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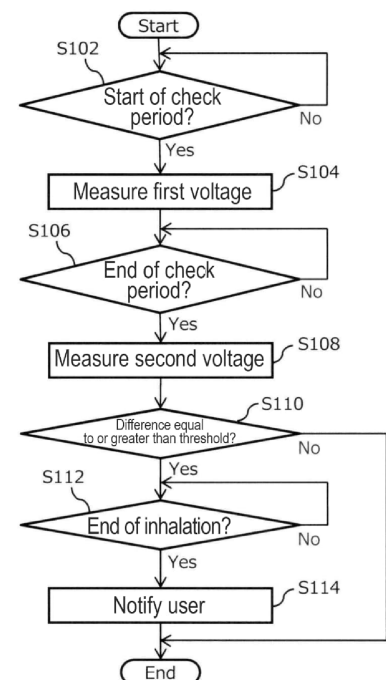
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(54) **FLAVOR INHALER OR AEROSOL GENERATION DEVICE, CONTROL METHOD THEREFOR, AND PROGRAM THEREFOR**

(57) To provide a flavor inhaler etc. which can be kept in a state where there is sufficient power remaining for inhalation on the next occasion. A method for controlling a device, which is a flavor inhaler or an aerosol-generating device, comprising: a heating unit for heating a flavor source or an aerosol source; a power source unit for applying a voltage to the heating unit; a memory unit for storing a heating profile; and a control unit for implementing the session in accordance with the heating profile, wherein the method comprises: a step of the control unit causing the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session; a step of the control unit identifying a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating; a step of the control unit calculating a difference between the first voltage and the second voltage; and a step of the control unit determining whether the difference is equal to or greater than a predefined threshold.

[Fig. 4]



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Description

TECHNICAL FIELD

[0001] The present invention relates to a flavor inhaler or an aerosol-generating device (referred to below as a "flavor inhaler etc.").

BACKGROUND ART

[0002] Flavor inhalers, etc. such as heated tobacco, in which a stick-type smoking article containing an aerosol source is heated, and the aerosol which is generated is inhaled, have become common alternatives to cigarettes. Once charged, flavor inhalers etc. such as this enable inhalation for multiple smoking articles. On the other hand, if the flavor inhaler etc. has insufficient power while the user is in the process of inhaling, the user can no longer continue to inhale because the battery has become depleted before the aerosol source contained in the smoking article has been used up. In light of this, PTL 1, for example, discloses technology that allows a user, who is about to start inhaling on a smoking article, to determine whether there is sufficient power remaining for inhalation until the aerosol source contained in the smoking article is used up.

CITATION LIST

PATENT LITERATURE

[0003] PTL 1: WO 2022/230322 A1

SUMMARY OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] With the technology disclosed in PTL 1, the determination as to whether there is sufficient power remaining for inhalation until the aerosol source contained in the smoking article is used up is made when the user is about to start inhaling. On the other hand, it would be more convenient for the user to be able to determine, at the end of inhalation, whether there will be sufficient power remaining for inhalation on the next occasion.

[0005] In light of this problem, the objective of the present invention lies in providing a flavor inhaler etc. which can be kept in a state where there is sufficient power remaining for inhalation on the next occasion.

SOLUTION TO PROBLEM

[0006] In order to solve the problem above, one aspect of the present invention is a device, which is a flavor inhaler or an aerosol-generating device, comprising: a heating unit for heating a flavor source or an aerosol source; a power source unit for applying a vol-

tage to the heating unit; a sensor unit for detecting the voltage applied to the heating unit; a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session; and a control unit for implementing the session in accordance with the heating profile, wherein the control unit is configured to: cause the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session, identify a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating, calculate a difference between the first voltage and the second voltage, and determine whether the difference is equal to or greater than a predefined threshold. It should be noted that "preheating" and "preliminary heating" are used with the same meaning in the present specification.

[0007] Furthermore, another aspect of the present invention is the abovementioned device, further comprising a notification unit for implementing processing to notify a user when the control unit has determined that the difference between the first voltage and the second voltage is equal to or greater than the predefined threshold.

[0008] Furthermore, another aspect of the present invention is the abovementioned device, wherein the notification unit implements the processing to notify the user at the end of the inhalation.

[0009] Furthermore, another aspect of the present invention is the abovementioned device, wherein, instead of determining whether the difference between the first voltage and the second voltage is equal to or greater than the predefined threshold, the control unit determines whether a difference between a third voltage, which is the voltage immediately before electrical supply to the heating unit 121 is implemented prior to inhalation, and the second voltage, is equal to or greater than a predefined threshold.

[0010] Furthermore, another aspect of the present invention is a method for controlling a device, which is a flavor inhaler or an aerosol-generating device, comprising: a heating unit for heating a flavor source or an aerosol source; a power source unit for applying a voltage to the heating unit; a sensor unit for detecting the voltage applied to the heating unit; a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session; and a control unit for implementing the session in accordance with the heating profile, wherein the method comprises: a step of the control unit causing the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session; a step of the control unit identifying a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when

there is a change to the voltage applied to the heating unit after the start of the preheating; a step of the control unit calculating a difference between the first voltage and the second voltage; and a step of the control unit determining whether the difference is equal to or greater than a predefined threshold.

[0011] Furthermore, another aspect of the present invention is a program for causing a processor of a device, which is a flavor inhaler or an aerosol-generating device, comprising: a heating unit for heating a flavor source or an aerosol source; a power source unit for applying a voltage to the heating unit; a sensor unit for detecting the voltage applied to the heating unit; a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session; and a control unit for implementing the session in accordance with the heating profile, to implement: a step of causing the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session; a step of identifying a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating; a step of calculating a difference between the first voltage and the second voltage; and a step of determining whether the difference is equal to or greater than a predefined threshold.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

[Fig. 1A] is a schematic diagram schematically showing a configuration example of a flavor inhaler etc. according to an embodiment of the present invention.

[Fig. 1B] is a schematic diagram schematically showing a configuration example of a flavor inhaler etc. according to an embodiment of the present invention.

[Fig. 2] is a diagram showing an example of a heating profile.

[Fig. 3] is a diagram showing an example of a drop voltage at the start of a check period and at the end of the check period.

[Fig. 4] is a flowchart showing an example of a processing flow implemented by the flavor inhaler etc. according to an embodiment of the present invention.

[Fig. 5] is a flowchart showing an example of a detailed processing flow implemented by the flavor inhaler etc. according to an embodiment of the present invention.

EMBODIMENTS OF THE INVENTION

[0013] Embodiments of the present invention will be described in detail below with reference to the drawings.

[0014] The flavor inhaler etc. according to this embodiment is a flavor inhaler or an aerosol-generating device which generates a substance to be inhaled by a user. The substance generated by the flavor inhaler etc. may be an aerosol, or a gas which is not an aerosol. Furthermore, the flavor inhaler is an instrument for inhaling a flavor, and may be, but is not limited to, an instrument for electronic cigarettes, heated tobacco, or conventional tobacco, for example. Furthermore, an aerosol-generating device is a device for inhaling a generated aerosol, and may be, but is not limited to, a device such as an electronic cigarette, heated tobacco, or a medical nebulizer, for example. Furthermore, flavor inhalers etc. include what are known as RRP (reduced-risk products).

(Configuration of flavor inhaler etc.)

(First configuration example)

[0015] Fig. 1A is a schematic diagram schematically showing a first configuration example of a flavor inhaler etc. As shown in fig. 1A, a flavor inhaler etc. 100A according to this configuration example includes a power supply unit 110, a cartridge 120, and a flavoring cartridge 130, by way of example. The power supply unit 110 comprises a power source unit 111A, a sensor unit 112A, a notification unit 113A, a memory unit 114A, a communication unit 115A, and a control unit 116A. The cartridge 120 includes a heating unit 121A, a liquid guiding portion 122, and a liquid storage portion 123. The flavoring cartridge 130 includes a flavor source 131 and a mouthpiece 124. An air flow path 180 is formed in the cartridge 120 and the flavoring cartridge 130.

