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(54) **ELECTRONIC ATOMIZATION DEVICE, POWER MECHANISM AND CONTROL METHOD**

(57) This application provides an electronic vaporization device, a power supply mechanism, and a control method. The electronic vaporization device includes: a battery cell, configured to supply power; a heating element, configured to heat and vaporize a liquid substrate; a first resistor, configured to be connected to the heating element to form a detectable loop; a controller, configured to determine an unfavorable condition according to a ratio of an electrical characteristic of the first resistor to an electrical characteristic of the heating element in the detectable loop. In the foregoing electronic vaporization device, the first resistor and the heating element are used to construct the detectable loop, and the unfavorable condition is determined according to the ratio of the electrical characteristic of the first resistor to the electrical characteristic of the heating element in the detectable loop.

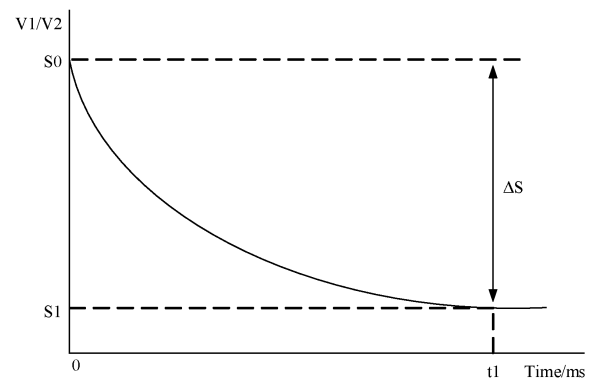


FIG. 3

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Chinese Patent Application No. 202110645729.4, filed with the China National Intellectual Property Administration on June 10, 2021 and entitled "ELECTRONIC VAPORIZATION DEVICE, POWER SUPPLY MECHANISM, AND CONTROL METHOD", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] Embodiments of this application relate to the field of electronic vaporization technologies, and in particular, to an electronic vaporization device, a power supply mechanism, and a control method.

BACKGROUND

[0003] Tobacco products (such as cigarettes, cigars, and the like) burn tobacco during use to produce tobacco smoke. Attempts are made to replace these tobacco-burning products by making products that release compounds without burning.

[0004] An example of this type of products is a heating device that releases compounds by heating rather than burning materials. For example, the materials may be tobacco or other non-tobacco products. These non-tobacco products may include or not include nicotine. In another example, there are aerosol-providing articles, for example, electronic vaporization devices. These devices usually contain a liquid, and the liquid is heated by a heating element to vaporize, so as to generate an inhalable aerosol. The liquid may contain nicotine, and/or aromatics, and/or aerosol-generation substances (such as glycerin).

[0005] In the foregoing heating device, a resistance change of the heating element is usually monitored to obtain a working temperature of the heating element, to determine whether the working temperature of the heating element exceeds a preset range, whether liquid supply is insufficient, among other unfavorable conditions.

SUMMARY

[0006] An embodiment of this application provides an electronic vaporization device, including:

a battery cell, configured to supply power;
a heating element, configured to heat and vaporize a liquid substrate;
a first resistor, configured to be connected to the heating element to form a detectable loop; and
a controller, configured to determine an unfavorable condition according to a ratio of an electrical characteristic of the first resistor to an electrical charac-

teristic of the heating element in the detectable loop.

[0007] In a preferred implementation, the electrical characteristic is detectable. In a more preferred implementation, the electrical characteristic is an electrical feature that is directly detected and does not require operation, for example, a voltage, or a current.

[0008] In a preferred implementation, the electronic vaporization device further includes:

a first switching transistor, operably connecting the heating element and the battery cell, and configured to enable the battery cell to supply power to the heating element to heat and vaporize the liquid substrate; and

a second switching transistor, operably changing from a first state to a second state to connect the first resistor and the heating element to form the detectable loop, and changing from the second state to the first state to disconnect the detectable loop.

[0009] In a preferred implementation, the first state of the second switching transistor is an off state, and the second state is an on state.

[0010] In a preferred implementation, the controller is configured to change the second switching transistor from the first state to the second state, and detect the electrical characteristics of the first resistor and the heating element in the second state.

[0011] In a preferred implementation, the electronic vaporization device includes a power supply mechanism and a vaporizer removably coupled to the power supply mechanism, where

the battery cell, the first resistor, and the controller are located in the power supply mechanism; and
the heating element is located in the vaporizer, and the vaporizer includes the liquid substrate.

[0012] In a preferred implementation, the first resistor is a standard resistor with a basically constant resistance value, and does not contact the liquid substrate.

[0013] In a preferred implementation, the first resistor and the heating element in the detectable loop are connected in series; and
the electrical characteristic includes a voltage.

[0014] In a preferred implementation, the controller is configured to determine the unfavorable condition according to a ratio of a voltage of the first resistor to a voltage of the heating element in the detectable loop being greater than a maximum threshold or less than a minimum threshold.

[0015] In a preferred implementation, the controller is configured to determine the unfavorable condition according to a ratio of a voltage of the first resistor to a voltage of the heating element in the detectable loop reaching a preset threshold outside an expected time period.

[0016] In a preferred implementation, the controller is configured to determine the unfavorable condition according to a change amount of a ratio of a voltage of the first resistor to a voltage of the heating element in the detectable loop within a predetermined time.

[0017] In a preferred implementation, the controller is configured to determine the unfavorable condition according to an initial value of a ratio of a voltage of the first resistor to a voltage of the heating element in the detectable loop and a ratio of the ratio to a change amount relative to the initial value at a moment.

[0018] In a preferred implementation, the first resistor and the heating element in the detectable loop are connected in parallel; and the electrical characteristic includes a current.

[0019] In a preferred implementation, the controller is configured to determine the unfavorable condition according to a ratio of a current flowing through the first resistor to a current flowing through the heating element in the detectable loop being greater than a maximum threshold or less than a minimum threshold.

[0020] In a preferred implementation, the controller is configured to determine the unfavorable condition according to a ratio of a current flowing through the first resistor to a current flowing through the heating element in the detectable loop reaching a preset threshold outside an expected time period.

