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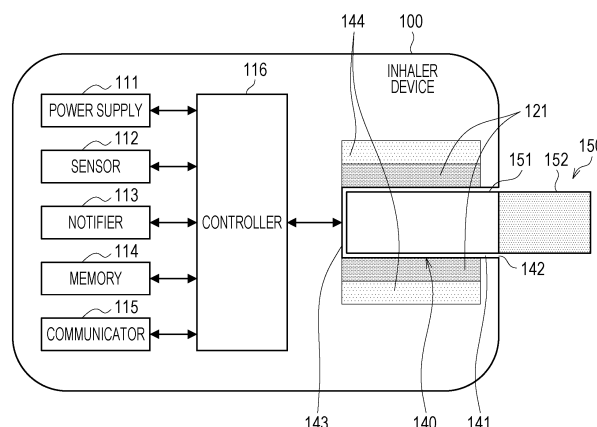
(54) **INHALATION DEVICE, CONTROL METHOD, AND PROGRAM**

(57) [Problem] To provide a mechanism capable of improving the quality of user experience.

[Solution] An inhalation device comprising: a power supply unit for accumulating and supplying electric power, a heating unit for heating a base material containing an aerosol source so as to generate an aerosol; a control unit for controlling power feeding from the power supply unit to the heating unit on the basis of heating condition, wherein the heating condition includes a heating profile that represents information to define transitional varia-

tions in target temperature which is a target value of temperature of the heating unit, and information to define a heating period representing a duration in which the base material is heated and a non-heating period representing a duration in which the base material is not to be heated, and the control; unit performs control on power feeding to the heating unit while alternately switching between the heating period and the non-heating period so as to raise the temperature of the heating unit to the target temperature.

FIG. 1



Description

Technical Field

5 **[0001]** The present invention relates to an inhaler device, a control method, and a program.

Background Art

10 **[0002]** Inhaler devices, such as e-cigarettes and nebulizers, that generate material to be inhaled by a user are wide-spread. For example, an inhaler device generates an aerosol having a flavor component imparted thereto, by using a substrate including an aerosol source for generating the aerosol, a flavor source for imparting the flavor component to the generated aerosol, and the like. The user is able to enjoy the flavor by inhaling the aerosol having the flavor component imparted thereto, which is generated by the inhaler device.

15 **[0003]** Typically, an inhaler device generates an aerosol by heating a substrate. The quality of user experience is greatly affected by the temperature at which the substrate is heated, and thus techniques have been developed to achieve appropriate temperature control. For example, Patent Literature 1 below discloses a technique of performing temperature control in three stages in which the temperature of a heater is increased, then decreased, and then increased again.

20 Citation List

Patent Literature

25 **[0004]** Patent Literature 1: Japanese Patent No. 6125008

Summary of Invention

Technical Problem

30 **[0005]** However, merely performing three-stage temperature control does not necessarily provide user experience of sufficient quality.

[0006] The present invention has been made in view of the above problem, and an object of the present invention is to provide a mechanism capable of further improving the quality of user experience.

35 Solution to Problem

[0007] To solve the above problem, according to an aspect to the present invention, there is provided an inhaler device including a power supply configured to store and supply electric power, a heater configured to heat a substrate including an aerosol source to generate an aerosol, and a controller configured to control, based on a heating condition, supply of electric power to the heater from the power supply. The heating condition includes a heating profile and information defining a heating period and a non-heating period, the heating profile being information defining transition of a target temperature which is a target value of a temperature of the heater, the heating period being a period during which the substrate is heated, the non-heating period being a period during which the substrate is not heated. The controller is configured to control the supply of electric power to the heater so that the temperature of the heater rises to the target temperature, while alternately switching between the heating period and the non-heating period.

[0008] The controller may be configured to execute the supply of electric power to the heater in the heating period.

[0009] The controller may be configured to perform, in the heating period, execution of the supply of electric power to the heater and stop of the supply of electric power to the heater while alternately switching between the execution and the stop.

50 **[0010]** The controller may be configured to keep the supply of electric power to the heater stopped over an entirety of the non-heating period.

[0011] The heating period and the non-heating period may each have a length that is equal to or longer than a time taken for a user to perform an action of inhaling the generated aerosol at least once.

[0012] The heating period and the non-heating period may each have a length of two seconds or more.

55 **[0013]** The heating period and the non-heating period may be set in a period during which the temperature of the heater rises in the heating profile.

[0014] The heating profile may include an initial temperature rise period during which the temperature of the heater rises from an initial temperature, an intermediate temperature drop period during which the temperature of the heater

drops after the initial temperature rise period, and a temperature re-rise period during which the temperature of the heater rises after the intermediate temperature drop period. The heating period and the non-heating period may be set in the temperature re-rise period.

[0015] The controller may be configured to switch between the heating period and the non-heating period in accordance with elapse of time.

[0016] The controller may be configured to, in a case where the temperature of the heater rises to the target temperature in the heating period, perform control so that the temperature of the heater is maintained at the target temperature until switching to the non-heating period.

[0017] The controller may be configured to, even in a case where the temperature of the heater does not rise to the target temperature in the heating period, stop the supply of electric power to the heater in the non-heating period subsequent to the heating period.

[0018] The controller may be configured to, in a case where the temperature of the heater does not rise to the target temperature in the heating period, perform control so that an amount of electric power supplied in a next heating period is larger than in a case where the temperature of the heater rises to the target temperature in the heating period.

[0019] The controller may be configured to perform switching from the heating period to the non-heating period in response to the temperature of the heater rising to the target temperature.

[0020] The controller may be configured to perform switching from the non-heating period to the heating period in response to the temperature of the heater decreasing to a lower limit temperature which is a lower limit value of the temperature of the heater.

[0021] The heating condition may further include transition of the lower limit temperature.

[0022] The controller may be configured to switch the target temperature in accordance with elapse of time.

[0023] The controller may be configured to switch the target temperature in accordance with the number of times the temperature of the heater has risen to the target temperature or the number of times switching between the heating period and the non-heating period has been performed.

[0024] The controller may be configured to control the number of times the temperature of the heater has risen to the target temperature or the number of times switching between the heating period and the non-heating period has been performed, each of the numbers being a criterion for switching the target temperature.

[0025] To solve the above problem, according to another aspect to the present invention, there is provided a control method for controlling an inhaler device including a power supply configured to store and supply electric power, and a heater configured to heat a substrate including an aerosol source to generate an aerosol. The control method includes controlling, based on a heating condition, supply of electric power to the heater from the power supply so that a temperature of the heater rises to a target temperature which is a target value of the temperature of the heater, while alternately switching between a heating period and a non-heating period, the heating condition including a heating profile and information defining the heating period and the non-heating period, the heating profile being information defining transition of the target temperature, the heating period being a period during which the substrate is heated, the non-heating period being a period during which the substrate is not heated.

[0026] To solve the above problem, according to another aspect to the present invention, there is provided a program for causing a computer that controls an inhaler device including a power supply configured to store and supply electric power, and a heater configured to heat a substrate including an aerosol source to generate an aerosol, to execute controlling, based on a heating condition, supply of electric power to the heater from the power supply so that a temperature of the heater rises to a target temperature which is a target value of the temperature of the heater, while alternately switching between a heating period and a non-heating period, the heating condition including a heating profile and information defining the heating period and the non-heating period, the heating profile being information defining transition of the target temperature, the heating period being a period during which the substrate is heated, the non-heating period being a period during which the substrate is not heated.

Advantageous Effects of Invention

[0027] As described above, according to the present invention, a mechanism capable of further improving the quality of user experience is provided.

Brief Description of Drawings

[0028]

[Fig. 1] Fig. 1 is a schematic diagram of an inhaler device according to a configuration example.

[Fig. 2] Fig. 2 is a graph illustrating an example of the transition of the temperature of a heater in a case where normal temperature control is performed on the basis of the heating profile shown in Table 1.

[Fig. 3] Fig. 3 is a graph illustrating an example of the transition of the temperature of the heater in a case where normal temperature control is performed in periods other than a temperature re-rise period and temperature control including switching between a heating period and a non-heating period is performed in the temperature re-rise period on the basis of the heating profile shown in Table 1.

[Fig. 4] Fig. 4 is a diagram for describing switching between a heating period and a non-heating period according to the present embodiment.

[Fig. 5] Fig. 5 is a diagram for describing switching between a heating period and a non-heating period according to the present embodiment.

[Fig. 6] Fig. 6 is a diagram for describing switching between a heating period and a non-heating period according to the present embodiment.

[Fig. 7] Fig. 7 is a diagram for describing switching between a heating period and a non-heating period according to the present embodiment.

[Fig. 8] Fig. 8 is a diagram for describing switching between a heating period and a non-heating period according to the present embodiment.

[Fig. 9] Fig. 9 is a flowchart for describing an example of a flow of a temperature control process executed by the inhaler device according to the present embodiment.

[Fig. 10] Fig. 10 is a diagram for describing providing of information prompting a puff in the present embodiment.

[Fig. 11] Fig. 11 is a diagram for describing providing of information prompting a puff in the present embodiment.

[Fig. 12] Fig. 12 is a flowchart illustrating an example of a flow of a process of providing information prompting a puff executed by the inhaler device according to the present embodiment.

Description of Embodiments

[0029] Hereinafter, a preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings. In the specification and the drawings, structural elements having substantially the same functional configuration are denoted by the same reference numerals, and a duplicate description will be omitted.

<1. Configuration example>

[0030] An inhaler device generates material to be inhaled by a user. In the example described below, the material generated by the inhaler device is an aerosol. Alternatively, the material generated by the inhaler device may be gas.

[0031] Fig. 1 is a schematic diagram of the inhaler device according to a configuration example. As illustrated in Fig. 1, an inhaler device 100 according to the present configuration example includes a power supply 111, a sensor 112, a notifier 113, a memory 114, a communicator 115, a controller 116, a heater 121, a holder 140, and a heat insulator 144.

[0032] The power supply 111 stores electric power. The power supply 111 supplies electric power to the structural elements of the inhaler device 100 under the control of the controller 116. The power supply 111 may be a rechargeable battery such as a lithium ion secondary battery.

[0033] The sensor 112 acquires various items of information regarding the inhaler device 100. In an example, the sensor 112 may be a pressure sensor such as a condenser microphone, a flow sensor, or a temperature sensor, and acquire a value generated in accordance with the user's inhalation. In another example, the sensor 112 may be an input device that receives information input by the user, such as a button or a switch.

[0034] The notifier 113 provides information to the user. The notifier 113 may be a light-emitting device that emits light, a display device that displays an image, a sound output device that outputs sound, or a vibration device that vibrates.

[0035] The memory 114 stores various items of information for operation of the inhaler device 100. The memory 114 may be a non-volatile storage medium such as flash memory.

[0036] The communicator 115 is a communication interface capable of communication in conformity with any wired or wireless communication standard. Such a communication standard may be, for example, Wi-Fi (registered trademark) or Bluetooth (registered trademark).

[0037] The controller 116 functions as an arithmetic processing unit and a control circuit, and controls the overall operations of the inhaler device 100 in accordance with various programs. The controller 116 includes an electronic circuit such as a central processing unit (CPU) or a microprocessor, for example.

[0038] The holder 140 has an internal space 141, and holds a stick substrate 150 in a manner partially accommodated in the internal space 141. The holder 140 has an opening 142 that allows the internal space 141 to communicate with outside. The holder 140 accommodates the stick substrate 150 that is inserted into the internal space 141 through the opening 142. For example, the holder 140 may be a tubular body having the opening 142 and a bottom 143 on its ends, and may define the pillar-shaped internal space 141. The holder 140 also has a function of defining a flow path of air supplied to the stick substrate 150. An air inlet hole, which is an inlet of air to the flow path, is disposed in the bottom 143, for example. On the other hand, an air outlet hole, which is an outlet of air from the flow path, is the opening 142.

[0039] The stick substrate 150 includes a substrate 151 and an inhalation port 152. The substrate 151 includes an aerosol source. In the present configuration example, the aerosol source is not limited to a liquid, and may be a solid. The stick substrate 150 held by the holder 140 includes the substrate 151 at least partially accommodated in the internal space 141 and the inhalation port 152 at least partially protruding from the opening 142. When the user inhales with the inhalation port 152 protruding from the opening 142 in his/her mouth, air flows into the internal space 141 through the air inlet hole (not illustrated), and the air and an aerosol generated from the substrate 151 reach inside the mouth of the user.

[0040] The heater 121 heats the aerosol source to atomize the aerosol source and generate the aerosol. In the example illustrated in Fig. 1, the heater 121 has a film-like shape and surrounds the outer circumference of the holder 140. Subsequently, heat produced from the heater 121 heats the substrate 151 of the stick substrate 150 from the outer circumference, generating the aerosol. The heater 121 produces heat when receiving electric power from the power supply 111. In an example, the electric power may be supplied in response to the sensor 112 detecting a start of the user's inhalation and/or an input of predetermined information. Subsequently, the supply of the electric power may be stopped in response to the sensor 112 detecting an end of the user's inhalation and/or an input of predetermined information.

[0041] The heat insulator 144 prevents heat from transferring from the heater 121 to the other structural elements. For example, the heat insulator 144 may be a vacuum heat insulator or an aerogel heat insulator.

[0042] The configuration example of the inhaler device 100 has been described above. The inhaler device 100 is not limited to the above configuration, and may be configured in various ways as exemplified below.