[0016] It should be noted that the cartridge 120 and the flavoring cartridge 130 are examples of what are known as "refills". One or both of the refills 120 and 130 may be at least partly colored according to the type of refill. Furthermore, coloring by type is not limited to the refills, and this may apply to any component mounted in the flavor inhaler etc. 100A.

[0017] The power source unit 111A stores electrical power. The power source unit 111A then supplies the electrical power to each component of the flavor inhaler etc. 100A in accordance with control performed by the control unit 116A. The power source unit 111A may be configured, for example, by a rechargeable battery such as a lithium ion secondary battery.

[0018] The sensor unit 112A acquires various types of information relating to the flavor inhaler etc. 100A. The sensor unit 112A may comprise a pressure sensor such as a microphone capacitor, a flow rate sensor or a temperature sensor, etc. Furthermore, the sensor unit

112A may comprise an input device, such as a button or a switch, for accepting input of information from the user.

[0019] The notification unit 113A has the function of notifying the user of various types of information relating to the flavor inhaler etc. 100A. The notification unit 113A may include, for example, a display device for displaying messages and images, a light-emitting device such as an LED (light-emitting diode) that emits light, a sound output device or acoustic element that outputs sound, or a vibration device that vibrates, etc.

[0020] The memory unit 114A stores various types of information for operation of the flavor inhaler etc. 100A. The memory unit 114A is configured by a non-volatile storage medium such as a flash memory, for example. The memory unit 114A may comprise a volatile memory providing a working area for control afforded by the control unit 116A. Furthermore, the memory unit 114A may store data for controlling a heating profile.

[0021] The communication unit 115A may be a communication interface capable of performing communication conforming to any wired or wireless communication standard. Standards such as Wi-Fi (registered trademark) or Bluetooth (registered trademark), etc., for example, may be adopted as the communication standard. Furthermore, the communication unit 115A may comprise a communication interface (including a communication module) conforming to a predetermined LPWA wireless communication standard, or a wireless communication standard having similar restrictions. Sigfox and LoRA-WAN, etc. may be adopted as this communication standard.

[0022] The control unit 116A functions as an arithmetic processing device and a control device, and controls overall operation within the flavor inhaler etc. 100A in accordance with various programs. The control unit 116A is realized by a central processing unit (CPU) or an electronic circuit such as a microprocessor, for example. For example, the control unit 116A may perform control for implementing processing for heating of an aerosol source in the heating unit 121A. As an example, the control unit 116A may control the heating processing in accordance with a heating profile indicating the manner in which the aerosol source should be heated.

[0023] The liquid storage portion 123 stores an aerosol source. The aerosol source is atomized to generate an aerosol. The aerosol source is a polyhydric alcohol such as glycerol or propylene glycol, or a liquid such as water, for example. The aerosol source may include a tobacco-derived or non-tobacco-derived flavor component. If the flavor inhaler etc. 100A is a medical inhaler such as a nebulizer, the aerosol source may include a drug.

[0024] The liquid guiding portion 122 guides the aerosol source, which is a liquid stored in the liquid storage portion 123, from the liquid storage portion 123, and holds the aerosol source. The liquid guiding

portion 122 is, for example, a wick formed by twisting either a fibrous material such as glass fibers or a porous material such as a porous ceramic. In this case, the aerosol source stored in the liquid storage portion 123 is guided by the capillary effect of the wick.

[0025] The heating unit 121A heats the aerosol source to atomize the aerosol source, thereby generating the aerosol. In the example shown in fig. 1A, the heating unit 121A is configured as a coil wrapped around the liquid guiding portion 122. When the heating unit 121A generates heat, the aerosol source held in the liquid guiding portion 122 is heated and atomized, generating the aerosol. The heating unit 121A generates heat when supplied with electricity from the power source unit 111A. By way of example, electricity may be supplied when the sensor unit 112A detects that the user has started inhaling, and that predetermined information has been input, or that the user has operated a button or switch, etc. at any timing, etc. The supply of electricity may then be stopped when the sensor unit 112A detects that the user has finished inhaling and/or that predetermined information has been input.

[0026] The flavor source 131 is a component for imparting a flavor component to the aerosol. The flavor source 131 may include tobacco-derived or non-tobacco-derived flavor components. It should be noted that in this embodiment, the flavor component is imparted to the aerosol by causing a mixed fluid of the generated aerosol and air to pass through the flavor source 131, as will be described later. However, a flavor source with which a flavored aerosol is generated by means of heating may be adopted in other embodiments.

[0027] The air flow path 180 is a flow path for air to be inhaled by the user. The air flow path 180 has a tubular structure with an air inflow hole 181, which is an inlet for air into the air flow path 180, and an air outflow hole 182, which is an outlet for air from the air flow path 180, at the two ends thereof. Part way along the air flow path 180, the liquid guiding portion 122 is disposed on the upstream side (the side closer to the air inflow hole 181), and the flavor source 131 is disposed on the downstream side (the side closer to the air outflow hole 182). Air that flows in through the air inflow hole 181 as the user inhales is mixed with the aerosol generated by the heating unit 121A and is transported through the flavor source 131 to the air outflow hole 182, as shown by the arrow 190. When the mixed fluid of aerosol and air passes through the flavor source 131, the flavor component contained in the flavor source 131 is added to the aerosol.

[0028] The mouthpiece 124 is a member that is held in the user's mouth during inhalation. The air outflow hole 182 is disposed in the mouthpiece 124. The user holds the mouthpiece 124 in their mouth and inhales, making it possible to draw the mixed fluid of aerosol and air into the oral cavity.

[0029] A configuration example of the flavor inhaler etc. 100A has been described above. The flavor inhaler

etc. 100A is, of course, not limited to the configuration described above, and various configurations, such as those illustrated below by way of example, may be adopted.

[0030] As an example, the flavor inhaler etc. 100A need not include the flavoring cartridge 130. In this case, the cartridge 120 is provided with the mouthpiece 124.

[0031] As another example, the flavor inhaler etc. 100A may include a plurality of types of aerosol sources. A plurality of types of aerosol generated from the plurality of types of aerosol sources may be mixed within the air flow path 180 to cause a chemical reaction, thereby generating yet more other types of aerosol.

(Second configuration example)

[0032] Fig. 1B is a schematic diagram schematically showing a second configuration example of a flavor inhaler etc. As shown in fig. 1B, a flavor inhaler etc. 100B according to this configuration example comprises, by way of example: a power source unit 111B, a sensor unit 112B, a notification unit 113B, a memory unit 114B, a communication unit 115B, a control unit 116B, a heating unit 121B, a holding portion 140, and a heat insulating portion 144.

[0033] The power source unit 111B, sensor unit 112B, notification unit 113B, memory unit 114B, communication unit 115B, and control unit 116B are each substantially the same as the corresponding component included in the flavor inhaler etc. 100A of the first configuration example.

[0034] The holding portion 140 has an internal space 141, and holds a stick-type substrate 150 while accommodating a portion of the stick-type substrate 150 in the internal space 141. Moreover, the stick-type substrate 150 is also an example of what is known as a "refill". The holding portion 140 has an opening 142 allowing the internal space 141 to communicate with the outside, and holds the stick-type substrate 150 which has been inserted into the internal space 141 from the opening 142. For example, the holding portion 140 is a cylindrical body comprising the opening 142 and a bottom portion 143 serving as a bottom surface, and defines a columnar internal space 141. The holding portion 140 also has a function for defining a flow path for air supplied to the stick-type substrate 150. An air inflow hole which is an inlet for air to the flow path is disposed in the bottom portion 143, for example. Meanwhile, the opening 142 forms an air outflow hole, which is an outlet for air from the flow path.