[0021] In a preferred implementation, the controller is configured to determine the unfavorable condition according to a change amount of a ratio of a current flowing through the first resistor to a current flowing through the heating element in the detectable loop within a predetermined time.

[0022] In a preferred implementation, the controller is configured to determine the unfavorable condition according to an initial value of a ratio of a current flowing through the first resistor to a current flowing through the heating element in the detectable loop and a ratio of the ratio to a change amount relative to the initial value at a moment.

[0023] In a preferred implementation, the controller is further configured to stop, when the unfavorable condition exists, the battery cell from supplying power to the heating element.

[0024] Another embodiment of this application provides an electronic vaporization device, including: a battery cell, configured to supply power; a heating element, configured to heat and vaporize a liquid substrate; a first resistor, configured to be connected to the heating element to form a detectable loop; and a controller, configured to determine an unfavorable condition according to a ratio of any two of an electrical characteristic of the battery cell, an electrical characteristic of the detectable loop, an electrical characteristic of the first resistor, and an electrical characteristic of the heating element in the detectable loop.

[0025] Still another embodiment of this application further provides a power supply mechanism, configured to

supply power to a vaporizer of an electronic vaporization device. The vaporizer includes a heating element configured to heat and vaporize a liquid substrate to generate an aerosol. The power supply mechanism includes:

a battery cell, configured to supply power;
a first resistor, configured to be connected to the heating element to form a detectable loop; and
a controller, configured to determine an unfavorable condition according to a ratio of an electrical characteristic of the first resistor to an electrical characteristic of the heating element in the detectable loop.

[0026] Still another embodiment of this application further provides a control method of an electronic vaporization device, where the electronic vaporization device includes:

a battery cell, configured to supply power;
a heating element, configured to heat and vaporize a liquid substrate; and
a first resistor, configured to be connected to the heating element to form a detectable loop,
where the method includes the following steps:

providing a first resistor to be connected to the heating element to form a detectable loop; and
determining an unfavorable condition according to a ratio of an electrical characteristic of the first resistor to an electrical characteristic of the heating element in the detectable loop. In the foregoing electronic vaporization device, the first resistor and the heating element are used to construct the detectable loop, and the unfavorable condition is determined according to the ratio of the electrical characteristic of the first resistor to the electrical characteristic of the heating element in the detectable loop.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The objective implementation, functional features and advantages of this application are further illustrated with reference to the accompanying drawings by using the embodiments. One or more embodiments are exemplarily described with reference to the corresponding figures in the accompanying drawings, and the descriptions do not constitute a limitation to the embodiments. Components in the accompanying drawings that have same reference numerals are represented as similar components, and unless otherwise particularly stated, the figures in the accompanying drawings are not drawn to scale.

FIG. 1 is a schematic diagram of an electronic vaporization device according to an embodiment of this application;

FIG. 2 is a schematic diagram of basic components

of an embodiment of a circuit in FIG. 1;
 FIG. 3 is a curve of a ratio of a voltage across two ends of a first resistor to a voltage across two ends of a heating element changing with time in an embodiment of the circuit in FIG. 2;
 FIG. 4 is a schematic diagram of basic components of another embodiment of the circuit in FIG. 1; and
 FIG. 5 is a curve of a ratio of a current flowing through a first resistor to a current flowing through a heating element changing with time in an embodiment of the circuit in FIG. 4.

DETAILED DESCRIPTION

[0028] To make the foregoing objects, features and advantages of the present invention more comprehensible, detailed description is made to specific implementations of the present invention below with reference to the accompanying drawings. In the following description, many specific details are described to give a full understanding of the present invention. However, the present invention may be implemented in many other manners different from those described herein. A person skilled in the art may make similar improvements without departing from the connotation of the present invention. Therefore, the present invention is not limited to the specific embodiments disclosed below.

[0029] In the descriptions of the present invention, it should be understood that orientation or position relationships indicated by the terms such as "center", "longitudinal", "transverse", "length", "width", "thickness", "on", "below", "front", "back", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", "clockwise", "anticlockwise", "axial", "radial", and "circumferential" are based on orientation or position relationships shown in the accompanying drawings, and are used only for ease of description of the present invention and brevity of description, rather than indicating or implying that the mentioned device or component must have a particular orientation or must be constructed and operated in a particular orientation. Therefore, such terms should not be construed as limiting of the present invention.

[0030] In addition, terms "first" and "second" are used merely for the purpose of description, and shall not be construed as indicating or implying relative importance or implying a quantity of indicated technical features. Therefore, a feature restricted by "first" or "second" may explicitly indicate or implicitly include at least one of such features. In the descriptions of the present invention, unless explicitly specified, "multiple" means at least two, for example, two or three.

[0031] In the present invention, unless otherwise explicitly specified or defined, the terms such as "mount", "install", "connect", "connection", and "fixed" should be understood in a broad sense. For example, the connection may be a fixed connection, a detachable connection, or an integral connection; or the connection may be a mechanical connection or an electrical connection; or the

connection may be a direct connection, an indirect connection through an intermediary, or internal communication between two components or mutual interaction relationship between two components unless otherwise explicitly defined. Persons of ordinary skill in the art may understand the specific meanings of the foregoing terms in the present invention according to specific situations.

[0032] In the present invention, unless otherwise explicitly specified or defined, the first feature being located "above" or "below" the second feature may be the first feature being in a direct contact with the second feature, or the first feature being in an indirect contact with the second feature through an intermediary. In addition, that the first feature is "above", "over", or "on" the second feature may indicate that the first feature is directly above or obliquely above the second feature, or may merely indicate that the horizontal position of the first feature is higher than that of the second feature. That the first feature is "below", "under", and "beneath" the second feature may be that the first feature is right below the second feature or at an inclined bottom of the second feature, or may merely indicate that the horizontal position of the first feature is lower than that of the second feature.

[0033] It should be noted that, when a component is referred to as "being fixed" or "disposed" on another component, the component may be directly on the other component, or an intervening component may be present. When a component is considered to be "connected to" another component, the component may be directly connected to the another component, or an intervening component may also be present. The terms "vertical", "horizontal", "up", "down", "left", "right", and similar expressions used herein are merely used for an illustrative purpose, but do not represent a unique implementation.

