A spraying system and a control method and apparatus therefor, an electronic device, a readable storage medium, and an air conditioner. The spraying system comprises a water outlet device (1), a spraying branch (2), a return flow branch (3), and a nozzle (4); a water outlet (11) of the water outlet device (1), the spraying branch (2), and the nozzle (4) are sequentially connected; the spraying branch (2), the return flow branch (3), and a water inlet (12) of the water outlet device (1) are sequentially connected; an electromagnetic valve is disposed in the spraying branch (2) and/or the return flow branch (3), the electromagnetic valve being used to control opening and closing of the spraying branch (2) and/or the return flow branch (3); when the spraying branch (2) is open, liquid flowing out of the water outlet device (1) flows out of the nozzle (4) via the spraying branch (2); and when the return flow branch (3) is open, liquid flowing out of the water outlet device (1) flows into the water outlet device (1) via the return flow branch (3). In this way, implementation of intermittent spraying can be ensured in a spraying system provided with a water pump (5), and water supply pressure can be increased by means of the return flow branch (3), so that the water pump (5) does not need to be frequently started and stopped, and the temperature inside the pump is not increased, thereby ensuring the service life and spraying cooling effect of the system during water-saving operation of the spraying system.

EP 4 357 685 A1

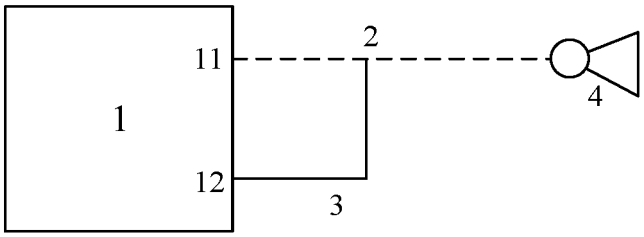

FIG. 1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Chinese patent application No. 202210239348.0, filed with CNIPA on March 11, 2022, and entitled "spraying system, method and apparatus for controlling spraying system, and electronic device", the entire contents of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to the field of air conditioner technologies, and more particularly, to a spraying system, a method and an apparatus for controlling spraying system, and an electronic device.

BACKGROUND

[0003] When an air conditioner performs a cooling operation under high-temperature weather, in order to improve a heat exchange efficiency of an outdoor unit, a method of cooling by spraying may be used for the heat exchanger of the outdoor unit. Moreover, in order to ensure water conservation, an intermittent spraying method may be used generally, a water pump needs to be operated continuously under normal circumstance. However, when an intermittent spraying mode is applied, the water pump needs to be turned on and turned off frequently, in this situation, a fault is prone to occur, and a service life of the water pump is shortened.

SUMMARY

[0004] In view of this, the present disclosure provides a spraying system, a method and an apparatus for controlling a spraying system, and an electronic device, in order to at least ensure a service life and a spray cooling effect of the system when the spraying system performs a water conservation operation.

[0005] A spraying system is provided in some embodiments of the present disclosure. The spraying system includes a water outlet device, a spraying branch, a backflow branch and a nozzle; a water outlet of the water outlet device, the spraying branch and the nozzle are communicated sequentially. The spraying branch, the backflow branch and a water inlet of the water outlet device are communicated sequentially. A solenoid valve is arranged in the spraying branch and/or the backflow branch, and the solenoid valve is configured to control turning on and turning off of the spraying branch and/or the backflow branch. When the spraying branch is turned on, liquid flowing out of the water outlet device flows out of the nozzle through the spraying branch. When the backflow branch is turned on, the liquid flowing out of the water outlet device flows into the water outlet device through the backflow branch.

[0006] In some embodiments of the present disclosure, the spraying branch includes a first spraying branch and a second spraying branch, and a water pump is arranged in the first spraying branch. The water outlet of the water outlet device, the first spraying branch, the second spraying branch and the nozzle are communicated sequentially. The water outlet of the water outlet device, the first spraying branch, the backflow branch and the water inlet of the water outlet device are communicated sequentially.

[0007] In some embodiments of the present disclosure, the second spraying branch is provided with a first solenoid valve, the backflow branch is provided with a second solenoid valve, both the first solenoid valve and the second solenoid valve are two-way solenoid valves.

[0008] In some embodiments of the present disclosure, a third solenoid valve is arranged at an intersection point of the first spraying branch, the second spraying branch and the backflow branch. Where, the third solenoid valve is a three-way solenoid valve.

[0009] In some embodiments of the present disclosure, if a switch module is arranged in the water pump, none of the second spraying branch and the backflow branch is provided with the solenoid valve. If the switch module is not arranged in the water pump, the second spraying branch is provided with a fourth solenoid valve or a fifth solenoid valve is provided in the backflow branch. Where, both the fourth solenoid valve and the fifth solenoid valve are two-way solenoid valves.

[0010] In some embodiments of the present disclosure, the spraying system further includes a detection module; the detection module is configured to detect startup and shutdown and a spraying mode of the spraying system.

[0011] In some embodiments of the present disclosure, the spraying system further includes a control module, the control module is in communication connection with the detection module, and the control module is communicated with a solenoid valve of the spraying system; the control module is configured to control turning on and turning off of the solenoid valve based on the detection mode.

[0012] In some embodiments of the present disclosure, the water outlet device is a water tank.

[0013] A method for controlling a spraying system is further provided in the embodiments of the present disclosure, the method is applied to the spraying system and includes: determining a spraying mode of the spraying system; if the spraying mode is a continuous spraying mode, controlling the spraying branch of the spraying system to turn on, and controlling the backflow branch of the spraying system to turn off, in order that liquid in the water outlet device of the spraying system continuously flows out of the nozzle of the spraying system; if the spraying mode is an intermittent spraying mode, controlling the spraying branch to turn on, and controlling the backflow branch or the spraying branch to turn off, and controlling the backflow branch to turn on, in order that

the liquid in the water outlet device intermittently flows out of the nozzle.

[0014] In some embodiments of the present disclosure, if the spraying mode is the continuous spraying mode, the step of controlling the spraying branch of the spraying system to turn on, and controlling the backflow branch of the spraying system to turn off may include: if the spraying mode is the continuous spraying mode, turning on the spraying branch; and controlling the water pump of the spraying system to start to operate after the spraying branch has been turned on for a preset first time.

[0015] In some embodiments of the present disclosure, the method further includes: obtaining a stop spraying signal, and controlling the water pump of the spray system to stop operation based on the stop spraying signal; turning off the spraying branch after the water pump stops operation for the first time.

[0016] In some embodiments of the present disclosure, if the spraying mode is the intermittent spraying mode, the step of controlling the spraying branch to turn on, controlling the backflow branch or the spraying branch to turn off, and controlling the backflow branch to turn on includes: determining a spraying time and a stop spraying time of the intermittent spraying mode, if the spraying mode is the intermittent spraying mode; controlling the spraying branch to turn on and controlling the backflow branch to turn off during the spraying time; and controlling the spraying branch to turn off and controlling the backflow branch to turn on during the stop spraying time.

[0017] In some embodiments of the present disclosure, the method further includes: turning on the backflow branch when the spraying time is switched to the stop spraying time and an operation time of the water pump is greater than a preset time threshold value; turning off the spraying branch after the backflow branch has been turned on for a preset second time; turning on the spraying branch when the stop spraying time is switched to the spraying time; turning off the backflow branch after the spraying branch has been turned on for the second time.

[0018] In some embodiments of the present disclosure, the method further includes: obtaining a stop spraying signal, and controlling the water pump to stop operation based on the stop spraying signal; maintaining a turned-off state of the solenoid valve of the spraying branch and the solenoid valve of the backflow branch if the solenoid valve of the spraying branch and the solenoid valve of the backflow branch are both in a turned-off state; if the solenoid valve of the spraying branch or the solenoid valve of the backflow branch is in a turned-on state, controlling the solenoid valve of the spraying branch in the turned-on state or the solenoid valve of the backflow branch in the turned-on state to turn on for the second time, and then controlling the solenoid valve of the spraying branch in the turned-on state or the solenoid valve of the backflow branch in the turned-on state to turn off.

[0019] An apparatus for controlling a spraying system is further provided in some embodiments of the present disclosure. The control apparatus is applied to the spraying system and may include: a spraying mode determination module configured to determine a spraying mode of the spray system; a continuous spraying control module configured to control the spraying branch of the spraying system to turn on, and control the backflow branch of the spraying system to turn off if the spraying mode is a continuous spraying mode, in order that liquid in a water outlet device of the spraying system continuously flows out of a nozzle of the spraying system; and an intermittent spraying control module configured to control the spraying branch to turn on, control the backflow branch or the spraying branch to turn off, and control the backflow branch to turn on, in order that the liquid in the water outlet device intermittently flows out of the nozzle, if the spraying mode is an intermittent spraying mode.

[0020] In some embodiments of the present disclosure, the continuous spraying control module is configured to turn on the spraying branch if the spraying mode is the continuous spraying mode, and control a water pump of the spraying system to start to operate after the spraying branch has been turned on for a preset first time.

[0021] In some embodiments of the present disclosure, the intermittent spraying control module is configured to determine a spraying time and a stop spraying time of the intermittent spraying mode if the spraying mode is the intermittent spraying mode; control the spraying branch to turn on and control the backflow branch to turn off during the spraying time, and control the spraying branch to turn off and control the backflow branch to turn on during the stop spraying time.

[0022] An electronic device is further provided in the embodiments of the present disclosure. The electronic device includes a memory and a processor, the memory is configured to store a computer program, and the processor is configured to execute the computer program to implement the aforesaid method for controlling the spraying system.

[0023] A readable storage medium is further provided in the embodiments of the present disclosure. The readable storage medium stores a computer program instruction, that, when being read and executed by a processor, causes the processor to implement the aforesaid method for controlling the spraying system.

[0024] An air conditioner is further provided in some embodiments of the present disclosure, the air conditioner includes the aforesaid spraying system.

[0025] At least following beneficial effects are generated in embodiments of the present disclosure, which are listed below:

[0026] According to the spraying system, the method and the apparatus for controlling the spraying system and the electronic device provided in some embodiments of the present disclosure, the spraying system may enable the liquid flowing out of the water outlet device to flow back to the water outlet device through the backflow

branch. In this method, it may be ensured that the intermittent spraying is realized in the spraying system containing the water pump through switching of the solenoid valves, and a water supply pressure is improved through the backflow branch. Thus, the water pump does not need to be turned on and turned off frequently, an occurrence of temperature rise in the pump would not be caused, a service life and a spray cooling effect of the system may be ensured when the spraying system is operated in a water conservation manner.

[0027] Other features and advantages of the present disclosure will be illustrated in the following description. Alternatively, some of the features and benefits may be derived or unambiguously determined from the description, or be learned by implementing the above-mentioned techniques of the present disclosure.