[0043] In an example, the heater 121 may have a blade-like shape, and may be disposed so that the heater 121 protrudes from the bottom 143 of the holder 140 toward the internal space 141. In this case, the heater 121 having the blade-like shape is inserted into the substrate 151 of the stick substrate 150 and heats the substrate 151 of the stick substrate 150 from its inside. In another example, the heater 121 may be disposed so that the heater 121 covers the bottom 143 of the holder 140. In still another example, the heater 121 may be implemented as a combination of two or more selected from a first heater that covers the outer circumference of the holder 140, a second heater having the blade-like shape, and a third heater that covers the bottom 143 of the holder 140.

[0044] In another example, the holder 140 may include an opening/closing mechanism that at least partially opens and closes an outer shell defining the internal space 141. Examples of the opening/closing mechanism include a hinge. In addition, the holder 140 may accommodate the stick substrate 150 while sandwiching the stick substrate 150 inserted into the internal space 141 by opening and closing the outer shell. In this case, the heater 121 may be at the sandwiching position of the holder 140 and may produce heat while pressing the stick substrate 150.

[0045] In addition, means for atomizing the aerosol source is not limited to heating by the heater 121. For example, the means for atomizing the aerosol source may be induction heating.

[0046] Inhalation of an aerosol generated by the inhaler device 100 by the user will be hereinafter also referred to as a puff or a puff action.

<2. Technical features>

(1) Heating profile

[0047] The controller 116 controls the operation of the heater 121 on the basis of a heating condition. The control of the operation of the heater 121 is implemented by controlling supply of electric power to the heater 121 from the power supply 111.

[0048] The heating condition is information defining an operation of heating the stick substrate 150 by the heater 121. The heating condition includes at least a heating profile. Hereinafter, the heating profile will be described in detail.

[0049] The heating profile is information defining the transition of a target temperature. The target temperature is a target value of the temperature of the heater 121. The controller 116 controls the temperature of the heater 121 so that the transition of the temperature (hereinafter also referred to as an actual temperature) of the heater 121 becomes similar to the transition of the target temperature defined in the heating profile. The heating profile is typically designed to optimize the flavor that a user tastes when the user inhales an aerosol generated from the stick substrate 150. Thus, controlling of supply of electric power to the heater 121 based on the heating profile makes it possible to optimize the flavor that the user tastes.

[0050] The heating profile includes one or more combinations of a target temperature and information indicating a timing at which temperature control is to be performed on the basis of the target temperature. At the time of performing heating based on the heating profile, the controller 116 controls the temperature of the heater 121 on the basis of the difference between the target temperature corresponding to the present and a current actual temperature. The temperature control of the heater 121 can be implemented by, for example, known feedback control. The feedback control may be, for example, proportional-integral-differential controller (PID control). The controller 116 may cause electric power

from the power supply 111 to be supplied to the heater 121 in the form of pulses generated by pulse width modulation (PWM) or pulse frequency modulation (PFM). In this case, the controller 116 is capable of controlling the temperature of the heater 121 by adjusting the duty ratio or frequency of electric power pulses in the feedback control. Alternatively, the controller 116 may perform simple ON/OFF control in the feedback control. For example, the controller 116 may execute heating by the heater 121 until the actual temperature reaches the target temperature, stop heating by the heater 121 in response to the actual temperature reaching the target temperature, and execute heating by the heater 121 again in response to the actual temperature becoming lower than the target temperature. In addition, the controller 116 may adjust a voltage in the feedback control. Such temperature control will be hereinafter also referred to as normal temperature control.

[0051] The temperature of the heater 121 can be quantified by, for example, measuring or estimating the electric resistance value of the heater 121 (more accurately, a heating resistor constituting the heater 121). This is because the electric resistance value of the heating resistor changes according to the temperature. The electric resistance value of the heating resistor can be estimated by, for example, measuring the amount of voltage drop in the heating resistor. The amount of voltage drop in the heating resistor can be measured by a voltage sensor that measures the potential difference applied to the heating resistor. In another example, the temperature of the heater 121 can be measured by a temperature sensor, such as a thermistor, installed near the heater 121.

[0052] A period from the start to the end of the process of generating an aerosol using the stick substrate 150 will be hereinafter also referred to as a heating session. In other words, the heating session is a period during which supply of electric power to the heater 121 is controlled on the basis of the heating condition (i.e., the heating profile). The start of the heating session is a timing at which heating based on the heating profile is started. The end of the heating session is a timing at which a sufficient amount of aerosol is no longer generated. The heating session consists of a first preheating period and a latter puffable period. The puffable period is a period during which a sufficient amount of aerosol is assumed to be generated. The preheating period is a period from the start of heating to the start of the puffable period. The heating performed in the preheating period is also referred to as preheating.

[0053] In the heating profile, the information indicating the timing at which temperature control is to be performed on the basis of the target temperature may be information indicating a time section whose start and end are defined by a time elapsed from the start of heating based on the heating profile. That is, in the heating profile, a target temperature to be reached may be set for each of one or more time sections. In this case, the controller 116 switches the target temperature in accordance with the elapse of time. That is, the controller 116 performs the temperature control of the heater 121 on the basis of the target temperature corresponding to the elapsed time from the start of heating based on the heating profile. This makes it possible to change the temperature of the heater 121 in a manner similar to the transition of the target temperature defined in the heating profile.

[0054] An example of the heating profile is shown in Table 1 below.

[Table 1]

Table 1. Example of heating profile		
Period	Elapsed time from start of heating	Target temperature
Initial temperature rise period	0 sec. to 35 sec.	295°C
Intermediate temperature drop period	35 sec. to 45 sec.	230°C
Temperature re-rise period	45 sec. to 110 sec.	230°C
	110 sec. to 180 sec.	240°C
	180 sec. to 260 sec.	250°C
	260 sec. to 355 sec.	260°C
Heating termination period	Thereafter	-

[0055] A description will be given of the transition of the temperature of the heater 121 in a case where the controller 116 performs normal temperature control in accordance with the heating profile shown in Table 1, with reference to Fig. 2. Fig. 2 is a graph illustrating an example of the transition of the temperature of the heater 121 in a case where normal temperature control is performed on the basis of the heating profile shown in Table 1. The horizontal axis of this graph represents time (seconds). The vertical axis of this graph represents the temperature of the heater 121. The line 21 in this graph indicates the transition of the temperature of the heater 121. As illustrated in Fig. 2, the temperature of the heater 121 changes in a manner similar to the transition of the target temperature defined in the heating profile.

[0056] As shown in Table 1, the heating profile includes an initial temperature rise period at the beginning. The initial

temperature rise period is a period during which the temperature of the heater 121 rises from an initial temperature. The initial temperature is the temperature of the heater 121 before the start of heating. As illustrated in Fig. 2, in the initial temperature rise period, the temperature of the heater 121 reaches 295°C after 25 seconds from the start of heating, and is maintained at 295°C until after 35 seconds from the start of heating. Accordingly, it is assumed that the temperature of the stick substrate 150 reaches a temperature at which a sufficient amount of aerosol is generated. Because the temperature rapidly rises to 295°C immediately after the start of heating, preheating can be finished early, and the puffable period can be started early. Although Fig. 2 illustrates an example in which the initial temperature rise period coincides with the preheating period, these periods may be different from each other.

[0057] As shown in Table 1, the heating profile includes an intermediate temperature drop period that comes next. The intermediate temperature drop period is a period during which the temperature of the heater 121 drops. As illustrated in Fig. 2, in the intermediate temperature drop period, the temperature of the heater 121 drops from 295°C to 230°C from 35 seconds after the start of heating to 45 seconds after the start of heating. In this period, supply of electric power to the heater 121 may be stopped. Even in this case, a sufficient amount of aerosol is generated by the remaining heat of the heater 121 and the stick substrate 150. Here, if the heater 121 is maintained at a high temperature, the aerosol source included in the stick substrate 150 is rapidly consumed, which may cause deterioration of flavor, such as excessively strong flavor tasted by the user. In this regard, the intermediate temperature drop period provided in the middle makes it possible to avoid such deterioration of flavor and improve the quality of puff experience of the user.

[0058] As shown in Table 1, the heating profile includes a temperature re-rise period that comes next. The temperature re-rise period is a period during which the temperature of the heater 121 rises. As illustrated in Fig. 2, in the temperature re-rise period, the temperature of the heater 121 rises stepwise from 230°C to 240°C, from 240°C to 250°C, and from 250°C to 260°C, from 45 seconds after the start of heating to 355 seconds after the start of heating. If the temperature of the heater 121 is continuously decreased, the temperature of the stick substrate 150 is also decreased. Thus, the amount of aerosol generated reduces, and the flavor tasted by the user may be deteriorated. In addition, as the heating profile progresses toward the end, the remaining amount of the aerosol source included in the stick substrate 150 decreases, and thus the amount of aerosol generated tends to reduce even if heating is continued at the same temperature. In this regard, re-rise of the temperature and an increase in the amount of aerosol generated makes it possible to compensate for a decrease in the amount of aerosol generated caused by a decrease in the remaining amount of the aerosol source. Accordingly, even in the latter half of the heating session, it is possible to prevent deterioration of the flavor that the user tastes.

[0059] As shown in Table 1, the target temperature may rise stepwise in the temperature re-rise period. With this configuration, the stepwise rise in the target temperature makes it possible to appropriately compensate for a decrease in the remaining amount of the aerosol source, which progresses as the heating profile progresses toward the end.

[0060] As shown in Table 1, the heating profile includes a heating termination period at the last. The heating termination period is a period after the temperature re-rise period, and is a period during which heating is not performed. The target temperature need not necessarily be set. As illustrated in Fig. 2, the temperature of the heater 121 decreases from 355 seconds after the start of heating. The supply of electric power to the heater 121 may be finished after 355 seconds from the start of heating. Even in this case, a sufficient amount of aerosol is generated for a while by the remaining heat of the heater 121 and the stick substrate 150. In the example illustrated in Fig. 2, the puffable period, that is, the heating session, ends after 365 seconds from the start of heating.

[0061] The user may be notified of the timing at which the puffable period starts and the timing at which the puffable period ends. Furthermore, the user may be notified of a timing that is a predetermined time before the end of the puffable period (for example, the timing at which supply of electric power to the heater 121 ends). In this case, the user is able to take a puff in the puffable period with reference to the notification.

(2) Switching between heating period and non-heating period

[0062] The heating condition may include, in addition to the above-described heating profile, information defining a heating period and a non-heating period. The information defines a heating period and a non-heating period in the period during which the temperature control based on the heating profile is performed. The heating period is a period during which the stick substrate 150 is heated. The non-heating period is a period during which the stick substrate 150 is not heated. The controller 116 controls supply of electric power to the heater 121 so that the temperature of the heater 121 rises to the target temperature, while alternately switching between the heating period and the non-heating period. With this configuration, it is possible to change the temperature of the heater 121 in a manner similar to the transition of the target temperature defined in the heating profile while alternately repeating a temperature rise in the heating period and a temperature drop in the non-heating period.

[0063] In addition, because the stick substrate 150 can be heated with repetition of a short-term temperature rise and temperature drop, a rapid change in the temperature of the stick substrate 150 can be prevented. Thus, it is possible to prevent the deterioration of flavor caused by a rapid rise or drop of the temperature of the stick substrate 150.

[0064] In addition, because the non-heating period is provided, the time during which the stick substrate 150 is at a high temperature can be shortened, compared to normal temperature control in which a non-heating period is not provided. Accordingly, the aerosol source is moderately consumed, and thus the life of the stick substrate 150 can be extended. The life of the stick substrate 150 refers to a period until the aerosol source included in the stick substrate

150 is exhausted, in other words, a period during which the user is able to taste a sufficient flavor.

[0065] The information defining the heating period and the non-heating period includes information indicating a criterion for switching between the heating period and the non-heating period. In an example, in a case where switching between the heating period and the non-heating period is performed in accordance with the elapse of time, the information defining the heating period and the non-heating period may include information indicating the length of each of the heating period and the non-heating period. In another example, in a case where switching between the heating period and the non-heating period is performed in accordance with the temperature of the heater 121, the information defining the heating period and the non-heating period may include information indicating the temperature of the heater 121 serving as a criterion for switching.

[0066] The controller 116 executes supply of electric power to the heater 121 in the heating period. With this configuration, it is possible to increase the temperature of the heater 121 in the heating period.

[0067] In particular, in the heating period, the controller 116 may perform execution of supply of electric power to the heater 121 and stop of supply of electric power to the heater 121 while alternately switching between the execution and the stop. For example, in the heating period, the controller 116 may execute supply of electric power while more frequently switching ON/OFF of supply of electric power by PWM control, PFM control, or the like. With this configuration, it is possible to prevent an excessively rapid temperature rise in the heating period.

[0068] The controller 116 keeps supply of electric power to the heater 121 stopped over the entire non-heating period. With this configuration, supply of electric power is stopped in the non-heating period, and thus electric power consumption can be reduced compared to normal temperature control in which a non-heating period is not provided.