[0034] For ease of understanding of this application, this application is described in further detail below with reference to the accompanying drawings and specific implementations.

[0035] An embodiment of this application provides an electronic vaporization device. Referring to FIG. 1, the electronic vaporization device includes: a vaporizer 100, configured to store a liquid substrate and heat and vaporize the liquid substrate to generate an aerosol; and a power supply mechanism 200, configured to supply power to the vaporizer 100.

[0036] In an optional implementation solution, as shown in FIG. 1, the power supply mechanism 200 includes: a receiving cavity 270, arranged at an end in a length direction and configured to receive and accommodate at least a part of the vaporizer 100. The power supply mechanism 200 further includes a first electrical contact 230, at least partially exposed on a surface of the receiving cavity 270, configured to be electrically connected to the vaporizer 100 to supply power to the vaporizer 100 when at least a part of the vaporizer 100 is received and accommodated in the power supply mechanism 200.

[0037] According to a preferred implementation solu-

tion shown in FIG. 1, an end portion of the vaporizer 100 opposite to the power supply mechanism 200 in the length direction is provided with a second electrical contact 21, so that when at least a part of the vaporizer 100 is received in the receiving cavity 270, the second electrical contact 21 forms conductivity through being in contact with and abutting against the first electrical contact 230.

[0038] A seal element 260 is arranged inside the power supply mechanism 200, and at least a part of an internal space of the power supply mechanism 200 is separated through the seal element 260 to form the receiving cavity 270. In the preferred implementation solution shown in FIG. 1, the seal element 260 is configured to extend in a cross section direction of the power supply mechanism 200, and is preferably prepared by a flexible material such as silica gel, so as to prevent the liquid substrate seeping from the vaporizer 100 to the receiving cavity 270 from flowing to a circuit 220, an airflow sensor 250, and other components inside the power supply mechanism 200.

[0039] In the preferred implementation shown in FIG. 1, the power supply mechanism 200 further includes a battery cell 210, located facing away from the receiving cavity 270 in the length direction, and configured to supply power. The power supply mechanism 200 further includes a circuit 220. The circuit 220 operably guides a current between the battery cell 210 and the first electrical contact 230.

[0040] The power supply mechanism 200 includes an airflow sensor 250, configured to sense an inhalation flow generated by the vaporizer 100 during inhalation by a user, so that the circuit 220 controls the battery cell 210 to output electricity to the vaporizer 100 according to a sensing signal of the airflow sensor 250.

[0041] Further, in the preferred implementation shown in FIG. 1, a charging interface 240 is arranged on another end of the power supply mechanism 200 facing away from the receiving cavity 270, and is configured to supply power to the battery cell 210.

[0042] In an optional embodiment, for example, in the embodiment shown in FIG. 1, the vaporizer 100 includes:

- a liquid storage cavity 20, configured to store a liquid substrate;
- a heating element 40, configured to heat the liquid substrate to generate the aerosol; and
- a liquid guide element 30, configured to transfer the liquid substrate between the liquid storage cavity 20 and the heating element 40.

[0043] In an optional implementation, the liquid substrate preferably includes a tobacco-containing material. The tobacco-containing material includes a volatile tobacco aroma compound released from the liquid substrate during heating. Alternatively, or additionally, the liquid substrate may include a non-tobacco material. The liquid substrate may include water, ethanol or another solvent, a vegetable extract, a nicotine solution, and a

natural or artificial flavoring agent. Preferably, the liquid substrate further includes an aerosol forming agent. An example of an appropriate aerosol forming agent is glycerin and/or propanediol.

[0044] In the embodiment shown in FIG. 1, the liquid guide element 30 is configured into a hollow cylindrical shape extending in a vertical direction of the vaporizer 100. The heating element 40 is formed in a cylindrical hollow of the liquid guide element 30. In use, as shown by an arrow R1, the liquid substrate in the liquid storage cavity 20 is absorbed by an outer surface in a radial direction of the liquid guide element 30, and is then transferred to the heating element 40 on an inner surface to be heated and vaporized to generate an aerosol. The generated aerosol is outputted in the vertical direction of the vaporizer 100 in the cylindrical hollow of the liquid guide element 30, as shown by an arrow R2 in FIG. 1.

[0045] In another variant implementation, the liquid guide element 30 includes flexible fibers such as cotton fibers, non-woven fabrics, and glass fiber ropes, or includes a porous ceramic with a microporous structure. In a specific implementation, the structure of the liquid guide element 30 made of a porous ceramic may have any of various regular or irregular shapes, for example, the shape recorded in Patent CN212590248U.

[0046] In some embodiments, the heating element 40 has a structure such as a heating wire or heating sheet, and is combined with the liquid guide element 30 in a contact manner. Alternatively, in another variant implementation, the heating element 40 can be combined onto the liquid guide element 30 through printing, deposition, sintering, physical assembly, or the like. In some other variant implementations, the liquid guide element 30 made of a porous ceramic may have a planar surface or a curved surface configured to support the heating element 40. The heating element 40 is formed on the planar surface or the curved surface of the liquid guide element 30 through bonding, printing, deposition, or the like.

[0047] A material of the heating element 40 may be a metal material, a metal alloy, graphite, carbon, a conductive ceramic or another composite material of a ceramic material and a metal material that has appropriate impedance. An appropriate metal or alloy material includes at least one of nickel, cobalt, zirconium, titanium, a nickel alloy, a cobalt alloy, a zirconium alloy, a titanium alloy, a nickel-chromium alloy, a nickel-iron alloy, an iron-chromium alloy, an iron-chromium-aluminum alloy, a titanium alloy, an iron-manganese-aluminum-base alloy, stainless steel, and the like. A metal or an alloy material having an appropriate resistor temperature coefficient, for example, a positive temperature coefficient or a negative temperature coefficient, may be selected for a resistor material of the heating element 40. In this way, a heating circuit may be used for heating and may be used as a sensor for sensing a real-time temperature of the heating element 40.