[0028] In order to make the above objectives, features, and advantages of the present disclosure to be more comprehensible, preferable embodiments are particularly exemplified hereinafter, and are described in detail below with reference to the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

[0029] In order to explain the technical solutions in the embodiments of the present disclosure or the related art more clearly, a brief introduction regarding the accompanying drawings that need to be used for describing the embodiments or the related art is given below. It is obvious that the accompanying figures described below are some embodiments of the present disclosure. For the person of ordinary skill in the art, other drawings may also be obtained according to these drawings without paying creative labor.

FIG. 1 illustrates a schematic structural diagram of one spraying system provided in some embodiments of the present disclosure;

FIG. 2 illustrates a schematic structural diagram of another spraying system provided in some embodiments of the present disclosure;

FIG. 3 illustrates a schematic diagram of an arrangement of a solenoid valve in a first spraying system provided in some embodiments of the present disclosure;

FIG. 4 illustrates a schematic diagram of an arrangement of a solenoid valve in a second spraying system provided in some embodiments of the present disclosure;

FIG. 5 illustrates a schematic diagram of an arrangement of a solenoid valve in a third spraying system provided in some embodiments of the present disclosure;

FIG. 6 illustrates a schematic diagram of an arrangement of a solenoid valve in a fourth spraying system provided in some embodiments of the present disclosure;

FIG. 7 illustrates a schematic structural diagram of another spraying system according to one embodiment of the present disclosure;

FIG. 8 illustrates a flow diagram of one method for controlling a spraying system provided in some embodiments of the present disclosure;

FIG. 9 illustrates a flow diagram of another method for controlling the spraying system provided in some embodiments of the present disclosure;

FIG. 10 illustrates a schematic diagram of a control method for a first consecutive spraying mode provided in some embodiments of the present disclosure;

FIG. 11 illustrates a schematic diagram of a control method for a first intermittent spraying mode provided in some embodiments of the present disclosure;

FIG. 12 illustrates a schematic diagram of a control method for a second consecutive spraying mode provided in some embodiments of the present disclosure;

FIG. 13 illustrates a schematic diagram of a control method for a second intermittent spraying mode provided in some embodiments of the present disclosure;

FIG. 14 illustrates a schematic diagram of a control method for a third consecutive spraying mode provided in some embodiments of the present disclosure;

FIG. 15 illustrates a schematic diagram of a control method for a third intermittent spraying mode provided in some embodiments of the present disclosure;

FIG. 16 illustrates a schematic structural diagram of an apparatus for controlling a spraying system provided in some embodiments of the present disclosure;

FIG. 17 illustrates a schematic structural diagram of an electronic device provided in some embodiments of the present disclosure.

[0030] Reference numerals are listed below: 1-water outlet device; 11-water outlet; 12-water inlet; 2-spraying branch; 21-first spraying branch; 22-second spraying branch; 3-backflow branch; 4-nozzle; 5-water pump; 61-first solenoid valve; 62-second solenoid valve; 63-third solenoid valve; 64-fourth solenoid valve; 65-fifth solenoid valve; 7-detection module; 8-control module; 1601-spraying mode determination module; 1602-continuous spraying control module; 1603-intermittent spraying control module; 100-memory; 101-processor; 102-bus; 103-communication interface.

DETAILED DESCRIPTIOIN OF EMBODIMENTS

[0031] In order to make the purpose, the technical solutions and the advantages of the present disclosure be clearer, the technical solutions in the embodiments of the present disclosure will be described clearly and comprehensively with reference to the accompanying drawings.

It is obvious that, the embodiments described below are only some embodiments of the present disclosure rather than all embodiments. Based on the embodiments in the present disclosure, some other embodiments, which are obtained by the person of ordinary skill in the art without paying creative labor, should all be included in the protection scope of the present disclosure.

[0032] At present, when the air conditioner performs a cooling operation under high-temperature weather, in order to improve a heat exchange efficiency of an outdoor unit, a spray cooling method may be used for the heat exchanger of the outdoor unit. Simultaneously, in order to ensure water conservation, an intermittent spraying method may be used generally, a water pump needs to be operated continuously under normal condition. However, when an intermittent spraying mode is used, the water pump needs to be turned on and turned off frequently. In this condition, a fault is prone to occur, so that a service life of the water pump is shortened.

[0033] In view of this, a spraying system, a method and an apparatus for controlling the spraying system, and an electronic device are provided in the embodiments of the present disclosure. In particular, the present disclosure relates to a spray cooling device, an air conditioner and a water conservation spraying control method. It can be ensured that, an intermittent spraying can be implemented in a spray cooling system including the water pump through switching of solenoid valves, damage to the water pump may be avoided while the purpose of spraying water and conserving water is achieved, a service life of the water pump is prolonged and user experience is improved.

[0034] In order to facilitate understanding of this embodiment, a method for controlling a spraying system disclosed in the embodiments of the present disclosure is described in detail.

[0035] The spraying system according to the embodiments of the present disclosure will be described in detail below with reference to the accompanying drawings.

[0036] The spraying system may include a water outlet device 1, a spraying branch 2, a backflow branch 3 and a nozzle 4. A water outlet 11 of the water outlet device 1, the spraying branch 2 and the nozzle 4 are communicated sequentially. The spraying branch 2, the backflow branch 3 and a water inlet 12 of the water outlet device 1 are communicated sequentially.

[0037] As shown in FIG. 1, a solid line branch in FIG. 1 represents the spraying branch, and a dotted line branch represents the backflow branch. A solenoid valve may be arranged in the spraying branch and/or the backflow branch, and the solenoid valve is configured to control turning on and turning off of the spraying branch and/or the backflow branch. That is, two-way solenoid valves may be respectively provided in the spraying branch and/or the backflow branch, and three-way solenoid valves may also be provided at an intersection of the spraying branch and the backflow branch. Thus, the turning on and turning off of the spraying branch and/or the backflow branch may be controlled through the solenoid valves.

[0038] When the spraying branch is turned on, liquid flowing out of the water outlet device may flow out of the nozzle through the spraying branch. When the backflow branch is turned on, the liquid flowing out of the water outlet device may flow into the water outlet device again through the backflow branch. The liquid flows into the water outlet device again through the backflow branch, such that the water pressure of the water outlet device may be improved, which means that, there is no need to increase the water pressure through the water pump.

[0039] If the intermittent spraying mode is adopted, the spraying branch may be turned on firstly, and the backflow branch is turned off for a period of time. In this condition, the liquid may flow out of the nozzle through the spraying branch. Then, the backflow branch is turned on, the spraying branch is turned off for a period of time, in this condition, the liquid flows into the water outlet device again through the backflow branch, the water pressure of the water outlet device may be increased, there is no need to increase the water pressure through the water pump in the entire intermittent spraying process, the service life of the water pump may be prolonged, and the damage to the water pump is avoided.

[0040] According to the spraying system, the apparatus and the electronic device provided in the embodiment of the present disclosure, the spraying system may enable the liquid flowing out of the water outlet device to flow back to the water outlet device through the backflow branch. In this method, it can be guaranteed that, the intermittent spraying in the spraying system including the water pump may be realized through switching of the solenoid valves, and a water supply pressure is improved through the backflow branch. Thus, the water pump does not need to be turned on and turned off frequently, occurrence of temperature rise in the pump would not be caused, the service life of the water pump may be prolonged, the damage to the water pump is avoided, and the user experience is improved.

[0041] Another spraying system according to the embodiments of the present disclosure will be described in detail below with reference to the accompanying drawings.

[0042] Another spraying system is provided in the embodiments of the present disclosure. This method is implemented on the basis of the above-mentioned embodiments. FIG. 2 illustrates a schematic structural diagram of another spraying system. In the spraying system in this embodiment, the spraying branch 2 may include a first spraying branch 21 and a second spraying branch 22, and a water pump 5 is arranged in the first spraying branch 21.

[0043] Where, a water outlet 11 of the water outlet device 1, the first spraying branch 21, the second spraying branch 22 and the nozzle 4 may be connected in sequence. A water outlet 11 of the water outlet device 1, the first spraying branch 21, the backflow branch 3, and

a water inlet 12 of the water outlet device 1 may be connected in sequence.

[0044] Liquid may be extracted from the water outlet device through the water pump. Where, the water outlet device may be a water tank or a water net, the liquid may be water or coolant liquid. The pumped liquid may flow out of the nozzle through the first spraying branch and the second spraying branch. Alternatively, the liquid flows into the water outlet device again through the first spraying branch and the backflow branch.

[0045] Regarding the solenoid valves in the spray system, in this embodiment, the solenoid valves may be arranged in the form of a two-way solenoid valve or a three-way solenoid valve. Referring to the arrangement of the solenoid valve in the first spray system shown in FIG. 3, a first solenoid valve 61 may be arranged in the second spraying branch 22, a second solenoid valve 62 may be arranged in the backflow branch 3. Both the first solenoid valve 61 and the second solenoid valve 62 are two-way solenoid valves. The first solenoid valve 61 may control turning on and turning off of the second spraying branch 22, the second solenoid valve 62 may control turning-on and turning-off of the backflow branch 3.

[0046] Referring to the schematic diagram of the arrangement of the solenoid valves in the second spray system shown in FIG. 4, a third solenoid valve 63 may be disposed at the intersection point of the first spraying branch 21, the second spraying branch 22 and the backflow branch 3. Where, the third solenoid valve 63 is a three-way solenoid valve. It needs to be noted that the three-way solenoid valve has the function of switching between accesses and cannot turn off the accesses. That is, even if the three-way solenoid valve only has the following two conditions: the second spraying branch is turned on and the backflow branch is turned off, or the second spraying branch is turned off and the backflow branch is turned on, the second spraying branch and the backflow branch cannot be turned off completely, the second spraying branch and the backflow branch cannot be turned on simultaneously, too.

[0047] Therefore, in order to turn off the second spraying branch and the backflow branch simultaneously, in this embodiment, a switch module may be arranged in the water pump, the water pump is turned on or turned off through the switch module. If the water pump is turned off, even though the second spraying branch and the backflow branch cannot be turned off, liquid cannot flow through the second spraying branch and the backflow branch. That is, if the switch module is arranged in the water pump, none of the second spraying branch and the backflow branch is provided with the solenoid valve.

[0048] Alternatively, the second spraying branch and the backflow branch may be turned off simultaneously by arranging two-way solenoid valves in the second spraying branch and the backflow branch. For example, a fourth solenoid valve is arranged in the second spraying branch or a fifth solenoid valve is arranged in the backflow branch, if the switch module is not arranged in the water pump. Where, both the fourth solenoid valve and the fifth solenoid valve are two-way solenoid valves.

[0049] Referring to the schematic diagram of the arrangement of the solenoid valves in the third spraying system shown in FIG. 5, a fourth solenoid valve 64 may be arranged in the second spraying branch 22, and the fourth solenoid valve 64 may control the second spraying branch 22 to be turned off and turned on. In this condition, if the second spraying branch 22 and the backflow branch 3 need to be turned off simultaneously, the backflow branch 3 may be controlled to turn off and the second spraying branch 22 may be controlled to turn on through the third solenoid valve 63first, then, the second spraying branch 22 is controlled to turn off through the fourth solenoid valve 64.

