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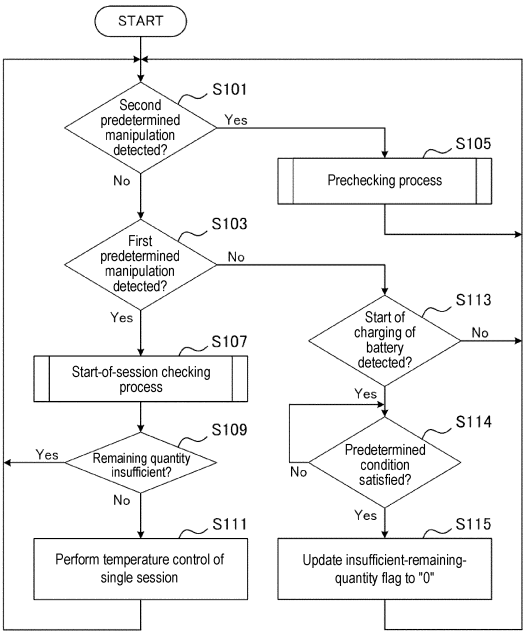
(54) **FLAVOR INHALER OR AEROSOL GENERATION DEVICE, AND OPERATION METHOD AND PROGRAM FOR SAME**

(57) The present invention provides a flavor inhaler or similar that is configured such that when heating for generating a flavor or similar using power from a power supply is restricted, the restriction is not released if the remaining capacity of the power supply is insufficient. Provided is a device that is a flavor inhaler or an aerosol generation device comprising a heater that is configured to heat one or both of a flavor source and an aerosol source, a power supply that supplies power to the heater, and a control unit that is configured to restrict the heating by the heater when the remaining capacity of the power supply is insufficient, wherein the control unit is further configured such that, when the heating by the heater is restricted, the control unit releases the restriction on the basis of a prescribed condition being fulfilled after the start of charging of the power supply (S113, S114, S115).

Fig. 7



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Description

TECHNICAL FIELD

[0001] The present application relates to a flavor inhaler or an aerosol generation device (hereinafter, a "flavor inhaler or the like").

[0002] In this regard, a flavor inhaler is a device used for inhaling flavor, and the flavor inhalers include a heating-type flavor inhaler (which generates flavor by applying heat) and a non-heating-type flavor inhaler (which generates flavor by performing ultrasonic atomization, for example). For example, although there is no intention to limit the flavor inhalers, the flavor inhalers include, specifically, an electronic cigarette, a heated tobacco product, and conventional tobacco. Further, an "aerosol generation device" is a device used for inhaling generated aerosol, and the aerosol generation devices include a heating-type aerosol generation device (which generates aerosol by applying heat) and a non-heating-type aerosol generation device (which generates aerosol by performing ultrasonic atomization, for example). For example, although there is no intention to limit the aerosol generation devices, the aerosol generation devices include, specifically, an electronic cigarette, a heated tobacco product, and a medical nebulizer. Thus, at least some of the flavor inhalers are aerosol generation devices, and at least some of the aerosol generation devices are flavor inhalers. Further, a heating-type aerosol generation device or the like which does not perform any combustion process, for example, an electronic cigarette, may be referred to as a RRP (Reduced-Risk Product).

BACKGROUND ART

[0003] Conventionally, in a flavor inhaler or the like which comprises a power supply such as a battery or the like and generates flavor and/or aerosol (hereinafter, "flavor or the like") by applying heat generated by using electric power from the power supply, control for checking a remaining quantity of power in the power supply before performing heating and restricting heating if the remaining quantity of power in the power supply is insufficient is performed (for example, refer to Patent Literature 1). Further, control for removing such a restriction with respect to heating, in response to charging of the power supply, is performed.

CITATION LIST

PATENT LITERATURE

[0004] PTL 1: PCT international publication No. WO 2020/084757

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] In this regard, there is a problem such that the restriction with respect to heating is removed even if the remaining quantity of power in the power supply is insufficient, if the restriction with respect to heating is removed simply in response to charging of the power supply.

[0006] The present invention has been achieved in view of the above matter; and an object of the present invention is to provide a flavor inhaler or the like which is configured in such a manner that, if heating for generating flavor or the like by using electric power from a power supply is being restricted, the restriction is not removed if the remaining quantity of power in the power supply is insufficient.

SOLUTION TO PROBLEM

[0007] According to an embodiment of the present invention, for solving the above problem, a device that is a flavor inhaler or an aerosol generation device is provided, and the device comprises: a heater configured to heat a flavor source and/or an aerosol source; a power supply for supplying electric power to the heater; and a controller configured to restrict heating performed by the heater, if a remaining quantity in the power supply is insufficient, and the controller is further configured to remove, if the heating performed by the heater is restricted, the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

[0008] In an embodiment, the controller may further be configured to perform, in response to a first predetermined manipulation applied to the device to start heating performed by the heater, a first determination with respect to whether the remaining quantity in the power supply is insufficient.

[0009] In an embodiment, the first determination may include: measuring the remaining quantity in the power supply; and/or temporarily supplying electric power from the power supply to the heater to measure an operating voltage of the power supply.

[0010] In an embodiment, the controller may further be configured to perform, in response to a second predetermined manipulation that is different from the first predetermined manipulation and is applied to the device, a second determination with respect to whether the remaining quantity in the power supply is insufficient.

[0011] In an embodiment, the controller may further be configured to set, if it is determined that the remaining quantity in the power supply is insufficient, an insufficient-remaining-quantity state: and the second determination may comprise: determining whether the insufficient-remaining-quantity state has been set; performing a measuring process if it is not determined that the insufficient-remaining-quantity state has been set, the measuring process comprising: measuring the remaining quantity in

the power supply; and/or temporarily supplying electric power from the power supply to the heater to measure an operating voltage of the power supply; and operation for omitting the measuring process if it is determined that the insufficient-remaining-quantity state has been set.

[0012] In an embodiment, the predetermined condition may be a condition that the remaining quantity in the power supply has increased by a predetermined quantity or more with reference to the remaining quantity in the power supply that was measured before a start of charging of the power supply.

[0013] In an embodiment, the predetermined quantity may be a quantity that is sufficient to perform a determination with respect to whether the remaining quantity in the power supply is insufficient.

[0014] In an embodiment, the device may be configured in such a manner that a base material comprising the flavor source and/or the aerosol source can be replaced, and the predetermined quantity may be a quantity that is sufficient for consuming at least one base material.

[0015] In an embodiment, the controller may further be configured to determine, based on temperature of the power supply, the quantity that is sufficient for consuming the at least one base material.

[0016] The device that is an embodiment may be configured to allow a user to set the predetermined quantity.

[0017] In an embodiment, the controller may further be configured to determine, based on history of use of the device by a user, the predetermined quantity.

[0018] The device which is an embodiment may be configured in such a manner that the predetermined quantity is rewritable.

[0019] In an embodiment, the predetermined condition may be a condition that the power supply has been fully charged.

[0020] In an embodiment, the predetermined condition may be a condition that a predetermined time or more has elapsed since a start of charging of the power supply.

