



(11)

EP 4 772 054 A1

(12)

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

(43) Date of publication:
08.07.2026 Bulletin 2026/28

(51) International Patent Classification (IPC):
A24F 40/57 (2020.01)

(21) Application number: **24884593.5**

(52) Cooperative Patent Classification (CPC):
A24F 40/40; A24F 40/46; A24F 40/50; A24F 40/57

(22) Date of filing: **25.10.2024**

(86) International application number:
PCT/CN2024/127343

(87) International publication number:
WO 2025/092590 (08.05.2025 Gazette 2025/19)

(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:
GE KH MA MD TN

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(30) Priority: **31.10.2023 CN 202311441622**

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(54) **CONTROL METHOD AND AEROSOL GENERATION APPARATUS**

(57) The embodiments of the present application relate to the technical field of electronic atomization. Disclosed are a control method and an aerosol generation apparatus. The control method comprises: during a first time phase of vaping, controlling a power source to supply energy to a heater, such that the temperature of the heater is at or below a first temperature; and during a second time phase of vaping, controlling the power source to intermittently supply energy to the heater multiple times, such that a maximum temperature reached after energy supply exceeds the first temperature. By means of the method, the temperature of the heater fluctuates in a waveform during the second time phase, the maximum temperature of the heater exceeding the first temperature. Thus, stable aerosol can be generated during vaping, thereby being conducive to maintaining a good mouthfeel of the aerosol; moreover, intermittent energy supply aligns with intermittent vaping habits of users, thereby preventing aerosol waste caused by continuous high-temperature baking of an aerosol-forming matrix.

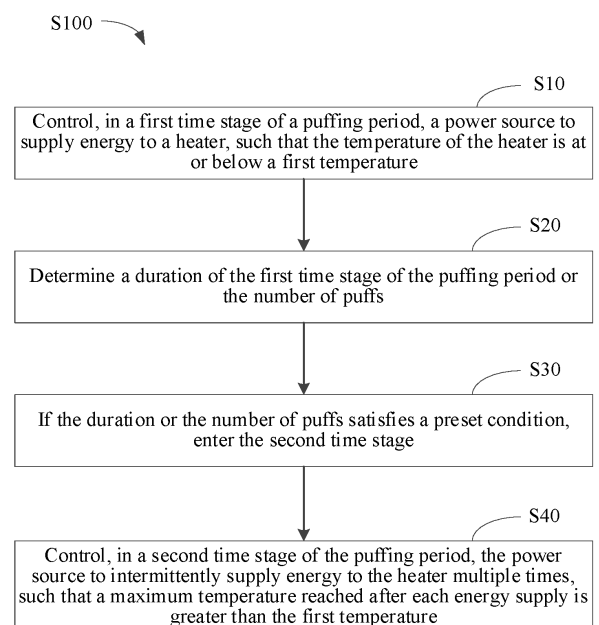


FIG. 3

EP 4 772 054 A1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Chinese Patent Application No. 202311441622.3, entitled "CONTROL METHOD AND AEROSOL GENERATING DEVICE", filed with the China National Intellectual Property Administration on October 31, 2023, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] Embodiments of the present application relate to the field of electronic atomization, and in particular, to a control method and an aerosol generating device.

BACKGROUND

[0003] An aerosol generating device uses a heater to heat and bake an aerosol generating substrate, thereby generating an aerosol for use by a user. A user typically expects the aerosol generating device to generate an aerosol with consistent characteristics throughout use. Typically, the aerosol generating device adjusts the temperature of the heater by varying the power output from a power supply and controls the temperature according to a predetermined temperature curve.

[0004] In a common approach, the temperature curve during the puffing period is substantially linear, that is, the target temperature of the heater remains substantially constant throughout the puffing period. However, during the puffing process, as the aerosol generating substrate is depleted and heat diffusion weakens, the amount of aerosol generated tends to become unstable, leading to a reduction in aerosol output and affecting the taste.

SUMMARY

[0005] In view of this, some embodiments of the present application provide a control method applied to an aerosol generating device, which enables stable aerosol generation during the puffing period and is conducive to maintaining good aerosol taste.

[0006] In a first aspect, some embodiments of the present application provide a control method applied to an aerosol generating device, where the aerosol generating device includes a heater configured to heat an aerosol generating substrate to generate an aerosol, and a power source configured to supply energy to the heater; the aerosol is delivered to a user during a puffing period; and the control method includes:

controlling, in a first time stage of the puffing period, the power source to supply energy to the heater, such that the temperature of the heater is at or below a first temperature; and
controlling, in a second time stage of the puffing

period, the power source to intermittently supply energy to the heater multiple times, such that a maximum temperature reached after each energy supply is greater than the first temperature.

[0007] In some embodiments, in the second time stage, a difference between at least one of the maximum temperatures and the first temperature is greater than or equal to 5°C.

[0008] In some embodiments, in the second time stage, the maximum temperatures gradually increase, and a difference between the highest maximum temperature and the first temperature is greater than or equal to 5°C.

[0009] In some embodiments, in the second time stage, a center temperature is greater than the first temperature, the center temperature in the second time stage being a midpoint between the maximum temperature reached after each energy supply and a minimum temperature reached before the energy supply.

[0010] In some embodiments, a difference between at least one of the center temperatures and the first temperature is greater than or equal to 5°C.

[0011] In some embodiments, the second time stage includes multiple second time periods; in each second time period, the power source is controlled to supply energy to the heater once, including:

controlling the power source to output energy and maintaining the output for a third time to reach the maximum temperature of the heater within the second time period; and
controlling the power source to stop outputting energy and maintaining the stop for a fourth time to reach a minimum temperature of the heater within the second time period.

[0012] In some embodiments, after the controlling the power source to stop outputting energy and maintaining the stop for a fourth time to reach a minimum temperature of the heater within the second time period, the control method further includes:

determining that the fourth time satisfies a preset first time threshold, and initiating energy supply for the next second time period; or
determining that the minimum temperature within the current second time period satisfies a preset first low-temperature threshold, and initiating energy supply for the next second time period; or
determining that a center temperature within the current second time period satisfies a preset first center temperature threshold, and initiating energy supply for the next second time period, where the center temperature of the second time period is a midpoint between the maximum temperature and the minimum temperature within the second time period.

[0013] In some embodiments, as the operating time increases, the maximum temperatures of the multiple second time periods remain consistent; or as the operating time increases, the maximum temperatures of the multiple second time periods gradually increase.

[0014] In some embodiments, a difference between the maximum temperature and the minimum temperature in the second time period is 20°C or more; or a difference between the maximum temperature and the minimum temperature in the second time period is 10°C or more.

[0015] In some embodiments, the control method further includes:

determining a duration of the first time stage of the puffing period or the number of puffs; and
if the duration or the number of puffs satisfies a preset condition, entering the second time stage.

[0016] In some embodiments, the first time stage includes multiple first time periods; in each first time period, the power source is controlled to supply energy to the heater once, including:

controlling the power source to output energy and maintaining the output for a first time to reach the maximum temperature of the heater within the first time period; and
controlling the power source to stop outputting energy and maintaining the stop for a second time to reach a minimum temperature of the heater within the first time period.

[0017] In some embodiments, after the controlling the power source to stop outputting energy and maintaining the stop for a second time to reach a minimum temperature of the heater within the first time period, the control method further includes:

determining that the second time satisfies a preset second time threshold, and initiating energy supply for the next first time period; or
determining that the minimum temperature within the current first time period satisfies a preset second low-temperature threshold, and initiating energy supply for the next first time period; or
determining that a center temperature within the current first time period satisfies a preset second center temperature threshold, and initiating energy supply for the next first time period, where the center temperature of the first time period is a midpoint between the maximum temperature and the minimum temperature within the first time period.

[0018] In some embodiments, a difference between the maximum temperature and the minimum temperature in the first time period is within 10°C.

[0019] In some embodiments, a center temperature of the first time period is equal to or less than a center temperature of the second time period, where the center temperature of the first time period is a midpoint between the maximum temperature and the minimum temperature within the first time period; and the center temperature of the second time period is a midpoint between the maximum temperature and the minimum temperature within the second time period.

[0020] In some embodiments, the minimum temperature of the first time period is greater than or equal to the minimum temperature of the second time period.

[0021] In some embodiments, the controlling, in a first time stage of the puffing period, the power source to supply energy to the heater, such that the temperature of the heater is at or below a first temperature includes: detecting, in the first time stage of the puffing period, a real-time temperature of the heater, and adjusting, according to the real-time temperature, a power and/or duty cycle of the power source to the heater, such that the temperature of the heater is maintained at at least one target temperature, the target temperature being less than or equal to the first temperature.

[0022] In a second aspect, some embodiments of the present application provide an aerosol generating device, including:

a heater, configured to heat an aerosol generating substrate to generate an aerosol;

a power source, configured to supply energy to the heater; and

a controller, configured to: control, in a first time stage of the puffing period, the power source to supply energy to the heater, such that the temperature of the heater is at or below a first temperature; and intermittently control, in a second time stage of the puffing period, the power source to supply energy to the heater multiple times, such that a maximum temperature reached after each energy supply is greater than the first temperature.

[0023] In some embodiments, the heater is made of a metal with a thermal conductivity greater than 10 W/(m·K).

[0024] In some embodiments, the heater is made of stainless steel, permalloy, or ferritic stainless steel; in the second time stage, a temperature difference between the maximum temperature reached after each energy supply and a minimum temperature reached before the energy supply is 10°C or more.

[0025] In some embodiments, the heater is made of aluminum alloy; in the second time stage, a temperature difference between the maximum temperature reached after each energy supply and a minimum temperature reached before the energy supply is 20°C or more.