[0050] Referring to the schematic diagram of the arrangement of the solenoid valves in the fourth spraying system shown in FIG. 6, a fifth solenoid valve 65 may be arranged in the backflow branch 3, and the fifth solenoid valve 65 may control turning off and turning on of the backflow branch 3. In this condition, if the second spraying branch 22 and the backflow branch 3 need to be turned off simultaneously, the backflow branch 3 may be controlled to turn on and the second spraying branch 22 may be controlled to turn off through the third solenoid valve 63, then, the backflow branch 3 is controlled to turn off through the fifth solenoid valve 65.

[0051] According to the spraying system provided in the embodiments of the present disclosure, a purpose of controlling turning on and turning off of the spraying branch and the backflow branch through the solenoid valves may be achieved by arranging the two-way solenoid valve or the three-way solenoid valve in the spraying branch and the backflow branch, the spraying system has a low cost and it is convenient to implement the spraying system.

[0052] Additionally, with reference to the structural schematic diagram of another spraying system shown in FIG. 7, the spraying system may further include a detection module 7. The detection module 7 is configured to detect a startup-shutdown and a spraying mode of the spray system.

[0053] Additionally, as shown in FIG. 7, the spraying system may further include a control module 8. The control module 8 may be in communication connection with the detection module 7, and the control module 8 is communicated with solenoid valves (i.e., the first solenoid valve 61 and the second solenoid valve 62) of the spraying system. The control module is configured to control turning on and turning off of the solenoid valves based on a detection mode.

[0054] The detection module and the control module may be arranged on the same circuit board, the detection module and the control module may be in communication connection. The control module is communicated with the solenoid valve and the water pump through wires, and controls power on and power off of the solenoid valve and the water pump through a relay mounted in the con-

trol module, and thereby controls the turning on and turning off states of the solenoid valve and the water pump. A floating ball valve is arranged in the water outlet device, when a liquid level is lower than a preset height, the floating ball valve is started to supply water into the water outlet device to ensure that the water outlet device is in a state of being filled with water. After the detection module detects an enable signal of the spraying system, whether the spraying system is in the intermittent spraying mode or in the continuous spraying mode is further determined.

[0055] The method for controlling the spraying system according to the embodiments of the present disclosure will be described in detail below with reference to the accompanying drawings.

[0056] A method for controlling a spraying system is provided in the embodiments of the present disclosure, this method is applied to the spraying system provided in the aforesaid embodiment. Where, the spraying system in this embodiment may include a water outlet device (in this embodiment, a water tank is taken as an example, which is not repeatedly described here), a water pipe, a water pump, a solenoid valve, a nozzle, a heat exchanger, a detection module, and a control module. In all embodiments of the present disclosure, a water pipe branch where the nozzle is located is defined as the spraying branch, and a branch flowing back to the water tank is defined as the backflow branch.

[0057] Based on the above description, referring to the flow diagram of the method for controlling the spraying system shown in FIG. 8, the method for controlling the spraying system may include the following steps:

[0058] In a step of S802, a spraying mode of the spray system is determined.

[0059] The spraying mode of the spraying system may be input by a user through a button on an air conditioner, a remote controller of the air conditioner or an application program of a terminal device. The spraying system may determine the spraying mode of the spraying system through the detection module.

[0060] The determination of the spraying mode of the spraying system may include a continuous spraying mode or an intermittent spraying mode. The continuous spraying mode may be interpreted as liquid in the water tank continuously flows out of the nozzle, and the intermittent spraying mode may be interpreted as the liquid in the water tank intermittently flows out of the nozzle. The liquid in the water tank may be cooling water or water, different spraying times and intermittent times may be set in the intermittent spraying mode. For example, the spraying time is 10 seconds, the intermittent time is 6 seconds, it may be understood that the liquid flows out from the nozzle between for 0-10 seconds, the liquid stops flowing out of the nozzle for 10-16 seconds, etc.

[0061] In a step of S804, the spraying branch of the spraying system is controlled to turn on, and the backflow branch of the spraying system is controlled to turn off, such that the liquid in the water outlet device of the spraying system continuously flows out of the nozzle of the spraying system, if the spraying mode is the continuous spraying mode.

[0062] If the spraying mode is the continuous spraying mode, the spraying branch may be controlled to turn on and the backflow branch is controlled to turn off through the solenoid valve of the spraying system. Where, the number and the type of the solenoid valve of the spraying system are not limited, that is, the spraying system may include a plurality of solenoid valves, and each of the solenoid valves may be a two-way solenoid valve or a three-way solenoid valve, and the like.

[0063] If the spraying branch is turned on and the backflow branch is turned off, the liquid in the water tank of the spraying system may sequentially flow out of the nozzle of the spraying system through the spraying branch, and water in the spraying system cannot flow into the water inlet of the water tank from the water outlet of the water tank through the backflow branch in sequence, in this condition, the liquid in the water tank continuously flows out of the nozzle.

[0064] In a step of S806, the spraying branch is controlled to turn on, the backflow branch is controlled to turn off, or the spraying branch is controlled to turn off and the backflow branch is controlled to turn on, such that the liquid in the water outlet device intermittently flows out of the nozzle, if the spraying mode is the intermittent spraying mode.

[0065] If the spraying branch is turned off, the backflow branch is turned on, in this condition, the liquid in the water tank of the spraying system may sequentially flow into the water inlet of the water tank from the water outlet of the water tank through the backflow branch, the liquid in the water tank cannot sequentially flow out of the nozzle of the spraying system through the spraying branch. That is, the liquid in the water tank stops flowing out of the nozzle, and the liquid flows into the water inlet of the water tank from the water outlet of the water tank, such that the water supply pressure may be increased, and maintenance of continuous operation of the water pump is unnecessary.

[0066] Thus, if the spraying mode is the intermittent spraying mode, the spraying branch may be controlled to turn on and the backflow branch may be controlled to turn off through the solenoid valve, or alternatively, the spraying branch is controlled to turn off, and the backflow branch is controlled to turn on, so that the liquid in the water tank flows out of the nozzle intermittently.

[0067] According to the method for controlling the spraying system provided in the embodiment of the present disclosure, if the spraying mode is the intermittent spraying mode, the spraying branch is controlled to turn on and the backflow branch is controlled to turn off through the solenoid valve, or alternatively, the spraying branch is controlled to turn off and the backflow branch is controlled to turn on, so that the liquid in the water tank flows out of the nozzle intermittently. In this way, it may be guaranteed that intermittent spraying is achieved in

the spraying system of the water pump through switching of the solenoid valve, and the water supply pressure is improved through the backflow branch. Thus, the water pump does not need to be turned on and turned off frequently, an occurrence of temperature rise in the pump would not be caused, the service life of the water pump may be prolonged, the damage to the water pump is avoided, and the user experience is improved.

[0068] Another method for controlling a spraying system provided in one embodiment of the present disclosure will be described in detail below with reference to the accompanying drawings.

[0069] Another method for controlling the spraying system is provided in this embodiment. This method is implemented on the basis of the aforesaid embodiment, FIG. 9 illustrates a flow diagram of another method for controlling the spraying system, the method for controlling the spraying system in this embodiment may include the following steps:

[0070] In a step of S902, a spraying mode of the spraying system is determined.

[0071] The solenoid valve in this embodiment may have different arrangements, the solenoid valves in the spray system may be arranged according to at least one of the following approaches: a two-way solenoid valve is provided in the spraying branch and the backflow branch; a two-way solenoid valve is provided in the spraying branch, and a three-way solenoid valve is disposed at the intersection of the spraying branch and the backflow branch; or, a two-way solenoid valve is arranged in the backflow branch, and a three-way solenoid valve is arranged at the intersection of the spraying branch and the backflow branch.

[0072] In a step of S904, the spraying branch is turned on if the spraying mode is the continuous spraying mode; the water pump of the spraying system is controlled to start to operate after the spraying branch has been turned off for a preset first time.

[0073] First, two-way solenoid valves arranged in the spraying branch and the backflow branch are taken as an example. As shown in FIG. 3, the spraying system includes two-way solenoid valves, that is, the first solenoid valve and the second solenoid valve, the first solenoid valve and the second solenoid valve are in a normal turned-off state when they are powered off.

[0074] If the spraying mode is determined as the continuous spraying mode, referring to the schematic diagram of the control mode of the first continuous spraying mode shown in FIG. 10, the detection module may transmit a signal to the control module through a communication wire, and the control module controls the first solenoid valve to turn on firstly.

[0075] In order to avoid or alleviate a water hammer phenomenon caused by violent change of waterway pressure which is caused due to the fact that the solenoid valve is not completely turned on and the water pump is in operation. After the first solenoid valve has been energized for a first time 11, the control module controls the water pump to turn on, and coolant liquid is obtained from the water tank, such that the coolant liquid in the water pipe is sprayed onto the heat exchanger at the nozzle through the first solenoid valve to realize spray evaporation cooling. In the operation process of the entire continuous spraying mode, the second solenoid valve is in a turned-off state.

[0076] In this way, turning on the water pump after the first solenoid valve has been turned on for the first time may be realized by setting. Thus, the water hammer phenomenon caused by violent change of the waterway pressure which is caused due to the fact that the solenoid valve is not completely turned on and the water pump is in operation may be avoided or alleviated, and the service life of the water pump is prolonged.

[0077] After a stop spraying signal is obtained by the detection module, the signal is transmitted to the control module, the water pump is controlled to stop operation. For example, the stop spraying signal is obtained, and the water pump is controlled to stop operation based on the stop spraying signal. After the water pump stops operation for the first time, the spraying branch is turned off.

[0078] After the water pump stops operation for the first time T1, the first solenoid valve is turned off, and the operation of the spray system is terminated. After the system is selected, T1 is usually a constant, however, startup time and shutdown time of different waterway systems, the water pump and the solenoid valves are different, the value of T1 is variable, T1 may be in the range of 1 s$\leq$T1$\leq$4 s.

[0079] In a step of S906, if the spraying mode is the intermittent spraying mode, the spraying time and the stop spraying time of the intermittent spraying mode are determined. During the spraying time, the spraying branch is controlled to turn on, and the backflow branch is controlled to turn off. During the stop spraying time, the spraying branch is controlled to turn off and the backflow branch is controlled to turn on.

[0080] If the spraying mode is the intermittent spraying mode, detection parameters may be further compared with an intermittent spraying table preset in the circuit board to determine the intermittent spraying mode (i.e., the spraying time is Tx seconds, the stop spraying time is Ty seconds, and spraying operation is performed periodically according to the rule).

[0081] Referring to the schematic diagram of the control mode of the first intermittent spraying mode shown in FIG. 11, the detection module transmits a signal to the control module through the communication wire, the control module first controls the first solenoid valve to turn on. After the first solenoid valve has been energized for the first time T1, the control module controls the water pump to turn on, the coolant liquid is obtained from the water tank, and the coolant liquid in the water pipe is sprayed onto the heat exchanger at the nozzle through the first solenoid valve to realize a spray evaporation cooling.