[0069] The length of each of the heating period and the non-heating period is equal to or longer than a time taken for the user to perform an operation of inhaling a generated aerosol at least once. Regarding cigarettes, it is known in Non-Patent Literature "Review of human smoking behaviour and recommendations for a new ISO standard for the machine smoking of cigarettes", ISO/TR 17219: 2013 (en), [retrieved on March 17, 2021], Internet <URL: <https://www.iso.org/obp/ui/#iso:std:iso:tr:17219:ed-1:v1:en>>, etc., that the time taken for one puff action is about 2 seconds. Thus, the length of each of the heating period and the non-heating period may be 2 seconds or more. An upper limit may be set for the length of each of the heating period and the non-heating period. In an example, the upper limit of the length of each of the heating period and the non-heating period may be 30 seconds. With this configuration, at least one of the relationships of the following four patterns is established between a two-second puff period during which a puff action is performed, and the heating period and the non-heating period. The relationships of the four patterns include a pattern in which a puff period is included in the heating period, a pattern in which a puff period is included in the non-heating period, a pattern in which the heating period is switched to the non-heating period during a puff period, and a pattern in which the non-heating period is switched to the heating period during a puff period. Thus, the user is able to taste different flavors in these four patterns.

[0070] The heating period and the non-heating period are set in a period in which the temperature of the heater 121 rises in the heating profile. With this configuration, it is possible to gradually increase the temperature of the stick substrate 150 as a whole while increasing and decreasing the temperature in a short term. Thus, it is possible to prevent deterioration of flavor caused by an excessively rapid rise in the temperature of the stick substrate 150.

[0071] Specifically, the heating period and the non-heating period are set in the temperature re-rise period. As described above, the temperature re-rise period is set to compensate for a decrease in the remaining amount of the aerosol source in the latter half of the heating profile. In this regard, with this configuration, it is possible to prevent both the deterioration of flavor caused by a decrease in the remaining amount of the aerosol source and the deterioration of flavor caused by an excessively rapid rise in the temperature of the stick substrate 150.

[0072] On the other hand, in the periods other than the temperature re-rise period, normal temperature control such as PWM control or PFM control may be performed. With this configuration, in the periods other than the temperature re-rise period, it is possible to make the transition of the target temperature defined in the heating profile and the transition of the temperature of the heater 121 more coincident with each other than in the temperature re-rise period. This point will be described with reference to Fig. 3.

[0073] Fig. 3 is a graph illustrating an example of the transition of the temperature of the heater 121 in a case where normal temperature control is performed in the periods other than the temperature re-rise period and temperature control including switching between the heating period and the non-heating period is performed in the temperature re-rise period on the basis of the heating profile shown in Table 1. The horizontal axis of this graph represents time (seconds). The vertical axis of this graph represents the temperature of the heater 121. The line 21 in this graph indicates the transition of the temperature of the heater 121. As illustrated in Fig. 3, the heating period and the non-heating period are repeated in the temperature re-rise period. Thus, the temperature of the heater 121 rises to the target temperature at the peak,

and falls below the target temperature before and after the peak. On the other hand, in the other periods, the temperature of the heater 121 is maintained at the target temperature, particularly in the period of 25 seconds to 35 seconds in the initial temperature rise period.

[0074] Hereinafter, the temperature control of the heater 121 will be described in detail with reference to Fig. 4 to Fig. 8. Fig. 4 to Fig. 8 are diagrams for describing switching between the heating period and the non-heating period according to the present embodiment. These figures each have a graph illustrating the transition of the temperature of the heater 121 in the temperature re-rise period. The horizontal axis of the graph represents the time (seconds) elapsed from the start of the heating session. The vertical axis of the graph represents the temperature of the heater 121. The line 21A indicates the transition of the temperature of the heater 121 in the heating period. The line 21B indicates the transition of the temperature of the heater 121 in the non-heating period.

[0075] In the example illustrated in Fig. 4, the controller 116 switches between the heating period and the non-heating period every 10 seconds. That is, the controller 116 switches between the heating period and the non-heating period in accordance with the elapse of time. Obviously, the length of each of the heating period and the non-heating period is not limited to 10 seconds. The length of the heating period and the length of the non-heating period may be the same or different. With this configuration, the heating period and the non-heating period can be switched therebetween at a predetermined cycle, and thus the processing load of the controller 116 can be reduced. In the example illustrated in Fig. 4, the temperature of the heater 121 rises to the target temperature at the end of the heating period.

[0076] In the example illustrated in Fig. 5, the heating period is 15 seconds, and the non-heating period is 10 seconds. The temperature of the heater 121 rises to the target temperature in the middle of the heating period, and thereafter the temperature of the heater 121 is maintained at the target temperature. In such a case where the temperature of the heater 121 rises to the target temperature in the heating period, the controller 116 may perform control so that the temperature of the heater 121 is maintained at the target temperature until switching to the non-heating period. With this configuration, even in a case where the temperature of the heater 121 rises faster than expected due to circumstances such as a high outside air temperature, it is possible to prevent the temperature of the heater 121 from exceeding the target temperature. Accordingly, it is possible to prevent deterioration of flavor and shortening of the life caused by an excessively high temperature of the stick substrate 150.

[0077] In the example illustrated in Fig. 6, the controller 116 switches between the heating period and the non-heating period every 10 seconds, and the temperature of the heater 121 does not rise to the target temperature at the end of the first heating period. Even in such a case where the temperature of the heater 121 does not rise to the target temperature in the heating period, the controller 116 stops supply of electric power to the heater 121 in the subsequent non-heating period. With this configuration, the heating period and the non-heating period can be switched therebetween at a predetermined cycle, and thus the processing load of the controller 116 can be reduced.

[0078] In a case where the temperature of the heater 121 does not rise to the target temperature in the heating period, the controller 116 may perform control so that the amount of electric power supplied in the next heating period is larger than in a case where the temperature of the heater 121 rises to the target temperature in the heating period. In the example illustrated in Fig. 6, the temperature of the heater 121 does not rise to the target temperature at the end of the first heating period, and thus the controller 116 supplies a larger amount of electric power in the latter heating period than in the first heating period. Accordingly, the slope of the line 21A in the latter heating period is steep, and the temperature of the heater 121 rises to the target temperature at the end of the latter heating period. With this configuration, even in a case where the temperature of the heater 121 is less prone to rise than expected due to circumstances such as a low outside air temperature, it is possible to increase the temperature of the heater 121 to the target temperature.

[0079] The controller 116 may control the temperature of the heater 121 on the basis of a lower limit temperature. The lower limit temperature is included in the heating condition, for example. The lower limit temperature is a lower limit value of the temperature of the heater 121. For example, if the temperature of the heater 121 falls below the lower limit temperature, a sufficient aerosol is not generated, or it is difficult to deliver a sufficient flavor to the user. Specifically, in response to the temperature of the heater 121 decreasing to the lower limit temperature, the controller 116 performs switching from the non-heating period to the heating period. With this configuration, even in a case where the temperature of the heater 121 is more prone to decrease than expected due to circumstances such as a low outside air temperature, it is possible to prevent the temperature of the heater 121 from falling below the lower limit temperature. Accordingly, it is possible to suppress the occurrence of inconvenience, such as insufficient generation of an aerosol or difficulty in delivering a sufficient flavor to the user. This point will be described with reference to Fig. 7 and Fig. 8.

[0080] In the example illustrated in Fig. 7, the controller 116 switches between the heating period and the non-heating period every 20 seconds. At any timing, the temperature of the heater 121 is not below the lower limit temperature.

[0081] In the example illustrated in Fig. 8, the heating period is 20 seconds and the non-heating period is 20 seconds, but the temperature of the heater 121 decreases to the lower limit temperature in the middle of the non-heating period. Thus, the controller 116 stops the non-heating period at the elapse of 10 seconds and switches the period to the heating period. However, for 10 seconds until the original end time of the non-heating period, the controller 116 performs control so that the temperature of the heater 121 is maintained at the lower limit temperature. With this control, it is possible to

prevent the temperature of the heater 121 from excessively rising in the heating period that is extended relative to the original heating period.

[0082] The heating condition may include the transition of the lower limit temperature. For example, the lower limit temperature may be a temperature lower than the target temperature by a predetermined temperature, and may change in accordance with the transition of the target temperature. In the latter half of the heating profile, the remaining amount of the aerosol source included in the stick substrate 150 reduces. Thus, in the latter half of the heating profile, at a temperature higher than in the first half of the heating profile, a sufficient aerosol is not generated, or it may be difficult to deliver a sufficient flavor to the user. In this regard, a rise in the lower limit temperature along with a rise in the target temperature in the temperature re-rise period makes it possible to suppress the occurrence of such an inconvenience.

[0083] Hereinafter, a flow of a temperature control process according to the present embodiment will be described with reference to Fig. 9.

[0084] Fig. 9 is a flowchart for describing an example of a flow of a temperature control process executed by the inhaler device 100 according to the present embodiment. In this flow, it is assumed that the operation of the heater 121 is controlled on the basis of the heating profile shown in Table 1.

[0085] As illustrated in Fig. 9, the inhaler device 100 first receives a user operation of providing an instruction to start heating (step S102). An example of the user operation of providing an instruction to start heating is an operation of pressing a button provided on the inhaler device 100.

[0086] Subsequently, the inhaler device 100 executes supply of electric power in the initial temperature rise period (step S104). For example, the controller 116 executes supply of electric power to the heater 121 on the basis of PWM control or PFM control in which the target temperature is 295°C.

[0087] Subsequently, the inhaler device 100 stops supply of electric power in the intermediate temperature drop period (step S106). For example, the controller 116 stops supply of electric power to the heater 121 from a timing at which 35 seconds have elapsed from the start of heating to a timing at which 45 seconds have elapsed from the start of heating.

[0088] Subsequently, in the temperature re-rise period, the inhaler device 100 executes supply of electric power while switching between the heating period and the non-heating period (step S108). For example, the controller 116 executes supply of electric power in the heating period while switching between the heating period and the non-heating period on the basis of various criteria, such as the elapse of time, whether the temperature of the heater 121 has risen to the target temperature, or whether the temperature of the heater 121 has decreased to the lower limit temperature.

[0089] The inhaler device 100 then stops supply of electric power (step S110). For example, the controller 116 stops supply of electric power to the heater 121 at a timing at which 355 seconds have elapsed from the start of heating.

(3) Providing of information prompting puff

[0090] In the heating session, the notifier 113 provides information prompting the user to inhale an aerosol, that is, information prompting a puff. In an example, the notifier 113 provides information prompting a puff by light emission, image display, vibration, and/or audio output. The user takes a puff with reference to the information and is thus able to taste a good flavor.

[0091] The notifier 113 provides information prompting a puff a plurality of times in the heating session. The user takes puffs with reference to the information and is thus able to taste a good flavor a plurality of times.

[0092] A timing to provide information prompting a puff (hereinafter also referred to as a notification timing) corresponds to a timing suitable for inhaling an aerosol (hereinafter also referred to as a puff timing suitable for a puff). The heating session has a plurality of timings suitable for a puff. Thus, the notifier 113 provides information prompting a puff at each of a plurality of notification timings corresponding to a corresponding one of a plurality of timings suitable for a puff. The user takes puffs with reference to the information and is thus able to taste a good flavor a plurality of times.

[0093] The notification timing may be a timing before a timing suitable for a puff. For example, the notification timing may be a timing several seconds before a timing suitable for a puff. A time lag may exist between when information prompting a puff is provided and when the user takes a puff with reference to the information. In this regard, with this configuration, it is possible to provide information prompting a puff in advance in consideration of the time lag. Thus, the user takes a puff in response to receipt of the information prompting a puff, and is thus able to naturally take a puff at a timing suitable for a puff. Accordingly, the user is able to taste a good flavor.

[0094] The notifier 113 may provide information indicating that a timing suitable for a puff will come, during a period from before the timing suitable for a puff to the timing suitable for a puff. In an example, the notifier 113 may display the time until the timing suitable for a puff comes in a countdown manner. With this configuration, the user is able to wait for the arrival of a timing suitable for a puff, and is thus able to easily take a puff at the timing suitable for a puff.

[0095] The notifier 113 may provide information that is different between a timing suitable for a puff and before and after the timing. In an example, the notifier 113 may output red light before and after the timing suitable for a puff, and may output green light at the timing suitable for a puff. With this configuration, the user is able to grasp a timing suitable for a puff and a timing unsuitable for a puff.

[0096] The timing suitable for a puff is at least included in the puffable period. In the puffable period, an aerosol can be inhaled, but both a timing suitable for a puff and a timing unsuitable for a puff may exist. From this viewpoint, providing of information prompting a puff at a notification timing corresponding to a timing suitable for a puff is different from notification of the timing at which the puffable period starts and the timing at which the puffable period ends described above. As a result of providing information prompting a puff at a notification timing corresponding to a timing suitable for a puff, it is possible to prompt the user to take a puff particularly at the timing suitable for a puff in the puffable period.

[0097] The notifier 113 may provide information prompting a puff at a timing included in a period in which the heating period and the non-heating period are set. In a case where the heating period and the non-heating period are set in the temperature re-rise period, the notifier 113 may provide information prompting a puff at a timing included in the temperature re-rise period. That is, the notification timing may be a timing included in the period in which the heating period and the non-heating period are set, and particularly may be a timing included in the temperature re-rise period. In the heating period, the temperature of the heater 121 increases, and in the non-heating period, the temperature of the heater 121 decreases. Thus, the period in which the heating period and the non-heating period are set may include both a timing suitable for a puff and a timing unsuitable for a puff. In this regard, with this configuration, even if there are both a timing suitable for a puff and a timing unsuitable for a puff, the user is able to taste a good flavor.