[0026] The control method provided in the embodiments of the present application is applied to an aerosol generating device, the aerosol generating device includ-

ing a heater configured to heat an aerosol generating substrate to generate an aerosol, and a power source configured to supply energy to the heater, the aerosol being delivered to a user during the puffing period. The control method includes: controlling, in a first time stage of the puffing period, the power source to supply energy to the heater, such that the temperature of the heater is at or below a first temperature; and controlling, in a second time stage of the puffing period, the power source to intermittently supply energy to the heater multiple times, such that a maximum temperature reached after each energy supply is greater than the first temperature.

[0027] In this embodiment, the heater is controlled using different energy supply modes in different time stages. In the first time stage, the temperature of the heater is at or below a first temperature. In the second time stage, energy is intermittently supplied to the heater multiple times, that is, the second time stage is divided into multiple time periods, with energy supplied in a time-division manner. As a result, the temperature of the heater fluctuates in a wave-like manner in the second time stage, with the maximum temperature being greater than the first temperature. In one aspect, the temperature in the second time stage is increased relative to the temperature in the first time stage, thereby increasing the aerosol output to compensate for the reduction in aerosol output during the late stage of puffing. Stable aerosol generation may be achieved during the puffing period, which is conducive to maintaining good aerosol taste. In another aspect, intermittent energy supply conforms to an intermittent puffing habit of a user and prevents aerosol waste caused by continuous high-temperature baking of the aerosol generating substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] One or more embodiments are exemplarily illustrated with reference to the drawings. These exemplary illustrations do not constitute limitations to the embodiments. Elements with the same reference numerals in the drawings represent similar elements. Unless otherwise specified, the drawings are not drawn to scale.

FIG. 1 is a schematic structural diagram of an aerosol generating article according to some embodiments of the present application;

FIG. 2 is a schematic structural diagram of an aerosol generating device according to some embodiments of the present application;

FIG. 3 is a schematic flow diagram of a control method according to some embodiments of the present application;

FIG. 4 is a schematic diagram of a temperature curve of a heater according to some embodiments of the present application;

FIG. 5 is a schematic diagram of a temperature curve of a heater according to some embodiments of the present application; and

FIG. 6 is a schematic diagram of a temperature curve of a heater according to some embodiments of the present application.

DETAILED DESCRIPTION

[0029] The present application is described in detail below with reference to specific embodiments. The following embodiments are provided to further enable a person skilled in the art to understand the present application, and do not limit the present application in any manner. It is to be noted that a person of ordinary skill in the art may make various modifications and improvements without departing from the concept of the present application. All such modifications and improvements fall within the scope of protection of the present application.

[0030] To make objectives, technical solutions, and advantages of the present application clearer, the present application is further described in detail below with reference to the drawings and the embodiments. It is to be understood that the specific embodiments described herein are provided only for explaining the present application and are not intended to limit the present application.

[0031] It is to be noted that, unless there is a conflict, features in the embodiments of the present application may be combined, and all such combinations fall within the scope of protection of the present application. In addition, although the division of functional modules is illustrated in the schematic diagrams of the device and a logical sequence is shown in the flowcharts, in some cases, the illustrated or described steps may be performed in a manner different from the module division in the device or the sequence shown in the flowcharts. In addition, the terms "first", "second", "third", and the like used herein do not limit the data or the execution order, but are merely used to distinguish the same items or similar items having substantially the same function or effect.

[0032] Unless otherwise defined, all technical and scientific terms used in this specification have the same meanings as those commonly understood by a person skilled in the art to which the present application pertains. The terms used in this specification of the present application are intended solely for describing specific implementations and are not intended to limit the present application. The term "and/or" as used in this specification includes any and all possible combinations of one or more of the relevant listed items.

[0033] In addition, the technical features disclosed in the various implementations of the present application described below may be combined as long as they are not mutually conflicting.

[0034] FIG. 1 is a schematic structural diagram of an aerosol generating article according to an implementation of the present application.

[0035] As shown in FIG. 1, the aerosol generating article 20 includes a mouthpiece section 21 and a sub-

strate section 22.

[0036] The substrate section 22 includes an aerosol generating substrate. The aerosol generating substrate is a substrate capable of releasing volatile compounds that can form an aerosol, and the volatile compounds can be released by heating the aerosol generating substrate.

[0037] The aerosol generating substrate may be a solid aerosol generating substrate. Alternatively, the aerosol generating substrate may include solid and liquid components. The aerosol generating substrate may include a tobacco material, which includes volatile tobacco flavor compounds that are released from the aerosol generating substrate upon heating. Alternatively, the aerosol generating substrate may include a non-tobacco material. The aerosol generating substrate may further include an aerosol-forming material. Examples of suitable aerosol-forming materials include glycerol and propylene glycol.

[0038] The aerosol generated from the substrate section 22 upon heating is delivered to a user via the mouthpiece section 21, and the mouthpiece section 21 may be an acetate fiber mouthpiece. The mouthpiece section 21 may be sprayed with a flavoring liquid to provide aroma, or a separate fiber coated with a flavoring liquid may be inserted into the mouthpiece section 21, thereby enhancing the persistence of the flavor delivered to the user. The mouthpiece section 21 may further include a capsule having a spherical or cylindrical shape, and the capsule may include a content with a flavoring substance.

[0039] The aerosol generating article 20 may further include a cooling section 23 disposed between the substrate section 22 and the mouthpiece section 21, configured to cool the aerosol generated from the substrate section 22 upon heating, so that the user can inhale the aerosol cooled to an appropriate temperature.

[0040] FIG. 2 is a schematic structural diagram of an aerosol generating device according to an implementation of the present application.

[0041] As shown in FIG. 1 and FIG. 2, the aerosol generating device 10 includes a cell 101, a controller 102, and a heater 103. In addition, the aerosol generating device 10 has an internal space defined by a housing, and the aerosol generating article 20 can be inserted into the internal space of the aerosol generating device 10.

[0042] The cell 101, serving as a power source, is configured to supply the electrical power for operating the aerosol generating device 10. For example, the cell 101 can supply electrical power to heat the heater 103 and to supply the electrical power required for operating the controller 102. In addition, the cell 101 can supply the electrical power required for operating a display device, sensors, a motor, and the like provided in the aerosol generating device 10.

[0043] The cell 101 may be, but is not limited to, a lithium iron phosphate (LiFePO_4) battery. For example, the cell 101 may be a lithium cobalt oxide (LiCoO_2) battery or a lithium titanate battery. The cell 101 may further be a rechargeable battery or a primary battery.

[0044] When the aerosol generating article 20 is inserted into the interior of the aerosol generating device 10, the aerosol generating device 10 can heat the heater 103 using electrical power supplied by the cell 101. The heater 103 increases the temperature of the aerosol generating substrate in the aerosol generating article 20 to generate an aerosol. The generated aerosol is delivered to the user via the mouthpiece section 21 of the aerosol generating article 20 for inhalation.

[0045] The heater 103 and the aerosol generating substrate may employ various heating configurations. For example, the heater may employ a central heating configuration, in which the heater, in the form of a pin, plate, rod, or the like, is inserted into the interior of the aerosol generating substrate so that the periphery of the heater is in contact with or is in close proximity to (as closely as possible) the aerosol generating substrate, thereby enabling heat transfer. In a peripheral heating configuration, the heater is typically in the form of a hollow cylinder, with the aerosol generating substrate disposed inside the hollow cylinder of the heater, so that the inner wall of the heater is in contact with or is in close proximity to (as closely as possible) the periphery of the aerosol generating substrate, thereby enabling heat transfer.

[0046] The heater 103 may employ various heating platforms, for example, a resistive heat conduction heating platform or an electromagnetic induction heat conduction heating platform.

[0047] The controller 102 can control the operation of the main components of the aerosol generating device 10. In particular, the controller 102 can control the operation of the cell 101 and the heater 103, and can control the operation of other components of the aerosol generating device 10.

[0048] The controller 102 is further configured to perform a control method for an aerosol generating device 10.

[0049] The controller 102 includes at least one processor. The controller may include a logic gate array, or may include a combination of a general-purpose microprocessor and a memory storing programs executable by the microprocessor.

[0050] For example, the controller 102 controls the operation of the heater 103. The controller 102 can control the amount of electrical power supplied to the heater 103, the duration for which electrical power is continuously supplied to the heater 103, and the cessation of power supply to the heater 103. In addition, the controller 102 can monitor the status of the cell 101 (for example, the remaining charge of the cell 101), and/or monitor the operating status of the heater 103 (for example, changes in the resistance of the heater 103), and, if necessary, generate a notification signal to alert the user.

[0051] In addition to the cell 101, the controller 102, and the heater 103, the aerosol generating device 10 may further include other general-purpose components. For example, the aerosol generating device 10 may include a display device for outputting visual information, and the

display device can be a visual display component such as a display screen, a touch screen, or a lighting assembly. The controller 102 can transmit information to the user regarding the status of the aerosol generating device 10 (for example, whether the aerosol generating device 10 is operable), information regarding the heater 103 (for example, preheating started, preheating in progress, or preheating completed), information regarding the cell 101 (for example, the remaining charge of the cell 101 or whether the cell 101 is operable), information related to resetting of the aerosol generating device 10 (for example, reset time, reset in progress, or reset completed), information related to cleaning of the aerosol generating device 10 (for example, cleaning time, cleaning required, cleaning in progress, or cleaning completed), information related to charging of the aerosol generating device 10 (for example, charging required, charging in progress, or charging completed), information related to puffing (for example, the number of puffs, puff completed notification), or information related to safety (for example, usage time). For example, the aerosol generating device 10 may further include a vibration motor for outputting haptic feedback information. The controller 102 can generate a vibration feedback signal using the vibration motor and can transmit the above information to the user. For example, the aerosol generating device 10 may further include an airflow sensor for detecting whether the user is puffing and/or the puffing intensity. For example, the aerosol generating device 10 may include at least one input device to control the functions of the aerosol generating device 10. In particular, the input device may include a button, a touch screen, or the like, through which the user can perform various functions. For example, the user can adjust the number of presses on the input device (for example, one or two presses) or the duration for which the input device is continuously pressed (for example, 0.1 s or 0.2 s) to perform a desired function of multiple functions of the aerosol generating device 10. The user can also use the input device to perform functions such as heating the heater 103, adjusting the temperature of the heater 103, cleaning the space into which the aerosol generating article is inserted, checking whether the aerosol generating device 10 is operable, displaying the remaining charge of the cell 101 (available electrical power), and resetting the aerosol generating device 10. However, the functions of the aerosol generating device 10 are not limited thereto.