[0082] When the solenoid valve starts to be switched,

in order to avoid the water hammer phenomenon caused due to instability of waterway, and fatigue stress damage of the system, it needs to ensure that the solenoid valve is switched when the water pump has been in a stable operation state. Following steps may be performed: the backflow branch is turned on when switching from the spraying time to the stop spraying time and the operation time of the water pump is greater than a preset time threshold; after the backflow branch has been turned on for a second time, the spraying branch is turned off.

[0083] When the water pump is energized and the operation time of the water pump is greater than a preset time threshold (e.g., at least 5 seconds), the second solenoid valve is controlled to turn on. In order to prevent the entire waterway from being turned off due to turning off of the first solenoid valve when the second solenoid valve is not turned on. After the second solenoid valve has been turned on for the second time T2, the first solenoid valve is controlled to turn off, in this condition, the spraying operation is stopped, the coolant liquid returns to the water tank through the second solenoid valve to realize circulation of the coolant liquid. T2 may be in the range of 1s $\leq$T2$\leq$3 s.

[0084] In addition, when switching from the stop spraying time to the spraying time, the spraying branch may be turned on; after the spraying branch has been turned on for the second time, the backflow branch is turned off.

[0085] After the first solenoid valve has been turned off for the Ty time, the first solenoid valve is turned on again. After the second time T2 is passed, the second solenoid valve is turned off, and the spray operation is performed. After the second solenoid valve has been turned off for Tx-T2 time, the second solenoid valve is turned on again, and the first solenoid valve is turned off after T2 time is passed. The aforesaid two steps are performed cyclically until a stop spraying signal is received.

[0086] In particular, in the process of the intermittent spraying mode, spraying operation may be stopped by performing the following steps: obtaining the stop spraying signal, and controlling the water pump to stop operation based on the stop spraying signal; maintaining turned-off states of the solenoid valves of the spraying branch and the backflow branch if the solenoid valves of the spraying branch and the backflow branch are both in the turned-off state; if the solenoid valve of the spraying branch or the backflow branch is in the turned on state, controlling the solenoid valve of the spraying branch or the backflow branch in the turned on state to turn on for the second time, and then turning off the solenoid valve of the spraying branch or the backflow branch in the turned state.

[0087] After the detection module obtains the stop spraying signal, the signal is transmitted to the control module, the water pump is controlled to stop operation firstly. When the water pump is controlled to stop operation, whether the first solenoid valve and the second solenoid valve are in the turned on state are determined. If the first solenoid valve and the second solenoid valve are in the turned-off state, the turned-off state of the first solenoid valve and the second solenoid valve are kept unchanged. If the first solenoid valve and the second solenoid valve are in the turned on state, the solenoid valve is turned off after the turning on state of the solenoid valve is maintained for T2 time forcibly, and the spraying system is terminated. After the spraying system stops operation, the process returns to the initial detection program, and the next spraying enable signal is waited.

[0088] As shown in FIG. 5, in this embodiment, a two-way solenoid valve (i.e., the fourth solenoid valve) may also be arranged in the spraying branch, a three-way solenoid valve (i.e., the third solenoid valve) is arranged at the intersection of the spraying branch and the backflow branch. The spraying system in this embodiment differs from the first spraying system shown in FIG. 3 in that the two-way solenoid valve in the backflow branch is replaced with the three-way solenoid valve, the three-way solenoid valve is arranged between the water pump and the fourth solenoid valve and is located at a branch point. Where, a port A is in communication with the water pump through the water pipe, a port B is in communication with the backflow branch flowing back to the water tank, and a port C is in communication with the fourth solenoid valve through the water pipe.

[0089] As shown in FIG. 5, when the port A is communicated with the port C, the coolant liquid flows through the fourth solenoid valve and is sprayed onto the heat exchanger at the nozzle. In this condition, the ports A and B are in the turned-off state, and the coolant liquid cannot flow back into the water tank. When the port A is communicated with the three-way solenoid valve B, the coolant liquid flows back to the water tank through the backflow branch. In this condition, the ports A and C are in a turned-off state, and the coolant liquid cannot be sprayed onto the heat exchanger. In an initial state, both the water pump and the fourth solenoid valve are turned off, the port A and the port C of the third solenoid valve are communicated.

[0090] After the detection module detects an enable signal of the spraying system, whether the spraying system is the intermittent spraying mode or in the continuous spraying mode is further determined. If the spraying mode is determined as the continuous spraying mode, referring to the schematic diagram of the control method of the second continuous spraying mode shown in FIG. 12, the detection module transmits a signal to the control module through the communication wire, and the control module controls the fourth solenoid valve to turn on firstly; after the first time T1 is passed, the water pump is turned on to perform the spraying operation. After the stop spraying signal is received, the water pump is controlled to turn off, after the water pump has been turned off for the first time T1, the fourth solenoid valve is turned off, and spraying operation is stopped.

[0091] If the spraying mode is determined as the intermittent spraying mode, referring to the schematic diagram of the control method of the second intermittent

spraying mode shown in FIG. 13, the detection module transmits a signal to the control module through the communication wire, and the control module controls the fourth solenoid valve to turn on firstly. After the first time T1 is passed, the water pump is turned on to perform the spraying operation; and after the Tx time is passed, the third solenoid valve switches from a AC access to a AB access, the coolant liquid flows back to the water tank, and the spray cooling operation is stopped. After Ty time is passed, the third solenoid valve switches from the AB access to the AC access to perform the spray operation.

[0092] The aforesaid steps are executed periodically in order to realize the intermittent spraying. After receiving the stop spraying signal, the water pump is controlled to turn off. After the water pump has been turned off for the first time T1, the fourth solenoid valve is turned off. If the third solenoid valve is in an AC access state, the current state is maintained unchanged. If the third solenoid valve is in an AB access state, the third solenoid valve is switched to the AC access. After the spraying system stops operation, the process returns to the initial detection program, and the next spraying enable signal is waited.

[0093] As shown in FIG. 6, in this embodiment, a two-way solenoid valve (i.e., the fifth solenoid valve) may also be arranged in the backflow branch, and a three-way solenoid valve (i.e., the third solenoid valve) is arranged at the intersection of the spraying branch and the backflow branch. Unlike the second spray system shown in FIG. 5, the two-way solenoid valve on the spraying branch is transferred to the backflow branch. In the initial state, both the water pump and the fifth solenoid valve are turned off, and the third solenoid valve is in a state in which the port A is communicated with the port B.

[0094] After the detection module detects the enable signal of the spraying system, whether the spraying system is in the intermittent spraying mode or in the continuous spraying mode is further determined. If the spraying mode is determined as the continuous spraying mode, referring to the schematic diagram of the control method of the third continuous spraying mode shown in FIG. 14, the detection module transmits a signal to the control module through the communication wire, and the control module controls the third solenoid valve to switch from the AB access to the AC access firstly. After the first time T1 is passed, the water pump is turned on to perform the spraying operation. After the stop spraying signal is received, the water pump is controlled to turn off. After the water pump has been turned off for the first time T1, the third solenoid valve switches from the AC access to the AB access, the spraying operation is terminated.

[0095] If the spraying mode is determined as the intermittent spraying mode, referring to the schematic diagram of the control method of the third intermittent spraying mode shown in FIG. 15, the detection module transmits a signal to the control module through the communication wire, the control module first controls the third solenoid valve to switch from the AB access to the AC access firstly, and the fifth solenoid valve is turned on simultaneously. After the first time T1 is passed, the water pump is turned on to perform the spraying operation. After the Tx time is passed, the third solenoid valve switches from the AC access to the AB access, the coolant liquid flows back to the water tank, and the spray cooling operation is stopped. After the Ty time is passed, the third solenoid valve switches from the AB access to the AC access to perform the spraying operation. The aforesaid steps may be performed sequentially and periodically to achieve the intermittent spraying.

[0096] After the stop spraying signal is received, the water pump is controlled to turn off. After the water pump has been turned off for the first time, if the third solenoid valve is in the AB access state, the current state of the third solenoid valve is maintained unchanged, and the fifth solenoid valve is turned off. If the third solenoid valve is in the AC access state, the third solenoid valve is switched to the AB access, and the fifth solenoid valve is turned off. After the spraying system stops operation, the process returns to the initial detection program, and the next spraying enable signal is waited.

[0097] An apparatus of controlling the spraying system according to the embodiments of the present disclosure will be described in detail below with reference to the accompanying drawings.

[0098] Corresponding to the aforesaid method embodiments, an apparatus for controlling a spraying system is provided in this embodiment of the present disclosure. The apparatus is applied to the spraying system. Referring to the schematic structural diagram of the apparatus for controlling the spraying system shown in FIG. 16, the apparatus for controlling the spraying system may include:

[0099] a spraying mode determination module 1601 configured to determine a spraying mode of the spray system;

[0100] a continuous spraying control module 1602 configured to control the spraying branch of the spraying system to turn on, and control the backflow branch of the spraying system to turn off if the spraying mode is a continuous spraying mode, in order that liquid in a water outlet device of the spraying system continuously flows out of a nozzle of the spraying system;

[0101] an intermittent spraying control module 1603 configured to control the spraying branch to turn on, control the backflow branch or the spraying branch to turn off, and control the backflow branch to turn on, in order that the liquid in the water outlet device intermittently flows out of the nozzle, if the spraying mode is an intermittent spraying mode.

[0102] According to the apparatus for controlling the spraying system provided in the embodiment of the present disclosure, if the spraying mode is the intermittent spraying mode, the spraying branch is controlled to turn on and the backflow branch is controlled to turn off through the solenoid valve, or alternatively, the spraying branch is controlled to turn off and the backflow branch

is controlled to turn on, so that the liquid in the water tank flows out of the nozzle intermittently. In this way, it may be guaranteed that intermittent spraying is achieved in the spraying system of the water pump through switching of the solenoid valve, and the water supply pressure is improved through the backflow branch. Thus, the water pump does not need to turn on and turned off frequently, an occurrence of temperature rise in the pump would not be caused, the service life of the system and the spray cooling effect may be guaranteed while the spraying system is operated in water conservation manner.

[0103] The continuous spraying control module is configured to turn on the spraying branch if the spraying mode is the continuous spraying mode, and control a water pump of the spraying system to start to operate after the spraying branch has been turned on for a preset first time.

[0104] The intermittent spraying control module is further configured to determine a spraying time and a stop spraying time of the intermittent spraying mode if the spraying mode is the intermittent spraying mode; control the spraying branch to turn on and control the backflow branch to turn off during the spraying time, and control the spraying branch to turn off and control the backflow branch to turn on during the stop spraying time.

[0105] The intermittent spraying control module is further configured to obtain a stop spraying signal, and control the water pump of the spraying system to stop operation based on the stop spraying signal, and turn off the spraying branch after the water pump has been stop operation for a first time.