[0098] An example of the timing suitable for a puff is a timing at which switching from the heating period to the non-heating period occurs. The timing at which switching from the heating period to the non-heating period occurs is typically a timing at which the temperature of the heater 121 is at the peak. It is considered that, at the timing at which the temperature of the heater 121 is at the peak, the amount of aerosol generated is also at the peak. Thus, the user takes a puff with reference to the information and is thus able to fully taste a flavor.

[0099] An example of the timing suitable for a puff is a timing at which the temperature of the heater 121 has reached the target temperature. In this case, the user takes a puff with reference to the information and is thus able to taste an optimum flavor as designed by the heating profile.

[0100] Hereinafter, providing of information prompting a puff in the temperature re-rise period will be specifically described with reference to Fig. 10 and Fig. 11. Fig. 10 and Fig. 11 are diagrams for describing providing of information prompting a puff in the present embodiment. These figures each have a graph illustrating the transition of the temperature of the heater 121 in the temperature re-rise period. The horizontal axis of the graph represents the time (seconds) elapsed from the start of the heating session. The vertical axis of the graph represents the temperature of the heater 121. The line 21A indicates the transition of the temperature of the heater 121 in the heating period. The line 21B indicates the transition of the temperature of the heater 121 in the non-heating period. The point 22 indicates a notification timing.

[0101] The notifier 113 may provide information prompting a puff at a timing included in the heating period. That is, the notification timing may be a timing included in the heating period. As illustrated in Fig. 10 and Fig. 11, the point 22 indicating a notification timing is included in the heating period. On the other hand, a timing suitable for a puff is a timing of switching from the heating period (a period during which the temperature of the heater 121 is increased or maintained) to the non-heating period (a period during which the temperature of the heater 121 is decreased). As illustrated in Fig. 10 and Fig. 11, the point 22 indicating a notification timing is a timing earlier than the timing suitable for a puff by the above-described time lag. Thus, the user is able to take a puff at the timing suitable for a puff with reference to the information prompting a puff at the point 22. In addition, even if a puff is taken between the notification timing and the timing suitable for a puff, the puff is taken at least during the heating period, and thus a decrease in the temperature of the heater 121 caused by the puff can be reduced, and deterioration of flavor can be prevented.

[0102] The notifier 113 may provide information prompting a puff at a timing after a predetermined time from the timing of switching from the non-heating period to the heating period. That is, the notification timing may be a timing after a predetermined time from the timing of switching from the non-heating period to the heating period. As illustrated in Fig. 10, in a case where the heating period is 10 seconds, the notifier 113 may provide information prompting a puff at a timing after 8 seconds from the timing of switching from the non-heating period to the heating period. With this configuration, the notification timing can be made earlier than the timing suitable for a puff by the above-described time lag, and thus the user is able to taste a good flavor with reference to the information prompting a puff. Here, the predetermined time is set on the basis of the length of the heating period. It is desired that the length of the predetermined time be set as a length equal to or more than half the length of the heating period, for example, 2/3 of the length of the heating period. This is because it is considered that the temperature of the heater 121 has sufficiently risen in the latter half of the heating period. With this configuration, even if a puff is taken during a period from the notification timing to the timing suitable for a puff, the puff is taken at a timing at which the temperature of the heater 121 is relatively high in the heating period. Thus, the user is able to taste a good flavor.

[0103] The notifier 113 may provide information prompting a puff at a timing at which a predetermined time has elapsed from the start of the heating session. That is, the notification timing may be a timing at which a predetermined time has elapsed from the start of the heating session. The predetermined time is set as a time that is assumed to be a timing included in the heating period. Furthermore, it is desired that the predetermined time be set as a time that is assumed

to be a timing after a predetermined time from the timing of switching from the non-heating period to the heating period. As illustrated in Fig. 10, the notifier 113 may provide, as information prompting a puff, information indicating each of a timing at which 120 seconds have elapsed from the start of the heating session and a timing at which 140 seconds have elapsed from the start of the heating session. These timings are included in the heating period and are timings after 8 seconds from the timing of switching from the non-heating period to the heating period. With this configuration, as described above, the user takes a puff with reference to the information prompting a puff and is thus able to taste a good flavor.

[0104] The notifier 113 may provide information prompting a puff at a timing at which the temperature of the heater 121 has risen to a predetermined temperature. That is, the notification timing may be a timing at which the temperature of the heater 121 has risen to a predetermined temperature. The predetermined temperature is a temperature at which a sufficient amount of aerosol is assumed to be generated. With this configuration, the user takes a puff with reference to the information and is thus able to inhale a sufficient amount of aerosol.

[0105] The predetermined temperature may be set on the basis of the target temperature. In an example, as illustrated in Fig. 10, the predetermined temperature may be set as a temperature lower than the target temperature by 5°C. In a case where the target temperature is 250°C, the notifier 113 may provide information prompting a puff at a timing at which the temperature of the heater 121 has risen to 245°C in the heating period. With this configuration, the predetermined temperature related to the notification timing can be changed in accordance with the transition of the target temperature. As described above, in the temperature re-rise period, the target temperature rises stepwise to compensate for a decrease in the remaining amount of the aerosol source included in the stick substrate 150. In this regard, as a result of causing the predetermined temperature to follow the rise in the target temperature, it is possible to prompt a puff at a timing at which a decrease in the remaining amount of the aerosol source included in the stick substrate 150 can be compensated for. That is, with this configuration, it is possible to prompt the user to take a puff at a timing at which the temperature has risen to a temperature at which a sufficient amount of aerosol is assumed to be generated even in consideration of a decrease in the remaining amount of the aerosol source included in the stick substrate 150.

[0106] The notifier 113 may provide information prompting a puff at a timing at which the temperature of the heater 121 has stopped rising. That is, the notification timing may be a timing at which the temperature of the heater 121 has stopped rising. As illustrated in Fig. 11, in a case where the temperature of the heater 121 rises to the target temperature in the middle of the heating period, the temperature control may be performed so that the temperature of the heater 121 is maintained at the target temperature until the heating period ends. In this case, the notifier 113 may provide information prompting a puff at a timing at which the temperature of the heater 121 has risen to the target temperature. With this configuration, a timing suitable for a puff continues after the notification timing, and thus the user is able to taste a good flavor by taking a puff with reference to the information.

[0107] The controller 116 may be capable of switching the heating profile to be used among a plurality of available heating profiles. For example, the memory 114 stores a plurality of available heating profiles. The controller 116 selects a heating profile to be used from among the plurality of available heating profiles stored in the memory 114. In an example, which heating profile is to be used may be set by the user.

[0108] The notifier 113 may provide information prompting a puff at a timing that varies according to the heating profile to be used. When the heating profile varies, the timing suitable for a puff may also vary. In this regard, with this configuration, it is possible to prompt the user to take a puff at a timing suitable for a puff, which may vary according to the heating profile.

[0109] Hereinafter, a flow of a process of providing information prompting a puff according to the present embodiment will be described with reference to Fig. 12.

[0110] Fig. 12 is a flowchart illustrating an example of a flow of a process of providing information prompting a puff executed by the inhaler device 100 according to the present embodiment. The process according to this flow is executed, for example, while the process according to step S108 illustrated in Fig. 9 is being executed.

[0111] As illustrated in Fig. 12, the controller 116 first determines whether a notification timing has come (step S202). An example of the notification timing is a timing included in the heating period. Another example of the notification timing is a timing after a predetermined time from a timing of switching from the non-heating period to the heating period. Another example of the notification timing is a timing at which a predetermined time has elapsed from the start of the heating session. Another example of the notification timing is a timing at which the temperature of the heater 121 has risen to a predetermined temperature set on the basis of the target temperature. Another example of the notification timing is a timing at which the temperature of the heater 121 has stopped rising.

[0112] If it is determined that the notification timing has not come (NO in step S202), the controller 116 waits until the notification timing comes.

[0113] If it is determined that the notification timing has come (YES in step S202), the controller 116 controls the notifier 113 to provide information prompting a puff (step S204).

[0114] Thereafter, the controller 116 determines whether to end the heating session (step S206). For example, the controller 116 determines to end the heating session when a predetermined time has elapsed from the start of the heating

session.

[0115] If it is determined not to end the heating session (NO in step S206), the process returns to step S202.

[0116] On the other hand, if it is determined to end the heating session (YES in step S206), the process ends.

5 <3. Supplementary description>

[0117] While a preferred embodiment of the present invention has been described in detail with reference to the accompanying drawings, the present invention is not limited the foregoing example. It will be apparent that those skilled in the art to which the present invention belongs are able to conceive of various modifications or variations within the scope of the technical ideas described in the claims, and it is understood that such modifications or variations also belong to the technical scope of the present invention.

(1) First supplement

[0118] In the above-described embodiment, a description has been given of an example of performing switching from a heating period to a non-heating period in accordance with the elapse of time, but the present invention is not limited to this example. For example, the controller 116 may perform switching from a heating period to a non-heating period when the temperature of the heater 121 has risen to a target temperature. With this configuration, it is possible to reliably increase the temperature of the heater 121 to the target temperature in the heating period. Thereafter, the controller 116 may perform switching from the non-heating period to the heating period in accordance with the elapse of time.

[0119] The lengths of the heating period and the non-heating period are not limited to the examples described above. The lengths of the heating period and the non-heating period may be the same or different from each other. The heating period may be longer than the non-heating period, for example, the heating period may be 10 seconds and the non-heating period may be 5 seconds. In this case, it is possible to increase the temperature of the heater 121 stepwise. For example, in the example of the heating profile shown in Table 1, it is desired to make the heating period longer than the non-heating period at timings at which the target temperature is switched after 110 seconds, 180 seconds, and 260 seconds from the start of heating. In this case, it is possible to quickly increase the temperature of the heater 121 to the target temperature after the switching.

[0120] In addition, the lengths of the heating period and the non-heating period may be increased or decreased. For example, the heating period may be $10 + \alpha$ seconds, the non-heating period may be 10 seconds, and α may increase as the heating profile progresses toward the end. With this configuration, it is possible to easily increase the temperature of the heater 121 as the heating profile progresses toward the end.

(2) Second supplement

[0121] In the above-described embodiment, a description has been given of an example in which the target temperature is switched in accordance with the elapse of time, but the present invention is not limited to this example.

[0122] In an example, the controller 116 may switch the target temperature on the basis of the number of times the temperature of the heater 121 has reached the target temperature. For example, the controller 116 switches the target temperature every time the temperature of the heater 121 reaches the target temperature three times in the temperature re-rise period. The number of times may vary according to the target temperature or may be the same. In this case, information indicating the timing at which the temperature control is to be performed on the basis of the target temperature in the heating profile is defined by the number of times the temperature of the heater 121 has reached the target temperature after the start of heating.

[0123] With this configuration, even in a case where the temperature of the heater 121 is less prone to rise than expected due to circumstances such as a low outside air temperature, the target temperature can be switched after the number of times the temperature of the heater 121 has risen to the target temperature reaches a specified number of times. Thus, it is possible to realize heating suitable for an environment such as an outside air temperature.

[0124] In another example, the controller 116 may switch the target temperature on the basis of the number of times switching between a heating period and a non-heating period has been performed. For example, the controller 116 switches the target temperature every time a set of a heating period and a non-heating period is repeated three times in the temperature re-rise period. The number of times may vary according to the target temperature or may be the same. In this case, information indicating the timing at which the temperature control is to be performed on the basis of the target temperature in the heating profile is defined by the number of times switching between a heating period and a non-heating period has been performed.

[0125] With this configuration, the timing to switch the target temperature can be made coincident with the timing of switching between a heating period and a non-heating period, and thus the temperature control can be simplified.

[0126] Here, the controller 116 may control the number of times the temperature of the heater 121 has risen to the

target temperature or the number of times switching between a heating period and a non-heating period has been performed, which is used as a criterion for switching the target temperature. The number of times the temperature of the heater 121 has risen to the target temperature and the number of times switching between a heating period and a non-heating period has been performed will be hereinafter collectively referred to as the number of peaks. This is because

[0127] In an example, the controller 116 may decrease the number of peaks serving as a criterion for switching the target temperature in a stepwise manner. For example, regarding the heating profile shown in Table 1, the controller 116 may switch the target temperature to 240°C when a peak has appeared four times in the target temperature of 230°C. Subsequently, the controller 116 may switch the target temperature to 250°C when a peak has appeared three times in the target temperature of 240°C. Subsequently, the controller 116 may switch the target temperature to 260°C when a peak has appeared twice in the target temperature of 250°C. With this configuration, it is possible to reduce the number of times the heater 121 reaches a high temperature, that is, the number of times the stick substrate 150 reaches a high temperature. Thus, a decrease in the aerosol source is alleviated, and thus the life of the stick substrate 150 can be extended.

[0128] In another example, the controller 116 may increase the number of peaks serving as a criterion for switching the target temperature in a stepwise manner. For example, regarding the heating profile shown in Table 1, the controller 116 may switch the target temperature to 240°C when a peak has appeared twice in the target temperature of 230°C. Subsequently, the controller 116 may switch the target temperature to 250°C when a peak has appeared three times in the target temperature of 240°C. Subsequently, the controller 116 may switch the target temperature to 260°C when a peak has appeared four times in the target temperature of 250°C. With this configuration, it is possible to increase the number of times the heater 121 reaches a high temperature, that is, the number of times the stick substrate 150 reaches a high temperature. Thus, it is possible to increase the amount of flavor delivered to the user per puff and increase the satisfaction per puff as the heating profile progresses toward the end.