[0021] In an embodiment, the controller may further be configured to: determine a type of an external device connected to the device for charging the power supply; and determine the predetermined time based on the determined type of the external device.

[0022] The device that is an embodiment may be configured in such a manner that the predetermined time is rewritable.

[0023] In an embodiment, restricting by the controller the heating performed by the heater may comprise restricting the heating so as to prevent the heater from starting the heating.

[0024] According to an embodiment of the present invention, for solving the above problem, a method performed by a controller in a device is provided. The device is a flavor inhaler or an aerosol generation device, and comprises a heater configured to heat a flavor source and/or an aerosol source, and a power supply for supplying electric power to the heater. The method comprises steps of: restricting heating performed by the heater if a remaining quantity in the power supply is insufficient; and removing the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

[0025] According to an embodiment of the present invention, for solving the above problem, a program is provided. The program causes a controller in a device to perform steps, The device is a flavor inhaler or an aerosol generation device, and comprises a heater configured to heat a flavor source and/or an aerosol source, and a power supply for supplying electric power to the heater. The steps comprise: restricting heating performed by the heater if the remaining quantity in the power supply is insufficient; and removing the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

ADVANTAGEOUS EFFECTS OF INVENTION

[0026] According to an embodiment of the present invention, removing of a restriction with respect to heating for generating flavor or the like by using electric power from a power supply is prevented, if the remaining quantity of power in the power supply is insufficient. Accordingly, unnecessary repetition of operation for restricting heating performed when the remaining quantity of power in the power supply is insufficient and operation for removing the restriction can be prevented.

BRIEF DESCRIPTION OF DRAWINGS

[0027]

Fig. 1 is a perspective view which shows an external appearance of an aerosol generation device according to an embodiment.

Fig. 2 is an explanatory drawing which is used for explaining insertion of a tobacco stick into the aerosol generation device in Fig. 1.

Fig. 3 is a block diagram which shows an example of a schematic circuit configuration in the aerosol generation device in Fig. 1.

Fig. 4 is an explanatory drawing which is used for explaining an example of a temperature profile that may be realized in a single session.

Fig. 5 is an explanatory drawing which is used for explaining dropping of a power supply voltage along progress of plural sessions.

Fig. 6 is an explanatory drawing which is used for explaining an example of setting of different thresholds for plural temperature ranges.

Fig. 7 is a flow chart which shows an example of a schematic flow of a process performed by an aerosol generation device according to an embodiment.

Fig. 8 is a flow chart which shows an example of a flow of a prechecking process according to an embodiment.

Fig. 9 is a flow chart which shows an example of a flow of a start-of-session checking process according to an embodiment.

Fig. 10 is a flow chart which shows an example of a flow of a voltage measuring process according to an embodiment.

DESCRIPTION OF EMBODIMENTS

[0028] In the following description, embodiments will be explained in detail with reference to the attached figures. In this regard, the following embodiments are not those used for limiting the inventions recited in the claims, and the invention does not necessarily include all combinations of the characteristics explained in relation to the embodiments. Two or more characteristics in the plural characteristics explained in relation to the embodiments may be combined arbitrarily. Also, a reference symbol that is the same as that assigned to one configuration is assigned to the other configuration if the other configuration is the same as or similar to the one configuration, and overlapping explanation of the configuration is omitted.

1 Configuration Example of Device

[0029] In the present specification, an example wherein the technique according to the present disclosure is applied to a non-combustion-type flavor inhaler or the like which generates, without performing a combustion process, aerosol by heating and thereby atomizing a flavor source and/or an aerosol source (hereinafter, a "flavor source or the like") will be explained mainly. In this regard, application is not limited to the example explained above, and the technique according to the present disclosure may be applied to any kinds of flavor sources or the like, such as a combustion-type device, a medical nebulizer, and so on.

1-1 External Appearance

[0030] Fig. 1 is a perspective view which shows an external appearance of a flavor inhaler or the like 10 according to an embodiment. Fig. 2 is an explanatory drawing which is used for explaining insertion of a tobacco stick into the flavor inhaler or the like 10 shown in in Fig. 1. When reference is made to Fig. 1, the flavor inhaler or the like 10 comprises a main body 101, a front panel 102, a display window 103, and a slider 104.

[0031] The main body 101 is a housing which supports, in the inside thereof, one or plural circuit boards of the flavor inhaler or the like 10. In the present embodiment, the main body 101 has an approximately rectangular-parallelepiped shape that is roundish and extends in an upward direction and a downward direction in the figure. The size of the main body 101 may be a size that allows a user to grasp the main body 101 by a hand of the user, for example. The front panel 102 is a flexible panel member which covers the front face of the main body 101. The front panel 102 may be detachable from the main body 101. The front panel 102 also functions as an input unit for accepting a user input. For example, a user input may be detected as a result that a center part of the front panel 102 is pushed by a user and a button (which is not shown in the figure) positioned between the main body 101 and the front panel 102 is pushed accordingly. The display window 103 is a belt-shaped window which is positioned in an approximately center part on the front panel 102 and extends in a longitudinal direction. The display window 103 makes the light emitted from one or plural LEDs (Light Emitting Diodes) arranged between the main body 101 and the front panel 102 be transmitted through it.

[0032] The slider 104 is a cover member which is arranged in such a manner that it can slide in a direction 104a on a top surface of the main body 101. As shown in Fig. 2, an opening 106 on the top surface of the main body 101 is exposed when the slider 104 is slid toward a user's side in the figure (i.e., when the slider 104 is opened). When a user inhales aerosol by using the flavor inhaler or the like 10, the user inserts a tobacco stick 15 into a tubular insertion hole 107 in a direction 106a, through the opening 106 which is exposed by opening the slider 104. That is, the insertion hole 107 has a role as an accepting unit for accepting the tobacco stick 15. A cross section perpendicular to a direction of an axis of the insertion hole 107 may have a circular, elliptical, or polygonal shape, for example, and the cross section area becomes smaller as the position of the cross section approaches closer to the bottom surface. Thus, an outer surface of the tobacco stick 15 inserted into the insertion hole 107 is pressed by an inner surface of the insertion hole 107, and, accordingly, falling of the tobacco stick 15 is prevented by frictional force, and transfer efficiency with respect to heat transfer to the tobacco stick 15 from a heater 130, which will be explained later, is improved. After terminating the aerosol inhaling action, a user pulls the tobacco stick 15 out of the insertion hole 107 and closes the slider 104.

[0033] The tobacco stick 15 is a tobacco article which holds, in the inside of cylindrical rolled paper, a filling material. The filling material of the tobacco stick 15 may be a mixture of an aerosol forming base substance and shredded tobacco, for example. A base substance including any kind of aerosol source, such as glycerin, propylene glycol, triacetin, 1,3-butanediol, or a mixture thereof, for example, may be used as the aerosol forming base substance. The shredded tobacco is a so-called flavor source. The material of the shredded tobacco may be laminae or stems. In this regard, a flavor source which is not originated from tobacco may be used instead of the shredded tobacco. That is, the tobacco stick 15 corresponds to a base substance comprising a flavor source or the like. In this regard, in a different embodiment, a base substance comprising either one of a flavor source and an aerosol source may be used.