[0052] FIG. 3 is a flowchart of a control method for an aerosol generating device according to some embodiments of the present application. As shown in FIG. 3, the controller 102 is configured to perform the control method for an aerosol generating device 10. The method S100 includes:

S10: controlling, in a first time stage of the puffing period, a power source to supply energy to a heater, such that the temperature of the heater is at or below a first temperature.

[0053] It can be understood that, during the puffing

period, the aerosol can be generated by the aerosol generating device at a satisfactory rate and inhaled by the user. In some embodiments, after the aerosol generating device has completed preheating or temperature maintenance operations, it enters a puffing period during which the aerosol can be inhaled. The preheating and temperature maintenance operations are conventional in the art and are not described in detail herein.

[0054] The puffing period here is divided into a first time stage and a second time stage described below. The first time stage may be an early stage of the puffing period, namely, a stage formed after a predetermined period from the start of the puffing period.

[0055] In the first time stage, the power source is controlled to supply energy to the heater, such that the temperature of the heater is at or below a first temperature. The first temperature may be the maximum temperature of the heater in the first time stage. It can be understood that the first temperature is greater than or equal to a baking temperature capable of generating the aerosol. In some embodiments, the first temperature is determined based on the baking temperature. Exemplarily, the first temperature is obtained by increasing the baking temperature by 3 to 5°C.

[0056] In the first time stage, the aerosol generating article is initially subjected to baking, and the aerosol generating substrate is sufficiently available. The temperature of the heater being at or below the first temperature is capable of generating sufficient aerosol with good taste.

[0057] In the first time stage, the energy supply mode from the power source may be continuous or intermittent, and the temperature curve of the heater varies depending on the energy supply mode. In any case, the temperature of the heater is at or below the first temperature.

[0058] In some embodiments, the foregoing step S10 specifically includes:

S11: detecting, in the first time stage of the puffing period, a real-time temperature of the heater, and adjust, according to the real-time temperature, a power and/or duty cycle of the power source to the heater, such that the temperature of the heater is maintained at at least one target temperature, the target temperature being less than or equal to the first temperature.

[0059] Here, the real-time temperature of the heater can be acquired by a temperature sensor or a corresponding temperature-detecting circuit and transmitted to the controller. The target temperature is the temperature to be reached by the heater. Based on the principle that heat is conducted from the heater to the aerosol generating article, the target temperature may be greater than the foregoing baking temperature used to generate the aerosol. Since the temperature of the heater in the first time stage is less than or equal to the first temperature, the target temperature is correspondingly less than or equal to the first temperature. In the first time stage, multiple target temperatures may exist to achieve stage-wise temperature control.

[0060] In some embodiments, the controller adjusts the power supplied by the power source to the heater according to the real-time temperature, such that the temperature of the heater is maintained at at least one target temperature. Exemplarily, a proportional-integral-derivative (PID) control algorithm is used to adjust the power output from the power source by proportional, integral, and derivative terms. When the temperature of the heater is higher than the target temperature, the PID control algorithm reduces the power output from the power source to allow the temperature of the heater to decrease toward the target temperature; when the temperature of the heater is lower than the target temperature, the PID control algorithm increases the power output from the power source to allow the temperature of the heater to rise toward the target temperature.

[0061] In some embodiments, the controller adjusts the duty cycle of the power output from the power source according to the real-time temperature, such that the temperature of the heater is maintained at at least one target temperature. The duty cycle of the power refers to the proportion of time during a cycle in which the power is actually supplied. In this embodiment, the actual power output from the power source remains constant. The higher the duty cycle, the greater the power supplied by the power source to the heater; the lower the duty cycle, the smaller the power supplied by the power source to the heater.

[0062] Exemplarily, a pulse-width modulation (PWM) control algorithm is used to control the average power output from the power source by changing the duty cycle of the signal, such that the temperature of the heater is maintained at at least one target temperature. When the temperature of the heater is higher than the target temperature, the PWM control algorithm reduces the duty cycle of the power output from the power source to allow the temperature of the heater to decrease toward the target temperature; when the temperature of the heater is lower than the target temperature, the PWM control algorithm increases the duty cycle of the power output from the power source to allow the temperature of the heater to rise toward the target temperature.

[0063] If there are multiple target temperatures, the temperature exhibits a stepped curve within the first time stage. For each target temperature, the maintenance mode may be the same or not entirely the same. For example, the target temperatures may all be maintained using a PID control algorithm or a PWM control algorithm. Alternatively, some target temperatures may be maintained using a PID control algorithm, while other target temperatures may be maintained using a PWM control algorithm.

[0064] In some embodiments, the first time stage includes multiple first time periods. Here, the first time stage is subdivided into multiple first time periods. Optionally, the durations of the first time periods are the same, and the corresponding energy supply is the same.

[0065] The preset energy corresponding to each first

time period is determined according to the energy demand characteristics during the baking process of the aerosol generating substrate. In some embodiments, the preset energy may be an experimental value obtained based on a large number of tests conducted by the applicant after the completion of the design of the aerosol generating device, in combination with specific materials of the aerosol generating substrate, or may be an empirical value. It can be understood that the preset energy may be adjusted based on the thermal insulation performance of the heating module, and may be adjusted based on the heat transfer rate between the aerosol generating substrate and the heater, etc.

[0066] Hereinafter, one of the first time periods is taken as an example to exemplarily illustrate the energy supply mode corresponding to the first time period.

[0067] In the first time period, the power source is controlled to supply energy to the heater once, including:

S 12: controlling the power source to output energy and maintain the output for a first time to reach the maximum temperature of the heater within the first time period.

S13: controlling the power source to stop outputting energy and maintain the stop for a second time to reach a minimum temperature of the heater within the first time period.

[0068] It can be understood that the first time period is divided into two portions: a first time and a second time. Within the first time, the power source is controlled to output energy so that the temperature of the heater rapidly rises to the maximum temperature. The first time is also referred to as the heating time. Within the second time, the power source is controlled to stop outputting energy so that the temperature of the heater decreases to the minimum temperature. The second time is also referred to as the natural cooling time. Due to the thermal insulation performance of the aerosol generating device, even in the absence of an energy supply, the temperature gradually decreases within the second time without dropping too quickly. Thus, throughout the entire first time period, the average temperature satisfies the baking temperature of the aerosol generating substrate, so that the aerosol generated after the aerosol generating substrate is baked can quickly reach an inhalable state and maintain the inhalable state.

[0069] For example, upon entering the current first time period, timing is started, and the power source is controlled to output energy for the current first time period. When the timing reaches the first time, the power source is controlled to stop outputting energy for the current first time period, at which point the temperature of the heater rises to the maximum temperature. Then, timing is restarted, and when the timing reaches the second time, the current first time period is ended, and the next time period is entered, at which point the temperature of the heater decreases to the minimum temperature.

[0070] In some embodiments, within the second time (i.e., the natural cooling time) of the first time period, the power source is controlled to output a relatively small amount of energy, which is much smaller than the energy supply within the first time. In one aspect, this does not affect the temperature of the heater from decreasing to the minimum temperature within the second time; in another aspect, maintaining this energy supply facilitates the subsequent transition to the energy supply for the next time period.

[0071] It can be understood that, in the embodiments of the present application, the maximum temperature refers to the highest temperature within a time period, and the minimum temperature refers to the lowest temperature within the time period.

[0072] In some embodiments, a difference between the maximum temperature and the minimum temperature in the first time period is within 10°C. When the heater is at the minimum temperature, the aerosol generating substrate is at a relatively low temperature, close to the minimum temperature. In the next time period, when the heater is rapidly heated to the maximum temperature, the aerosol generating substrate remains at a relatively low temperature due to the lag in heat transfer. Accordingly, the temperature difference between the surface of the heater and the surface of the aerosol generating substrate is increased, thereby disrupting thermal equilibrium. Based on the characteristics of heat conduction (i.e., heat is transferred from a higher-temperature object to a lower-temperature object, and the larger the temperature difference, the greater the amount of heat transferred), under the effect of the temperature difference, a larger proportion of the heat provided by the heater is absorbed by the aerosol generating substrate, thereby enhancing energy utilization efficiency and reducing energy consumption.

[0073] It can be understood that, since the temperature difference within the first time period is relatively small, it may be applied to the early stage of puffing (i.e., the first time stage) in which sufficient aerosol is present, such that a relatively small energy supply can be used to heat and activate the aerosol generating substrate to generate sufficient aerosol.

[0074] In some embodiments, after the foregoing step S12, the control method S 100 further includes:

- (1) determining that the second time satisfies a preset second time threshold, and initiate energy supply for the next first time period.

[0075] The second time threshold is a time threshold characterizing the natural cooling time of the first time stage. The second time threshold is preset, and may be set by a person skilled in the art according to actual requirements.

[0076] After ending the energy supply for the current first time period, the controller enters the second time of the current first time period and performs timing. When

the accumulated second time reaches the second time threshold, the current first time period is ended, and the next first time period is entered.

[0077] In this case, the controller may directly perform energy supply for multiple first time periods and switch between the first time periods according to the preset energy of each first time period and the second time threshold (i.e., the natural cooling time). In this manner, whether initiating or stopping energy supply in the current first time period, it is not necessary to monitor the real-time temperature of the heater. Instead, the control may be performed strictly according to the preset energy of each first time period and parameters such as the second time threshold (i.e., the natural cooling time). Accordingly, the impact caused by inaccurate heater temperature control may be avoided, and control may be implemented based on the amount of heat required for the aerosol generating substrate to generate aerosol.