[0035] The stick-type substrate 150 comprises a substrate portion 151 and a mouthpiece portion 152. The substrate portion 151 contains an aerosol source. The aerosol source may be a solid or a liquid, and is atomized by heating to generate an aerosol. The aerosol source may be, for example, a tobacco-derived sub-

stance such as cut tobacco, or a processed product obtained by molding a tobacco raw material into a granular form, a sheet form, or a powder form. Furthermore, the aerosol source may also contain a non-tobacco-derived substance produced from a plant other than tobacco (e.g., mint or herb, etc.). As one example, the aerosol source may contain a flavoring component such as menthol. When the flavor inhaler etc. 100B is a medical inhaler, the aerosol source may include a drug to be inhaled by a patient. In a state in which the stick-type substrate 150 is being held in the holding portion 140, at least a portion of the substrate portion 151 is accommodated in the internal space 141, and at least a portion of the mouthpiece portion 152 protrudes from the opening 142. Then, when the user holds the mouthpiece portion 152 protruding from the opening 142 in their mouth and inhales, air flows into the internal space 141 from an air inflow hole (not depicted) and reaches the inside of the user's mouth together with the aerosol generated from the substrate portion 151.

[0036] The heating unit 121B has the same configuration as the heating unit 121A according to the first configuration example. However, in the example illustrated in fig. 1B, the heating unit 121B is configured in a film shape and is disposed so as to cover the outer periphery of the holding portion 140. Then, when the heating unit 121B generates heat, the substrate portion 151 of the stick-type substrate 150 is heated from the outer periphery, generating the aerosol. The heat insulating portion 144 prevents heat transfer from the heating unit 121B to other components. For example, the heat insulating portion 144 is configured from a vacuum heat insulating material or an aerogel heat insulating material, or the like.

[0037] A configuration example of the flavor inhaler etc. 100B has been described above. The flavor inhaler etc. 100B is, of course, not limited to the configuration described above, and various configurations, such as those illustrated below by way of example, may be adopted.

[0038] As one example, the heating unit 121B may have a blade-like form and may be arranged so as to protrude into the internal space 141 from the bottom portion 143 of the holding portion 140. In that case, the blade-like heating unit 121B is inserted into the substrate portion 151 of the stick-type substrate 150 and heats the substrate portion 151 of the stick-type substrate 150 from the inside. As another example, the heating unit 121B may be arranged so as to cover the bottom portion 143 of the holding portion 140. Furthermore, the heating unit 121B may be configured by a combination of two or more from among a first heating unit covering the outer circumference of the holding portion 140, a blade-like second heating unit, and a third heating unit covering the bottom portion 143 of the holding portion 140.

[0039] As another example, the holding portion 140 may comprise an opening/closing mechanism such as

a hinge for opening/closing part of a casing that forms the internal space 141. Then, by opening and closing part of the outer casing, the holding portion 140 may grip the stick-type substrate 150 that has been inserted into the internal space 141. In this case, the heating unit 121B may be provided on the gripping part of the holding portion 140, and may heat the stick-type substrate 150 while pressing same.

[0040] Furthermore, the flavor inhaler etc. 100B may additionally include the heating unit 121A, the liquid guiding portion 122, the liquid storage portion 123, and the air flow path 180 according to the first configuration example, and the air outflow hole 182 of the air flow path 180 may also serve as the air inflow hole to the internal space 141. In this case, the mixed fluid of the aerosol generated by the heating unit 121A and air flows into the internal space 141 and is further mixed with the aerosol generated by the heating unit 121B, and reaches the oral cavity of the user.

(Heating profile)

[0041] The control unit 116 controls the operation of the heating unit 121 based on the heating profile. The operation of the heating unit 121 is controlled by controlling electrical supply from the power source unit 111 to the heating unit 121. The heating unit 121 heats the aerosol source contained in the cartridge 120 and flavoring cartridge 130, or the stick-type substrate 150 (referred to below as "the stick-type substrate etc. 150"), by using the power supplied from the power source unit 111.

[0042] The heating profile is control information for controlling the temperature at which the aerosol source is heated. The heating profile may be control information for controlling the temperature of the heating unit 121. As an example, the heating profile may include a target value of the temperature of the heating unit 121 (also referred to below as the "target temperature"). The target temperature may vary according to the elapsed time since the start of heating, in which case the heating profile includes information defining a time-series transition of the target temperature. As another example, the heating profile may comprise a parameter (hereinafter also referred to as a power supply parameter) defining how power is supplied to the heating unit 121. The power supply parameters include, for example, a voltage applied to the heating unit 121, ON/OFF of the power supply to the heating unit 121, or a method of feedback control to be employed. ON/OFF of the power supply to the heating unit 121 may be considered as ON/OFF of the heating unit 121.

[0043] The control unit 116 controls operation of the heating unit 121 so that the temperature of the heating unit 121 transitions in the same way as the target temperature defined in the heating profile. The flavor tasted by the user may be varied by controlling operation of the heating unit 121 based on the heating profile.

[0044] The temperature control of the heating unit 121 can be realized by known feedback control, for example. The feedback control is PID control in this embodiment. The control unit 116 may cause power from the power source unit 111 to be supplied to the heating unit 121 in the form of pulses by pulse width modulation (PWM), for example. In that case, the control unit 116 can control the temperature of the heating unit 121 by adjusting the duty ratio of the power pulses in the feedback control.

[0045] The temperature of the heating unit 121 can be quantified by measuring or estimating the electrical resistance value of the heating unit 121 (a heating resistive element constituting the heating unit 121, to be more precise), for example. This is because the electrical resistance value of the heating resistive element varies with temperature. The electrical resistance value of the heating resistive element can be estimated by measuring the amount of voltage drop at the heating resistive element, for example. The amount of voltage drop at the heating resistive element can be measured by a voltage sensor measuring a potential difference applied to the heating resistive element. In another example, the temperature of the heating unit 121 can be measured by a temperature sensor such as a thermistor installed near the heating unit 121.

[0046] The period from the start to the end of the processing to generate an aerosol from the aerosol source contained in the stick-type substrate 150 etc. is also referred to hereinafter as a session. In other words, a session is a period of time during which electrical supply to the heating unit 121 is controlled on the basis of the heating profile. The beginning of the session is the timing at which heating based on the heating profile is started. The end of the session is a timing at which a sufficient amount of aerosol is no longer being generated. The session comprises a preheating period and an inhalation-possible period following the preheating period. The inhalation-possible period is the period of time during which a sufficient amount of aerosol is expected to be generated. The preheating period is the period of time during which the aerosol source is heated before the user inhales, and is the period from the start of heating until the inhalation-possible period starts. Heating performed in the preheating period is also referred to as preheating or preliminary heating.

[0047] Fig. 2 is an explanatory diagram to illustrate an example of a heating profile which can be implemented in one session. The horizontal axis in the drawing denotes elapsed time from the start of electrical supply to the heating unit 121, and the vertical axis denotes temperature of the heating unit 121. The thick line denotes a heating profile 40 serving as an example. The heating profile 40 comprises an initial preheating period (T0-T2) and an inhalation-possible period (T2-T8) following the preheating period. By way of example, the length of the entire inhalation-possible period may be around 5 minutes. Note that T0, T1,... T8

denote time points during the session.

[0048] The preheating period comprises: a temperature-increase section (T0-T1) during which the temperature of the heating unit 121 is rapidly increased from ambient temperature H0 to a first temperature H1; and a maintaining section (T1-T2) during which the temperature of the heating unit 121 is maintained at the first temperature H1. By rapidly heating the heating unit 121 to the first temperature H1 at the start in this way, the heat can be sufficiently distributed at an early stage throughout the stick-type substrate 150 etc., making it possible to start providing the user with good-quality aerosol sooner.