[0034] In the following explanation, it is supposed that

the tobacco stick 15 comprises a flavor source or the like, wherein the quantity thereof is that allowing M times of actions for inhaling the flavor source or the like. M may be any integer equal to or greater than 2. For example, M may be a number in a range of approximately 10-20 that is close to the number of times of inhalation actions performed for a single conventional cigarette.

[0035] In this regard, the flavor inhaler or the like 10 is not limited to that explained above, and may be possible to accept an article (for example, a capsule, a cartridge, or a reservoir) which has a shape other than a stick shape. The flavor source or the like included in the article may be solid or liquid.

1-2 Configuration of Circuit

[0036] Fig. 3 is a block diagram which shows an example of a schematic circuit configuration in the flavor inhaler or the like 10. When reference is made to Fig. 3, the flavor inhaler or the like 10 comprises a controller 120, a memory 121, an input detector 122, a state detector 123, a suction detector 124, a light emitter 125, a vibration generator 126, a communication interface (I/F) 127, a connection I/F 128, a heater 130, a first switch 131, a second switch 132, a battery 140, a boosting circuit 141, a remaining quantity meter 142, and a measuring circuit 150.

[0037] The controller 120 may be a processor such as a CPU (Central Processing Unit), a microcontroller, or the like. The controller 120 controls functions of the flavor inhaler or the like 10 in general, by executing a computer program (this is also referred to as software or firmware) stored in the memory 121. The memory may be a semiconductor memory, for example. The memory 121 stores one or plural computer programs and data (for example, plural kinds of thresholds for determinations) used in a temperature controlling function and a checking function that will be explained later.

[0038] The input detector 122 is a detection circuit for detecting a user input for manipulation of the flavor inhaler or the like 10. For example, the input detector 122 detects pressing of the front panel 102 (pressing of a button) by a user, and outputs an input signal representing a detected state to the controller 120. In this regard, the flavor inhaler or the like 10 may comprise, in place of (or in addition to) the front panel 102, any kind of input device such as a button, a switch, or a touch sensitive plane, for example. The state detector 123 is a detection circuit for detecting an open/close state of the slider 104, wherein opening/closing of the slider is manipulation applied to the flavor inhaler or the like. For example, the state detector 123 may comprise a Hall IC which detects, by using a Hall element, change in a magnetic field due to opening/closing of the slider 104. The state detector 123 outputs a state detection signal that shows whether the slider 104 is being opened or closed, to the controller 120. The suction detector 124 is a detection circuit for detecting a suction action (a puff) applied to the tobacco stick 15 performed by a user. For example, the suction detector 124 may comprise a thermistor (which is not shown in the figure) arranged in a position close to the opening 106. In such a case, the suction detector 124 may detect a suction action, based on change in a resistance value of the thermistor that occurs due to temperature change due to a suction action performed by a user. In a different example, the suction detector 124 may comprise a pressure sensor (which is not shown in the figure) arranged in a position on the bottom of the insertion hole 107. In such a case, the suction detector 124 may detects a suction action, based on decrease in air pressure due to the flow of air caused by a suction action. For example, the suction detector 124 outputs a suction detection signal that shows whether or not a suction action is being performed, to the controller 120.

[0039] The light emitter 125 comprises one or plural LEDs and a driver for driving the one or plural LEDs. The light emitter 125 makes each LED emit light according to an instruction signal inputted from the controller 120. The vibration generator 126 comprises a vibrator (for example, an eccentric motor) and a driver for driving the vibrator. The vibration generator 126 makes the vibrator vibrate according to an instruction signal inputted from the controller 120. The controller 120 may use, in an arbitrarily selected pattern, the light emitter 125 and/or the vibration generator 126 for notifying a user of a status (for example, a remaining quantity of power in the battery 120 that will be explained later) of the flavor inhaler or the like 10. Accordingly, in the present embodiment, the light emitter 125 and the vibration generator 126 may collectively be referred to as a notifier 160. For example, the light emission patterns of the light emitter 120 may be distinguished based on factors such as light emission states of each LED (always -on light emission, blinking, no light emission), frequencies of blinking, the number of LEDs which emit light, colors of emitted light, and so on. The vibration pattern of the vibration generator 126 may be distinguished based on factors such as vibration states of the vibrator (vibrating, not vibrating), the strength of vibration, the length of time of vibration, and so on.

[0040] The wireless I/F 127 is a communication interface for making the flavor inhaler or the like 10 possible to wirelessly communicate with the other device (for example, a PC (Personal computer) or a smart phone possessed by a user). The wireless I/F 127 may be an interface which conforms to any wireless communication protocol, such as Bluetooth (a registered trademark), NFC (Near Field Communication), wireless LAN (Local Area Network), or the like, for example. The connection I/F 128 is an interface which has a mechanism, such as a terminal, a coil, and so on, for connecting the flavor inhaler or the like 10 to the other device. The connection I/F 128 may be a USB (Universal Serial Bus) interface, for example. The connection I/F 128 may be used for charging the battery 140 from an external electric power supply (via a feeder line which is not shown in the figure,

or in a wireless manner).

[0041] The heater 130 is a resistance heating part, i.e., a heater, for heating an aerosol source included in the aerosol forming base substance in the tobacco stick 15 to thereby generate aerosol. In this regard, in the present embodiment, it is configured in such a manner that flavor is added to aerosol as a result that the generated aerosol passes through the flavor source included in the tobacco stick 15. On the other hand, in a different embodiment, it may be possible to use a flavor source which generates flavor as a result that it is heated. As the resistance heating material of the heater 130, one or two or more of copper, nickel alloy, chromium alloy, stainless steel, and platinum-rhodium, for example, may be used. One end of the heater 130 is connected to a positive electrode of the battery 140 via the first switch 131 and the boosting circuit 141, and the other end of the heater 130 is connected to a negative electrode of the battery 140 via the second switch 132. The first switch 131 is a switching element arranged on a feeder line between the heater 130 and the boosting circuit 141. The second switch 132 is a switching element arranged on a ground wire between the heating element 130 and the battery 140. Each of the first switch 131 and the second switch 132 may be an FET (Field Effect Transistor). For example, the controller 120 is able to turn on both the first switch 131 and the second switch 132 by outputting control signals that are pulse signals to the gates of the switches, to supply electric power that has a voltage amplified by the boosting circuit 141, from the battery 140 to the heater 130.

[0042] The battery 140 is an electric power supply for supplying electric power to the heater 130 and other components in the flavor inhaler or the like 10. In Fig. 3, feeder lines from the battery 140 to the components other than the heater 130 are omitted. The battery 140 may be a lithium-ion battery, for example. In the present embodiment, the battery 140 has a capacity that corresponds to a quantity of electric power required for completing N (N is an integer equal to or greater than 2) sessions (that is, an electric-power quantity that is sufficient for consuming flavor sources or the like included in N tobacco sticks 15). Thus, if the battery 140 is fully charged, a user is not required to recharge the battery 140 every time when a session is completed, and, thus, is able to enjoy plural tobacco sticks 15 consecutively. The capacity of the battery 140 may be determined by taking a trade-off between the cost and the size into consideration, and N may be approximately 25, although this is a mere example. The boosting circuit (a DC/DC converter) 141 is a voltage conversion circuit for amplifying the voltage of the battery 140, for supplying electric power to the heater 130.