[0129] In another example, the controller 116 may set the numbers of peaks serving as a criterion for switching the target temperature to be the same. For example, regarding the heating profile shown in Table 1, the controller 116 may switch the target temperature to 240°C when a peak has appeared three times in the target temperature of 230°C. Subsequently, the controller 116 may switch the target temperature to 250°C when a peak has appeared three times in the target temperature of 240°C. Subsequently, the controller 116 may switch the target temperature to 260°C when a peak has appeared three times in the target temperature of 250°C. With this configuration, it is possible to both extend the life of the stick substrate 150 and increase the satisfaction per puff.

[0130] In another example, the controller 116 may randomly set the numbers of peaks serving as a criterion for switching the target temperature. For example, regarding the heating profile shown in Table 1, the controller 116 may switch the target temperature to 240°C when a peak has appeared three times in the target temperature of 230°C. Subsequently, the controller 116 may switch the target temperature to 250°C when a peak has appeared four times in the target temperature of 240°C. Subsequently, the controller 116 may switch the target temperature to 260°C when a peak has appeared twice in the target temperature of 250°C. With this configuration, the user is able to taste a random flavor.

[0131] The number of peaks serving as a criterion for switching the target temperature may be set by the user. In this case, the user is able to taste a flavor he or she likes.

(3) Third supplement

[0132] The width of rise in the target temperature in the temperature re-rise period may be set in any manner.

[0133] In an example, the width of rise in the target temperature in the temperature re-rise period may be constant. For example, as in the example shown in Table 1, the target temperature in the temperature re-rise period may be initially set to 230°C, then to 240°C, then to 250°C, and finally to 260°C. In this case, the width of rise is constantly 10°C. With this configuration, the temperature of the heater 121 gradually rises, and thus the life of the stick substrate 150 can be extended.

[0134] In another example, the width of rise in the target temperature in the temperature re-rise period may be increased stepwise. For example, the target temperature in the temperature re-rise period may be initially set to 230°C, then to 240°C, then to 255°C, and finally to 275°C. In this case, the width of rise in temperature increases stepwise from 10°C to 15°C, and from 15°C to 20°C. With this configuration, it is possible to increase the amount of flavor delivered to the user per puff and increase the satisfaction per puff as the heating profile progresses toward the end.

(4) Others

[0135] In the above-described embodiment, a description has been given of an example of providing information prompting a puff in the temperature re-rise period, but the present invention is not limited to this example. The notifier 113 may provide information prompting a puff in the initial temperature rise period or the intermediate temperature drop period.

[0136] A series of processes performed by the individual devices described in this specification may be implemented by using any of software, hardware, and a combination of software and hardware. Programs constituting the software are stored in advance in, for example, a recording medium (non-transitory medium) provided inside or outside each device. Each program is read into a RAM and is executed by a processor such as a CPU when being executed by a computer that controls each device described in this specification, for example. The recording medium is, for example, a magnetic disk, an optical disc, a magneto-optical disc, a flash memory, or the like. In addition, the foregoing computer program may be distributed via a network, for example, without using a recording medium.

[0137] In addition, the processes described using a flowchart and a sequence diagram in this specification need not necessarily be executed in the illustrated order. Some processing steps may be executed in parallel. In addition, an additional processing step may be employed, and some processing steps may be omitted.

[0138] The following configurations also belong to the technical scope of the present invention.

(1)

An inhaler device including:

a power supply configured to store and supply electric power;
 a heater configured to heat a substrate including an aerosol source to generate an aerosol; and
 a controller configured to control, based on a heating condition, supply of electric power to the heater from the power supply, wherein
 the heating condition includes a heating profile and information defining a heating period and a non-heating period, the heating profile being information defining transition of a target temperature which is a target value of a temperature of the heater, the heating period being a period during which the substrate is heated, the non-heating period being a period during which the substrate is not heated, and
 the controller is configured to control the supply of electric power to the heater so that the temperature of the heater rises to the target temperature, while alternately switching between the heating period and the non-heating period.

(2) The inhaler device according to (1) above, wherein

the controller is configured to execute the supply of electric power to the heater in the heating period.

(3) The inhaler device according to (2) above, wherein

the controller is configured to perform, in the heating period, execution of the supply of electric power to the heater and stop of the supply of electric power to the heater while alternately switching between the execution and the stop.

(4) The inhaler device according to any one of (1) to (3) above, wherein

the controller is configured to keep the supply of electric power to the heater stopped over an entirety of the non-heating period.

(5) The inhaler device according to any one of (1) to (4) above, wherein

the heating period and the non-heating period each have a length that is equal to or longer than a time taken for a user to perform an action of inhaling the generated aerosol at least once.

(6) The inhaler device according to any one of (1) to (5) above, wherein

the heating period and the non-heating period each have a length of two seconds or more. (7)

(7) The inhaler device according to any one of (1) to (6) above, wherein

the heating period and the non-heating period are set in a period during which the temperature of the heater rises in the heating profile.

(8) The inhaler device according to (7) above, wherein

the heating profile includes

an initial temperature rise period during which the temperature of the heater rises from an initial temperature,

an intermediate temperature drop period during which the temperature of the heater drops after the initial temperature rise period, and

a temperature re-rise period during which the temperature of the heater rises after the intermediate temperature drop period, and

the heating period and the non-heating period are set in the temperature re-rise period.

(9) The inhaler device according to any one of (1) to (8) above, wherein the controller is configured to switch between the heating period and the non-heating period in accordance with elapse of time.

(10) The inhaler device according to (9) above, wherein

the controller is configured to, in a case where the temperature of the heater rises to the target temperature in the heating period, perform control so that the temperature of the heater is maintained at the target temperature until switching to the non-heating period.

(11) The inhaler device according to (9) or (10) above, wherein

the controller is configured to, even in a case where the temperature of the heater does not rise to the target temperature in the heating period, stop the supply of electric power to the heater in the non-heating period subsequent to the heating period.

(12) The inhaler device according to any one of (9) to (11) above, wherein

the controller is configured to, in a case where the temperature of the heater does not rise to the target temperature in the heating period, perform control so that an amount of electric power supplied in a next heating period is larger than in a case where the temperature of the heater rises to the target temperature in the heating period.

(13) The inhaler device according to any one of (1) to (8) above, wherein

the controller is configured to perform switching from the heating period to the non-heating period in response to the temperature of the heater rising to the target temperature.

(14) The inhaler device according to any one of (1) to (13) above, wherein

the controller is configured to perform switching from the non-heating period to the heating period in response to the temperature of the heater decreasing to a lower limit temperature which is a lower limit value of the temperature of the heater.

(15) The inhaler device according to (14) above, wherein

the heating condition further includes transition of the lower limit temperature.

(16) The inhaler device according to any one of (1) to (15) above, wherein

the controller is configured to switch the target temperature in accordance with elapse of time.

(17) The inhaler device according to any one of (1) to (15) above, wherein

the controller is configured to switch the target temperature in accordance with the number of times the temperature of the heater has risen to the target temperature or the number of times switching between the heating period and the non-heating period has been performed.

(18) The inhaler device according to (17) above, wherein

the controller is configured to control the number of times the temperature of the heater has risen to the target temperature or the number of times switching between the heating period and the non-heating period has been performed, each of the numbers being a criterion for switching the target temperature.

(19) A control method for controlling an inhaler device including a power supply configured to store and supply electric power, and a heater configured to heat a substrate including an aerosol source to generate an aerosol, the control method including:

controlling, based on a heating condition, supply of electric power to the heater from the power supply so that a temperature of the heater rises to a target temperature which is a target value of the temperature of the heater, while alternately switching between a heating period and a non-heating period, the heating condition including a heating profile and information defining the heating period and the non-heating period, the heating profile being information defining transition of the target temperature, the heating period being a period during which the substrate is heated, the non-heating period being a period during which the substrate is not heated.

(20) A program for causing a computer that controls an inhaler device including a power supply configured to store and supply electric power, and a heater configured to heat a substrate including an aerosol source to generate an aerosol, to execute:

controlling, based on a heating condition, supply of electric power to the heater from the power supply so that a temperature of the heater rises to a target temperature which is a target value of the temperature of the heater, while alternately switching between a heating period and a non-heating period, the heating condition including a heating profile and information defining the heating period and the non-heating period, the heating profile being information defining transition of the target temperature, the heating period being a period during which the substrate is heated, the non-heating period being a period during which the substrate is not heated.

Reference Signs List

[0139]

100 inhaler device

	111	power supply
	112	sensor
	113	notifier
	114	memory
5	115	communicator
	116	controller
	121	heater
	140	holder
	141	internal space
10	142	opening
	143	bottom
	144	heat insulator
	150	stick substrate
	151	substrate
15	152	inhalation port

Claims

- 20 1. An inhaler device comprising:
- a power supply configured to store and supply electric power;
a heater configured to heat a substrate including an aerosol source to generate an aerosol; and
a controller configured to control, based on a heating condition, supply of electric power to the heater from the
25 power supply, wherein
the heating condition includes a heating profile and information defining a heating period and a non-heating
period, the heating profile being information defining transition of a target temperature which is a target value
of a temperature of the heater, the heating period being a period during which the substrate is heated, the non-
heating period being a period during which the substrate is not heated, and
30 the controller is configured to control the supply of electric power to the heater so that the temperature of the
heater rises to the target temperature, while alternately switching between the heating period and the non-
heating period.
- 35 2. The inhaler device according to claim 1, wherein
the controller is configured to execute the supply of electric power to the heater in the heating period.
3. The inhaler device according to claim 2, wherein
the controller is configured to perform, in the heating period, execution of the supply of electric power to the heater
and stop of the supply of electric power to the heater while alternately switching between the execution and the stop.
40 4. The inhaler device according to any one of claims 1 to 3, wherein
the controller is configured to keep the supply of electric power to the heater stopped over an entirety of the non-
heating period.
- 45 5. The inhaler device according to any one of claims 1 to 4, wherein
the heating period and the non-heating period each have a length that is equal to or longer than a time taken for a
user to perform an action of inhaling the generated aerosol at least once.
- 50 6. The inhaler device according to any one of claims 1 to 5, wherein
the heating period and the non-heating period each have a length of two seconds or more.
7. The inhaler device according to any one of claims 1 to 6, wherein
the heating period and the non-heating period are set in a period during which the temperature of the heater rises
in the heating profile.
55 8. The inhaler device according to claim 7, wherein
the heating profile includes

an initial temperature rise period during which the temperature of the heater rises from an initial temperature, an intermediate temperature drop period during which the temperature of the heater drops after the initial temperature rise period, and
 a temperature re-rise period during which the temperature of the heater rises after the intermediate temperature drop period, and
 the heating period and the non-heating period are set in the temperature re-rise period.

9. The inhaler device according to any one of claims 1 to 8, wherein the controller is configured to switch between the heating period and the non-heating period in accordance with elapse of time.
10. The inhaler device according to claim 9, wherein the controller is configured to, in a case where the temperature of the heater rises to the target temperature in the heating period, perform control so that the temperature of the heater is maintained at the target temperature until switching to the non-heating period.
11. The inhaler device according to claim 9 or 10, wherein the controller is configured to, even in a case where the temperature of the heater does not rise to the target temperature in the heating period, stop the supply of electric power to the heater in the non-heating period subsequent to the heating period.
12. The inhaler device according to any one of claims 9 to 11, wherein the controller is configured to, in a case where the temperature of the heater does not rise to the target temperature in the heating period, perform control so that an amount of electric power supplied in a next heating period is larger than in a case where the temperature of the heater rises to the target temperature in the heating period.
13. The inhaler device according to any one of claims 1 to 8, wherein the controller is configured to perform switching from the heating period to the non-heating period in response to the temperature of the heater rising to the target temperature.
14. The inhaler device according to any one of claims 1 to 13, wherein the controller is configured to perform switching from the non-heating period to the heating period in response to the temperature of the heater decreasing to a lower limit temperature which is a lower limit value of the temperature of the heater.
15. The inhaler device according to claim 14, wherein the heating condition further includes transition of the lower limit temperature.
16. The inhaler device according to any one of claims 1 to 15, wherein the controller is configured to switch the target temperature in accordance with elapse of time.
17. The inhaler device according to any one of claims 1 to 15, wherein the controller is configured to switch the target temperature in accordance with the number of times the temperature of the heater has risen to the target temperature or the number of times switching between the heating period and the non-heating period has been performed.
18. The inhaler device according to claim 17, wherein the controller is configured to control the number of times the temperature of the heater has risen to the target temperature or the number of times switching between the heating period and the non-heating period has been performed, each of the numbers being a criterion for switching the target temperature.
19. A control method for controlling an inhaler device including a power supply configured to store and supply electric power, and a heater configured to heat a substrate including an aerosol source to generate an aerosol, the control method comprising:
 controlling, based on a heating condition, supply of electric power to the heater from the power supply so that a temperature of the heater rises to a target temperature which is a target value of the temperature of the heater, while alternately switching between a heating period and a non-heating period, the heating condition including a heating profile and information defining the heating period and the non-heating period, the heating profile being

information defining transition of the target temperature, the heating period being a period during which the substrate is heated, the non-heating period being a period during which the substrate is not heated.