[0049] The inhalation-possible period comprises: a maintaining section (T2-T3) during which the temperature of the heating unit 121 is maintained at the first temperature H1; a temperature-reduction section (T3-T4) during which the temperature of the heating unit 121 is reduced to a second temperature H2; and a maintaining section (T4-T5) during which the temperature of the heating unit 121 is maintained at the second temperature H2. By reducing the temperature of the heating unit 121, which was increased to the first temperature H1 before, to the second temperature H2 in this way, the user can be stably provided with the proper inhalation taste for a longer period of time. The supply of power from the power source unit 111 to the heating unit 121 may be stopped in the temperature-reduction section. The inhalation-possible period further comprises: a temperature increase section (T5-T6) during which the temperature of the heating unit 121 is gradually increased from the second temperature H2 to a third temperature H3; a maintaining section (T6-T7) during which the temperature of the heating unit 121 is maintained at the third temperature H3; and a temperature-reduction section (T7-T8) during which the temperature of the heating unit 121 is allowed to fall to ambient temperature H0. By once again increasing the temperature of the heating unit 121 in the latter half of the inhalation-possible period in this way, it is possible to inhibit a drop in taste as the aerosol source (or flavor source; the same hereinafter) contained in the stick-type substrate 150 etc. decreases, so that the user can be provided with a very satisfying experience until the end of the inhalation-possible period.

[0050] As an example, the first temperature H1 may be 320°C, the second temperature H2 may be 230°C, and the third temperature H3 may be 260°C. However, different heating profiles may be designed according to manufacturer design guidelines, user preferences, and characteristics of different brands of tobacco articles.

[0051] When the temperature of the heating unit 121 is to be rapidly increased during the session, as in the heating profile 40, there is a marked increase in the amount of current output from the power source unit 111 during the rapid temperature increase. When the amount of current output from the power source unit 111 increases, there is a corresponding increase in vol-

tage drop in the internal resistance of the power source unit 111, and the power source voltage also drops significantly for a time. The flavor inhaler etc. 100A of this embodiment utilizes this voltage drop in order to determine whether there will be, on the next occasion, sufficient power remaining in the power source unit 111 (battery, etc.) for inhalation by the user until the aerosol source contained in the stick-type substrate 150 etc. is used up. Note that this voltage drop may also be referred to below as a "drop voltage".

(Determination of whether inhalation is possible)

[0052] The flavor inhaler etc. 100A according to this embodiment determines whether there will be, on the next occasion, sufficient power remaining in the power source unit 111 (also referred to below as the "battery etc.") for inhalation by the user until the aerosol source contained in the stick-type substrate 150 etc. is used up, based on a difference between a first voltage, which is the drop voltage at the start of a check period, and a second voltage, which is the drop voltage at the end of the check period. "At the end of the check period" means immediately before the end of the check period, for example. Furthermore, "when there is a change to the voltage applied to the heating unit 121 after the start of preheating" may mean "immediately before there is a change to the voltage applied to the heating unit 121 after the start of preheating". Firstly, for example, in the flavor inhaler etc. 100 according to this embodiment, the voltage applied to the heating unit 121 is 5 V (volts) in the period 0-T3 in fig. 2, a control parameter is switched so that the voltage applied to the heating unit 121 changes from 5 V to 4.5 V in the following period T3-T4, and the voltage applied to the heating unit 121 is set at 4.5 V from T4. In this embodiment, the period 0-T3 in which the voltage applied to the heating unit 121 is 5 V before the switch will be referred to as the "check period". That is to say, the "check period" in this embodiment means a period during which the value of the voltage applied to the heating unit 121 is maintained at the start of heating to preheat the flavor inhaler etc. 100 prior to inhalation. It should be noted that the voltages applied during the period 0-T3 and at the time point T4 and onward are not limited to 5 V and 4.5 V, respectively, and when the power source is a step-up power source, both applied voltages should have greater values than the power source unit.

[0053] The flavor inhaler etc. 100A according to this embodiment determines that there will not be, on the next occasion, sufficient power remaining in the power source unit 111 for inhalation by the user until the aerosol source contained in the stick-type substrate 150 etc. is used up, when the difference (potential difference) between the first voltage, which is the drop voltage at the start of the check period, and the second voltage, which is the drop voltage at the end of the check peri-

od, is equal to or greater than a predefined threshold. When the battery has sufficient remaining capacity, the difference in drop voltages at the start of the check period and at the end of the check period is a value close to zero. This is because the electrical resistance value of the heating unit 121 rises as preheating progresses and the discharge current decreases, and there is no large difference in the drop voltages at the start of the check period and at the end of the check period. Furthermore, the period T3-T4 is a period during which the temperature of the heating unit 121 decreases, and the voltage applied to the heating unit 121 is shut off during the period T3-T4. This means that if the determination relating to the difference between the first voltage and the second voltage is made at the time point T3, the potential difference can be compared more correctly than after switching of the applied voltage by taking a measurement at the same applied voltage as when the first voltage was measured. This is because load conditions on the battery fluctuate with different applied voltages, and it is difficult to correctly determine the drop voltage. Furthermore, the load tends to be higher when 5 V is applied to the battery etc. than when 4.5 V is applied at the time point T4 and onward, so it is also feasible that a voltage drop will be more likely to occur due to a reduction in the remaining capacity of the battery etc.

[0054] The "predefined threshold" is 0.05 V, by way of example. The threshold should be determined while taking account of noise, etc. Furthermore, the threshold should be set in accordance with the type of battery constituting the power source unit 111 (nickel-manganese-cadmium, nickel-hydrogen battery, etc.), the model (peak current value), and the battery temperature state, etc. Furthermore, the threshold should be set at a suitable value based on experiments.

[0055] Fig. 3 is a diagram showing an example of the drop voltage at the start of the check period and at the end of the check period. It should be noted that fig. 3 mainly shows the change in voltage applied to the power source unit 111 during the check period, and part of the inhalation-possible period is omitted. In the example, the drop voltage at the start of the check period indicated by the solid line arrow is 2.70 V. Furthermore, the drop voltage at the end of the check period indicated by the broken line arrow is 2.60 V. In this example, the difference between the two is therefore 0.1 V, which is greater than the threshold of 0.05 V. In such a case, the control unit 116 of the flavor inhaler etc. 100 would determine that there will not be, on the next occasion, sufficient power remaining in the power source unit 111 for inhalation by the user until the aerosol source contained in the stick-type substrate 150 etc. is used up. The control unit 116 then controls the notification unit 113 to notify the user that inhalation until the aerosol source contained in the smoking article is used up will not be possible on the next occasion, i.e., that charging is required. By this means, the user can

charge the flavor inhaler etc. 100 beforehand to avoid a situation such as inhalation not being possible to the point where the aerosol source contained in the stick-type substrate 150 etc. is used up, on the next occasion of inhalation.

[0056] The method of notification may be any method such as display of a message on a display device, emission of light from an LED or the like, output of sound, or vibration. The timing at which the notification is given in this embodiment is at the end of inhalation (when heating in accordance with the heating profile has ended (also including where the user has ended the heating profile partway through)). This is because the flavor inhaler etc. 100A is often positioned close to the user's face during inhalation, and it could be difficult for the user to notice the notification if it were given during inhalation. However, this is not limiting. For example, the notification may be given immediately after the determination processing relating to inhalation on the next occasion at the end of the check period, or during subsequent user inhalation.

[0057] It should be noted that in this embodiment, it is determined whether or not inhalation is possible on the next occasion based on the difference in drop voltages at the start of the check period and at the end of the check period, but instead of this, it is also possible to determine whether or not inhalation is possible on the next occasion based on a difference between a voltage immediately before electrical supply to the heating unit 121 is implemented for heating indicated by the singled dot chain arrow in fig. 3 (this is referred to as the "OCV" (open-circuit voltage) in the present specification), and the drop voltage at the end of the check period. In this case also, the flavor inhaler etc. 100 may determine that there will not be, on the next occasion, sufficient power remaining in the power source unit 111 for inhalation by the user, when the difference between the OCV at the start of the check period and the drop voltage at the end of the check period is equal to or greater than a predefined threshold.

(Flowchart)

[0058] Fig. 4 is a flowchart showing an example of a processing flow implemented by the flavor inhaler etc. 100 according to this embodiment.

[0059] The control unit 116 first of all determines whether the current timing is the start of the check period (step S102). For example, the control unit 116 implements processing for electrical supply to the heating unit 121 (a command or control, etc. or signal control, etc.), in order to start preheating based on the heating profile. The control unit 116 can determine that the time of implementation of this processing is the start of the check period.