[0048] To accurately monitor a working state of the heating element 40, FIG. 2 is a schematic diagram of

basic components of an embodiment of a circuit 20. Components and connections of the circuit 20 include the following.

[0049] A first switching transistor Q1 is positioned between a battery cell 210 and a heating element 40. When being turned on, the first switching transistor Q1 is configured to enable the battery cell 210 to supply electricity to the heating element 40.

[0050] A first resistor R1 is positioned between a second switching transistor Q2 and the heating element 40, and specifically, has a first end connected to the second switching transistor Q2 and a second end connected to the heating element 40. The first resistor R1 is a standard resistor with a basically constant resistance value. The resistance value is approximately close to a working resistance value of the heating element 40, and is configured to form a series connection with the heating element 40 when the second switching transistor Q2 is turned on, to further form a detection loop that may detect voltages of the first resistor R1 and the heating element 40 through voltage division. Certainly, when detection is not required, the second switching transistor Q2 is turned off to disconnect the detection loop.

[0051] In a specific implementation shown in FIG. 2, a first end of the heating element 40 includes two paths. The first path is connected to the first switching transistor Q1, and the second path is configured to form a series connection with the first resistor R1. A second end of the heating element 40 is grounded, and a potential of the second end of the heating element 40 is 0.

[0052] Further, in the specific implementation shown in FIG. 2, an MCU controller 221 controls on or off of the first switching transistor Q1 and the second switching transistor Q2, and the first switching transistor Q1 and the second switching transistor Q2 are not turned on simultaneously. When it is necessary to supply power to the heating element 40, the MCU controller 221 controls the first switching transistor Q1 to be turned on and the second switching transistor Q2 to be turned off, to enable the battery cell 210 to supply power to the heating element 40. When an unfavorable condition needs to be detected, the MCU controller 221 controls the first switching transistor Q1 to be turned off and the second switching transistor Q2 to be turned on. An unfavorable condition is determined by detecting related electrical characteristics such as voltages, currents, or the like of the first resistor R1 and/or the heating element 40.

[0053] In a preferred implementation, a voltage across the two ends of the first resistor R1 is denoted as V1, and a voltage across two ends of the heating element 40 is denoted as V2. In a detection process, the MCU controller 221 may sample a voltage at the first end of the first resistor R1, that is, a sampling point a in FIG. 2, and the voltage is denoted as Va, and sample a voltage Vb at the first end of the heating element 40, that is, a sampling point b in FIG. 2. Based on that the second end of the heating element 40 in FIG. 3 is grounded, the voltage at the sampling point b is Vb = V2, and the voltage across

the two ends of the first resistor R1 is V1 = Va - V2.

[0054] Further, calculation is performed according to a voltage division formula $Va/V2 = 1 + V1/V2 = (R1 + R40)/R40 = 1 + R1/R40$. R40 is a real-time resistance value of the heating element 40. Further, in use, the first resistor R1 is a given standard resistor. The resistance value is constant. The only variable that affects the result of V1/V2 is the real-time resistance value R40 of the heating element 40, so that a working state of the heating element 40 may be determined through V1/V2.

[0055] Further, based on the voltage division formula, $V1/V2 = (Va - V2)/V2 = Va/V2 - 1$. Because 1 is a fixed constant, a ratio of V1/V2 and a ratio of Va/V2 are identical or equivalent in terms of meanings and results. Further, in an implementation, the MCU controller 221 may use the ratio of Va/V2 as the ratio of V1/V2.

[0056] Further, FIG. 3 is a schematic diagram of the ratio of V1/V2 changing with time in an inhalation process in an embodiment. According to FIG. 3, the ratio of V1/V2 gradually decreases as a temperature of the heating element 40 rises in a heating process.

[0057] Based on the foregoing, in an embodiment, the MCU controller 221 determines an unfavorable condition of the heating element 40 according to a ratio of the voltage V1 across the two ends of the first resistor R1 and the voltage V2 across the two ends of the heating element 40. Further, the battery cell 210 may further be controlled according to whether an unfavorable condition exists to supply electricity to the heating element 40.

[0058] Alternatively, based on the foregoing $V1/V2 = Va/V2 - 1$, the ratio of Va/V2 and the ratio of V1/V2 are identical or equivalent in terms of meanings and results. In some similar embodiments, the MCU controller 221 determines the unfavorable condition of the heating element 40 according to a ratio of a voltage of a detectable loop formed by the first resistor R1 and the heating element 40, that is, the voltage Va at the sampling point a, to the voltage V2 across the two ends of the heating element 40.

[0059] Alternatively, based on a similar implementation, the voltage of the detectable loop is $Va = V1 + V2$. It is calculated that $V1/V2 = V1/(Va - V1) = V1/Va - 1$. A ratio of V1 to Va and the ratio of V1/V2 are also identical or equivalent in terms of meanings and results. In some similar embodiments, the MCU controller 221 determines the unfavorable condition of the heating element 40 according to a ratio of a voltage of a detectable loop formed by the first resistor R1 and the heating element 40, that is, the voltage Va at the sampling point a, to the voltage V1 across the two ends of the first resistor R1.

[0060] Alternatively, based on a similar embodiment, the voltage Va of the detectable loop is actually provided by a voltage Vbat outputted by the battery cell 210. When there is a basically rated loss or difference between the voltage Va of the detectable loop and the voltage Vbat outputted by the battery cell 210, in the foregoing calculation, the voltage Vbat outputted by the battery cell 210 and the voltage Va of the detectable loop are identical or

equivalent in terms of meanings and results. In some similar embodiments, it can be implemented that the MCU controller 221 determines the unfavorable condition of the heating element 40 according to a ratio of any two of the voltage V_{bat} outputted by the battery cell 210, the voltage V_1 across the two ends of the first resistor R_1 , the voltage V_2 across the two ends of the heating element 40, or the voltage V_a of the formed detectable loop.

[0061] In a specific implementation, the unfavorable condition of the heating element 40 is that a liquid substrate transferred or provided to the heating element 40 is insufficient or used up. Generally, when a constant power or electricity is supplied to the heating element 40, when a smaller amount of liquid substrate is transferred or provided to the heating element 40, the temperature of the heating element 40 is higher.