[0078] In some embodiments, after the foregoing step S12, the control method S100 further includes:

- (2) determining that the minimum temperature within the current first time period satisfies a preset second low-temperature threshold, and initiate energy supply for the next first time period.

[0079] The second low-temperature threshold is a lower limit of the minimum temperature to be provided by the heater within the first time period. In some embodiments, a person skilled in the art may set the second low-temperature threshold according to the baking temperature and/or the thermal insulation performance of the heating module.

[0080] In this embodiment, after ending the energy supply for the current first time period, the controller enters the natural cooling time of the current first time period and detects the real-time temperature of the heater during the natural cooling time. When the real-time temperature satisfies a preset second low-temperature threshold (i.e., the real-time temperature is less than or equal to the second low-temperature threshold), the current first time period is ended, and energy supply for the next first time period is initiated.

[0081] During this period, if it is detected that the real-time temperature of the heater is lower than the second low-temperature threshold, it indicates excessive heat loss, which may affect whether the heater can reach or maintain the target temperature. In this case, the power source is controlled to supply heating energy to the heater to ensure the temperature of the heater. In this case, the current first time period is ended, and the next first time period is entered.

[0082] In this manner, the real-time temperature of the heater needs to be referenced only when determining when to start a first time period for supplying energy to the heater. However, within each first time period, the energy supply, including when to stop the energy supply, is still strictly controlled according to the preset energy of each first time period. Similarly, the impact of variations in the real-time temperature of the heater on temperature con-

trol may be eliminated, and control may be implemented based on the amount of heat required for the aerosol generating substrate to generate aerosol.

[0083] In some embodiments, after the foregoing step S12, the control method S100 further includes:

(3) determining that a center temperature within the current first time period satisfies a preset second center temperature threshold, and initiate energy supply for the next first time period.

[0084] The center temperature of the first time period is the midpoint between the maximum temperature and the minimum temperature within the first time period. The center temperature is the average temperature of the heater during actual heating and can more accurately reflect the temperature condition of the heater. The second center temperature threshold is a lower limit of the center temperature to be provided by the heater within the first time period. In some embodiments, a person skilled in the art may set the second center temperature threshold according to the baking temperature and/or the thermal insulation performance of the heating module.

[0085] In this embodiment, during energy supply for the current first time period, the real-time temperature of the heater is synchronously detected to acquire the maximum temperature within the current first time period. After ending the energy supply for the current first time period, the controller enters the natural cooling time of the current first time period and synchronously detects the real-time temperature of the heater during the natural cooling time to acquire the minimum temperature within the current first time period. The center temperature of the current first time period may be determined by calculating the mean value of the maximum temperature and the minimum temperature within the current first time period.

[0086] It can be understood that, during the natural cooling time, the real-time temperature of the heater gradually decreases, and the real-time temperature represents the minimum temperature, where the detected minimum temperature is continuously updated. When it is monitored that the center temperature determined based on the latest minimum temperature (i.e., the real-time temperature) is less than or equal to the second center temperature threshold, the current first time period is ended, and energy supply for the next first time period is initiated.

[0087] During this period, if it is detected that the calculated center temperature is lower than the second center temperature threshold, it indicates that the average temperature of the heater is too low, which may affect whether the heater can reach or maintain the target temperature. In this case, the power source is controlled to supply heating energy to the heater to ensure the temperature of the heater. In this case, the current first time period is ended, and the next first time period is entered.

[0088] This manner is similar to the above minimum temperature monitoring manner. The real-time tempera-

ture of the heater needs to be referenced only when determining when to start a first time period for supplying energy to the heater. However, within each first time period, the energy supply, including when to stop the energy supply, is still strictly controlled according to the preset energy of each first time period. Similarly, the impact of variations in the real-time temperature of the heater on temperature control may be eliminated, and control may be implemented based on the amount of heat required for the aerosol generating substrate to generate aerosol.

[0089] The first time stage is a stage of the puffing period, namely, a stage formed after a predetermined period from the start of the puffing period. The end time of the first time stage may be determined based on the consumption amount of the aerosol generating substrate. For example, when the consumption amount of the aerosol generating substrate reaches 70%, the first time stage is ended.

[0090] To accurately determine the end time of the first time stage and improve aerosol generation characteristics by supplying energy in time stages (as the aerosol generating substrate is depleted and heat diffusion weakens, leading to a reduction in aerosol output), in some embodiments, the control method S100 further includes:

S20: determining a duration of the first time stage of the puffing period or the number of puffs;

S30: If the duration or the number of puffs satisfies a preset condition, enter the second time stage.

[0091] It can be understood that, after the aerosol generating device is activated, preheating and temperature maintenance operations are first performed, and then the first time stage of the puffing period is entered. The aerosol generating device may determine whether preheating and temperature maintenance operations have been completed based on the accumulated time after startup or the temperature, thereby determining the time for entering the first time stage. After entering the first time stage, timing is initiated to obtain the duration of the first time stage.

[0092] The preset condition may be that a time threshold is reached. A person skilled in the art may determine the time threshold based on the puffing lifetime of the aerosol generating article. For example, if the puffing lifetime is 6 min, the time threshold may be 4 min.

[0093] In some embodiments, when it is detected that the duration of the first time stage reaches the time threshold, the preset condition is satisfied, and the controller controls the power source to enter a second time stage, that is, the power source is controlled to supply energy according to the energy supply mode of the second time stage.

[0094] In some embodiments, the end of the first time stage and the entry into the second time stage may be determined based on the number of puffs. The number of puffs refers to the number of times a user inhales the

aerosol. It can be understood that each time the user inhales the aerosol, the number of puffs increases by one.

[0095] In some embodiments, the number of puffs may be obtained by an airflow sensor. When the user inhales aerosol, air enters the aerosol generating device and the aerosol is drawn out of the aerosol generating device, causing a change in airflow within the aerosol generating device. Accordingly, the airflow change may be detected by an airflow sensor, and the number of puffs may be indirectly determined based on the detected airflow change.

[0096] The preset condition may be that the number of puffs reaches a puff count threshold. A person skilled in the art may determine the puff count threshold based on the puffing lifetime of the aerosol generating article. For example, if the puffing lifetime is 20 puffs, the puff count threshold may be 15 puffs.

[0097] Exemplarily, when the number of puffs reaches a preset puff count threshold, the preset condition is satisfied, and the controller controls the power source to enter the second time stage, that is, the power source is controlled to supply energy according to the energy supply mode of the second time stage.

[0098] In this embodiment, by monitoring whether the duration of the first time stage or the number of puffs satisfies the preset condition, the end time of the first time stage can be accurately determined, such that supplying energy in time stages can improve aerosol generation characteristics (as the aerosol generating substrate is depleted and heat diffusion weakens, leading to a reduction in aerosol output).

S40: controlling, in a second time stage of the puffing period, the power source to intermittently supply energy to the heater multiple times, such that a maximum temperature reached after each energy supply is greater than the first temperature.

[0099] After the first time stage is ended, the second time stage is entered, and the second time stage may be a late stage of the puffing period. The power supply mode corresponding to the second time stage is different from the energy supply mode of the first time stage. It can be understood that parameters corresponding to the second time stage, such as the energy supply frequency, interval time, and the amount of energy supplied each time, are pre-stored in a memory inside the aerosol generating device for retrieval by the controller.

[0100] The power source intermittently supplies energy to the heater multiple times. It can be understood that the power source outputs power intermittently at a relatively low frequency (which may include no power output or low-frequency power output), and each power output lasts for a period of time. For example, the frequency of the power output may be lower than 10 Hz. Exemplarily, the frequency of the power output may be 5 Hz, that is, energy is supplied five times per second. Each power output may last for 5 s, followed by a 7 s pause before the next power output is performed. It can be

understood that the low-frequency output is different from the high-frequency driving pulses in an electromagnetic induction heater assembly, and the frequency of the high-frequency driving pulses is generally about 100 Hz to 10 kHz.

[0101] It can be understood that, since the power source intermittently supplies energy to the heater multiple times, the temperature of the heater rises during energy supply and decreases due to outward heat dissipation when energy is not supplied, thereby exhibiting a wave-like variation, for example, fluctuating between a maximum temperature and a minimum temperature. The maximum temperature reached after each energy supply is greater than the first temperature.

[0102] As described above, in the first time stage, the temperature of the heater is at or below the first temperature. In the second time stage, each maximum temperature is greater than the first temperature, indicating that the heating temperature in the second time stage is increased relative to the heating temperature in the first time stage. It can be understood that, during the late stage of the puffing period, the aerosol generating substrate is nearly depleted and heat diffusion weakens, leading to a reduction in aerosol output. In this case, increasing the heating temperature can mitigate the weakening of heat diffusion, thereby increasing the aerosol output to compensate for the reduction in aerosol output in the late stage of puffing. Stable aerosol generation may be achieved during the puffing period, which is conducive to maintaining good aerosol taste.

[0103] In this embodiment, the heater is controlled to perform heating using different energy supply modes in different time stages. In the first time stage, the temperature of the heater is at or below the first temperature. In the second time stage, energy is intermittently supplied to the heater multiple times, that is, the second time stage is divided into multiple time periods, with energy supplied in a time-division manner. As a result, the temperature of the heater fluctuates in a wave-like manner in the second time stage, with the maximum temperature being greater than the first temperature. In one aspect, the overall temperature in the second time stage is increased relative to the temperature in the first time stage, thereby increasing the aerosol output to compensate for the reduction in aerosol output during a late stage of puffing. Stable aerosol generation may be achieved during the puffing period, which is conducive to maintaining good aerosol taste. In another aspect, intermittent energy supply conforms to puffing habits (i.e., intermittent puffing) of a user and does not cause waste of aerosol due to continuous high-temperature baking of the aerosol generating substrate.