[0060] When the control unit 116 has determined that the current timing is the start of the check period (step S102: Yes), the control unit 116 measures the first vol-

tage which is the drop voltage at the start of the check period (step S104). More specifically, for example, the control unit 116 performs control so that a current flows to the heating unit 121 for a given period before the start of preheating, and measures the voltage (first voltage) of the heating unit 121 at that time. The control unit 116 then starts preheating.

[0061] After this, the control unit 116 determines whether the current timing is the end of the check period (step S106). "The end of the check period" also includes immediately before the end of the check period. For example, when the control unit 116 has determined that the current timing is immediately before a change to the voltage applied to the heating unit 121 after the start of preheating, this may be determined as immediately before the end of the check period. The manner in which the voltage applied to the heating unit 121 is changed is set in the heating profile, so the control unit 116 can determine whether the current timing is immediately before the change to the voltage applied (immediately before the end of the check period) by referring to the heating profile. Step S106 is repeated (step S106: No) until the control unit 116 determines that the current timing is the end of the check period. When the control unit 116 has determined that the current timing is the end of the check period (step S106: Yes), the control unit 116 measures the second voltage which is the drop voltage at the end of the check period (step S108). More specifically, the control unit 116 performs control so that a current flows to the heating unit 121 for a given period at the end of the check period (time point T3), and measures the voltage (second voltage) of the heating unit 121 at that time. Furthermore, the given period for which the current flows to the heating unit 121 at this time is preferably the same period as for when the first voltage is measured in step S104.

[0062] The control unit 116 determines whether the difference between the first voltage measured in step S104 and the second voltage measured in step S108 is equal to or greater than a predefined threshold (step S110). If this difference is less than the threshold (step S110: No), the control unit 116 determines that there will be, on the next occasion, sufficient power remaining in the power source unit 111 for inhalation by the user until the aerosol source contained in the stick-type substrate 150 etc. is used up, and then terminates the processing. Meanwhile, if this difference is equal to or greater than the threshold (step S110: Yes), the control unit 116 determines that there will not be, on the next occasion, sufficient power remaining in the power source unit 111 for inhalation by the user until the aerosol source contained in the stick-type substrate 150 etc. is used up, and stands by (step S112: No) until inhalation has ended (until heating in accordance with the heating profile has ended (also including where the user has ended the heating profile partway through)), and when inhalation is deemed to have ended (step S112: Yes), the notification unit 113 notifies the user of

the determination by displaying a message on a display device, emitting light from an LED, etc., outputting sound, or vibrating, etc. (step S114).

[0063] In this example, the notification is given to the user at the end of inhalation (steps S112, S114), but the notification may equally be given to the user during inhalation. Furthermore, instead of measuring the first voltage in step S104 in this example, the control unit 116 may measure the third voltage, which is the voltage immediately before electrical supply to the heating unit 121 is implemented prior to inhalation, and instead of determining whether the difference between the first voltage and the second voltage is equal to or greater than a predefined threshold in step S110, the control unit 116 may determine whether the difference between the third voltage and the second voltage is equal to or greater than a predefined threshold.

[0064] Fig. 5 is an example of a more specific flowchart.

[0065] The control unit 116 measures the first voltage at the timing of a first voltage drop occurring at the start of preheating (step S202). After this, the control unit 116 causes the heating unit 121 to start preheating prior to inhalation, in accordance with the start of heating in the heating profile (step S204). More specifically, for example, the control unit 116 performs control so that a current flows to the heating unit 121 for a given period before the start of preheating, and measures the voltage (first voltage) of the heating unit 121 at that time. The control unit 116 then starts preheating. Next, the control unit 116 determines whether the current timing is the time of a change to the voltage applied to the heating unit 116 after the start of preheating (step S206). "The time of a change to the voltage applied" also includes immediately before the change to the voltage applied. The manner in which the voltage applied to the heating unit 121 is changed is set in the heating profile, so the control unit 116 can determine whether the current timing is immediately before the change to the voltage applied by referring to the heating profile. When the control unit 116 has determined that the current timing is the time of the change to the voltage applied to the heating unit 116 after the start of preheating (step S206: Yes), the control unit 116 measures the second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied (step S208).

[0066] The control unit 116 calculates the difference between the first voltage measured in step S204 and the second voltage measured in step S208 (step S210). The control unit 116 determines whether the difference calculated in step S210 is equal to or greater than a predefined threshold (step S212). If this difference is less than the threshold (step S212: No), the control unit 116 determines that there will be, on the next occasion, sufficient power remaining in the power source unit 111 for inhalation by the user until the aerosol source contained in the stick-type substrate 150 etc.

is used up, and then terminates the processing. Meanwhile, if this difference is equal to or greater than the threshold (step S212: Yes), the control unit 116 determines that there will not be, on the next occasion, sufficient power remaining in the power source unit 111 for inhalation by the user until the aerosol source contained in the stick-type substrate 150 etc. is used up, and stands by (step S214: No) until inhalation has ended (until heating in accordance with the heating profile has ended (also including where the user has ended the heating profile partway through)), and when inhalation is deemed to have ended (step S214: Yes), the notification unit 113 notifies the user of the determination by displaying a message on a display device, emitting light from an LED, etc., outputting sound, or vibrating, etc. (step S216).

[0067] In this example, the notification is given to the user at the end of inhalation (steps S214, S216), but the notification may equally be given to the user during inhalation. Furthermore, instead of measuring the first voltage in step S204 in this example, the control unit 116 may measure the third voltage, which is the voltage immediately before electrical supply to the heating unit 121 is implemented prior to inhalation. Then, instead of calculating the difference between the first voltage and the second voltage in step S210, the control unit 116 may calculate the difference between the third voltage and the first voltage. Instead of determining whether the difference between the first voltage and the second voltage is equal to or greater than the predefined threshold in step S212, the control unit may determine whether the difference between the third voltage and the second voltage is equal to or greater than the predefined threshold.

[0068] The flavor inhaler etc. 100 according to this embodiment makes it possible to avoid a situation such as inhalation being interrupted before the aerosol source contained in the smoking article has been used up because of a lack of power, on the next occasion of inhalation. Furthermore, when the flavor inhaler etc. 100 has a function for determining, at the start of inhalation, whether there is sufficient power remaining for inhalation until the aerosol source contained in the smoking article is used up, such as disclosed in PTL 1, the flavor inhaler etc. will need to be charged when the user is about to start inhaling if the flavor inhaler etc. 100 is not sufficiently charged. In such a case, the user might have the dissatisfaction of having to wait until the flavor inhaler etc. is sufficiently charged, despite wanting to start inhaling immediately, but this situation can also be avoided with the flavor inhaler etc. 100 according to the embodiment.

[0069] An embodiment of the present invention has been described thus far, but the present invention is not limited to the abovementioned embodiment, and it goes without saying that the present invention may be implemented in various different forms within the scope of the technical concept thereof.

[0070] Furthermore, the scope of the present invention is not limited to the illustrative embodiment depicted and described, and also includes all embodiments demonstrating equivalent effects to those intended by the present invention. In addition, the scope of the present invention is not limited to the combination of inventive features defined in the claims, and may be defined by any desired combination of specific features among all of the features disclosed.

[0071] It should be noted that the following configurations also fall within the technical scope of the present invention.

(1) A device, which is a flavor inhaler or an aerosol-generating device, comprising:

- a heating unit for heating a flavor source or an aerosol source;
- a power source unit for applying a voltage to the heating unit;
- a sensor unit for detecting the voltage applied to the heating unit;
- a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session; and
- a control unit for implementing the session in accordance with the heating profile, wherein the control unit is configured to:

- cause the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session,
- identify a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating,
- calculate a difference between the first voltage and the second voltage, and
- determine whether the difference is equal to or greater than a predefined threshold.

(2) The device as disclosed in (1) above, further comprising a notification unit for implementing processing to notify a user when the control unit has determined that the difference between the first voltage and the second voltage is equal to or greater than the predefined threshold.

(3) The device as disclosed in (1) or (2) above, wherein the notification unit implements the processing to notify the user at the end of the inhalation.