[0106] The intermittent spraying control module is configured to: determine a spraying time and a stop spraying time of the intermittent spraying mode if the spraying mode is the intermittent spraying mode; control the spraying branch to turn on and control the backflow branch to turn off during the spraying time, and control the spraying branch to turn off and control the backflow branch to turn on during the stop spraying time.

[0107] The intermittent spraying control module is configured to: turn on the backflow branch when the spraying time is switched to the stop spraying time and an operation time of the water pump is greater than a preset time threshold value, turn off the spraying branch after the backflow branch has been turned on for a preset second time; turn on the spraying branch when the stop spraying time is switched to the spraying time; turn off the backflow branch after the spraying branch has been turned on for the second time.

[0108] The intermittent spraying control module is configured to: obtain a stop spraying signal, and control the water pump to stop operation based on the stop spraying signal; maintain turned-off states of the solenoid valve of the spraying branch and the solenoid valve of the backflow branch if the solenoid valve of the spraying branch and the solenoid valve of the backflow branch are both in a turned-off state; control, if the solenoid valve of the spraying branch or the solenoid valve of the backflow branch is in a turned-on state, the solenoid valve of the spraying branch in the turned off state or the solenoid valve of the backflow branch in the turned-on state to turn on for the second time, and then turn off the solenoid valve of the spraying branch in the turned-on state or the solenoid valve of the backflow branch in the turned-on state.

[0109] It can be clearly understood by a person of ordinary skill in the art that, in order to describe the present disclosure conveniently and concisely, regarding the detailed operation process of the aforesaid apparatus for controlling the spraying system, reference can be made to the corresponding process of the embodiments of the method for controlling the spraying system described above, the detailed operation process of the aforesaid apparatus for controlling the spraying system is not repeatedly described herein.

[0110] An electronic device provided in the embodiments of the present disclosure will be described in detail below with reference to the accompanying figures.

[0111] An electronic device is further provided in the embodiments of the present disclosure, the electronic device is used for operating the aforesaid method for controlling the spray system. Referring to the schematic structural diagram of the electronic device shown in FIG. 17, the electronic device may include a memory 100 and a processor 101. The memory 100 may be used to store one or a plurality of computer instruction(s), when the processor 101 is configured to execute the one or a plurality of computer instruction(s) so as to implement the aforesaid method for controlling the spray system.

[0112] In some embodiments, the electronic device shown in FIG. 17 may also include a bus 102 and a communication interface 103. The processor 101, the communication interface 103 and the memory 100 are connected through the bus 102.

[0113] The memory 100 may include a high-speed random access memory (RAM), or alternatively, the memory 100 may further include a non-volatile memory, for example, at least one disk memory. Communication connection between a system network element and at least one other network element may be implemented through the at least one communication interface 103 (which may be wired or wireless). Internet, a wide area network, a local area network, a metropolitan area network (MAN), etc. may be used. The bus 102 may be an ISA bus, a PCI bus, an EISA bus, or the like. The bus may be divided into an address bus, a data bus, a control bus, etc. For the convenience of representation, only one bidirectional arrow is used to represent the bus in FIG. 17. However, this bidirectional arrow does not mean that there is only one bus or one type of bus.

[0114] The processor 101 may be an integrated circuit chip having signal processing capabilities. During an implementation process, the various steps of the aforesaid method may be completed through the integrated logic circuit in hardware form or the software instructions in software form in the processor 101. The aforesaid proc-

essor 101 may be a general-purpose processor which includes a central processing unit (CPU), a network processor (NP), etc. The processor 101 may also be a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), or other programmable logic devices, discrete gates or transistor logic devices, or discrete hardware components. The methods, steps, and logical block diagrams disclosed in the embodiments of the present disclosure may be implemented or executed. The general-purpose processor may be a microprocessor or any conventional processor. The steps of the method disclosed in the embodiment of the present disclosure may be directly executed and completed by a processor for hardware decoding, or by the combination of hardware and software modules in the processor for hardware decoding. Software modules may be located in a conventional storage medium in this field, such as random access memory (RAM), flash memory, read-only memory (ROM), programmable read-only memory (PROM), or electrically erasable programmable read-only memory (EEPROM), registers, etc. The storage medium may be located in the memory 100. The processor 101 may read information in the memory 100, and complete the steps of the method in the embodiments described above in combination with hardware thereof.

[0115] A computer-readable storage medium is further provided in the embodiments of the present disclosure. The computer-readable storage medium may store a computer-executable instruction, that, when being invoked and executed by the processor, causes the processor to implement the aforesaid method for controlling the spraying system. Regarding the specific implementation, reference can be made to the method embodiments. The specific implementation is not repeatedly described herein.

[0116] The spraying system, the method and the apparatus for controlling the spraying system, and a computer program product of the electronic device provided in the embodiments of the present disclosure include the computer-readable storage medium that stores program codes. The program codes include instructions that can be used for performing the aforesaid method in the aforesaid method embodiments. Regarding the specific implementation, reference can be made to the method embodiments. The specific implementation is not repeatedly described herein.

[0117] It can be clearly understood by the person of ordinary skill in the art that, in order to describe the present disclosure conveniently and concisely, regarding the detailed operation process of the system and/or the apparatus, reference can be made to the corresponding process in the method embodiments, the detailed operation process of the of the system and/or the apparatus is not repeatedly described herein.

[0118] In the description of the embodiments of the present disclosure, unless there is additional explicit stipulation and limitation, terms including "mount", "connect with each other", "connect" should be generalizedly interpreted. For example, "connect" may be interpreted as being fixedly connected, detachably connected, or connected integrally; "connect" can also be interpreted as being mechanically connected or electrically connected; "connect" may be further interpreted as being directly connected or indirectly connected through intermediary, or being internal communication between two components. The person of ordinary skill in the art may understand the specific meanings of these terms in the present disclosure according to specific conditions.

[0119] When the integrated unit is implemented in the form of a software functional unit and sold or used as an independent product, the integrated unit may be stored in a computer readable storage medium. Based on such understanding, the technical solutions of the present disclosure essentially, or the part contributing to the prior art, or all or a part of the technical solutions may be implemented in the form of a software product. The software product is stored in a storage medium and includes a plurality of instructions for instructing a computer device (which may be a personal computer, a server, a network device, etc.) to perform all or some of the steps of the methods described in the embodiments of the present disclosure. The foregoing storage medium includes: any medium that can store program code, such as a USB flash drive, a removable hard disk, a read-only memory (ROM), a random access memory (RAM), a magnetic disk, or an optical disc.

[0120] In the description of the present application, it needs to be explained that, directions or location relationships indicated by terms including "center", "up", "down", "left", "right", "vertical", "horizontal", "inside", "outside" are the directions or location relationships shown in the accompanying figures, which are only intended to describe the present application conveniently and to simplify the description, rather than indicating or implying that an indicated device or component must have specific locations or be constructed and manipulated according to specific locations. Thus, these terms shouldn't be regarded as limitations to the present application. In addition, terms "the first" and "the second", "the third" are only used for description purposes, and should not be interpreted as indicating or implying any relative importance.

[0121] Lastly, it should be explained that, the various embodiments mentioned above are implementation methods of the present disclosure, and are only intended to explain the technical solutions of the present application, rather than limiting the technical solutions of the present application, the protection scope of the present disclosure are not limited thereto. Although the present application has been described in detail with reference to these embodiments, the person of ordinary skilled in the art should understand that, any technician who is familiar with this technical field can also amend the technical solutions disclosed in the embodiments, or can be conceived of changes, or equivalently replace some

technical features within the technical scope of the present disclosure. These amendments or the equivalent replacements don't cause the essence of the corresponding technical solutions to be deviated from the spirit and the scope of the technical solutions in the embodiments of the present application, and thus should all be included in the protection scope of the present application. The protection scope of the present disclosure should be determined by the scope of the claims.

Industrial Applicability

[0122] A spraying system, a method and an apparatus for controlling a spraying system, an electronic device, a computer-readable storage medium and an air conditioner are provided in the present disclosure. The spray system includes a water outlet device, a spraying branch, a backflow branch, and a nozzle. A water outlet of the water outlet device, the spraying branch, and the nozzle are communicated sequentially. A solenoid valve is arranged in the spraying branch and/or the backflow branch, and the solenoid valve is used for controlling turning on and turning off of the spraying branch and/or the backflow branch. When the spraying branch is turned on, liquid flowing out of the water outlet device flows out of the nozzle through the spraying branch. When the backflow branch is turned on, the liquid flowing out of the water outlet device flows into the water outlet device through the backflow branch. In this way, it can be guaranteed that an intermittent spraying is achieved in the spraying system including the water pump, and a water supply pressure is improved through the backflow branch. Thus, the water pump does not need to be turned on and turned off frequently, an occurrence of temperature rise in the pump would not be caused, and a service life and a spray cooling effect of the system may be guaranteed when the spraying system is operated in a water conservation manner.

[0123] In addition, it should be understood that the spraying system, the method and the apparatus for controlling the spraying system, the electronic device, the computer-readable recording medium and the air conditioner of the present disclosure may be reproducible, and may be applied in various applications. For example, the spraying system of the present disclosure, the method and the apparatus for controlling the spraying system, the electronic device, and the computer-readable storage medium may be applied to the technical field of air conditioners.

Claims

1. A spraying system, **characterized in that**:

the spraying system comprises a water outlet device, a spraying branch, a backflow branch and a nozzle, wherein a water outlet of the water outlet device, the spraying branch and the nozzle are communicated sequentially, and the spraying branch, the backflow branch and a water inlet of the water outlet device are communicated sequentially;

a solenoid valve is arranged in the spraying branch and/or the backflow branch, and the solenoid valve is configured to control turning on and turning off of the spraying branch and/or the backflow branch;

when the spraying branch is turned on, liquid flowing out of the water outlet device flows out of the nozzle through the spraying branch; and

when the backflow branch is turned on, the liquid flowing out of the water outlet device flows into the water outlet device through the backflow branch.

2. The spraying system according to claim 1, wherein:

the spraying branch comprises a first spraying branch and a second spraying branch, and a water pump is arranged in the first spraying branch; and

the water outlet of the water outlet device, the first spraying branch, the second spraying branch and the nozzle are communicated sequentially, and the water outlet of the water outlet device, the first spraying branch, the backflow branch and the water inlet of the water outlet device are communicated sequentially.

3. The spraying system according to claim 2, wherein:

the second spraying branch is provided with a first solenoid valve;

the backflow branch is provided with a second solenoid valve; and

both the first solenoid valve and the second solenoid valve are two-way solenoid valves.

4. The spraying system according to claim 2, wherein a third solenoid valve is arranged at an intersection point of the first spraying branch, the second spraying branch and the backflow branch, wherein the third solenoid valve is a three-way solenoid valve.