[0062] In still another implementation, the unfavorable condition of the heating element 40 is that a working parameter such as a temperature or a voltage of the heating element 40 exceeds a normal expected value, that is, the working state of the heating element 40 exceeds an expected normal range, and there may be a safety risk.

[0063] In still another variant implementation, the unfavorable condition of the heating element 40 is that the vaporizer 100 coupled to the power supply mechanism 200 is counterfeit or substandard or damaged. A counterfeit or substandard or damaged vaporizer 100 does not have the same working parameter or characteristic (for example, a voltage, or a current) as a standard heating element 40 at given electricity.

[0064] In an unfavorable condition in another implementation, a liquid substrate provided by the vaporizer 100 to the heating element 40 is undesired. Specifically, the undesired liquid substrate may have different ingredients as a desired liquid substrate, resulting in different viscosities, thermal capacities, boiling points, or the like, and has a higher or lower temperature or electricity or power than expected during heating and vaporization.

[0065] Further, the MCU controller 221 may further be configured to stop, when there is an unfavorable condition, the battery cell 210 from supplying power to the heating element 40.

[0066] In a specific implementation, the MCU controller 221 is configured to determine the unfavorable condition of the heating element 40 when the ratio of the voltage V_1 across the two ends of the first resistor R_1 and the voltage V_2 across the two ends of the heating element 40 is greater than a maximum threshold or less than a minimum threshold. For example, according to FIG. 3, the maximum threshold during normal working may be selected as or set to S_0 , and the minimum threshold may be selected as or set to S_1 . When it is detected that the ratio of V_1/V_2 is greater than S_0 or less than S_1 , the unfavorable condition of the heating element 40 is determined.

[0067] Alternatively, in still another a specific implementation, the MCU controller 221 is configured to de-

termine the unfavorable condition of the heating element 40 when the ratio of the voltage V_1 across the two ends of the first resistor R_1 and the voltage V_2 across the two ends of the heating element 40 reaches a preset threshold outside an expected time period. For example, in FIG. 3, in an inhalation process, the ratio of V_1/V_2 reaches S_1 from an initial value S_0 after a predetermined time t_1 .

[0068] It should be clearly described that "when the ratio of the voltage V_1 across the two ends of the first resistor R_1 and the voltage V_2 across the two ends of the heating element 40 reaches a preset threshold outside an expected time period" covers a case in which the described ratio reaches the preset threshold earlier or later than the expected time period or cannot reach the preset threshold. In some optional implementations, the foregoing expected time period is, for example, 50 ms to 200 ms; or may be 80 ms to 200 ms, or the like. Alternatively, in some preferred implementations, the expected time period ranges between 50 ms and 150 ms.

[0069] In still another a specific implementation, the MCU controller 221 is configured to determine the unfavorable condition of the heating element 40 according to a change amount of the ratio of the voltage V_1 across the two ends of the first resistor R_1 and the voltage V_2 across the two ends of the heating element 40 within a predetermined time. For example, during working, it is calculated whether a change amount or change rate of V_1/V_2 within 100 ms exceeds a preset threshold range to determine whether an unfavorable condition exists in the working of the heating element 40. Alternatively, in another variant implementation, the predetermined time may be 50 ms, 80 ms, or the like. For example, in FIG. 3, in an inhalation process, the change amount of the ratio of V_1/V_2 within the predetermined time t_1 is ΔS (that is, $S_0 - S_1$), and it is determined, according to whether the change amount or change rate meets expectations, whether an unfavorable condition exists.

[0070] Alternatively, in still another specific implementation, the MCU controller 221 is configured to determine, according to a ratio (that is, $\Delta S/S_0$) of the change amount ΔS of the ratio of the voltage V_1 across the two ends of the first resistor R_1 and the voltage V_2 across the two ends of the heating element 40 at a moment after the predetermined time to the initial value S_0 , whether an unfavorable condition exists. In a specific implementation, the maximum threshold and the minimum threshold that meet normal working may be selected according to a ratio of $\Delta S/S_0$. When the ratio of $\Delta S/S_0$ is greater than the maximum threshold or less than the minimum threshold, it may be determined that an unfavorable condition exists.

[0071] In the foregoing, a specific unfavorable condition is determined through the ratio of the voltage V_1 across the two ends of the first resistor R_1 and the voltage V_2 across the two ends of the heating element 40, and it is allowed to set a relatively precise threshold. The foregoing ratio of voltages does not depend on a change in the size or shape of the heating element 40 caused by a

manufacturing tolerance and does not depend on a change in a voltage outputted by the battery cell 210, but only depends on material characteristics of the heating element 40 and liquid substrate.

[0072] FIG. 4 is a schematic diagram of basic components of still another embodiment of a circuit 20. Components and connections of the circuit 20 include the following.

[0073] A first switching transistor Q1 is located between a battery cell 210 and a heating element 40, and is configured to enable the battery cell 210 to supply power to the heating element 40.

[0074] A second switching transistor Q2 and a first resistor R1 that are connected in series are connected in parallel to the heating element 40. When the second switching transistor Q2 is turned on at the same time, the first resistor R1, the heating element 40, and the battery cell 210 form a detection loop, to detect currents flowing through the first resistor R1 and the heating element 40. Certainly, when detection is not required, the second switching transistor Q2 is turned off to disconnect the detection loop.

[0075] Specifically, the first resistor R1 is a standard resistor with a basically constant resistance value. When the first switching transistor Q1 and the second switching transistor Q2 are turned on at the same time, the MCU controller 221 detects a ratio of a current I1 flowing through the first resistor R1 to a current I2 flowing through the heating element 40, that is, $I1/I2$, to determine whether an unfavorable condition exists.

[0076] In some similar embodiments, it can be implemented that the MCU controller 221 determines the unfavorable condition of the heating element 40 according to a ratio of any two of a current outputted by the battery cell 210, the current I1 flowing through the first resistor R1, the current I2 flowing through the heating element 40, or a total current of a detectable loop.