[0104] In some embodiments, the second time stage includes multiple second time periods. Here, the second time stage is subdivided into multiple second time periods. The energy supply corresponding to the second time period is different from the energy supply corresponding to the first time period described above.

[0105] In this embodiment, the second time period is a time period different from the first time period. In particular, the third time (i.e., the energy supply time within the second time period) is greater than the first time (i.e., the energy supply time within the first time period), and the fourth time (i.e., the natural cooling time within the second time period) is greater than the second time (i.e., the natural cooling time within the first time period).

[0106] It can be understood that the energy supply corresponding to each second time period is pre-stored in a memory inside the aerosol generating device for retrieval by the controller. Within each second time period, the controller controls the power source to supply energy to the heater strictly according to the preset energy corresponding to the second time period.

[0107] The preset energy corresponding to each second time period is determined according to the energy demand characteristics during the baking process of the aerosol generating substrate. In some embodiments, the preset energy may be an experimental value obtained based on a large number of tests conducted by the applicant after the completion of the design of the aerosol generating device, in combination with specific materials of the aerosol generating substrate, or may be an empirical value. It can be understood that the preset energy may be adjusted based on the thermal insulation performance of the heating module, the consumption amount or remaining amount of the aerosol generating substrate, and may be adjusted based on the heat transfer rate between the aerosol generating substrate and the heater, etc.

[0108] Hereinafter, one of the second time periods is taken as an example to exemplarily illustrate the energy supply mode corresponding to the second time period.

[0109] In the second time period, the power source is controlled to supply energy to the heater once, including:

S41: controlling the power source to output energy and maintain the output for a third time to reach the maximum temperature of the heater within the second time period;

S42: controlling the power source to stop outputting energy and maintain the stop for a fourth time to reach a minimum temperature of the heater within the second time period.

[0110] It can be understood that the second time period is divided into two portions: a third time and a fourth time. Within the third time, the power source is controlled to output energy so that the temperature of the heater rapidly rises to the maximum temperature. The third time is also referred to as the heating time. Within the fourth time, the power source is controlled to stop outputting energy so that the temperature of the heater decreases to the minimum temperature. The fourth time is also referred to as the natural cooling time. Due to the thermal insulation performance of the aerosol generating device, even in the absence of an energy supply, the temperature

gradually decreases within the fourth time without dropping too quickly. Thus, throughout the entire second time period, the average temperature satisfies the baking temperature of the aerosol generating substrate, so that the aerosol generated after the aerosol generating substrate is baked can quickly reach an inhalable state and maintain the inhalable state.

[0111] For example, upon entering the current second time period, timing is started, and the power source is controlled to output energy for the current second time period. When the timing reaches the third time, the power source is controlled to stop outputting energy for the current second time period, at which point the temperature of the heater rises to the maximum temperature. Then, timing is restarted, and when the timing reaches the fourth time, the current second time period is ended, and the next time period is entered, at which point the temperature of the heater decreases to the minimum temperature.

[0112] In some embodiments, within the fourth time (i.e., the natural cooling time) of the second time period, the power source is controlled to output a relatively small amount of energy, which is much smaller than the energy supply within the third time. In one aspect, this does not affect the temperature of the heater from decreasing to the minimum temperature within the fourth time; in another aspect, maintaining this energy supply facilitates the subsequent transition to the energy supply of the next time period.

[0113] It can be understood that, here, the maximum temperature refers to the highest temperature within a second time period, and the minimum temperature refers to the lowest temperature within a second time period.

[0114] In some embodiments, a difference between the maximum temperature and the minimum temperature in the second time period is 20°C or more; or a difference between the maximum temperature and the minimum temperature in the second time period is 10°C or more.

[0115] When the heater is at the minimum temperature, the aerosol generating substrate is at a relatively low temperature, close to the minimum temperature. In the next time period, when the heater is rapidly heated to the maximum temperature, the aerosol generating substrate remains at a relatively low temperature due to the lag in heat transfer. Accordingly, the temperature difference between the surface of the heater and the surface of the aerosol generating substrate is increased, thereby disrupting thermal equilibrium. Based on the characteristics of heat conduction (i.e., heat is transferred from a higher-temperature object to a lower-temperature object, and the larger the temperature difference, the greater the amount of heat transferred), when the temperature difference is relatively large (e.g., 10°C or more, or 20°C or more), a larger proportion of the heat provided by the heater can be absorbed by the aerosol generating substrate, thereby enhancing energy utilization efficiency and reducing energy consumption.

[0116] It can be understood that a relatively large temperature difference within the second time period may be applied to the late stage of puffing (i.e., the second time stage) when the aerosol generating substrate is about to be depleted, to compensate for the reduction in aerosol output during the late stage of puffing. Stable aerosol generation may be achieved during the puffing period, which is conducive to maintaining good aerosol taste.

[0117] In some embodiments, after the foregoing step S42, the control method S100 further includes:

- (1) determining that the fourth time satisfies a preset first time threshold, and initiate energy supply for the next second time period.

[0118] The first time threshold is a time threshold characterizing the natural cooling time of the second time stage. The first time threshold is preset, and may be set by a person skilled in the art according to actual requirements.

[0119] After ending the energy supply for the current second time period, the controller enters the fourth time of the current second time period and performs timing. When the accumulated fourth time reaches the first time threshold, the current second time period is ended, and the next second time period is entered.

[0120] In this case, the controller may directly perform energy supply for multiple second time periods and switching between the second time periods according to the preset energy of each second time period and the first time threshold (i.e., the natural cooling time). In this manner, whether initiating or stopping energy supply in the current second time period, it is not necessary to monitor the real-time temperature of the heater. Instead, the control may be performed strictly according to the preset energy of each second time period and parameters such as the first time threshold (i.e., the natural cooling time). Accordingly, the adverse interference caused by the temperature of the heater may be avoided, and control may be implemented based on the amount of heat required for the aerosol generating substrate to generate aerosol.

[0121] In some embodiments, after the foregoing step S42, the control method S100 further includes:

- (2) determining that the minimum temperature within the current second time period satisfies a preset first low-temperature threshold, and initiate energy supply for the next second time period.

[0122] The first low-temperature threshold is a lower limit of the minimum temperature to be provided by the heater within the second time period. In some embodiments, a person skilled in the art may set the first low-temperature threshold according to the baking temperature and/or the thermal insulation performance of the heating module.

[0123] In this embodiment, after ending the energy supply for the current second time period, the controller enters the natural cooling time of the current second time

period and detects the real-time temperature of the heater during the natural cooling time. When the real-time temperature satisfies a preset first low-temperature threshold (i.e., the real-time temperature is less than or equal to the first low-temperature threshold), the current second time period is ended, and energy supply for the next second time period is initiated.

[0124] During this period, if it is detected that the real-time temperature of the heater is lower than the first low-temperature threshold, it indicates excessive heat loss, which may affect whether the heater can reach the baking temperature. In this case, the power source is controlled to supply heating energy to the heater to ensure the temperature of the heater. In this case, the current second time period is ended, and the next second time period is entered.

[0125] In this manner, the real-time temperature of the heater needs to be referenced only when determining when to start a second time period for supplying energy to the heater. However, within each second time period, the energy supply, including when to stop the energy supply, is still strictly controlled according to the preset energy of each second time period. Similarly, the impact of variations in the real-time temperature of the heater on temperature control may be eliminated, and control may be implemented based on the amount of heat required for the aerosol generating substrate to generate aerosol.

[0126] In some embodiments, after the foregoing step S42, the control method S100 further includes:

- (3) determining that a center temperature within the current second time period satisfies a preset first center temperature threshold, and initiate energy supply for the next second time period.

[0127] The center temperature of the second time period is the midpoint between the maximum temperature and the minimum temperature within the second time period. The center temperature is the average temperature of the heater during actual heating and can more accurately reflect the temperature condition of the heater.

The first center temperature threshold is a lower limit of the center temperature to be provided by the heater within the second time period. In some embodiments, a person skilled in the art may set the second center temperature threshold according to the baking temperature and/or the thermal insulation performance of the heating module.

[0128] In this embodiment, during energy supply for the current second time period, the real-time temperature of the heater is synchronously detected to acquire the maximum temperature within the current second time period. After ending the energy supply for the current second time period, the controller enters the natural cooling time of the current second time period and synchronously detects the real-time temperature of the heater during the natural cooling time to acquire the minimum temperature within the current second time period. The center temperature of the current second time period may be determined by calculating the mean value of

the maximum temperature and the minimum temperature within the current second time period.

[0129] It can be understood that, during the natural cooling time, the real-time temperature of the heater gradually decreases, and the real-time temperature represents the minimum temperature, where the detected minimum temperature is continuously updated. When it is monitored that the center temperature determined based on the latest minimum temperature (i.e., the real-time temperature) is less than or equal to the first center temperature threshold, the current second time period is ended, and energy supply for the next second time period is initiated.

[0130] During this period, if it is detected that the calculated center temperature is lower than the first center temperature threshold, it indicates that the average temperature of the heater is too low, which may affect whether the heater can reach or maintain the target temperature. In this case, the power source is controlled to supply heating energy to the heater to ensure the temperature of the heater. In this case, the current second time period is ended, and the next second time period is entered.

[0131] This manner is similar to the above minimum temperature monitoring manner. The real-time temperature of the heater needs to be referenced only when determining when to start a second time period for supplying energy to the heater. However, within each second time period, the energy supply, including when to stop the energy supply, is still strictly controlled according to the preset energy of each second time period. Similarly, the impact of variations in the real-time temperature of the heater on temperature control may be eliminated, and control may be implemented based on the amount of heat required for the aerosol generating substrate to generate aerosol.