5. The spraying system according to claim 2 or 4, wherein:

if a switch module is arranged in the water pump, none of the second spraying branch and the backflow branch is provided with the solenoid valve; and

if the switch module is not arranged in the water pump, the second spraying branch is provided with a fourth solenoid valve or a fifth solenoid valve is provided in the backflow branch, where-

in both the fourth solenoid valve and the fifth solenoid valve are two-way solenoid valves.

6. The spraying system according to any one of claims 1 to 5, further comprising a detection module, wherein the detection module is configured to detect startup and shutdown and a spraying mode of the spraying system.

7. The spraying system according to claim 6, further comprising a control module, wherein:

the control module is in communication connection with the detection module;
the control module is communicated with a solenoid valve of the spraying system; and
the control module is configured to control turning on and turning off of the solenoid valve based on the detection mode.

8. The spraying system according to claim 1, wherein the water outlet device is a water tank.

9. A method for controlling a spraying system, applicable to the spraying system according to any one of claims 1-8, wherein the method comprises:

determining a spraying mode of the spraying system;
if the spraying mode is a continuous spraying mode, controlling the spraying branch of the spraying system to turn on, and controlling the backflow branch of the spraying system to turn off, in order that liquid in the water outlet device of the spraying system continuously flows out of the nozzle of the spraying system; and
if the spraying mode is an intermittent spraying mode, controlling the spraying branch to turn on, controlling the backflow branch or the spraying branch to turn off, and controlling the backflow branch to turn on, in order that the liquid in the water outlet device intermittently flows out of the nozzle.

10. The method according to claim 9, wherein if the spraying mode is the continuous spraying mode, the step of controlling the spraying branch of the spraying system to turn on and controlling the backflow branch of the spraying system to turn off comprises:

turning on the spraying branch if the spraying mode is the continuous spraying mode; and
controlling the water pump of the spraying system to start to operate after the spraying branch has been turned on for a preset first time.

11. The method according to claim 10, further comprising:

obtaining a stop spraying signal, and controlling the water pump of the spray system to stop operation based on the stop spraying signal; and
turning off the spraying branch after the water pump stops operation for the first time.

12. The method according to claim 10 or 11, wherein if the spraying mode is the intermittent spraying mode, the step of controlling the spraying branch to turn on, controlling the backflow branch or the spraying branch to turn off, and controlling the backflow branch to turn on comprises:

determining a spraying time and a stop spraying time of the intermittent spraying mode if the spraying mode is the intermittent spraying mode;
controlling the spraying branch to turn on and controlling the backflow branch to turn off during the spraying time; and
controlling the spraying branch to turn off and controlling the backflow branch to turn on during the stop spraying time.

13. The method according to claim 12, further comprising:

turning on the backflow branch when the spraying time is switched to the stop spraying time and an operation time of the water pump is greater than a preset time threshold value;
turning off the spraying branch after the backflow branch has been turned on for a preset second time;
turning on the spraying branch when the stop spraying time is switched to the spraying time; and
turning off the backflow branch after the spraying branch has been turned on for the second time.

14. The method according to any one of claims 10 to 13, further comprising:

obtaining a stop spraying signal, and controlling the water pump to stop operation based on the stop spraying signal;
maintaining a turned-off state of the solenoid valve of the spraying branch and the solenoid valve of the backflow branch if the solenoid valve of the spraying branch and the solenoid valve of the backflow branch are both in a turned-off state; and
if the solenoid valve of the spraying branch or the solenoid valve of the backflow branch is in a turned-on state, controlling the solenoid valve of the spraying branch in the turned-on state or the solenoid valve of the backflow branch in the turned-on state to turn on for the second time,

and then controlling the solenoid valve of the spraying branch in the turned-on state or the solenoid valve of the backflow branch in the turned-on state to turn off.

15. An apparatus for controlling a spraying system, wherein the control apparatus is applied to the spraying system according to any one of claims 1 to 8, and comprises:

a spraying mode determination module configured to determine a spraying mode of the spray system;
a continuous spraying control module configured to control the spraying branch of the spraying system to turn on, and control the backflow branch of the spraying system to turn off, in order that liquid in a water outlet device of the spraying system continuously flows out of a nozzle of the spraying system, if the spraying mode is a continuous spraying mode;
an intermittent spraying control module configured to control the spraying branch to turn on, control the backflow branch or the spraying branch to turn off, and control the backflow branch to turn on, in order that the liquid in the water outlet device intermittently flows out of the nozzle, if the spraying mode is an intermittent spraying mode.

16. The control apparatus according to claim 15, wherein the continuous spraying control module is configured to:

turn on the spraying branch if the spraying mode is the continuous spraying mode; and
control a water pump of the spraying system to start to operate after the spraying branch has been turned on for a preset first time.

17. The control apparatus according to claim 15 or 16, wherein the intermittent spraying control module is configured to:

determine a spraying time and a stop spraying time of the intermittent spraying mode if the spraying mode is the intermittent spraying mode; and
control the spraying branch to turn on and control the backflow branch to turn off during the spraying time, and control the spraying branch to turn off and control the backflow branch to turn on during the stop spraying time.

18. An electronic device, wherein the electronic device comprises a processor and a memory, the memory stores a computer-executable instruction executable by the processor, the processor is configured to execute the computer-executable instruction so as to implement the control method of the spray system according to any one of claims 9 to 14.

19. A computer-readable storage medium, wherein the computer-readable storage medium stores a computer-executable instruction, that, when being invoked and executed by a processor, causes the processor to implement the control method for the spray system according to any one of claims 9 to 14.