[0043] The remaining quantity meter 142 is an IC chip for monitoring the remaining quantity of electric power and other statuses of the battery 140. For example, the remaining quantity meter 142 derives the remaining quantity of electric power in the battery 140 by measuring, according to a Coulomb counting method, the quantity of current flown into the battery 140 when it is charged and the quantity of current flown out of the battery 140 when it is discharged, and adding the measured quantities of current. In this regard, the remaining quantity meter 142 may derive the remaining quantity of electric power in the battery 140, according to a different algorithm such as a voltage measuring method, an impedance tracking method, or the like. Further, the remaining quantity meter 142 may be able to measure temperature of the battery 140. For example, the controller 120 is connected to the remaining quantity meter 142 via an I2C (Inter-Integrated Circuit) communication line comprising a clock line and a data line, and operates as a master device of the I2C. In such a case, the controller 120 may be able to obtain, at arbitrarily selected timing, a value R_C of the battery's remaining quantity and a value T_{BAT} of the battery temperature that are periodically updated by the remaining quantity meter 142 which is a slave device. The remaining quantity meter 142 may further be able to measure other statuses of the battery 140, such as the state of charge (SOC: State Of Charge), the state of health (SOH: State Of Health), the relative state of charge (RSOC), and so on, and output values of the above statuses.

[0044] The measuring circuit 150 is a circuit for measuring a temperature index that correlates to the temperature of the heater 130. The temperature index in the present case may represent the temperature of the heater 130 as it stands, or an electric resistance value of the heater 130. In general, the electric resistance value of a resistance heating material has a characteristic such that it monotonously increases as temperature increases (i.e., it correlates to temperature), for example, and, accordingly, the electric resistance value of the heater 130 may be used as a temperature index. In this regard, the temperature of the heater 130 may be measured by using a thermistor (which is not shown in the figure) arranged in a position close to the heater 130.

[0045] In the present embodiment, the controller 120 is able to measure the output voltage V_{BAT} of the battery 140 (hereinafter, this is also simply referred to as a power supply voltage), in addition that the controller 120 is able to obtain various status values including the remaining-quantity value R_C and the temperature value T_{BAT} of the battery 140 from the remaining quantity meter 142. For example, the controller 120 may output short control pulses to the first switch 131 and the second switch 132, to apply a voltage pulse from the battery 140 to the heater 130, and perform analog-digital conversion of the voltage level of the voltage pulse to thereby obtain the value V_{BAT} representing the power supply voltage. In the example in Fig. 3, the controller 130 is configured to obtain the voltage value V_{BAT} via the boosting circuit 141. In this regard, the controller 120 may perform, plural times consecutively at predetermined intervals, measurement of the power supply voltage, and obtain an average value of the measured results as the voltage value V_{BAT}, for reducing or removing effect of noise.

1-3 Example of Temperature Profile

[0046] The controller 120 controls supplying of electric power from the battery 140 to the heater 130, for realizing a desired temperature profile for providing a user with good experience throughout a whole session. In the present specification, a session refers to a set of time periods during that temperature control for consuming a flavor source or the like included in a single article (in the present case, one tobacco stick 15 accepted in the insertion hole 107) is performed. The session may be referred to as a heating period. As explained above, a user is allowed to perform at most M suction actions during a single session.

[0047] The temperature control performed by the controller 120 may typically be feedback control (for example, PID control), wherein the temperature index measured by the measuring circuit 150 is defined as a controlled variable and the duty ratio of supplying of electric power is defined as a manipulated variable. For example, in each of the repeated control cycles, the controller 120 outputs, to each of the first switch 131 and the second switch 132, a control pulse that has been modulated according to the duty ratio derived through the PID control. Then, a voltage pulse is applied from the battery 140 to the heater 130 with a corresponding duty ratio. Through repetition of the control cycle such as that explained above, the temperature of the heater 130 becomes closer to a target value of the PID control.

[0048] Fig. 4 is an explanatory drawing which is used for explaining an example of a temperature profile that may be realized in a single session. A horizontal axis in the figure represents time elapsed since a start of supplying of electric power to the heater 130, and a vertical axis represents temperature of the heater 130. A thick polygonal line represents a temperature profile 40 that is shown as an example. The temperature profile 40 comprises a preheating period (T0-T2) in the first part, and a suction allowable period (T2-T8) following the preheating period. For example, the length of the whole suction allowable period may be approximately 5 minutes.

[0049] The preheating period comprises a temperature increasing section (T0-T1) for rapidly increasing the temperature of the heater 130 from environmental temperature H0 to first temperature H1, and a maintaining section (T1-T2) for maintaining the temperature of the heater 130 at the first temperature H1. By rapidly heating, in a first stage, the heater 130 to have the first temperature H1 as explained above, heat spreads sufficiently throughout the hole aerosol forming base substance in the tobacco stick 15 in an early stage, and, accordingly, it becomes possible to start supplying of quality aerosol to a user more quickly.

[0050] The suction allowable period comprises a maintaining section (T2-T3) for maintaining the temperature of the heater 130 at the first temperature H1, a temperature lowering section (T3-T4) for lowering the temperature of the heater 130 to second temperature H2, and a maintaining section (T4-T5) for maintaining the temperature of the heater 130 at the second temperature H2. By lowering the temperature of the heater 130 that has been raised once to the first temperature H1, to the second temperature H2, it becomes possible to allow a user to perform suction action longer and stably with moderate smoke flavor. In the temperature lowering section, supplying of electric power from the battery 140 to the heater 130 may be stopped. The suction allowable period further comprises a temperature increasing section (T5-T6) for gradually increasing the temperature of the heater 130 from the second temperature H2 to third temperature H3, a maintaining section (T6-T7) for maintaining the temperature of the heater 130 at the third temperature H3, and a temperature lowering section (T7-T8) for lowering the temperature of the heater 130 to the environmental temperature H0. By again increasing the temperature of the heater 130 in the latter half of the suction allowable period as explained above, lowering of the smoke flavor during a situation in which the flavor source or the like included in the tobacco stick 15 is being reduced is suppressed, and, accordingly, it becomes possible to provide a user with a highly satisfactory experience until an end of the suction allowable period.

[0051] For example, the first temperature H1 may be 295 degrees Celsius, the second temperature H2 may be 230 degrees Celsius, and the third temperature H3 may be 260 degrees Celsius. In this regard, it is possible to design a different temperature profile, according to designing principle of a manufacturer, preference of a user, or a characteristic of each tobacco article brand.

[0052] In the case that the temperature of the heater 130 is increased rapidly in the middle of the session like the case of the temperature profile 40, the quantity of current outputted from the battery 140 increases notably. If the quantity of current outputted from the battery 140 increases, the quantity of voltage drop relating to internal resistance of the battery 140 increases in response thereto, and, also, the power supply voltage significantly drops temporarily. Further, there is a risk that the device performs defective operation, if a minimum value of the power supply voltage (hereinafter, the minimum voltage) becomes that lower than an operable voltage of the circuit in the flavor inhaler or the like 10 during a session. For preventing the above matters, and for notifying a user of the state of the battery 140 at appropriate timing for encouraging the user to recharge the battery, plural functions that will be explained in the following section are incorporated in the flavor inhaler or the like 10 according to the present embodiment.