(4) The device as disclosed in any of (1) to (3) above, wherein, instead of determining whether

the difference between the first voltage and the second voltage is equal to or greater than the predefined threshold, the control unit determines whether a difference between a third voltage, which is the voltage immediately before electrical supply to the heating unit 121 is implemented prior to inhalation, and the second voltage, is equal to or greater than a predefined threshold.

(5) A method for controlling a device, which is a flavor inhaler or an aerosol-generating device, comprising: a heating unit for heating a flavor source or an aerosol source; a power source unit for applying a voltage to the heating unit; a sensor unit for detecting the voltage applied to the heating unit; a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session; and a control unit for implementing the session in accordance with the heating profile, wherein the method comprises:

a step of the control unit causing the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session;

a step of the control unit identifying a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating;

a step of the control unit calculating a difference between the first voltage and the second voltage; and

a step of the control unit determining whether the difference is equal to or greater than a predefined threshold.

(6) A program for causing a processor of a device, which is a flavor inhaler or an aerosol-generating device, comprising: a heating unit for heating a flavor source or an aerosol source; a power source unit for applying a voltage to the heating unit; a sensor unit for detecting the voltage applied to the heating unit; a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session; and a control unit for implementing the session in accordance with the heating profile, to implement:

a step of causing the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session;

a step of identifying a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the

timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating;

a step of calculating a difference between the first voltage and the second voltage; and a step of determining whether the difference is equal to or greater than a predefined threshold.

REFERENCE SIGNS LIST

[0072]

- 40... Heating profile
- 100A, 100B... Flavor inhaler etc.
- 110... Power supply unit
- 111A, 111B... Power source unit
- 112A, 112B... Sensor unit
- 113A, 113B... Notification unit
- 114A, 114B... Memory unit
- 115A, 115B... Communication unit
- 116A, 116B... Control unit
- 120... Cartridge
- 121A, 121B... Heating unit
- 122... Liquid guiding portion
- 123... Liquid storage portion
- 124... Mouthpiece
- 130... Flavoring cartridge
- 131... Flavor source
- 140... Holding portion
- 141... Internal space
- 142... Opening
- 143... Bottom portion
- 144... Heat insulating portion
- 150... Stick-type substrate
- 151... Substrate portion
- 152... Mouthpiece portion
- 180... Air flow path
- 181... Air inflow hole
- 182... Air outflow hole

Claims

1. A device, which is a flavor inhaler or an aerosol-generating device, comprising:

a heating unit for heating a flavor source or an aerosol source;
 a power source unit for applying a voltage to the heating unit;
 a sensor unit for detecting the voltage applied to the heating unit;
 a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session;
 and

a control unit for implementing the session in accordance with the heating profile, wherein the control unit is configured to:

- cause the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session,

identify a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating,

calculate a difference between the first voltage and the second voltage, and determine whether the difference is equal to or greater than a predefined threshold.
- 2. The device as claimed in claim 1, further comprising a notification unit for implementing processing to notify a user when the control unit has determined that the difference between the first voltage and the second voltage is equal to or greater than the predefined threshold.
- 3. The device as claimed in claim 1 or 2, wherein the notification unit implements the processing to notify the user at the end of the inhalation.
- 4. The device as claimed in any one of claims 1 to 3, wherein, instead of determining whether the difference between the first voltage and the second voltage is equal to or greater than the predefined threshold, the control unit determines whether a difference between a third voltage, which is the voltage immediately before electrical supply to the heating unit 121 is implemented prior to inhalation, and the second voltage, is equal to or greater than a predefined threshold.
- 5. A method for controlling a device, which is a flavor inhaler or an aerosol-generating device, comprising: a heating unit for heating a flavor source or an aerosol source; a power source unit for applying a voltage to the heating unit; a sensor unit for detecting the voltage applied to the heating unit; a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session; and a control unit for implementing the session in accordance with the heating profile, wherein the method comprises:

a step of the control unit causing the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session;

a step of the control unit identifying a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating;

a step of the control unit calculating a difference between the first voltage and the second voltage; and

a step of the control unit determining whether the difference is equal to or greater than a predefined threshold.

- 6. A program for causing a processor of a device, which is a flavor inhaler or an aerosol-generating device, comprising: a heating unit for heating a flavor source or an aerosol source; a power source unit for applying a voltage to the heating unit; a sensor unit for detecting the voltage applied to the heating unit; a memory unit for storing a heating profile defining a time-series transition of a target temperature of the heating unit over a session; and a control unit for implementing the session in accordance with the heating profile, to implement:

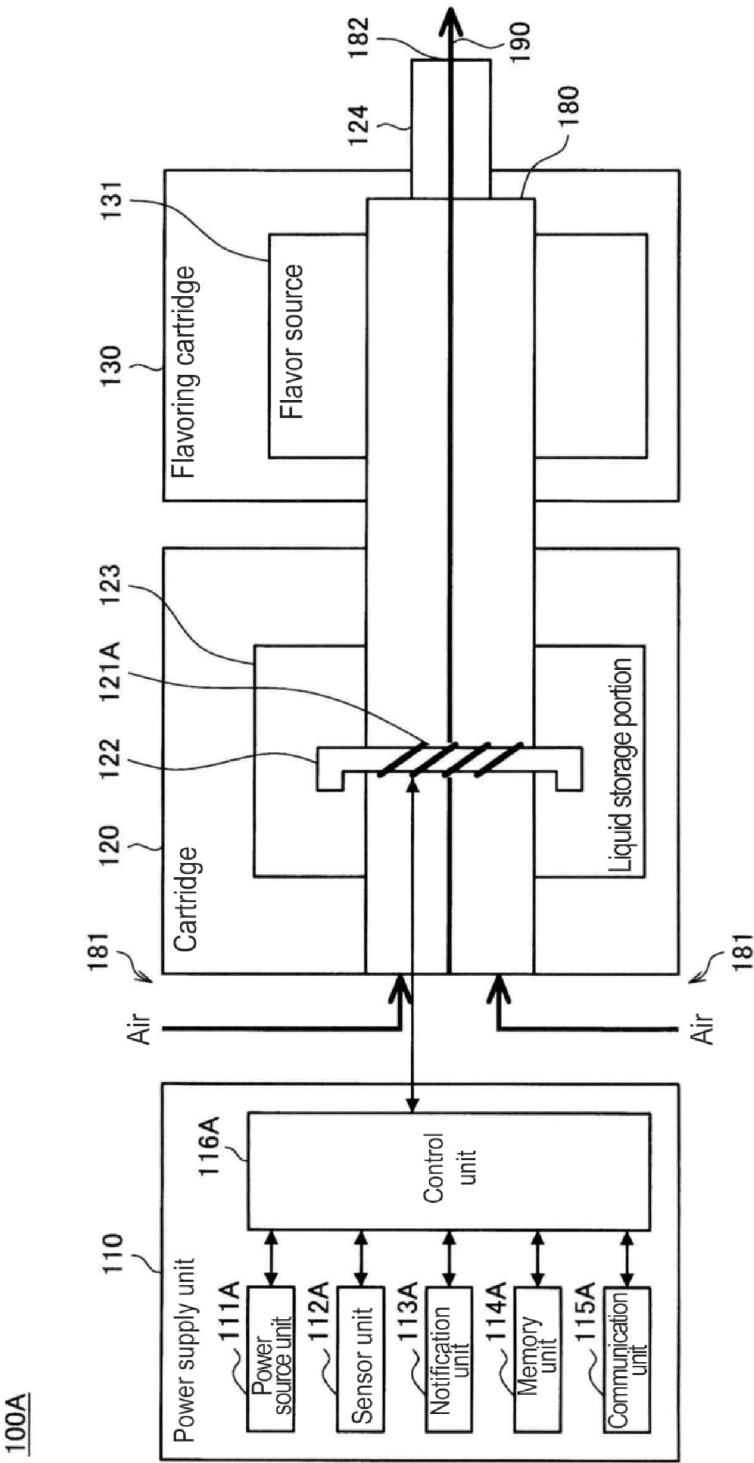
a step of causing the heating unit to start preheating prior to inhalation, in accordance with the start of heating in the heating profile for the session;

a step of identifying a first voltage at the timing of a first voltage drop occurring at the start of the preheating, and a second voltage at the timing of a second voltage drop occurring when there is a change to the voltage applied to the heating unit after the start of the preheating;