- 5 **20.** A program for causing a computer that controls an inhaler device including a power supply configured to store and supply electric power, and a heater configured to heat a substrate including an aerosol source to generate an aerosol, to execute:
- 10 controlling, based on a heating condition, supply of electric power to the heater from the power supply so that a temperature of the heater rises to a target temperature which is a target value of the temperature of the heater, while alternately switching between a heating period and a non-heating period, the heating condition including a heating profile and information defining the heating period and the non-heating period, the heating profile being information defining transition of the target temperature, the heating period being a period during which the substrate is heated, the non-heating period being a period during which the substrate is not heated.

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FIG. 1

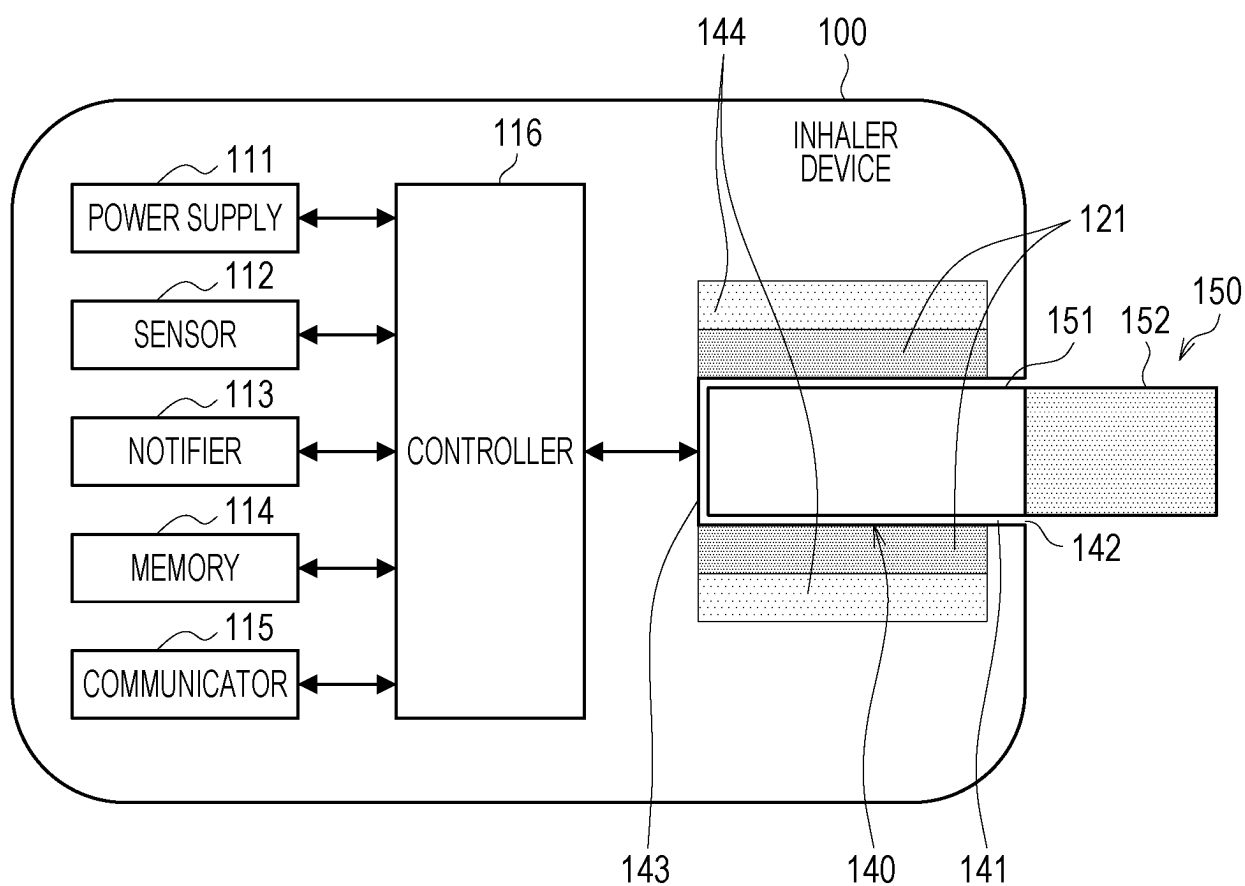