2 Checking of State of Battery

2-1 Start-of-Session Checking

[0053] Fig. 5 is an explanatory drawing which is used for explaining dropping of a power supply voltage relating to progress of plural sessions. A horizontal axis in the

figure represents progress of time through plural sessions, wherein intervals between sessions are omitted. A vertical axis in the figure represents a power supply voltage (V). A voltage value $V_{init,n}$ represents a power supply voltage of the battery 140 at the beginning of an n-th session, and a voltage value $V_{min,n}$ represents a smallest voltage of the battery 140 during the n-th session. A solid line part 50 in a graph in the figure represents chronological change in the power supply voltage in the n-th session, wherein the power supply voltage temporarily drops from the $V_{init,n}$ at the beginning of the session to $V_{init,n}$ and thereafter recovers to $V_{init,n+1}$ in a latter half of the session If self-discharge during intervals between sessions is ignored, the power supply voltage at the beginning of a next, i.e., (n+1)th, session will be $V_{init,n+1}$.

[0054] A horizontal line 55 in the figure represents an operable voltage of the circuit in the flavor inhaler or the like 10. In the example in Fig. 5, since the smallest voltage $V_{min,n}$ in the n-th session is not lower than the operable voltage 55, the flavor inhaler or the like 10 is able to complete the n-th session. On the other hand, the smallest voltage $V_{min,n+1}$ in the (n+1)th session is lower than the operable voltage 55. Accordingly, if the (n+1)th session is started with the power supply voltage $V_{init,n+1}$ shown in the figure, the flavor inhaler or the like 10 will perform defective operation in the middle of the (n+1)th session, and the session will be stopped in the middle thereof. Stopping of a session in the middle thereof such as that explained above disadvantages a user, specifically, it damages an inhalation experience of the user, and, in addition, causes the remaining flavor source of the like included in the tobacco stick 15 which is being heated be wasted.

[0055] For preventing disadvantage due to stopping of a session in the middle thereof, there may be a measure wherein the power supply voltage is measured at the time of a start of a session, and the session is not started if the measure value is lower than a predetermined voltage threshold. In the present embodiment, the controller 120 obtains a voltage value V_{BAT} in response to detection of a user input such as a predetermined manipulation applied to the flavor inhaler or the like 10, for example, long pressing of a button or the like, that represents a request for starting of heating, and determines that a session is not to be started (i.e., performs control for limiting heating operation in such a manner that the heater 130 does not start heating) if the obtained voltage value V_{BAT} is lower than a voltage threshold V_{th}.

[0056] In this regard, as explained above, the voltage value V_{BAT} is obtained by measuring a voltage level of a voltage pulse applied from the battery 140 to the heater 130. The above-explained application of a pulse to the heater 130 that is not for the purpose of heating should be performed at a minimum required frequency, since it consumes electric power and may raise the temperature unnecessarily. On the other hand, the power supply voltage at the time of a start of a session has a characteristic that it decreases as the battery's remaining quantity decreases. By focusing on the above characteristic, in the present embodiment, the controller 120 compares the battery's remaining quantity with a remaining-quantity threshold, before comparing the power supply voltage with the voltage threshold. Specifically, the controller 120 obtains, from the remaining quantity meter 142, a remaining-quantity value R_C representing a remaining quantity of electric power in the battery 140, in response to detection of a predetermined manipulation that is applied to the flavor inhaler or the like 10 and represents a request for starting of heating, and determines that a session is not to be started (i.e., performs control for limiting heating operation in such a manner that the heater 130 does not start heating) if the remaining-quantity value R_C is lower than a predetermined remaining-quantity threshold R_{th0} In such a case, since the controller 120 can determine insufficiency of the remaining quantity before comparing the voltage value V_{BAT} with the voltage threshold V_{th}, it becomes possible to avoid waste of electric power and unnecessary raising of temperature due to measuring of the voltage.

[0057] If the remaining-quantity value R_C is larger than the remaining-quantity threshold R_{th0}, the controller 120 further compares the voltage value V_{BAT} with the voltage threshold V_{th} explained above, and, if the voltage value V_{BAT} is larger than the voltage threshold V_{th}, determines that a session is to be started (i.e., makes the heater 130 start heating). By performing double-checking based on the remaining-quantity value and the voltage value as explained above, the probability of occurrence of an error in determinations due to a factor such as an error in a remaining-quantity measuring algorithm, temporary disturbance, individual differences between devices, or the like, is lowered, and stopping of a session in the middle thereof is prevented certainly.

[0058] In the following description, the above-explained checking function, that is performed in response to a predetermined manipulation that is applied to the flavor inhaler or the like 10 and represents a request for starting of heating, will be referred to as "start-of-session checking." Although an example in which double-checking based on the remaining-quantity value and the voltage value has been explained in relation to the present embodiment, it may be possible to perform checking based on either one of the remaining-quantity value and the voltage value in a different embodiment.

2-2 Prechecking

[0059] In the case that the start-of-session checking only is installed in the flavor inhaler or the like 10, a user has to perform a manipulation for requesting a start of heating to know whether a sufficient quantity of electric power remains in the battery 140. However, user is not allowed to perform such a manipulation in a place where inhaling of aerosol is not allowed. On the other hand, if the only way to invoke the above-explained start-of-session checking is to perform a manipulation that has no relation

with starting of heating, a user has to perform, when starting a session, two manipulations, i.e., one for invoking the start-of-session checking and the other for starting heating, for avoiding stopping of the session in the middle thereof. Thus, in the present embodiment, the flavor inhaler or the like 10 is equipped with, in addition to the above-explained start-of-session checking that is triggered by a predetermined manipulation that is applied to the flavor inhaler or the like 10 and represents a request for starting of heating, a function for checking the remaining quantity of power in the battery 140, wherein the function is that triggered by a different predetermined manipulation applied to the flavor inhaler or the like 10. In the following description, the above different checking function is referred to as "prechecking."

[0060] For convenience of explanation, the predetermined manipulation applied to the flavor inhaler or the like 10 for invoking the start-of-session checking is referred to as a first predetermined manipulation, and the predetermined manipulation applied to the flavor inhaler or the like 10 for invoking the prechecking is referred to as a second predetermined manipulation. The first predetermined manipulation corresponds to a manipulation for requesting starting of heating, and may be long pressing of a button (the front panel 102). In such a case, the second predetermined manipulation may be any manipulation different from long pressing of the button, such as a manipulation for opening the slider 104, short-pressing of the button, pounding of the button, or the like, for example.