20. An air conditioner, wherein the air conditioner comprises the spraying system according to any one of claims 1 to 8.

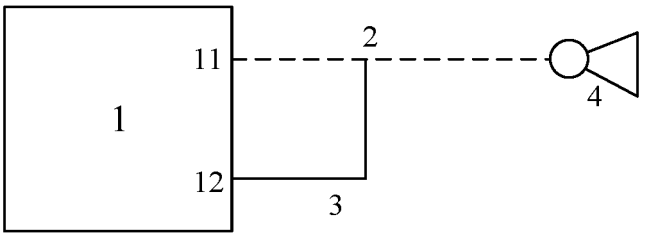

FIG. 1

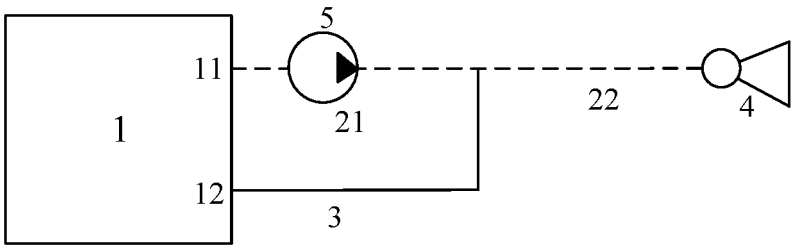

FIG. 2

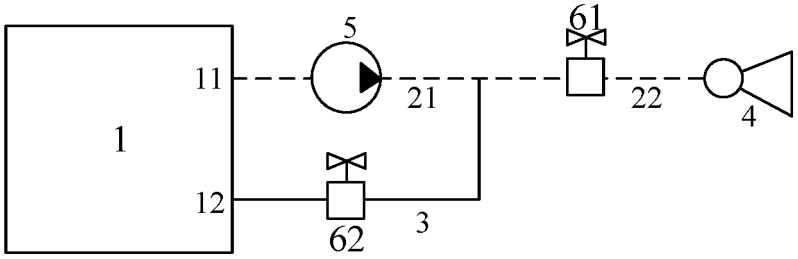

FIG. 3

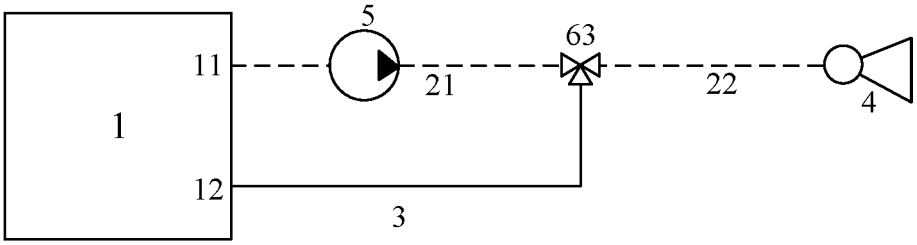

FIG. 4

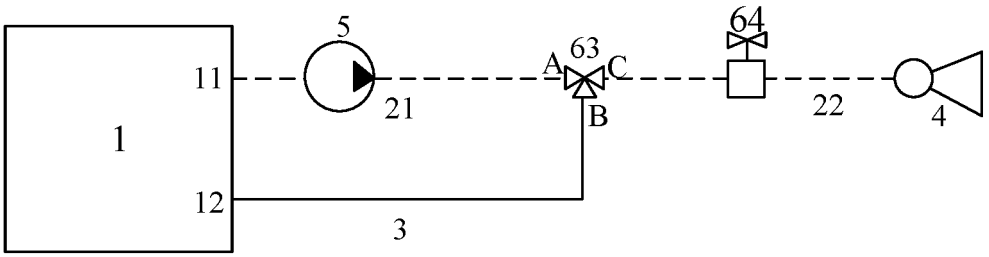

FIG. 5

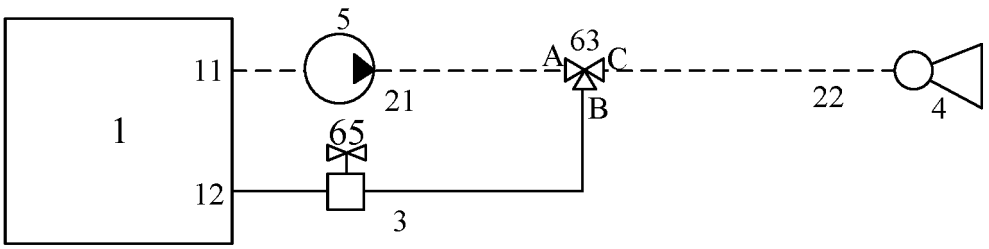

FIG. 6

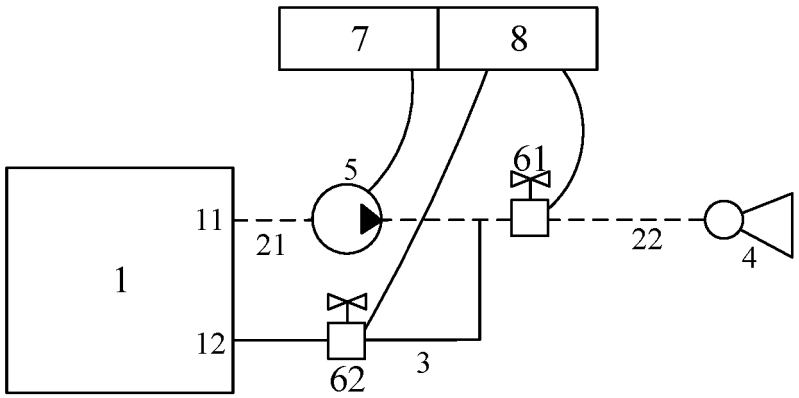

FIG. 7

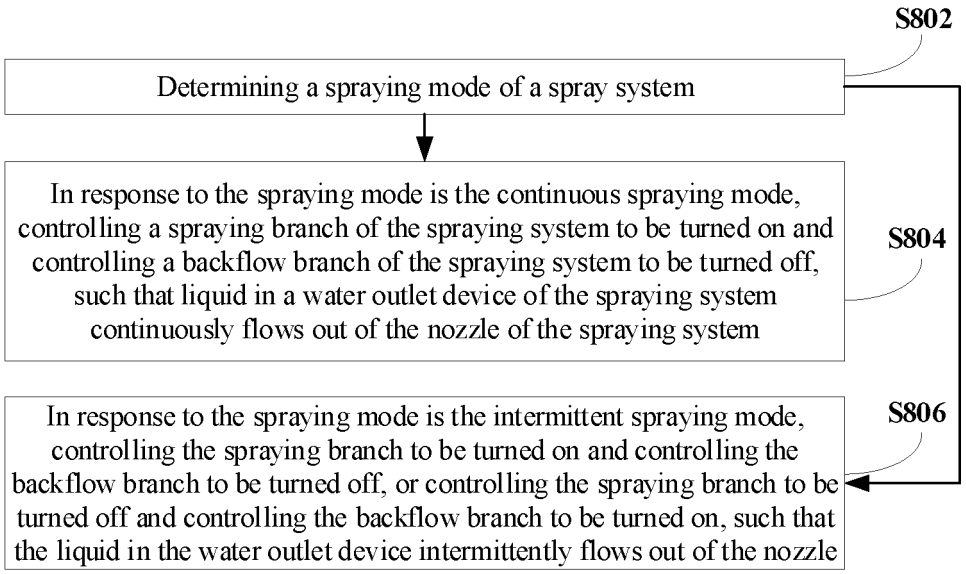
S802
Determining a spraying mode of a spray system
In response to the spraying mode is the continuous spraying mode, controlling a spraying branch of the spraying system to be turned on and controlling a backflow branch of the spraying system to be turned off, such that liquid in a water outlet device of the spraying system continuously flows out of the nozzle of the spraying system
S804
In response to the spraying mode is the intermittent spraying mode, controlling the spraying branch to be turned on and controlling the backflow branch to be turned off, or controlling the spraying branch to be turned off and controlling the backflow branch to be turned on, such that the liquid in the water outlet device intermittently flows out of the nozzle
S806

FIG. 8

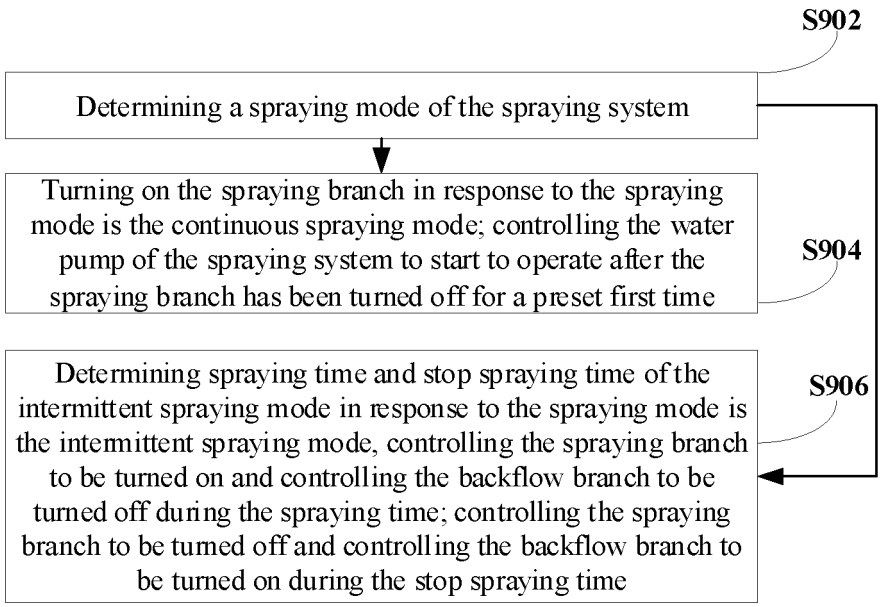
S902
Determining a spraying mode of the spraying system
Turning on the spraying branch in response to the spraying mode is the continuous spraying mode; controlling the water pump of the spraying system to start to operate after the spraying branch has been turned off for a preset first time
S904
Determining spraying time and stop spraying time of the intermittent spraying mode in response to the spraying mode is the intermittent spraying mode, controlling the spraying branch to be turned on and controlling the backflow branch to be turned off during the spraying time; controlling the spraying branch to be turned off and controlling the backflow branch to be turned on during the stop spraying time
S906

FIG. 9

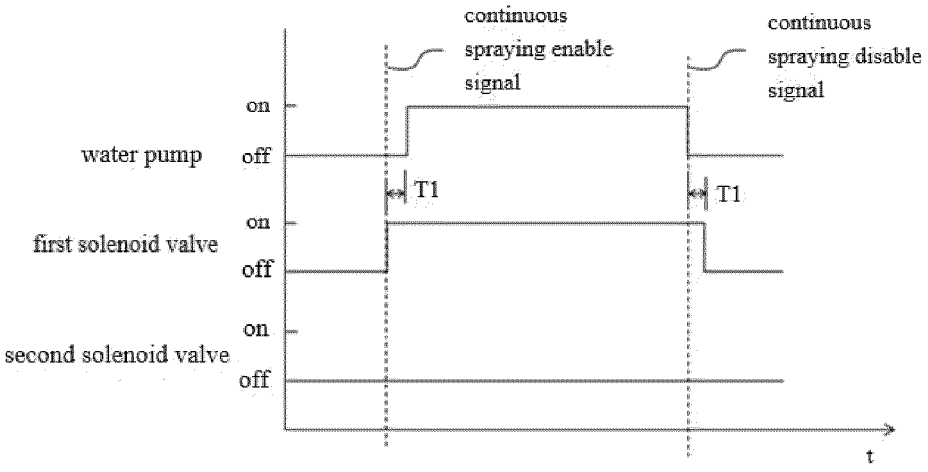
continuous
spraying enable
signal
continuous
spraying disable
signal
water pump
on
off
T1
T1
first solenoid valve
on
off
second solenoid valve
on
off
t

FIG. 10

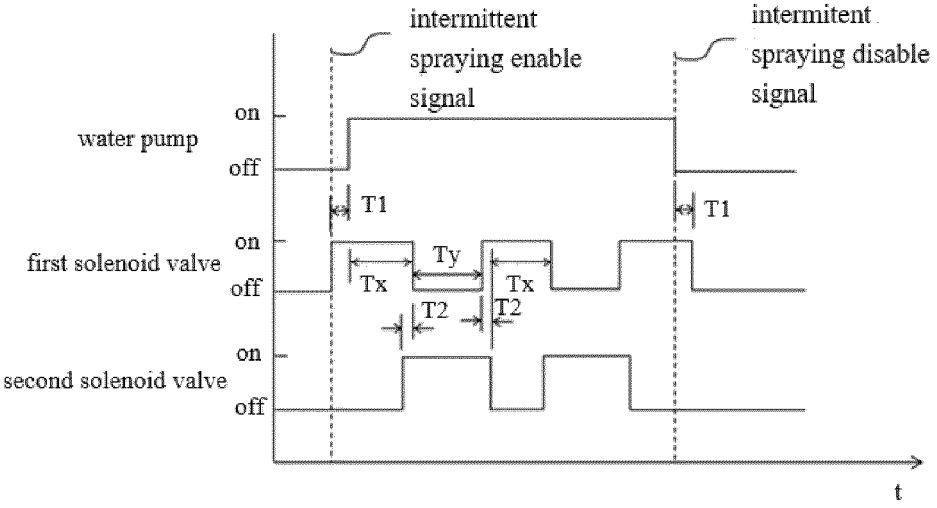
intermittent
spraying enable
signal
intermitent
spraying disable
signal
water pump
on
off
T1
T1
first solenoid valve
on
off
Ty
Tx
Tx
T2
T2
second solenoid valve
on
off
t

FIG. 11

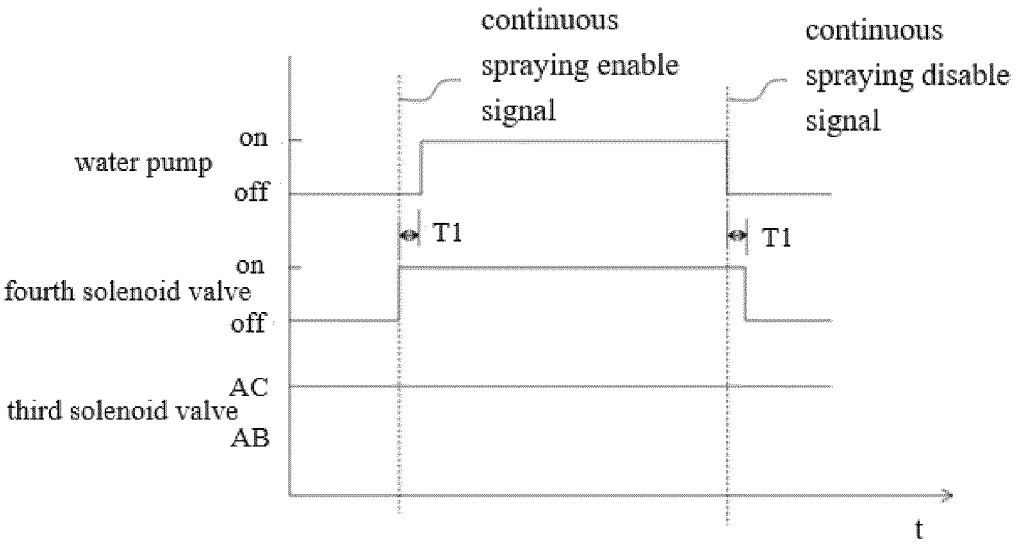
continuous
spraying enable
signal
continuous
spraying disable
signal
water pump
on
off
T1
T1
fourth solenoid valve
on
off
third solenoid valve
AC
AB
t