[0132] Referring to FIG. 4, the first time stage, which is in the early stage of puffing, includes multiple first time periods. Within each first time period, the temperature fluctuates between a maximum temperature and a minimum temperature, and the temperature curve presents a small-wave curve. The second time stage, which is in the late stage of puffing, includes multiple second time periods. Within each second time period, the temperature fluctuates between a maximum temperature and a minimum temperature, and the temperature curve presents a large-wave curve. In this embodiment, based on a control strategy in which the center temperature of the temperature wave curve remains constant, the energy supply for each time period is configured such that both the small-wave curve and the large-wave curve fluctuate above and below the same center temperature. That is, the center temperature in the first time period is equal to the center temperature in the second time period. The minimum temperature of the first time period is greater than the minimum temperature of the second time period.

[0133] As shown in FIG. 4, after the aerosol generating device is activated for heating, it first performs preheating

and heat preservation, and then enters the puffing stage. In the early stage of puffing (i.e., the first time stage), which includes multiple first time periods, the controller controls the power source to output power according to the energy supply mode corresponding to each first time period. The temperature of the heater exhibits small-wave fluctuations within $\pm 5^{\circ}\text{C}$. In the first time stage, the temperature of the heater is at or below a first temperature, where the first temperature may be the maximum temperature of the heater in the first time stage.

[0134] It can be understood that, in the early stage of puffing, the aerosol generating substrate is sufficient, a relatively small amount of energy is supplied each time, and the temperature fluctuates in a small wave pattern, thereby heating and activating the aerosol generating substrate to generate sufficient aerosol. Compared with continuously supplying energy during the early stage of puffing, this approach can enhance energy utilization efficiency and reduce energy consumption.

[0135] In the late stage of puffing (i.e., the second time stage), which includes multiple second time periods, the controller controls the power source to output power according to the energy supply mode corresponding to each second time period, such that the difference between the maximum temperature and the minimum temperature in each second time period is 10°C or more, or 20°C or more. Exemplarily, the temperature of the heater exhibits large-wave fluctuations within $\pm 25^{\circ}\text{C}$.

[0136] In the late stage of puffing, the power source is controlled to output power according to the energy supply mode corresponding to each second time period. The energy supply corresponding to the second time period is relatively greater, and the maximum temperature in the second time stage is greater than the first temperature compared with the early stage of puffing, thereby increasing the aerosol output. In some embodiments, in the second time stage, a difference between at least one of the maximum temperatures and the first temperature is greater than or equal to 5°C . That is, the maximum temperature in at least one second time period is at least 5°C greater than the first temperature. Exemplarily, as the operating time increases, the maximum temperatures of the multiple second time periods remain consistent, and each of the maximum temperatures is 5°C greater than the first temperature.

[0137] The heating temperature in the second time stage is increased relative to the heating temperature in the first time stage. It can be understood that, during the late stage of the puffing period, the aerosol generating substrate is nearly depleted and heat diffusion weakens, leading to a reduction in aerosol output. In this case, increasing the heating temperature can mitigate the weakening of heat diffusion, thereby increasing the aerosol output to compensate for the reduction in aerosol output in the late stage of puffing. Stable aerosol generation may be achieved during the puffing period, which is conducive to maintaining good aerosol taste. In addition, intermittently increasing the temperature conforms

to the puffing habits (intermittent puffing) of the user and does not cause waste of aerosol due to continuous high-temperature baking of the aerosol generating substrate.

[0138] Referring to FIG. 5, in the first time stage, the temperature curve is a small-wave curve that fluctuates upward starting from the minimum temperature. In the second time stage, the temperature curve includes two large-wave curves with different amplitudes. The first time stage and the second time stage have the same minimum temperature, that is, the minimum temperature of the first time period is equal to the minimum temperature of the second time period. In this embodiment, based on a control strategy in which the lower limit of the temperature wave curve remains constant, the energy supply for each time period is set such that the wave curve fluctuates upward starting from the minimum temperature.

[0139] In some embodiments, as the operating time increases, the maximum temperatures of the multiple second time periods gradually increase. As shown in FIG. 6, the maximum temperature in sub-stage 2# of the second time stage is greater than the maximum temperature in sub-stage 1# of the second time stage. It can be understood that, in other embodiments, the second time stage may further be divided into multiple sub-stages, each sub-stage including multiple second time periods, and the maximum temperatures of the second time periods within each sub-stage being the same. As the operating time increases, the maximum temperature of each sub-stage gradually increases. That is, in this embodiment, as the aerosol generating substrate is gradually consumed, the maximum temperature is progressively increased in the second time stage, such that the maximum temperature is matched with the remaining amount of the aerosol generating substrate, thereby effectively ensuring stable aerosol generation in the late stage of puffing and alleviating the problem of the reduction in aerosol output.

[0140] In some embodiments, a difference between the highest maximum temperature in the second time stage and the first temperature is greater than or equal to 5°C. Exemplarily, the maximum temperature of each sub-stage in the second time stage gradually increases, and a difference between the maximum temperature of each sub-stage and the first temperature also gradually increases. For example, the difference may be 1°C, 2°C, 3°C, and 4°C, gradually increasing to 5°C. That is, by gradually increasing the maximum temperature in the second time stage relative to the first temperature, stable aerosol generation in the late stage of puffing can be effectively ensured, thereby alleviating the problem of the reduction in aerosol output.

[0141] In some embodiments, as shown in FIG. 5 or FIG. 6, a center temperature of the first time period is less than a center temperature of the second time period, and the center temperature in the second time stage is greater than the first temperature. It can be understood that the center temperature of the first time period is the midpoint

between the maximum temperature and the minimum temperature within the first time period; and the center temperature of the second time period is the midpoint between the maximum temperature and the minimum temperature within the second time period.

[0142] In a case that the second time stage includes multiple sub-stages, multiple center temperatures exist, and each of the multiple center temperatures is greater than the first temperature. In some embodiments, a difference between at least one center temperature in the second time stage and the first temperature is greater than or equal to 5°C. Exemplarily, the center temperature of each sub-stage in the second time stage gradually increases, and a difference between the center temperature of each sub-stage and the first temperature also gradually increases. For example, the difference may be 1°C, 2°C, 3°C, and 4°C, gradually increasing to 5°C. That is, by gradually increasing the center temperature in the second time stage relative to the first temperature, stable aerosol generation in the late stage of puffing can be effectively ensured, thereby alleviating the problem of the reduction in aerosol output.

[0143] A person skilled in the art may adopt a control strategy in which the center temperature remains constant or a control strategy in which the minimum temperature remains constant, as required, to set the energy supply in each time period, thereby achieving a flexible configuration of the temperature curve such that the temperature curve presents different forms as needed. For example, when a control strategy in which the center temperature remains constant is adopted, the center temperature within the first time period is equal to the center temperature within the second time period. The minimum temperature of the first time period is greater than the minimum temperature of the second time period. As the operating time increases, the maximum temperature or the center temperature of the multiple second time periods gradually increases, and a difference between at least one of the maximum temperatures or at least one of the center temperatures in the second time stage and the first temperature is greater than or equal to 5°C. For example, when a control strategy in which the minimum temperature remains constant is adopted, the minimum temperature of the first time period is the same as the minimum temperature of the second time period, the center temperature of the first time period is less than the center temperature of the second time period, and the center temperature in the second time stage is greater than the first temperature (for example, at least one center temperature is 5°C greater than the first temperature). As the operating time increases, the maximum temperature or the center temperature of the multiple second time periods gradually increases.

[0144] In summary, in some embodiments of the present application, different energy supply modes are adopted in different time stages to control the heating of the heater. In the first time stage, the temperature of the heater is at or below the first temperature. In the second

time stage, energy is intermittently supplied to the heater multiple times, that is, the second time stage is divided into multiple time periods, with energy supplied in a time-division manner. As a result, the temperature of the heater fluctuates in a wave-like manner in the second time stage, with the maximum temperature being greater than the first temperature. In one aspect, the temperature in the second time stage is increased relative to the temperature in the first time stage, thereby increasing the aerosol output to compensate for the reduction in aerosol output during the late stage of puffing. Stable aerosol generation may be achieved during the puffing period, which is conducive to maintaining good aerosol taste. In another aspect, intermittent energy supply conforms to puffing habits (i.e., intermittent puffing) of a user and does not cause waste of aerosol due to continuous high-temperature baking of the aerosol generating substrate.

[0145] In some embodiments of the present application, an aerosol generating device is further provided. The aerosol generating device includes a heater, a power source, and a controller. The heater and the power source are communicatively connected to the controller.

[0146] The heater is configured to heat an aerosol generating substrate to generate an aerosol. Exemplarily, in terms of appearance, the heater may be a needle-shaped or tubular heater; and in terms of heating principles, the heater may be a resistive heater or an electromagnetic induction heater. The power source is a cell configured to supply energy to the heater.

[0147] The controller is configured to: control, in a first time stage of the puffing period, the power source to supply energy to the heater, such that the temperature of the heater is at or below a first temperature; and intermittently control, in a second time stage of the puffing period, the power source to supply energy to the heater multiple times, such that a maximum temperature reached after each energy supply is greater than the first temperature.

[0148] In this embodiment, the heater is controlled to perform heating using different energy supply modes in different time stages. In the first time stage, the temperature of the heater is at or below the first temperature. In the second time stage, energy is intermittently supplied to the heater multiple times, that is, the second time stage is divided into multiple time periods, with energy supplied in a time-division manner. As a result, the temperature of the heater fluctuates in a wave-like manner in the second time stage, with the maximum temperature being greater than the first temperature. In one aspect, the temperature in the second time stage is increased relative to the temperature in the first time stage, thereby increasing the aerosol output to compensate for the reduction in aerosol output during the late stage of puffing. Stable aerosol generation may be achieved during the puffing period, which is conducive to maintaining good aerosol taste. In another aspect, intermittent energy supply conforms to puffing habits (i.e., intermittent puffing) of a user

and does not cause waste of aerosol due to continuous high-temperature baking of the aerosol generating substrate.

[0149] In some embodiments, the controller is configured to perform the control method according to any one of the above method embodiments, so that the aerosol generating device is capable of implementing the functions realized by the control method according to any one of the above method embodiments, and details thereof are not repeated herein.