[0077] Specifically, during working, with a change resistance generated as the temperature of the heating element 40 rises, the ratio of the current I1 flowing through the first resistor R1 to the current I2 flowing through the heating element 40 during detection changes.

[0078] For example, FIG. 5 shows a curve of the ratio of the current I1 flowing through the first resistor R1 to the current I2 flowing through the heating element 40, that is, $I1/I2$, changing with time in an embodiment. At an initial moment, the ratio of $I1/I2$ is $S0$. When power is supplied to a moment $t1$, the ratio of $I1/I2$ rises from $S0$ to $S1$. An MCU controller 221a determines an unfavorable condition according to the ratio of $I1/I2$.

[0079] Specifically, in an embodiment, the MCU controller 221a determines the unfavorable condition of the heating element 40 according to the ratio of $I1/I2$ being greater than a maximum threshold or less than a minimum threshold.

[0080] Alternatively, in still another embodiment, the MCU controller 221a is configured to determine the unfavorable condition of the heating element 40 when the

ratio of $I1/I2$ reaches a preset threshold outside an expected time period. It should be clearly described that "when the ratio of $I1/I2$ reaches a preset threshold outside an expected time period" covers a case in which the described ratio reaches the preset threshold earlier or later than the expected time period or cannot reach the preset threshold. In some optional implementations, the foregoing expected time period is, for example, 50 ms to 200 ms; or may be 80 ms to 200 ms, or the like. Alternatively, in some preferred implementations, the expected time period ranges between 50 ms and 150 ms.

[0081] In still another specific implementation, the MCU controller 221a is configured to determine the unfavorable condition of the heating element 40 according to a change amount of the ratio of $I1/I2$ within a predetermined time. For example, in FIG. 5, the change amount of the ratio of $I1/I2$ within the predetermined time $t1$ is ΔS (that is, $S0-S1$), and it is determined, according to whether the change amount or change rate meets expectations, whether an unfavorable condition exists.

[0082] Alternatively, in still another specific implementation, the MCU controller 221a is configured to determine, according to a ratio (that is, $\Delta S/S0$) of the change amount ΔS of the ratio of $I1/I2$ at a moment after the predetermined time to the initial value $S0$, whether an unfavorable condition exists. In a specific implementation, the maximum threshold and the minimum threshold that meet normal working may be selected according to a ratio of $\Delta S/S0$. When the ratio of $\Delta S/S0$ is greater than the maximum threshold or less than the minimum threshold, it may be determined that an unfavorable condition exists.

[0083] The technical features in the foregoing embodiments may be randomly combined. For concise description, not all possible combinations of the technical features in the embodiments are described. However, provided that combinations of the technical features do not conflict with each other, the combinations of the technical features are considered as falling within the scope described in this specification.

[0084] The foregoing embodiments only describe several implementations of the present invention, which are described specifically and in detail, but cannot be construed as a limitation to the patent scope of the present invention. It should be noted that for a person of ordinary skill in the art, several transformations and improvements can be made without departing from the idea of the present invention. These transformations and improvements belong to the protection scope of the present invention. Therefore, the protection scope of the patent of the present invention shall be subject to the appended claims.

Claims

1. An electronic vaporization device, comprising:

- a battery cell, configured to supply power;
 a heating element, configured to heat and vaporize a liquid substrate;
 a first resistor, configured to be connected to the heating element to form a detectable loop; and
 a controller, configured to determine an unfavorable condition according to a ratio of an electrical characteristic of the first resistor to an electrical characteristic of the heating element in the detectable loop.
2. The electronic vaporization device according to claim 1, wherein the electrical characteristic is detectable.
3. The electronic vaporization device according to claim 1, further comprising:
- a first switching transistor, operably connecting the heating element and the battery cell, and configured to enable the battery cell to supply power to the heating element to heat and vaporize the liquid substrate; and
 a second switching transistor, operably changing from a first state to a second state to connect the first resistor and the heating element to form the detectable loop, and changing from the second state to the first state to disconnect the detectable loop.
4. The electronic vaporization device according to claim 3, wherein the controller is configured to change the second switching transistor from the first state to the second state, and detect the electrical characteristics of the first resistor and the heating element in the second state.
5. The electronic vaporization device according to any one of claims 1 to 4, wherein the electronic vaporization device comprises a power supply mechanism and a vaporizer removably coupled to the power supply mechanism, wherein
- the battery cell, the first resistor, and the controller are located in the power supply mechanism; and
 the heating element is located in the vaporizer, and the vaporizer comprises the liquid substrate.
6. The electronic vaporization device according to any one of claims 1 to 4, wherein the first resistor is a standard resistor with a basically constant resistance value, and does not contact the liquid substrate.
7. The electronic vaporization device according to any one of claims 1 to 4, wherein the first resistor and the heating element in the detectable loop are connected in series; and
 the electrical characteristic comprises a voltage.
8. The electronic vaporization device according to claim 7, wherein the controller is configured to determine the unfavorable condition according to a ratio of a voltage of the first resistor to a voltage of the heating element in the detectable loop being greater than a maximum threshold or less than a minimum threshold.
9. The electronic vaporization device according to claim 7, wherein the controller is configured to determine the unfavorable condition according to a ratio of a voltage of the first resistor to a voltage of the heating element in the detectable loop reaching a preset threshold outside an expected time period.
10. The electronic vaporization device according to claim 7, wherein the controller is configured to determine the unfavorable condition according to a change amount of a ratio of a voltage of the first resistor to a voltage of the heating element in the detectable loop within a predetermined time.
11. The electronic vaporization device according to claim 7, wherein the controller is configured to determine the unfavorable condition according to an initial value of a ratio of a voltage of the first resistor to a voltage of the heating element in the detectable loop and a ratio of the ratio to a change amount relative to the initial value at a moment.
12. The electronic vaporization device according to any one of claims 1 to 4, wherein the first resistor and the heating element in the detectable loop are connected in parallel; and
 the electrical characteristic comprises a current.
13. The electronic vaporization device according to claim 12, wherein the controller is configured to determine the unfavorable condition according to a ratio of a current flowing through the first resistor to a current flowing through the heating element in the detectable loop being greater than a maximum threshold or less than a minimum threshold.
14. The electronic vaporization device according to claim 12, wherein the controller is configured to determine the unfavorable condition according to a ratio of a current flowing through the first resistor to a current flowing through the heating element in the detectable loop reaching a preset threshold outside an expected time period.
15. The electronic vaporization device according to claim 12, wherein the controller is configured to determine the unfavorable condition according to a

change amount of a ratio of a current flowing through the first resistor to a current flowing through the heating element in the detectable loop within a predetermined time.