[0061] In the prechecking, the controller 120 obtains the remaining-quantity value R_C from the remaining quantity meter 142 in response to the second predetermined manipulation, and, based on the obtained remaining-quantity value R_C, determines whether a quantity of electric power that is sufficient for consuming the flavor source or the like included in one tobacco stick 15 remains in the battery 140. The determination is made by comparing the remaining-quantity value R_C with the above-explained remaining-quantity threshold R_{th0} If the remaining-quantity value R_C is greater than the remaining-quantity threshold R_{th0}, the controller 120 may determine that a sufficient quantity of electric power remains in the battery 140, and a single session can be completed without stopping the session in the middle thereof. On the other hand, if the remaining-quantity value R_C is smaller than the remaining-quantity threshold R_{th0}, the controller 120 may determine that the quantity remained is insufficient.

[0062] By making it possible to check, in response to a manipulation that is different from a manipulation for requesting starting of heating, whether battery's remaining quantity is insufficient, a user is allowed to know result of checking with respect to the remaining quantity of electric power when user is staying in any place other than a place where smoking is allowed.

[0063] In the prechecking, the controller 120 may determine whether the remaining quantity of electric power in the battery 140 is approximately a quantity that is sufficient for completing a single session at most, in addition to the above-explained determination with respect to insufficiency of the remaining quantity. The above determination is made by comparing the remaining-quantity value R_C with a further remaining-quantity threshold Rth_1, in addition to comparison with the remaining-quantity threshold R_{th0} ($R_{th1}>R_{th0}$). If the remaining-quantity value R_C is greater than the remaining-quantity threshold R_{th1}, the controller 120 may determine that a quantity of electric power that is sufficient for consuming flavor sources or the like included in two or more tobacco sticks 15 remains in the battery 140. On the other hand, 1f the remaining-quantity value R_C is greater than the remaining-quantity threshold R_{th0} and lower than the remaining-quantity threshold R_{th1}, the controller 120 may determine that, although the quantity of electric power in the battery 140 is not insufficient at present, the quantity of electric power will be insufficient after one more tobacco stick 15 is consumed by a user.

2-3 Notification with Respect to Result of Checking

[0064] A user may be notified of, in various forms, check results of the above-explained prechecking and start-of-session checking. For example, the controller 120 may instruct the notifier 160 to provide, in respective forms, information with respect to the following five kinds of check results.

- Prechecking - Insufficient Quantity Remained
- Prechecking - One Stick Left
- Prechecking - Two or More Sticks Left
- Start-of-session checking - Insufficient Quantity Remained
- Start-of-session checking - Start heating

(1) Prechecking - Insufficient Quantity Remained

[0065] In the prechecking, if $R_C<R_{th0}$, i.e., if the remaining-quantity value R_C indicates that a quantity of electric power that is sufficient for consuming a flavor source or the like included in the one tobacco stick 15 does not remain in the battery 140, the notifier 160 notifies a user of insufficiency of the remaining quantity. The above notification with respect to insufficiency of the remaining quantity may be realized by emitting light having a warning color (for example, red) from an LED or blinking the LED, or generating, by a vibrator, vibration that is relatively strong or lasts for a relatively long time, for example, for making a user surely recognize necessity of charging.

(2) Prechecking - One Stick Left

[0066] In the prechecking, if $R_{th0}\leq R_C\leq R_{th0}$, i.e., if the remaining-quantity value R_C indicates that, although the remaining quantity is not insufficient, only a quantity of electric power that allows consuming of a flavor source or

the like included in the one tobacco stick 15 at most remains in the battery 140, the notifier 160 notifies a user that the number of tobacco sticks 15 that can be used hereafter without charging is one. In terms of notification modes (for example, light emission patterns or a vibration patterns), the above notification is distinguished from the above-explained notification and notification with respect to Two or More Sticks Left that will be explained later. As a result that a user receives the information of One Stick Left, the user can recognize, in advance, that it will become unable to inhale aerosol further if recharging is not performed after using one more tobacco stick.

(3) Prechecking - Two or More Sticks Left

[0067] In the prechecking, if $R_{th1} \leq R_C$, i.e., if the remaining-quantity value R_C indicates that a quantity of electric power that is sufficient for consuming flavor sources or the like included in the two or more tobacco stick 15 remains in the battery 140, the notifier 160 may notify a user of the quantity of electric power remaining in the battery 140 (the battery's remaining quantity). For example, the battery's remaining quantity may be reported in the form such as a battery level that is determined as a discrete value, a relative charging rate, the number of tobacco sticks which can be used hereafter without charging, or the like. For example, the battery level or the number of tobacco sticks left may be represented by the number of LEDs which are turned on to emit light, the number of times of blinking of an LED, or the number of times of vibration of the vibrator.

(4) Start-of-Session Checking - Insufficient Quantity Remained

[0068] In the start-of-session checking, if $R_C < R_{th0}$ or $V_{BAT} < V_{th}$, i.e., if the remaining-quantity value R_C or the voltage value V_{BAT} indicates that a quantity of electric power that is sufficient for consuming a flavor source or the like included in the one tobacco stick 15 does not remain in the battery 140, the notifier 160 notifies a user of insufficiency of the remaining quantity. The above notification with respect to insufficiency of the remaining quantity may be performed in a mode that is the same as (or different from) that of the notification with respect to insufficiency of the remaining quantity in the prechecking.

(5) Start-of-Session Checking - Start Heating

[0069] In the start-of-session checking, if R_{th0}:R_C and $V_{th} < \leq V_{BAT}$, the notifier 160 notifies a user of starting of heating. The notification with respect to starting of heating may be performed by emitting light having a non-warning color (for example, white) from an LED or blinking the LED, or generating, by the vibrator, vibration that is relatively weak or lasts for a relatively short time. After the notification (or at the same time as the notification), the controller 120 makes the battery 140 start supplying of electric power to the heater 130. Thereafter, the controller 120 may makes the notifier 160 perform further notification (for example, advance announcements with respect to an end of the preheating period and an end of the suction allowable period) at some points in time in the sessions that progress as explained by using Fig. 4.

(6) Other Notification Modes

[0070] With respect to the present embodiment, an example in which the light emitter 125 and/or the vibration generator 126 perform notification has been explained; however, the mode of notification is not limited to the above example. For example, the above explained notification may be realized by using, instead of light emission or vibration (or in addition thereto), sound outputted from a speaker or a message transmitted to an external device.

2-4 Example of Setting of Threshold

(1) Basic Concept

[0071] The values of the voltage threshold V_{th}, the remaining-quantity threshold R_{th0} (the first remaining-quantity threshold), and the second remaining-quantity threshold R_{th1} explained above are determined in advance and stored in the memory 121. For example, the voltage threshold V_{th} may be determined by adding, to the minimum operable voltage 55 that ensures normal operation of the circuit in the flavor inhaler or the like 10, a margin for absorbing a quantity of voltage drop during a heating period (for example a difference between $V_{init,n}$ and $V_{min,n}$) and voltage variation.

[0072] The remaining-quantity threshold R_{th0} may be determined by converting the value of the voltage threshold V_{th} to a remaining-quantity value, by using a characteristic graph representing relationship between the remaining quantity of the battery 140 (mAh) and the output voltage (at the time of a start of a session) (V). The remaining-quantity threshold R_{th1} may be determined by adding, to the remaining-quantity threshold R_{th0}, the quantity of electric power that is consumed when one tobacco stick 12 is used (i.e., when a single session is completed).