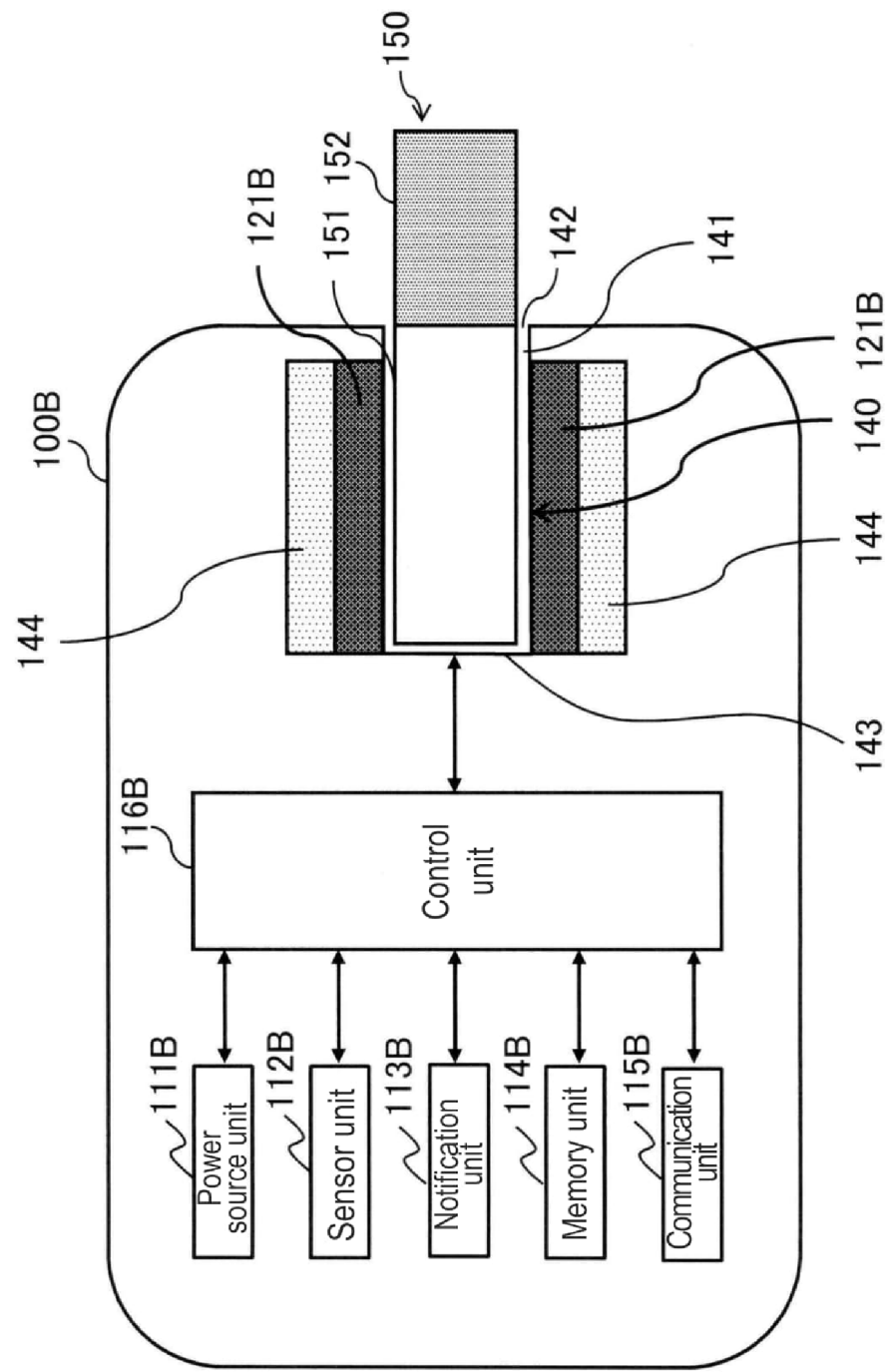
a step of calculating a difference between the first voltage and the second voltage; and

a step of determining whether the difference is equal to or greater than a predefined threshold.

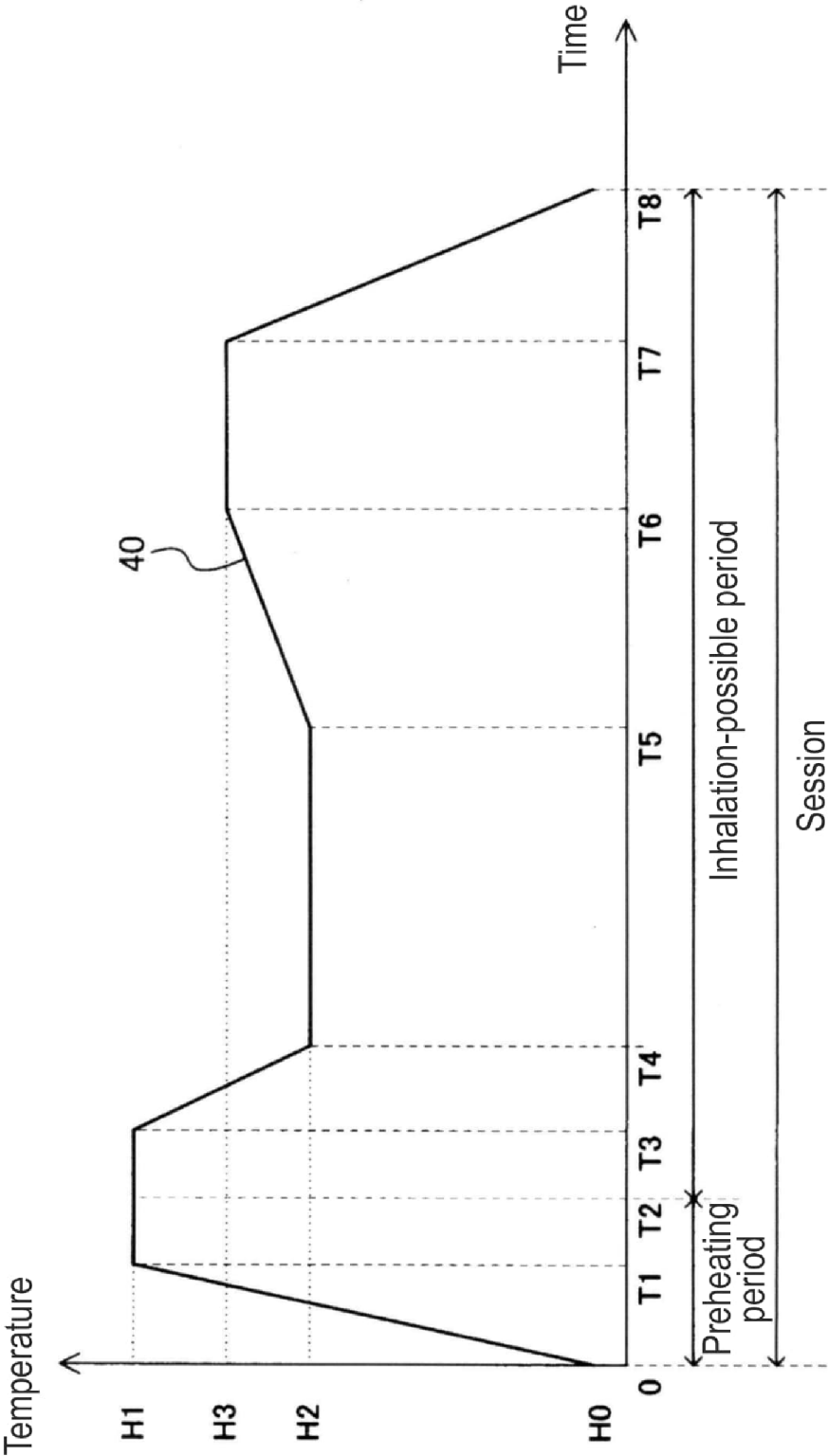
[Fig. 1A]