16. The electronic vaporization device according to claim 12, wherein the controller is configured to determine the unfavorable condition according to an initial value of a ratio of a current flowing through the first resistor to a current flowing through the heating element in the detectable loop and a ratio of the ratio to a change amount relative to the initial value at a moment.
17. The electronic vaporization device according to any one of claims 1 to 4, wherein the controller is further configured to stop, when the unfavorable condition exists, the battery cell from supplying power to the heating element.
18. An electronic vaporization device, comprising:
- a battery cell, configured to supply power;
 - a heating element, configured to heat and vaporize a liquid substrate;
 - a first resistor, configured to be connected to the heating element to form a detectable loop; and
 - a controller, configured to determine an unfavorable condition according to a ratio of any two of an electrical characteristic of the battery cell, an electrical characteristic of the detectable loop, an electrical characteristic of the first resistor, and an electrical characteristic of the heating element in the detectable loop.
19. A power supply mechanism, configured to supply power to a vaporizer of an electronic vaporization device, wherein the vaporizer comprises a heating element configured to heat and vaporize a liquid substrate to generate an aerosol, wherein the power supply mechanism comprises:
- a battery cell, configured to supply power;
 - a first resistor, configured to be connected to the heating element to form a detectable loop; and
 - a controller, configured to determine an unfavorable condition according to a ratio of an electrical characteristic of the first resistor to an electrical characteristic of the heating element in the detectable loop.
20. A control method of an electronic vaporization device, wherein the electronic vaporization device comprises:
- a battery cell, configured to supply power; and
 - a heating element, configured to heat and vaporize a liquid substrate,

wherein the method comprises the following steps:

- providing a first resistor to be connected to the heating element to form a detectable loop; and
- determining an unfavorable condition according to a ratio of an electrical characteristic of the first resistor to an electrical characteristic of the heating element in the detectable loop.