[0073] In this regard, in many cases, the battery's remaining quantity, that corresponds to the voltage threshold determined based on the operable voltage of the circuit, is greater than the quantity of electric power consumed for a single session. Accordingly, in this explanation, an example in which the voltage threshold V_{th} and the remaining-quantity threshold R_{th0} are determined based on the operable voltage of the circuit has been explained; however, the voltage threshold V_{th} and the remaining-quantity threshold R_{th0} are not limited to those in the above example, and they may be determined based on the electric power consumed for completing a single session.

(2) Temperature-dependent Threshold

[0074] The inventors has been recognized that the "battery's remaining quantity - output voltage" characteristic may become different depending on battery temperature. Typically, if the battery's remaining quantities are the same with one another, there is a tendency that the output voltage decreases as the battery temperature decreases. Accordingly, in the present embodiment, it is supposed that the memory 121 stores, in relation to each of the remaining-quantity thresholds R_{th0} and Rth_1, different set values associated with two or more temperature ranges, respectively.

[0075] Fig. 6 is an explanatory drawing which is used for explaining an example of setting of different thresholds for plural temperature ranges. In the example in Fig. 6, the battery temperature T_{BAT} is categorized into three temperature ranges, specifically, less than 10 degrees Celsius (category C1), equal to or higher than 10 degrees Celsius to less than 20 degrees Celsius (category C2), and equal to or higher than 20 degrees Celsius (category C3). The remaining-quantity threshold R_{th1} is set to R_{th1_low} if the battery temperature T_{BAT} is that in the category C1, R_{th1_mid} if the battery temperature T_{BAT} is that in the category C2, and R_{th1_high} if the battery temperature T_{BAT} is that in the category C3. Similarly, the remaining-quantity threshold R_{th0} is set to R_{th0_low} if the battery temperature T_{BAT} is that in the category C1, R_{th0_mid} if the battery temperature T_{BAT} is that in the category C2, and R_{th0_high} if the battery temperature T_{BAT} is that in the category C3. The following relationship holds for the above set values:

$$R_{th1\_high} < R_{th1\_mid} < R_{th1\_low}$$

$$R_{th0\_high} < R_{th0\_mid} < R_{th0\_low}$$

By selectively using different remaining-quantity thresholds in relation to the battery temperature T_{BAT} in the prechecking and the start-of-session checking in the manner explained above, highly reliable checking can be performed irrespective of change in environmental temperature (or the battery temperature that is affected by the environmental temperature).

[0076] In the example in Fig. 6, the voltage threshold V_{th} is set to a common value, irrespective of the categories of the battery temperature. In this regard, the voltage threshold V_{th} may also be set differently according to each of the categories of the battery temperature.

[0077] Here, a use case will be considered. It is supposed that the remaining-quantity thresholds are set in such a manner that R_{th1_low} = 400 mAh, R_{th1_mid} = 380 mAh, R_{th0_low} = 260 mAh, and R_{th0_mid} = 240 mAh, for example. Further, it is supposed that a user has the flavor inhaler or the like 10 in which the battery's remaining quantity is 250 mAh (i.e., R_C = 250 mAh), and stays in an indoor place where the environment temperature is 15 degrees Celsius. In the present case, inhaling of aerosol is possible in the outdoors where the environment temperature is 5 degrees Celsius. A user first invokes the prechecking function by performing the second predetermined manipulation in the indoor place. The controller 120 compares the remaining-quantity value R_C with the remaining-quantity thresholds R_{th1_mid} (= 380 mAh) and R_{th0_mid} (= 240 mAh) since the battery temperature T_{BAT} is 15 degrees Celsius, and determines that only one more tobacco stick 15 can be used ($R_{th0\_mid} < R_C < R_{th1\_mid}$). The notifier 160 notifies the user of the result of the determination. The user goes to the outdoors for enjoying the last one stick, and instructs, by performing the first predetermined manipulation, the flavor inhaler or the like 10 to start heating. At that time, due to change in the environmental temperature, the battery temperature T_{BAT} decreases to temperature lower than 15 degrees Celsius. If the remaining-quantity thresholds R_{th1_mid} and R_{th0_mid} that are the same as those shown above are used in the start-of-session checking in the present case, it will be determined that the battery's remaining quantity is not insufficient, and heating will be started. However, due to low temperature, there may be a risk that the device performs defective operation due to insufficient output of the battery 140 in the middle of a session started after a start of heating. In contrast to the above, in the present embodiment, the controller 120 takes the lowered battery temperature T_{BAT} into consideration, and compares, in the start-of-session checking, the remaining-quantity value R_C with the remaining-quantity thresholds R_{th1_low} (= 400 mAh) and R_{th0_low} (= 260 mAh). In such a case, since the remaining-quantity value R_C is less than R_{th0_low}, the controller 120 determines that the remaining quantity is insufficient, and does not make the heater 130 start heating. Accordingly, stopping of a session in the middle thereof is prevented, and occurrence of the situation that the half-heated tobaccos tick 15 is wasted is avoided.

2-5 Omission of Redundant Redetermination

[0078] The controller may store, in the memory, a flag that shows result of a determination, which was performed in the prechecking or the start-of-session checking, with respect to insufficiency of the remaining quantity (hereinafter, an insufficient-remaining-quantity flag). Specifically, if the controller 120 has determined in each time of checking that a sufficient quantity of electric power does not remain in the battery 140 (Remaining quantity value R_C < Remaining-quantity threshold R_{th0}), the controller 120 rewrites the value of the insufficient-remaining-quantity flag to a value representing insufficiency of the remaining quantity (for example, "1"). In this regard, it has been set such that the value of the insufficient-remaining-quantity flag being a value representing the remaining quantity being insufficient means the flavor inhaler or the like 10 being in the state that remaining quantity is insufficient, and it corresponds to that heating

by the heater 130 is being restricted. Next, after the controller 120 has detected a start of charging of the battery 140, the controller 120 restores the value of the insufficient-remaining-quantity flag to an original value (for example, "0") (that represents that the remaining quantity is not insufficient) if the controller 120 has determined that a predetermined condition(s) has been satisfied. In this regard, it has not been set such that the value of the insufficient-remaining-quantity flag being a value representing the remaining quantity being not insufficient means the flavor inhaler or the like 10 being in the state that remaining quantity is insufficient, and it corresponds to that restriction on heating by the heater 130 is being removed.

[0079] The controller 120 refers to the insufficient-remaining-quantity flag in response to the second predetermined manipulation that requests it to perform the prechecking, and, if the value thereof shows the remaining quantity being insufficient, determines, without performing a determination based on the remaining-quantity value R_c, that the battery's remaining quantity is insufficient; this is because the battery 140 has not yet charged sufficiently since it was determined once that the remaining quantity is insufficient.

[0080] Similarly, the controller 120 refers to the insufficient-remaining-quantity flag in response to the first predetermined manipulation that requests it to start heating, and, if the value thereof shows that the remaining quantity being insufficient, determines, without performing a determination based on the remaining-quantity value R_c and the voltage value V_{BAT}, that the battery's remaining quantity is insufficient; this is because the battery 140 has not yet charged sufficiently since it was determined once that the remaining quantity is insufficient. At that time, the controller 120 restricts heating in such a manner that starting of heating by the heater 130 in response to the first predetermined manipulation is prevented.