[0150] In some embodiments, the heater is made of a metal with a thermal conductivity greater than 10 W/(m·K). It can be understood that the greater the thermal conductivity, the better the heat transfer performance, and the heat of the heater can be rapidly transferred to the aerosol generating substrate. Thus, during the heating time (for example, the first time or the third time described above), the temperature of the heater can rapidly increase, thereby forming a relatively large temperature difference between the heater and the aerosol generating substrate. It can be understood that the magnitude of the temperature difference is positively correlated with the thermal conductivity. For example, the difference between the maximum temperature and the minimum temperature in the second time period is 10°C or more, or 20°C or more. For example, the magnitude of the temperature difference within the second time period may reach 50°C.

[0151] Exemplarily, the heater is made of stainless steel, permalloy, or ferritic stainless steel. In the second time stage, a temperature difference between the maximum temperature reached after each energy supply and the minimum temperature reached before the energy supply is 10°C or more.

[0152] Exemplarily, the heater is made of an aluminum alloy. In the second time stage, a temperature difference between the maximum temperature reached after each energy supply and the minimum temperature reached before the energy supply is 20°C or more.

[0153] In this embodiment, the heater is made of a metal having a thermal conductivity greater than 10 W/(m·K). The thermal conductivity is positively correlated with the temperature rise rate. Accordingly, the heater can rapidly increase in temperature within a short period of time, which facilitates energy supply in different time periods as disclosed in the present application and prevents excessive temperature drop from affecting puffing.

[0154] It is to be noted that the device embodiments described above are merely illustrative. The units described as separate components may or may not be physically separate. The components shown as units may or may not be physical units, and may be located in one place or distributed across multiple network units. Part or all of the modules may be selected as required to achieve the objectives of the solution of this embodiment.

[0155] Finally, it is to be noted that the above embodiments are merely intended to illustrate the technical solutions of the present application, and are not intended

to limit the present application. Under the concept of the present application, the technical features in the above embodiments or different embodiments may be combined, and the steps may be performed in any order. Numerous other variations in various aspects of the present application as described above also exist, and for the sake of brevity, they are not described in detail. Although the present application has been described in detail with reference to the foregoing embodiments, a person of ordinary skill in the art shall understand that modifications may be made to the technical solutions described in the foregoing embodiments, or equivalent substitutions may be made for part of the technical features therein. Such modifications or substitutions do not cause the essence of the corresponding technical solutions to depart from the scope of the technical solutions of the embodiments of the present application.

Claims

1. A control method applied to an aerosol generating device, wherein the aerosol generating device comprises a heater configured to heat an aerosol generating substrate to generate an aerosol, and a power source configured to supply energy to the heater; the aerosol is delivered to a user during a puffing period; and the method comprises:
 - controlling, in a first time stage of the puffing period, the power source to supply energy to the heater, such that the temperature of the heater is at or below a first temperature; and
 - controlling, in a second time stage of the puffing period, the power source to intermittently supply energy to the heater multiple times, such that a maximum temperature reached after each energy supply is greater than the first temperature.
2. The control method of claim 1, wherein in the second time stage, a difference between at least one of the maximum temperatures and the first temperature is greater than or equal to 5°C.
3. The control method of claim 2, wherein in the second time stage, the maximum temperatures gradually increase, and a difference between the highest maximum temperature and the first temperature is greater than or equal to 5°C.
4. The control method of claim 1, wherein in the second time stage, a center temperature is greater than the first temperature, the center temperature in the second time stage being a midpoint between the maximum temperature reached after each energy supply and a minimum temperature reached before the energy supply.
5. The control method of claim 4, wherein in the second time stage, a difference between at least one of the center temperatures and the first temperature is greater than or equal to 5°C.
6. The control method of claim 1, wherein the second time stage comprises multiple second time periods; and in each second time period, the power source is controlled to supply energy to the heater once, comprising:
 - controlling the power source to output energy and maintaining the output for a third time to reach the maximum temperature of the heater within the second time period; and
 - controlling the power source to stop outputting energy and maintaining the stop for a fourth time to reach a minimum temperature of the heater within the second time period.
7. The control method of claim 6, wherein, after the controlling the power source to stop outputting energy and maintaining the stop for a fourth time to reach a minimum temperature of the heater within the second time period, the control method further comprises:
 - determining that the fourth time satisfies a preset first time threshold, and initiating energy supply for the next second time period; or
 - determining that the minimum temperature within the current second time period satisfies a preset first low-temperature threshold, and initiating energy supply for the next second time period; or
 - determining that a center temperature within the current second time period satisfies a preset first center temperature threshold, and initiating energy supply for the next second time period, wherein the center temperature of the second time period is a midpoint between the maximum temperature and the minimum temperature within the second time period.
8. The control method of claim 7, wherein, as the operating time increases, the maximum temperatures of the multiple second time periods remain consistent; or as the operating time increases, the maximum temperatures of the multiple second time periods gradually increase.
9. The control method of claim 6, wherein a difference between the maximum temperature and the minimum temperature in the second time period is 20°C or more; or a difference between the maximum temperature and the minimum temperature in the second time period

is 10°C or more.

- 10.** The control method of claim 1, further comprising:

determining a duration of the first time stage of the puffing period or the number of puffs; and if the duration or the number of puffs satisfies a preset condition, entering the second time stage.

- 11.** The control method of claim 1, wherein the first time stage comprises multiple first time periods; and in each first time period, the power source is controlled to supply energy to the heater once, comprising:

controlling the power source to output energy and maintaining the output for a first time to reach the maximum temperature of the heater within the first time period; and controlling the power source to stop outputting energy and maintaining the stop for a second time to reach a minimum temperature of the heater within the first time period.

- 12.** The control method of claim 11, wherein, after the controlling the power source to stop outputting energy and maintaining the stop for a second time to reach a minimum temperature of the heater within the first time period, the control method further comprises:

determining that the second time satisfies a preset second time threshold, and initiating energy supply for the next first time period; or determining that the minimum temperature within the current first time period satisfies a preset second low-temperature threshold, and initiating energy supply for the next first time period; or determining that a center temperature within the current first time period satisfies a preset second center temperature threshold, and initiating energy supply for the next first time period, wherein the center temperature of the first time period is a midpoint between the maximum temperature and the minimum temperature within the first time period.

- 13.** The control method of claim 11, wherein a difference between the maximum temperature and the minimum temperature in the first time period is within 10°C.

- 14.** The control method of claim 11, wherein a center temperature of the first time period is equal to or less than a center temperature of the second time period, wherein the center temperature of the first time period is a midpoint between the maximum temperature and the minimum temperature within the first time

period; and the center temperature of the second time period is a midpoint between the maximum temperature and the minimum temperature within the second time period.

- 15.** The control method of claim 11, wherein the minimum temperature of the first time period is greater than or equal to the minimum temperature of the second time period.

- 16.** The control method of claim 1, wherein the controlling, in a first time stage of the puffing period, the power source to supply energy to the heater, such that the temperature of the heater is at or below a first temperature comprises:

detecting, in the first time stage of the puffing period, a real-time temperature of the heater, and adjusting, according to the real-time temperature, a power and/or duty cycle of the power source to the heater, such that the temperature of the heater is maintained at at least one target temperature, the target temperature being less than or equal to the first temperature.

- 17.** An aerosol generating device, comprising:

a heater, configured to heat an aerosol generating substrate to generate an aerosol;
a power source, configured to supply energy to the heater; and
a controller, configured to: control, in a first time stage of the puffing period, the power source to supply energy to the heater, such that the temperature of the heater is at or below a first temperature; and
intermittently control, in a second time stage of the puffing period, the power source to supply energy to the heater multiple times, such that a maximum temperature reached after each energy supply is greater than the first temperature.

- 18.** The device of claim 17, wherein the heater is made of a metal with a thermal conductivity greater than 10 W/(m·K).

- 19.** The device of claim 18, wherein the heater is made of stainless steel, permalloy, or ferritic stainless steel; and in the second time stage, a temperature difference between the maximum temperature reached after each energy supply and a minimum temperature reached before the energy supply is 10°C or more.

- 20.** The device of claim 18, wherein the heater is made of aluminum alloy; and in the second time stage, a temperature difference between the maximum temperature reached after each energy supply and a minimum temperature reached before the energy

supply is 20°C or more.

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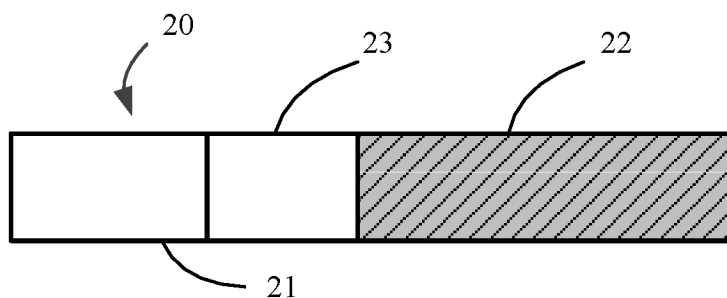