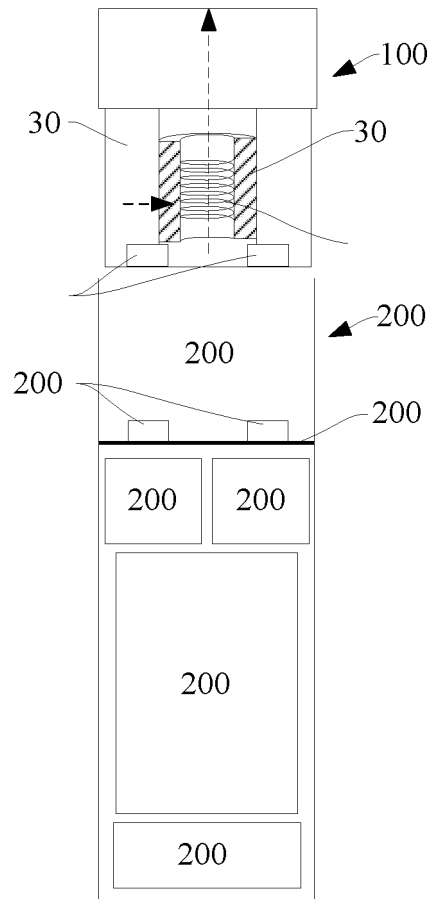


FIG. 1

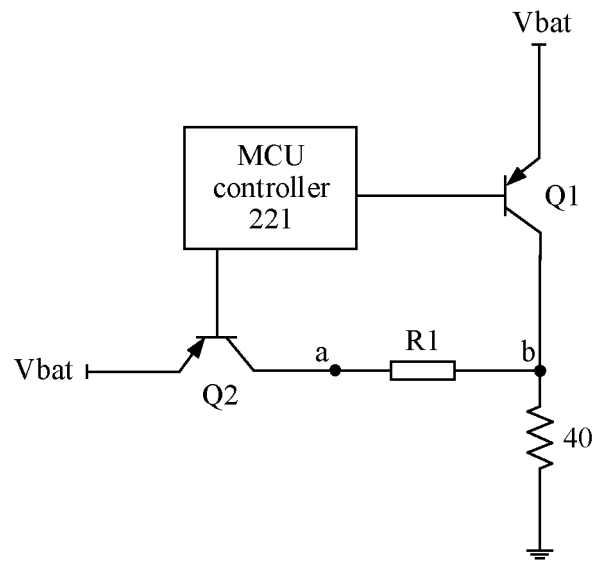


FIG. 2

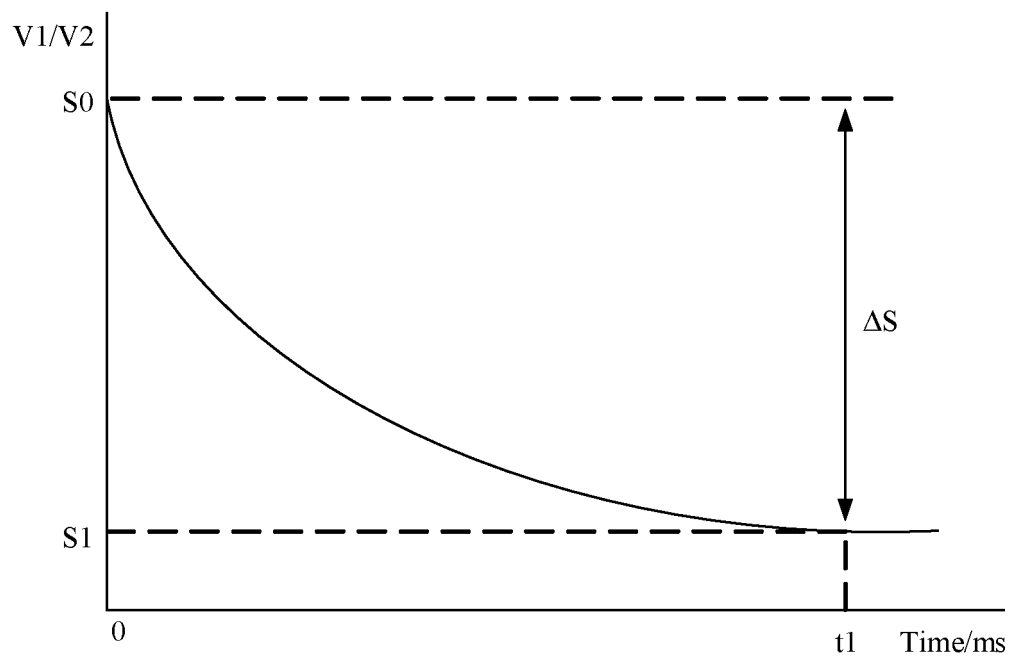


FIG. 3

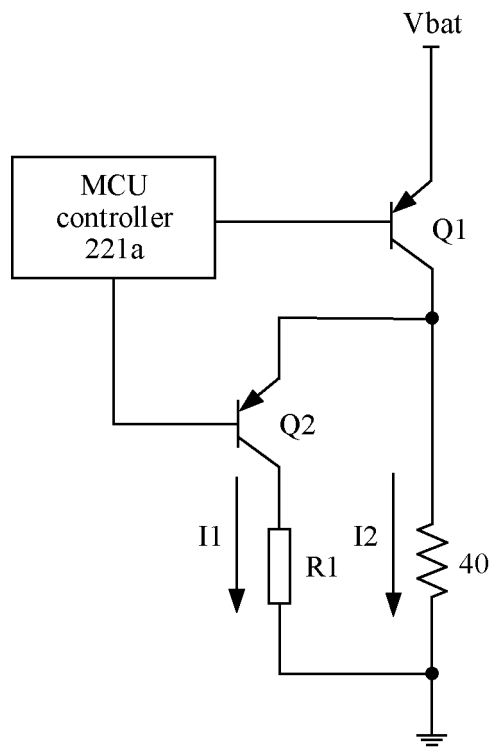


FIG. 4

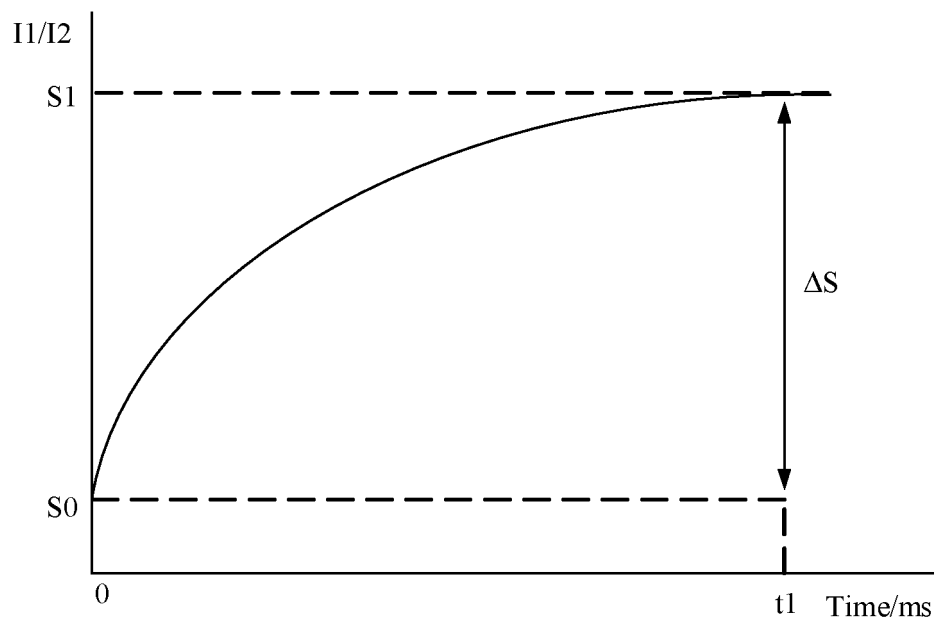


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/098162

A. CLASSIFICATION OF SUBJECT MATTER

A24F 40/46(2020.01)i; A24F 40/40(2020.01)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)

A24F

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)

CNTXT; CNKI; VEN; ENTXT; ENTXTC: 深圳市合元科技有限公司, 雾化, 加热, 电阻, 电压, 电流, 比值, 比率, 温度, 检测, 监测, 监控, 阈值, heat+, resistance, resistor, ratio, current, monitor+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 215347063 U (SHENZHEN FIRST UNION TECHNOLOGY CO., LTD.) 31 December 2021 (2021-12-31) description, paragraphs [0045]-[0090], and figures 1-5	1-20
X	CN 108363432 A (SHANGHAI NEW TOBACCO PRODUCT RESEARCH INSTITUTE CO., LTD. et al.) 03 August 2018 (2018-08-03) description, paragraphs [0027]-[0052], and figures 1(a) and 1(b)	1-20
X	CN 209231795 U (SHANGHAI NEW TOBACCO PRODUCT RESEARCH INSTITUTE CO., LTD. et al.) 09 August 2019 (2019-08-09) description, paragraphs [0017]-[0027], and figure 1(a)	1-20
A	CN 206479257 U (BMC MEDICAL CO., LTD.) 08 September 2017 (2017-09-08) entire document	1-20

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

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Date of the actual completion of the international search

03 August 2022

Date of mailing of the international search report

15 August 2022

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2022/098162

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 215347063 U	31 December 2021	None	
CN 108363432 A	03 August 2018	None	
CN 209231795 U	09 August 2019	None	
CN 206479257 U	08 September 2017	None	

REFERENCES CITED IN THE DESCRIPTION

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- CN 202110645729 [0001]
- CN 212590248 U [0045]