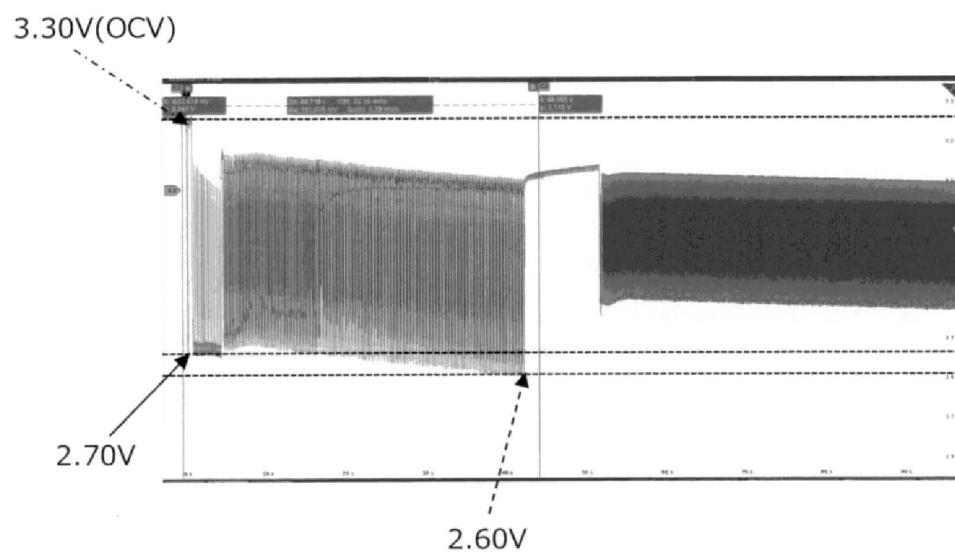
[Fig. 1B]



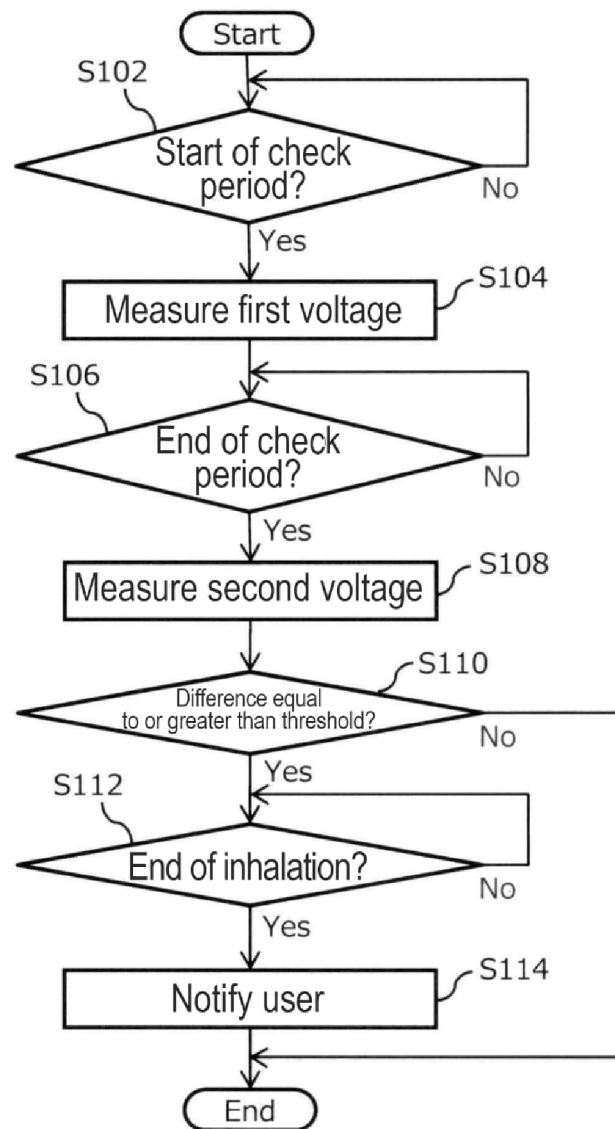
[Fig. 2]



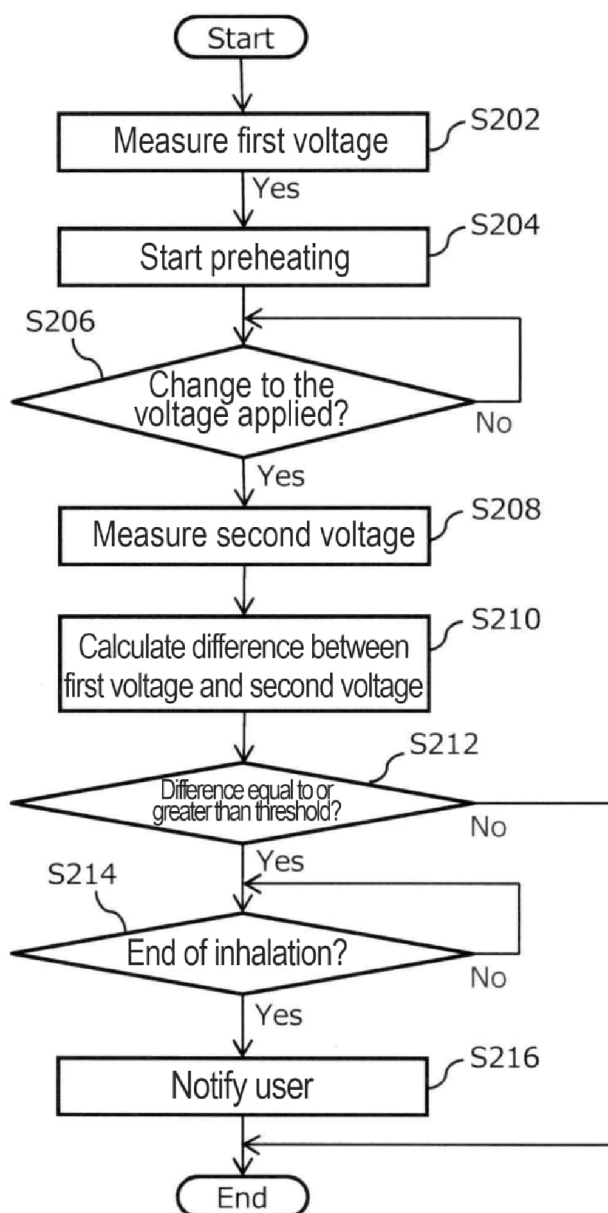
[Fig. 3]



[Fig. 4]



[Fig. 5]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/044564

A. CLASSIFICATION OF SUBJECT MATTER

A24F 40/90(2020.01)i; **A24F 40/53**(2020.01)i
FI: A24F40/90; A24F40/53

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A24F 40/00-40/95, 47/00; G01R 31/36-31/396; H02J 7/00-7/36; H01M 10/48

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2024
Registered utility model specifications of Japan 1996-2024
Published registered utility model applications of Japan 1994-2024

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	JP 2020-509760 A (PHILIP MORRIS PRODUCTS S.A.) 02 April 2020 (2020-04-02) paragraph [0082]	1-6
A	JP 2020-58237 A (JAPAN TOBACCO INC.) 16 April 2020 (2020-04-16) paragraph [0183]	1-6
A	WO 2020/084757 A1 (JAPAN TOBACCO INC.) 30 April 2020 (2020-04-30) abstract	1-6
A	WO 2022/230322 A1 (JAPAN TOBACCO INC.) 03 November 2022 (2022-11-03) abstract	1-6
A	JP 2023-534408 A (LG ENERGY SOLUTION, LTD.) 09 August 2023 (2023-08-09) claim 1	1-6

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

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“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

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“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

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Date of the actual completion of the international search

19 February 2024

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Name and mailing address of the ISA/JP

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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/044564

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Information on patent family members

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