FIG. 1

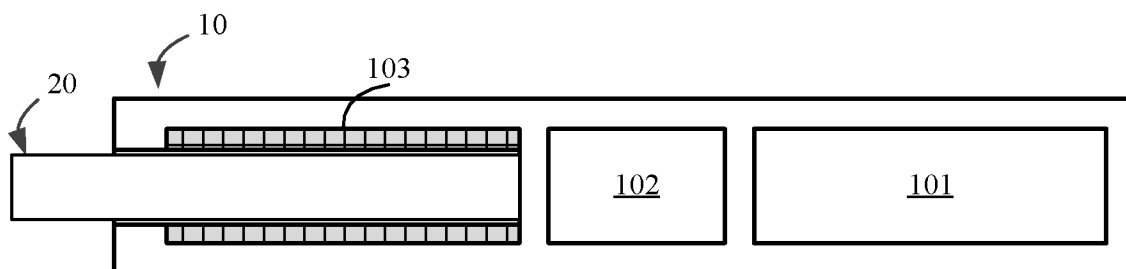


FIG. 2

S100

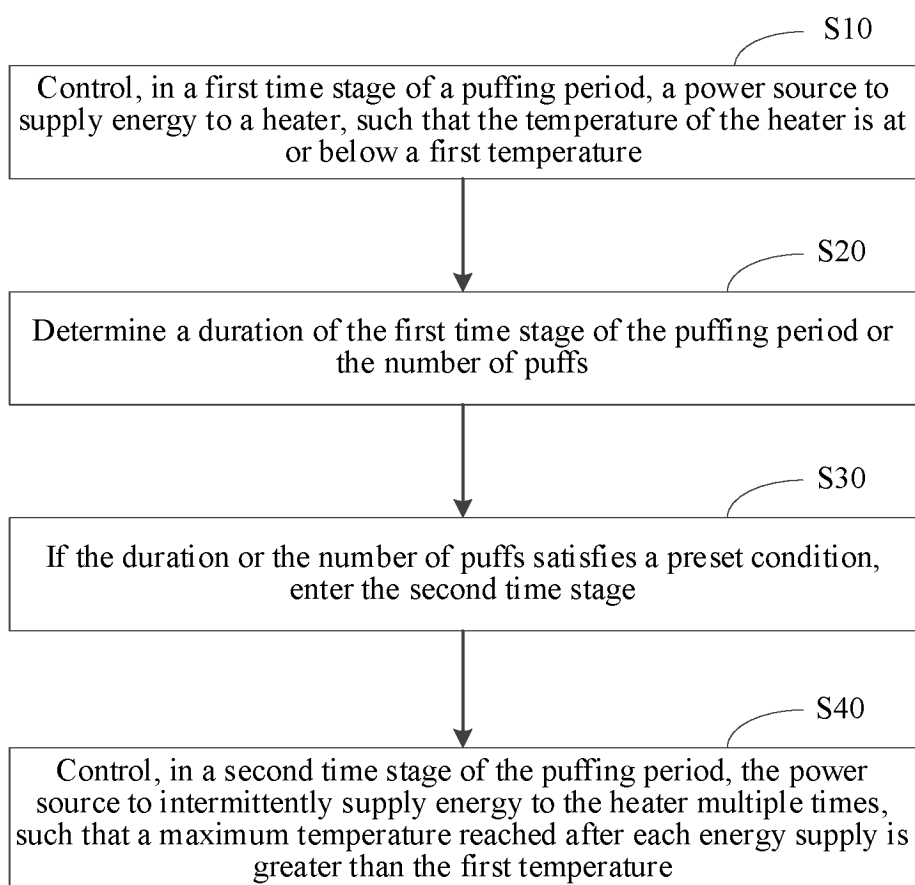


FIG. 3

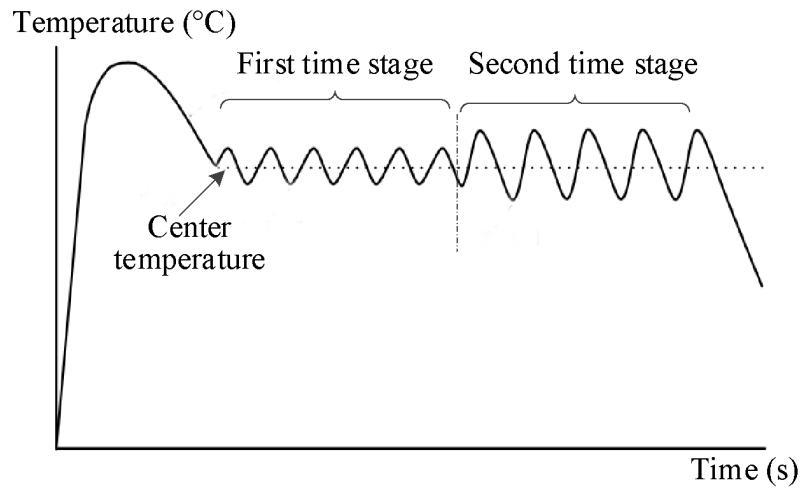


FIG. 4

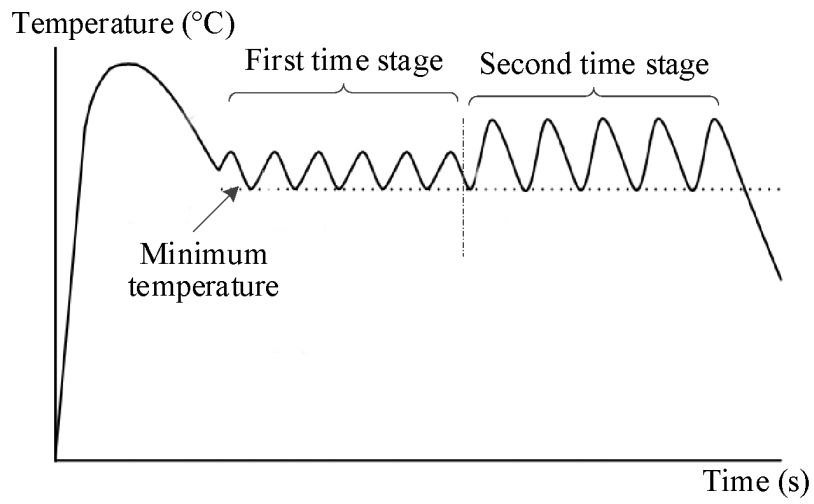


FIG. 5

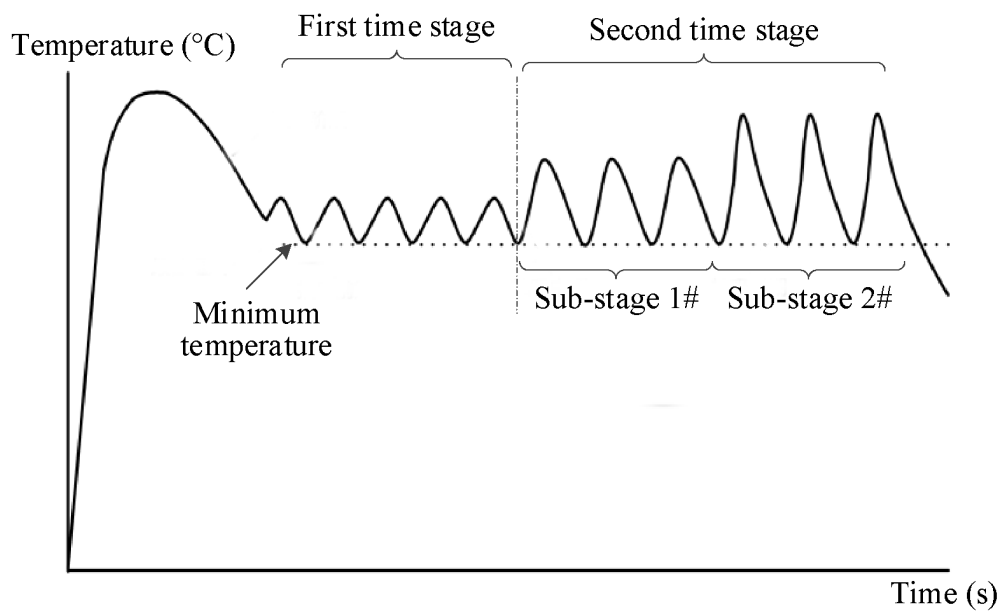


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/127343

A. CLASSIFICATION OF SUBJECT MATTER

A24F40/57(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)

IPC: A24F40/-

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, CNKI, ENTXTC, DWPI: 电子烟, 气溶胶, 加热, 雾化, 基质 s (减少 or 消耗 or 较少), 抽吸, 释放量, 口味, 下降, 温度, 上升, 功率, 增加, 加大, 增大, 控制; electrical, cigarette, aerosol, heating, generating, substrates, temperature, power, curve, high, low, up, down, maximum, minimum

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 115413226 A (JT INTERNATIONAL S.A.) 29 November 2022 (2022-11-29) description, paragraphs 0046-0058, and figure 3	1-20
Y	CN 116261985 A (SHENZHEN FIRST UNION TECHNOLOGY CO., LTD.) 16 June 2023 (2023-06-16) description, paragraphs 0005-0006 and 0054-0061, and figures 3-4	1-20
A	CN 113383998 A (CHONGQING CHINA TOBACCO INDUSTRY CO., LTD.) 14 September 2021 (2021-09-14) entire document	1-20
A	CN 115211610 A (ZHENGZHOU TOBACCO RESEARCH INSTITUTE OF CNTC et al.) 21 October 2022 (2022-10-21) entire document	1-20
A	CN 111990703 A (SHENZHEN MAISHI TECHNOLOGY CO., LTD.) 27 November 2020 (2020-11-27) entire document	1-20

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

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"D" document cited by the applicant in the international application	"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
"E" earlier application or patent but published on or after the international filing date	"&" document member of the same patent family
"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	

Date of the actual completion of the international search

20 January 2025

Date of mailing of the international search report

23 January 2025

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

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/127343

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2023194236 A1 (PHILIP MORRIS PRODUCTS S.A.) 12 October 2023 (2023-10-12) entire document	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2024/127343

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	115413226	A	29 November 2022	JP	2023517167	A	24 April 2023
				WO	2021175640	A1	10 September 2021
				KR	20220149662	A	08 November 2022
				EP	4114220	A1	11 January 2023
				US	2023096771	A1	30 March 2023
CN	116261985	A	16 June 2023	None			
CN	113383998	A	14 September 2021	None			
CN	115211610	A	21 October 2022	None			
CN	111990703	A	27 November 2020	None			
WO	2023194236	A1	12 October 2023	IL	315971	A	01 November 2024

REFERENCES CITED IN THE DESCRIPTION

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