FIG. 2

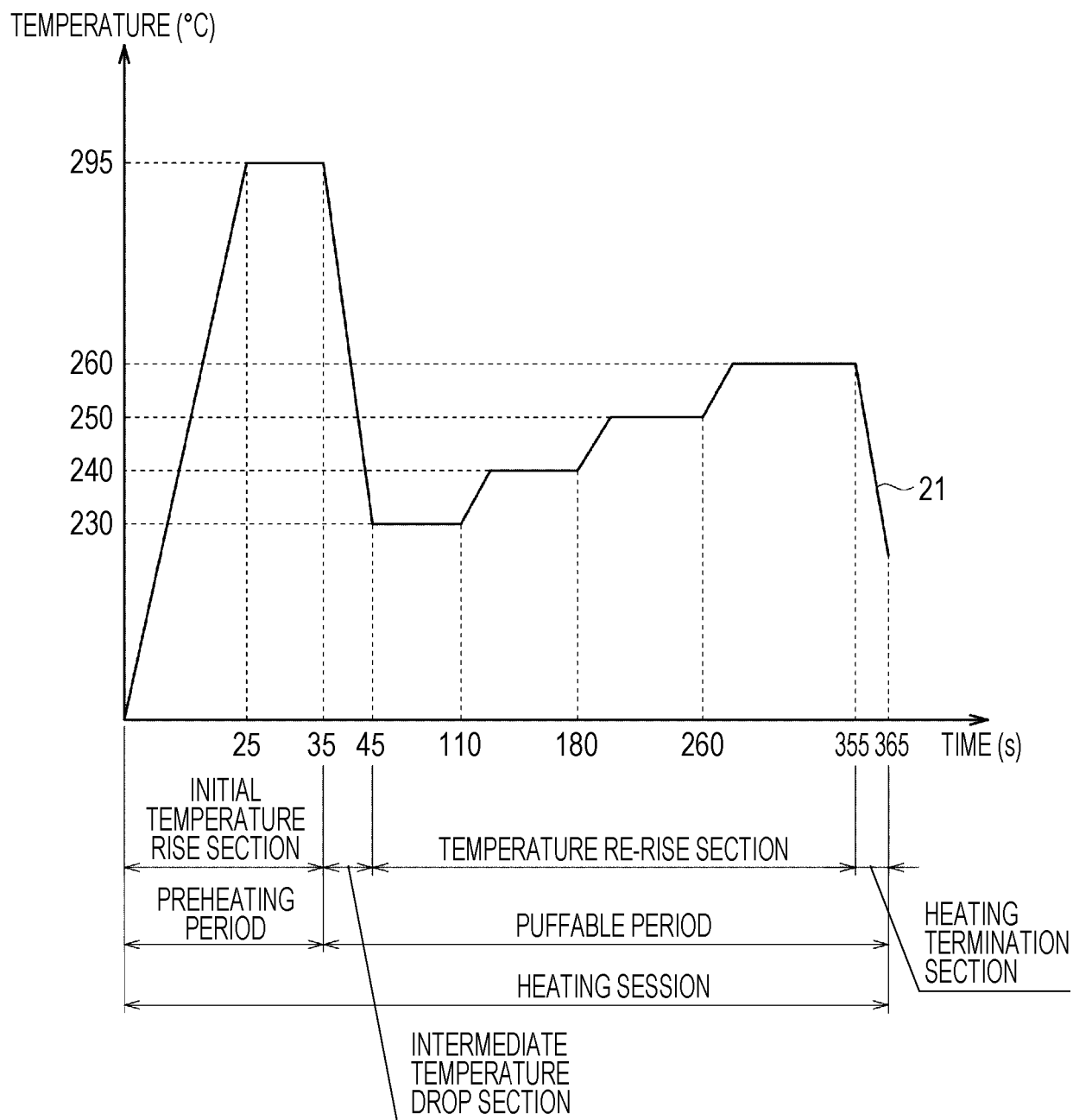


FIG. 3

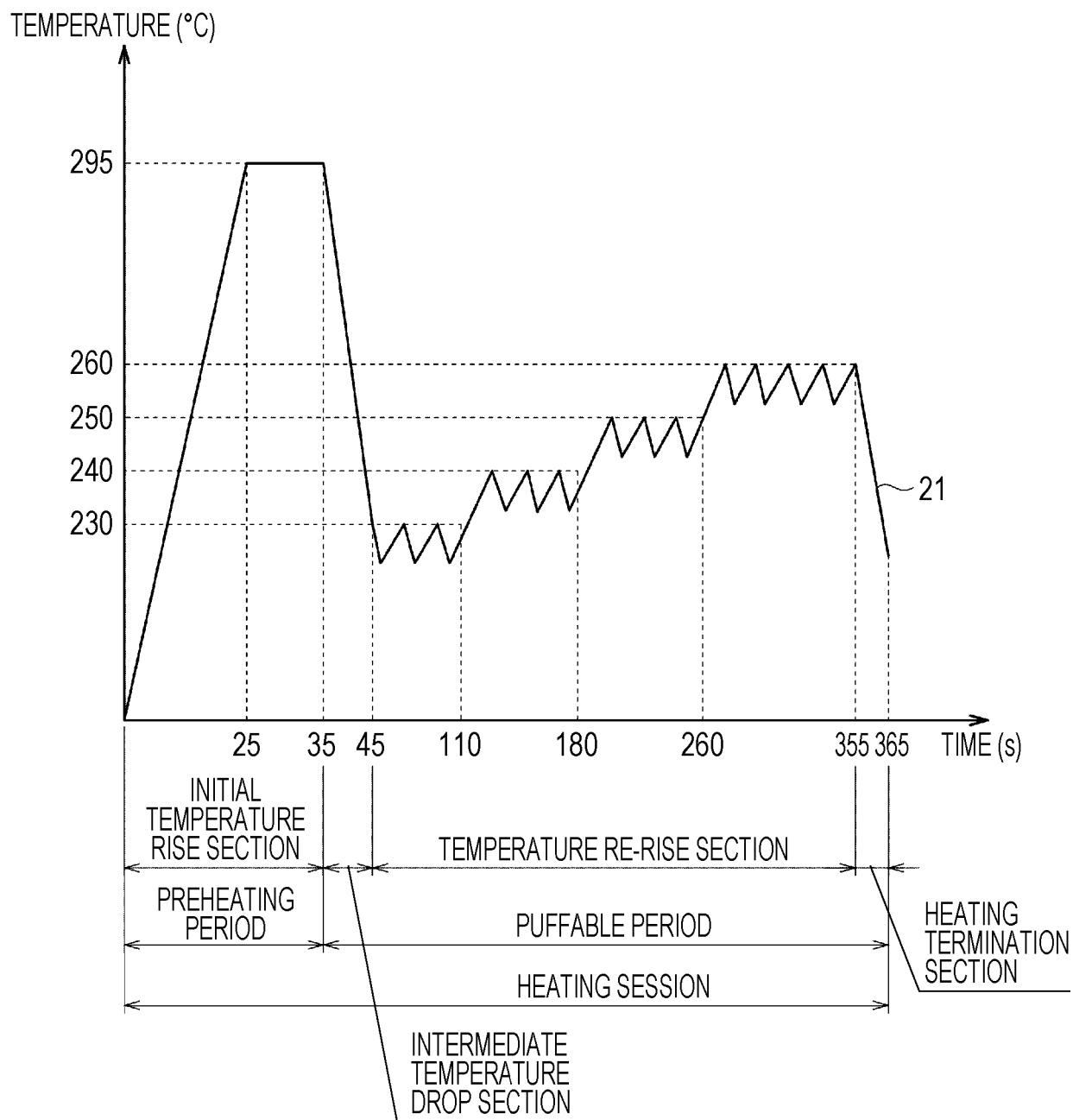


FIG. 4

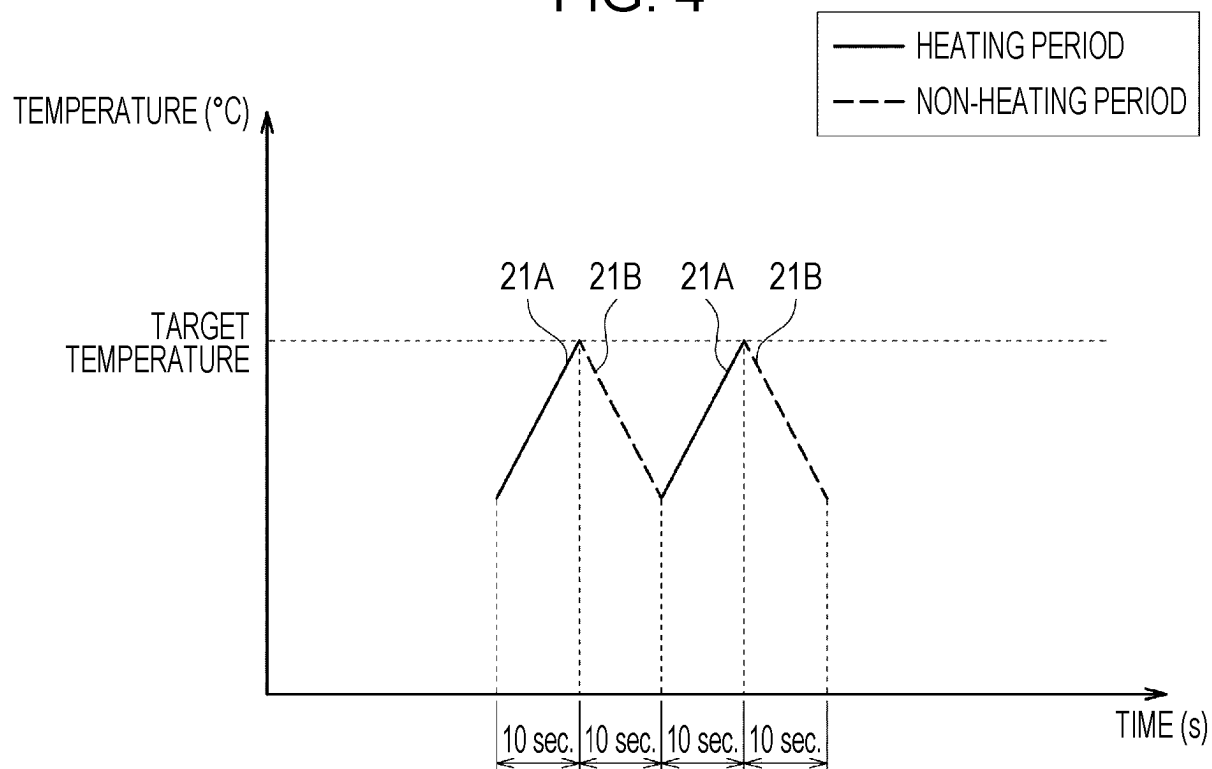


FIG. 5

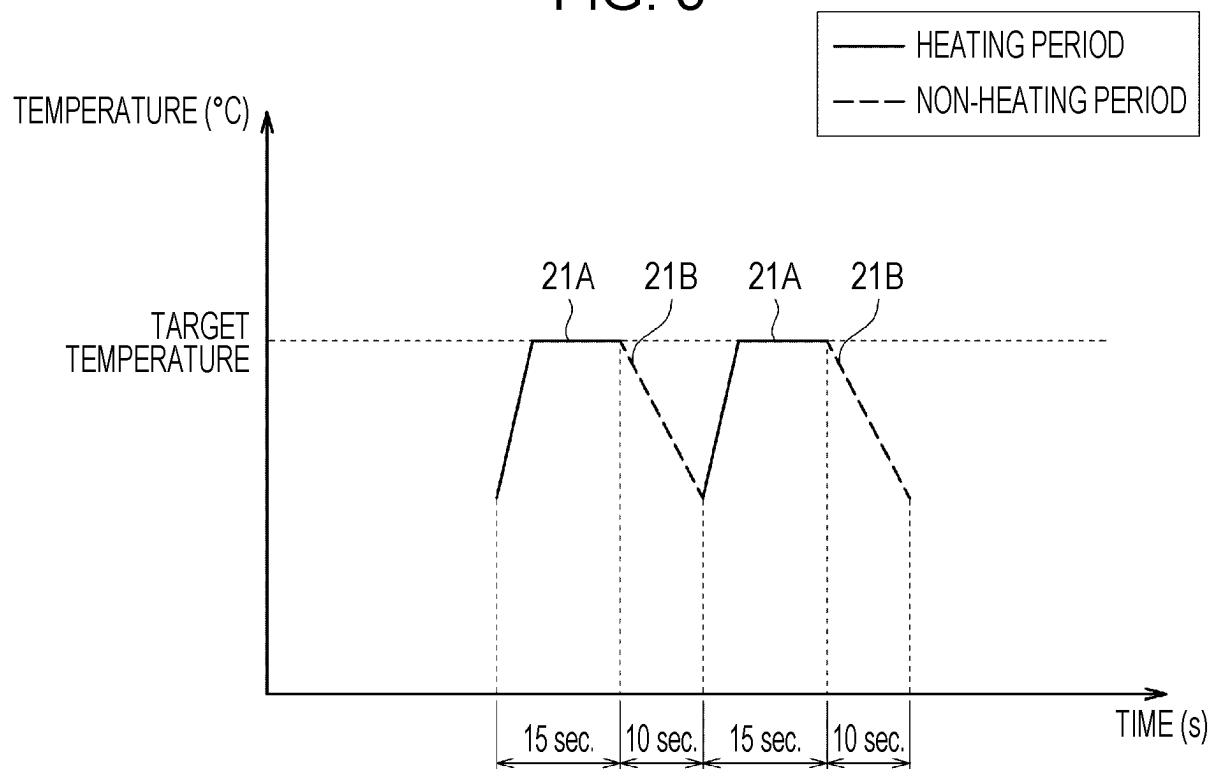


FIG. 6

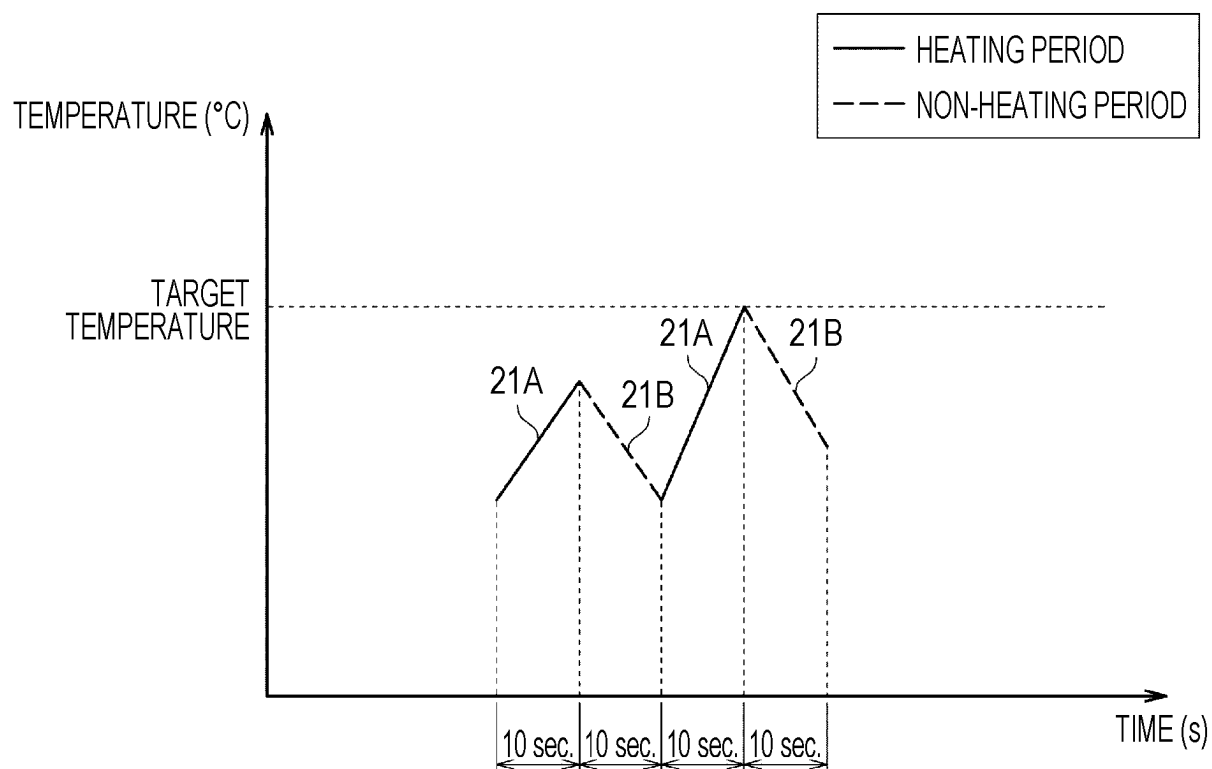


FIG. 7

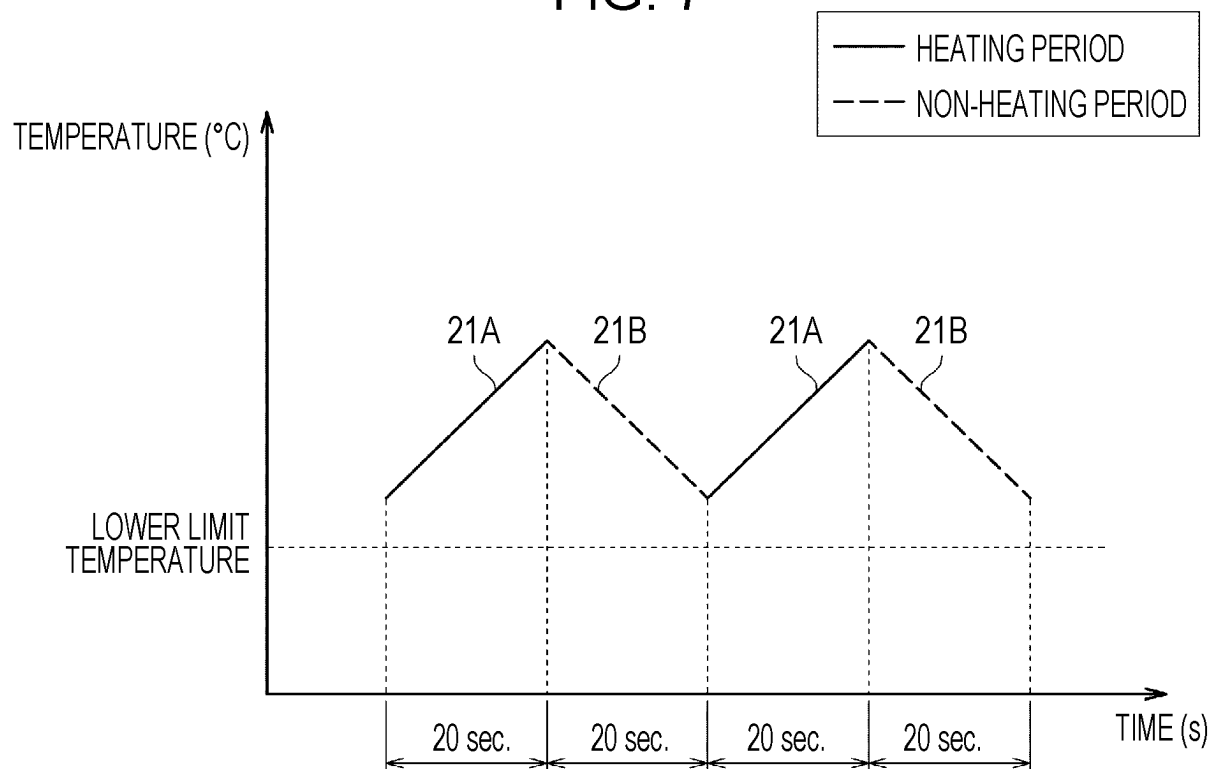


FIG. 8

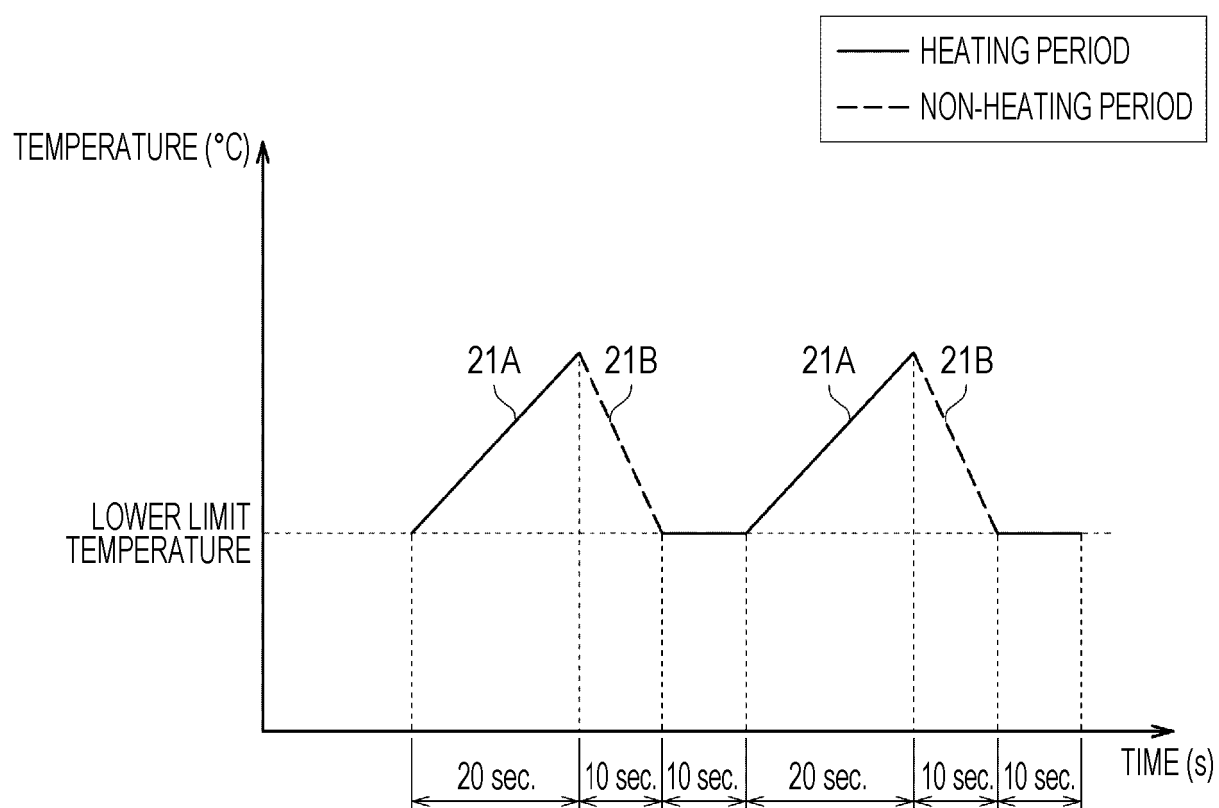


FIG. 9

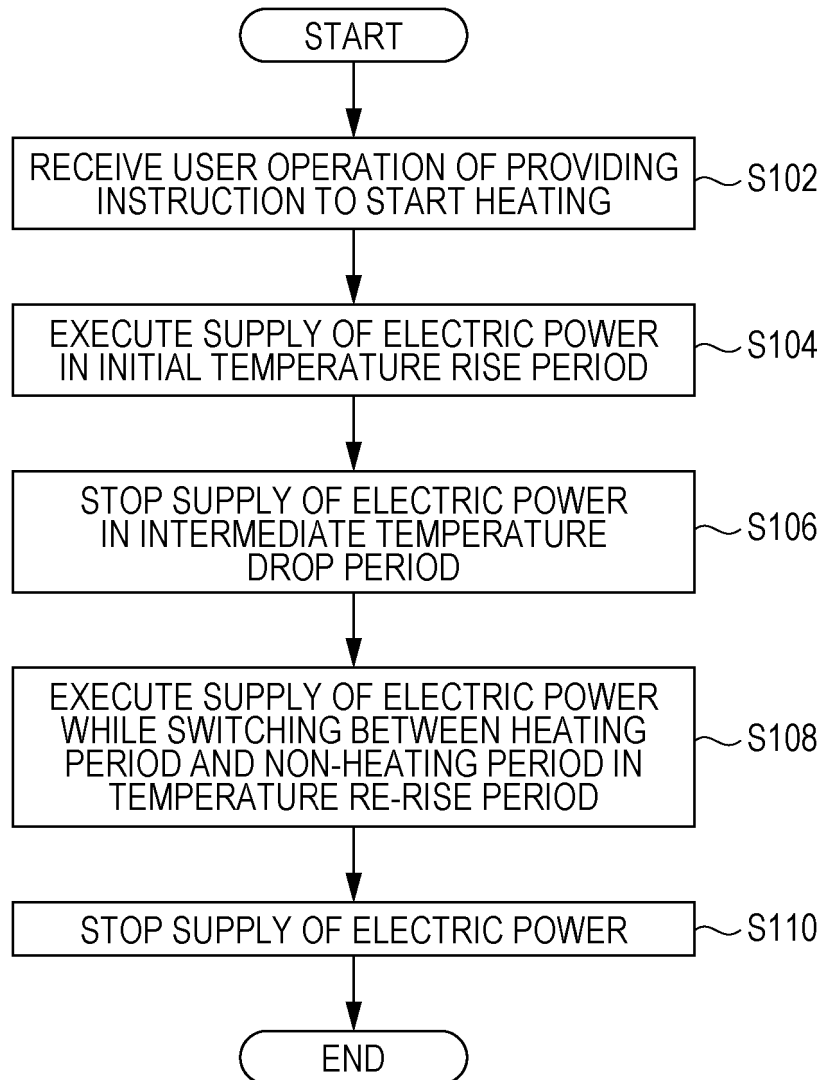


FIG. 10

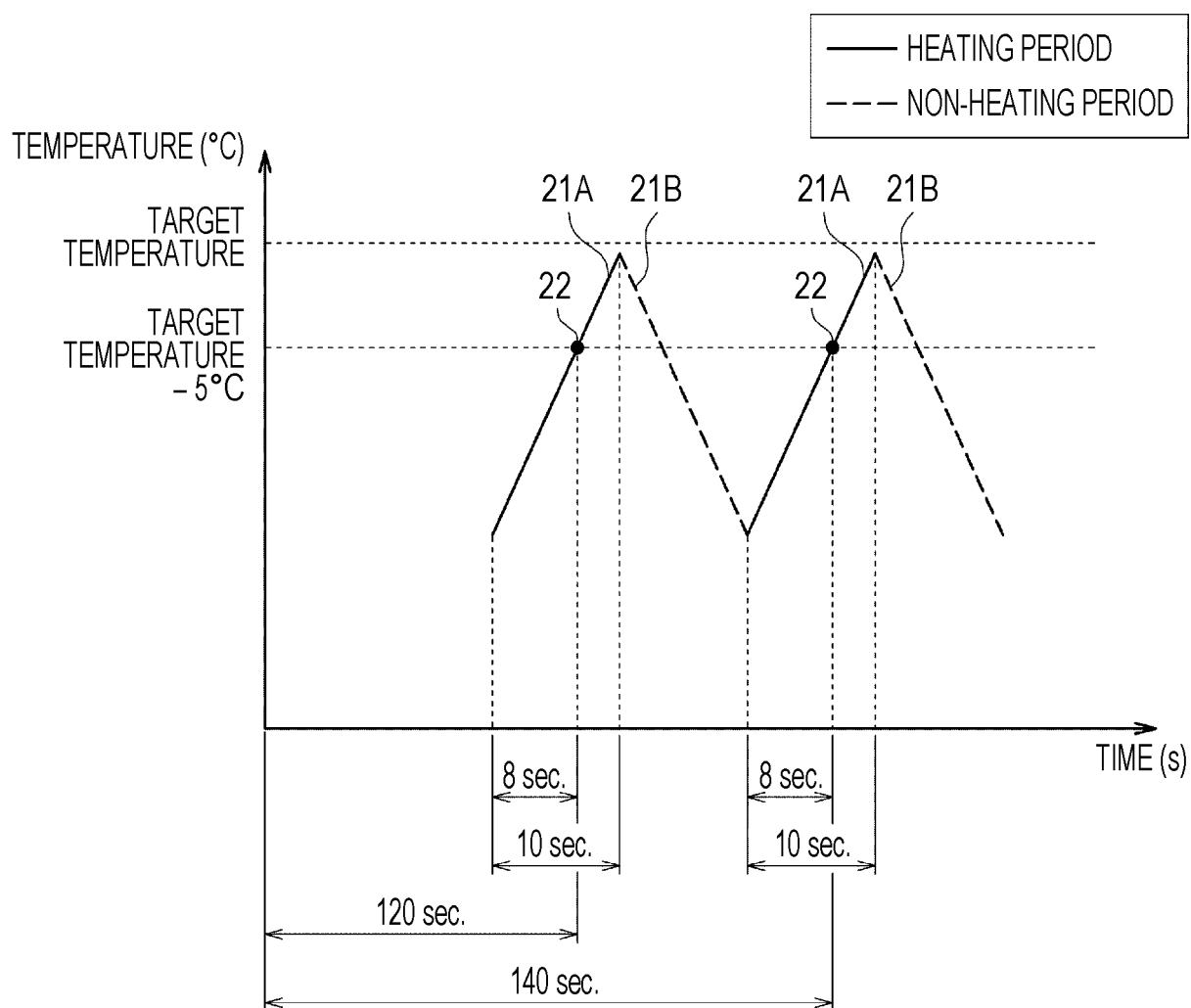


FIG. 11

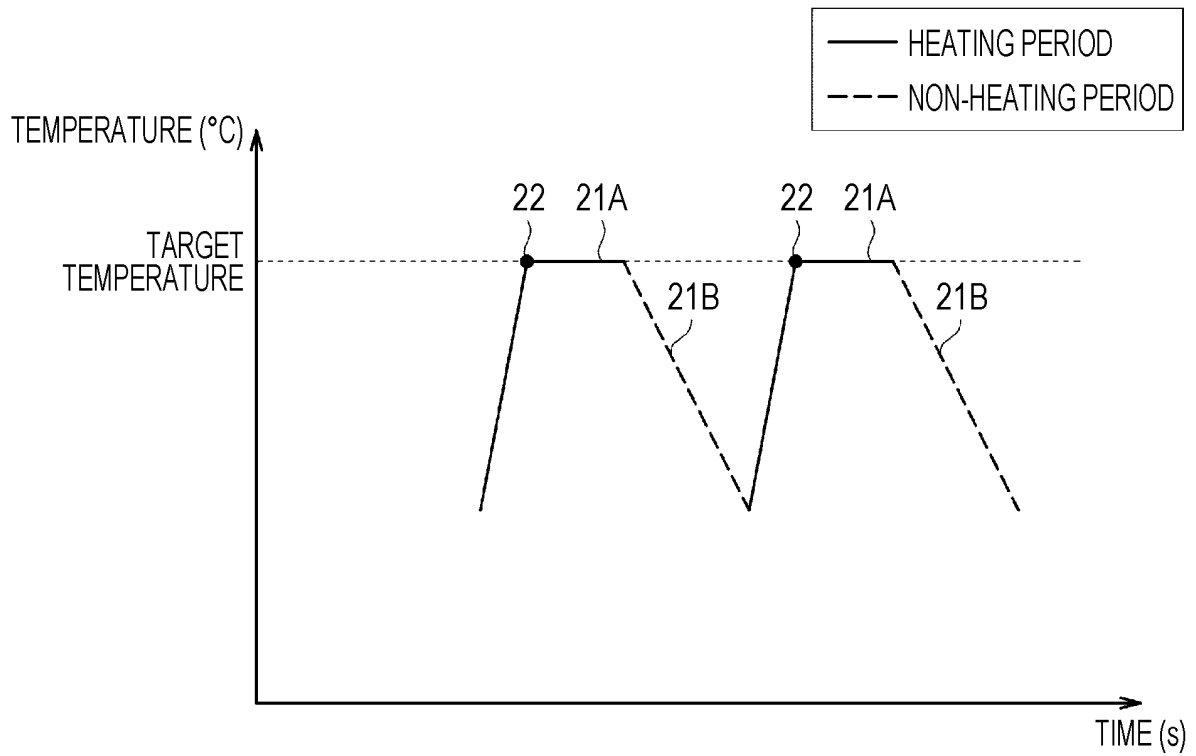
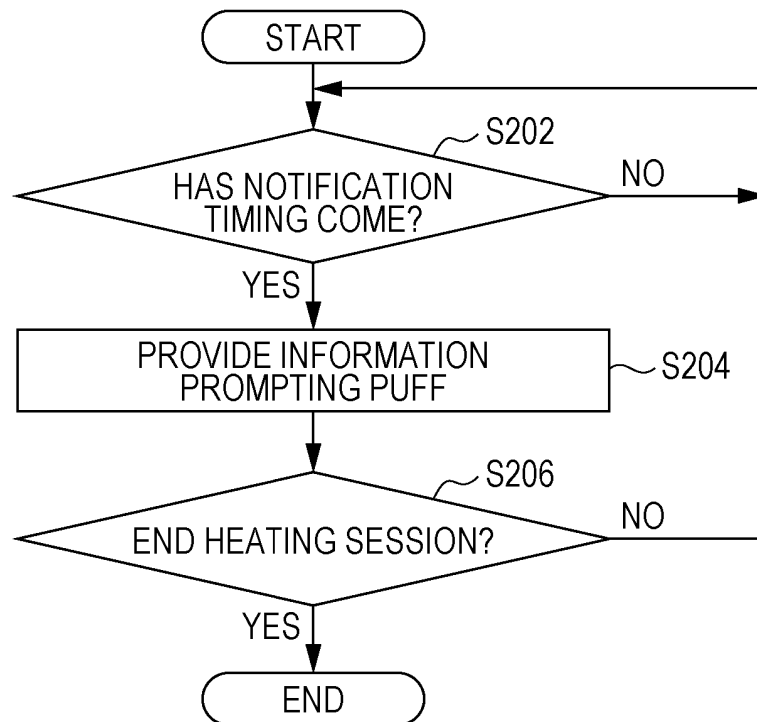


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/011978

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. A24F40/57 (2020.01) i
FI: A24F40/57

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)
Int. Cl. A24F40/57

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 1971-2021
Registered utility model specifications of Japan 1996-2021
Published registered utility model applications of Japan 1994-2021

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2016/194075 A1 (JAPAN TOBACCO INC.) 08 December 2016 (2016-12-08), paragraphs [0024]-[0140], fig. 1-11	1-20
Y	WO 2019/068821 A1 (PHILIP MORRIS PRODUCTS S.A.) 11 April 2019 (2019-04-11), p. 11, line 39 to p. 12, line 37, fig. 4	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search
17.05.2021

Date of mailing of the international search report
01.06.2021

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
 Information on patent family members

 International application No.
 PCT/JP2021/011978

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
WO 2016/194075 A1	08.12.2016	US 2018/0077971 A1 paragraphs [0034]– [0159], fig. 1–11 EP 3289894 A1 EP 3566595 A1 EP 3569081 A1 EP 3574780 A1 TW 201641028 A CN 107613797 A CN 109907372 A CN 110353312 A CN 110353313 A CN 110353314 A CN 110353315 A HK 1246101 A1	
WO 2019/068821 A1	11.04.2019	US 2020/275707 A1 EP 3691482 A1 CN 111093409 A KR 10-2020-0067139 A	

REFERENCES CITED IN THE DESCRIPTION

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