FIG. 12

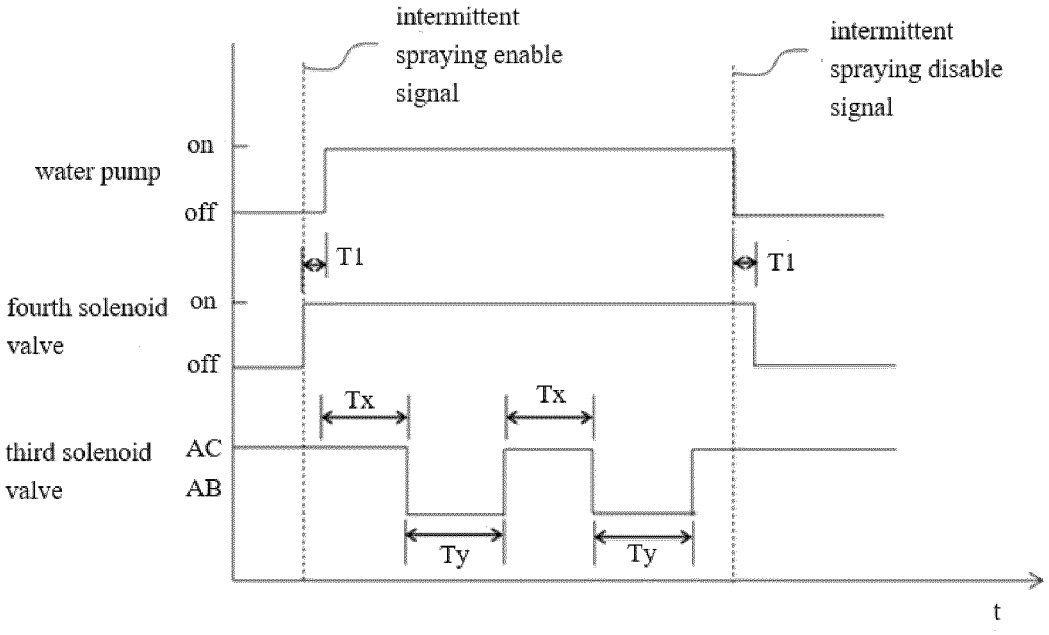
intermittent
spraying enable
signal
intermittent
spraying disable
signal
water pump
on
off
T1
T1
fourth solenoid
valve
on
off
Tx
Tx
third solenoid
valve
AC
AB
Ty
Ty
t

FIG. 13

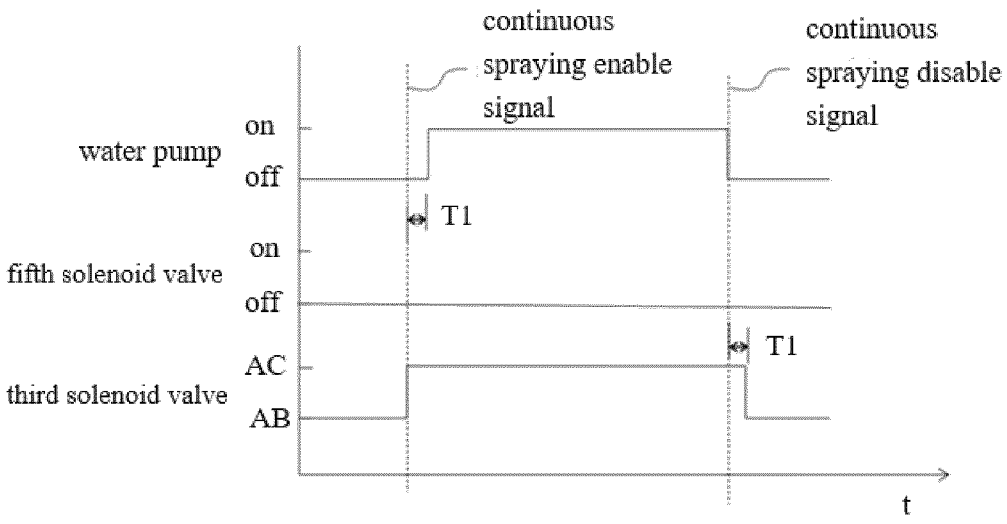
continuous
spraying enable
signal
continuous
spraying disable
signal
water pump
on
off
T1
fifth solenoid valve
on
off
T1
third solenoid valve
AC
AB
t

FIG. 14

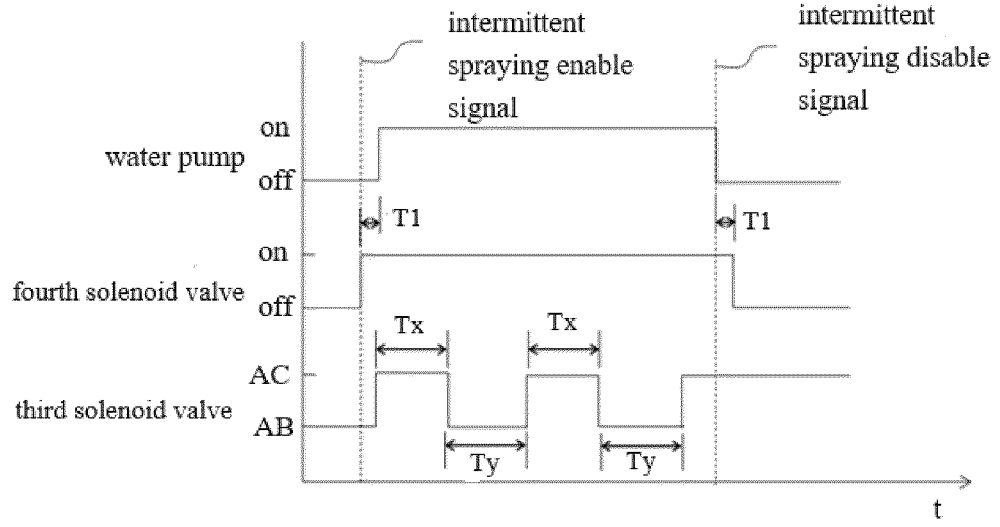
intermittent
spraying enable
signal
intermittent
spraying disable
signal
water pump
on
off
T1
T1
fourth solenoid valve
on
off
Tx
Tx
third solenoid valve
AC
AB
Ty
Ty
t

FIG. 15

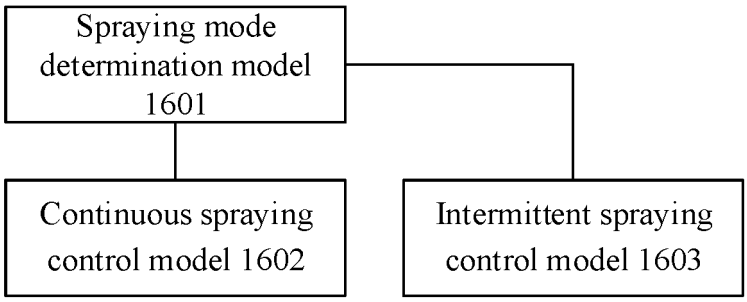
Spraying mode determination model 1601
Continuous spraying control model 1602
Intermittent spraying control model 1603

FIG. 16

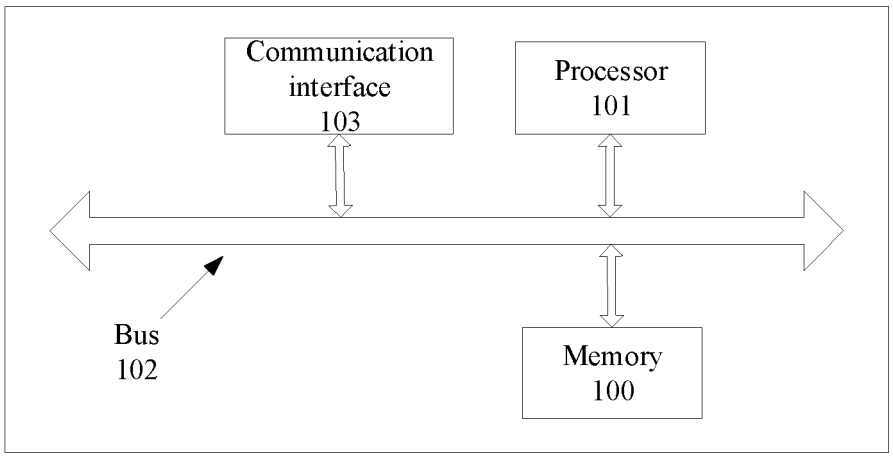
Communication interface 103
Processor 101
Bus 102
Memory 100

FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/079957

A. CLASSIFICATION OF SUBJECT MATTER

F24F1/14(2011.01)i;F24F11/61(2018.01)i;F24F11/64(2018.01)i;F24F11/65(2018.01)i;F24F11/84(2018.01)i;F24F11/85(2018.01)i;F25B39/04(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)

IPC:F24F, F25B

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

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

CNABS, CNTXT, WPABSC, VEN, CNKI: 喷淋, 喷洒, 喷水, 连续, 间歇, 回流, 循环, 空调, 回路, 时间, air, condition, sprink+, water, valve, branch, spray, continu+, intermitten+, interval, return, back, circulat+, inverse, tim+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 203899786 U (WU XIAOMING et al.) 2014-10-29 (2014-10-29) description, paragraphs [0005]-[0031], and figures 1-2	1-8
Y	CN 203899786 U (WU XIAOMING et al.) 2014-10-29 (2014-10-29) description, paragraphs [0005]-[0031], and figures 1-2	9-20
Y	CN 110822698 A (ZHUHAI GREE ELECTRIC APPLIANCES INC.) 2020-02-21 (2020-02-21) description, paragraphs [0005]-[0046], and figures 1-6	9-20
Y	CN 110319630 A (NINGBO AUX ELECTRIC CO., LTD.) 2019-10-11 (2019-10-11) description, paragraphs [0003]-[0047], and figures 1-3	10-14, 16-17
A	CN 203024306 U (XI'AN POLYTECHNIC UNIVERSITY) 2013-06-26 (2013-06-26) entire document	1-20
A	CN 211526566 U (ZHEJIANG JUXING CHEMICAL FIBER CO., LTD.) 2020-09-18 (2020-09-18) entire document	1-20

☑ 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
"D" document cited by the applicant in the international application
"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
31 March 2023	**08 April 2023**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/079957

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 111578470 A (QINGDAO HAIER AIR CONDITIONER GENERAL CO., LTD. et al.) 2020-08-25 (2020-08-25) entire document	1-20
A	CN 112628967 A (VECK (TIANJIN) CO., LTD.) 2021-04-09 (2021-04-09) entire document	1-20
A	JP H06319828 A (KAJIMA CORP.) 1994-11-22 (1994-11-22) entire document	1-20
A	CN 111895497 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI et al.) 2020-11-06 (2020-11-06) entire document	1-20
A	CN 203163109 U (BEIJING UNIVERSITY OF CIVIL ENGINEERING AND ARCHITECTURE) 2013-08-28 (2013-08-28) entire document	1-20

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/079957

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 203899786 U	29 October 2014	None	
CN 110822698 A	21 February 2020	None	
CN 110319630 A	11 October 2019	None	
CN 203024306 U	26 June 2013	None	
CN 211526566 U	18 September 2020	None	
CN 111578470 A	25 August 2020	None	
CN 112628967 A	09 April 2021	None	
JP H06319828 A	22 November 1994	JP 2635907 B2	30 July 1997
CN 111895497 A	06 November 2020	None	
CN 203163109 U	28 August 2013	None	

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 202210239348 **[0001]**