[0081] By performing flag management such as that explained above, redundant redetermination relating to the battery's remaining quantity can be omitted. As a result, the quantity of communication between the controller 120 and the remaining quantity meter 142 is reduced, and the load on the circuit is suppressed. Further, as a result, electric power consumed for measuring the remaining-quantity value R_c and the voltage value V_{BAT} is reduced, and, accordingly, even if the prechecking or the start-of-session checking is repeatedly performed, it becomes possible to lower the possibility that the remaining quantity of power in the battery 140 is extremely lowered to the extent that a permanent failure is decided.

2-6 Predetermined Condition for Removing Restriction on Heating

2-6-1 First Type

[0082] An example of the predetermined condition for removing restriction on heating is a condition that the remaining quantity in the battery 140 has increased by a quantity equal to or greater than a predetermined quantity ΔR_c, compared with a reference that is a remaining-quantity value R_{C_latest} that is a remaining-quantity value R_C measured before a start of charging of the battery 140. For the above purpose, the controller 120 is able to store, in the memory 121 and as a remaining-quantity value R_{C_latest}, a remaining-quantity value R_C that is measured when the prechecking or the start-of-session checking, that is performed before a start of charging of the battery 140, is performed.

[0083] The predetermined quantity ΔR_C may be a quantity that is sufficient for use to perform a determination relating to the remaining quantity in the battery 140. Accordingly, the predetermined quantity ΔR_C may be a quantity that is sufficient for completing, at least a single time, the start-of-session checking process or the prechecking process that will be explained later. A predetermined quantity ΔR_C such as that explained above may be obtained experimentally in advance and stored in the memory 121 in advance.

[0084] The predetermined quantity ΔR_C may be a quantity that is sufficient for consuming at least one tobacco stick 15. Accordingly, the predetermined quantity ΔR_C may be determined as Remaining-quantity threshold R_{th0} - Remaining-quantity value R_{C_latest}, or a difference between the remaining-quantity threshold R_{th1} and the remaining-quantity value R_{th0}, i.e., R_{th1}-R_{th0}. Further, the quantity that is sufficient for consuming at least one tobaccos stick 15 may be determined based on the battery temperature T_{BAT}. That is, the predetermined quantity ΔR_C may be determined as R_{th0_low}-R_{C_latest} or R_{th1_low}-R_{th0_low} if the battery temperature T_{BAT} belongs to the category C1, R_{th0_mid}-R_{C_latest} or R_{th1_mid}-R_{th0_mid} if the battery temperature T_{BAT} belongs to the category C2, and R_{th0_high}-R_{C_latest} or R_{th1_high}-R_{tho_high} if the battery temperature T_{BAT} belongs to the category C3.

[0085] The flavor inhaler or the like 10 may be configured in such a manner that a user is allowed to set the predetermined quantity ΔR_C. The flavor inhaler or the like 10 may be configured in such a manner that a user is allowed to input the predetermined quantity ΔR_C via the front panel 102 (the input unit) or the wireless I/F 127. In a different configuration, the flavor inhaler or the like 10 may be configured to determine the predetermined quantity ΔR_C, based on the number ΔN of tobacco sticks 15 that is inputted by a user via the front panel 102 (the input unit) or the wireless I/F 127 and represents the number of tobacco sticks 15 that can be consumed. For example, the controller 120 may be configured to determine the predetermined quantity ΔR_C as $(R_{th1}$-$R_{th0})\Delta N$.

[0086] The controller 120 may be configured to determine the predetermined quantity ΔR_C, based on history of use of the flavor inhaler or the like 10 by a user. For example, the controller 120 may be configured in such a manner that it stores, as use history in the memory 121, an average, minimum, or maximum number $\Delta N_{statisfical}$ of

tobacco sticks 15 (hereinafter, "average-or-the-like number") that were consumed by a user after charging of the battery 140, and determines the predetermined quantity ΔR_C as $(R_{th1}-R_{th0})\Delta N_{statistical}$, or determines it by performing machine learning, to allow consuming of the average-or-the-like number $\Delta N_{statistical}$ of tobacco sticks 15.

[0087] In this regard, it will be understood according to a configuration such as that explained above that the flavor inhaler or the like 10 can be configured to be able to rewrite the predetermined quantity ΔR_C.

2-6-2 Second Type

[0088] A different example of the predetermined condition for removing restriction on heating is a condition that the battery 140 has been fully charged. In this regard, the method for judging whether the battery 140 has been fully charged can be selected arbitrarily. In the following description, non-limiting examples will be explained.

[0089] The controller 120 may determine that the battery 140 has been fully charged, when the remaining-quantity value R_C measured during charging has become that equal to or greater than a predetermined value. In a different configuration, the controller 120 may determine that the battery 140 has been fully charged, when the state of charge or the relative state of charge of the battery 140 measured during charging has become that equal to or greater than a predetermined value. Further, in a different configuration, the controller 120 may determine that the battery 140 has been fully charged, when the current flowing through the battery 140 during charging has become that equal to or smaller than a predetermined value, or when the voltage value V_{BAT} in the battery 140 during charging has become that equal to or greater than a predetermined value.

[0090] Further, it may be configured in such a manner that the flavor inhaler or the like 10 stores, in the memory 121 in advance, the above thresholds relating to degrees of deterioration of the battery 140, and the controller 120 determines the above threshold based on the degree of deterioration of the battery 140 measured during charging. Further, it may be configured in such a manner that the flavor inhaler or the like 10 stores, in the memory 121 in advance, the above thresholds relating to the temperature T_{BAT} of the battery 140, and the controller 120 determines the above threshold based on the temperature T_{BAT} of the battery 140 measured during charging.

[0091] In this regard, the battery 140 may temporarily become a state in which it is not determined that the battery 140 has been fully charged when charging of the battery 140 is continued after the battery 140 becomes a state in which it is determined that the battery 140 has been fully charged, due to that minor discharging and charging are repeated. Accordingly, the controller 120 may be configured in such a manner that, after it is determined once that the battery 140 has been fully charged, such a determination is maintained until charging is terminated.

2-6-3 Third Type

[0092] A further different example of the predetermined condition for removing restriction on heating is a condition that a predetermined time Δt or a time longer than the predetermined time Δt has elapsed since a start of charging. the controller 120 may be configured in such a manner that it determines the type of an external device connected to the flavor inhaler or the like for charging the battery 140, and determines the predetermined time Δt based on the determined external-device type. For example, the controller 120 is able to determine the external-device type based on the time change rate of the value of current flowing through the battery 140 during charging, and determine the predetermined time Δt in such a manner that an external device relating to a larger time change rate is associated with a shorter predetermined time Δt. The flavor inhaler or the like 10 may be configured to store, in the memory 121 in advance, the predetermined time Δt corresponding to each external-device type. Further, the flavor inhaler or the like 10 can be configured to be able to rewrite the predetermined time Δt.

2-7 Variations

[0093] Instead of obtaining the battery temperature T_{BAT} from the remaining quantity meter 142 in the first variation that has been explained with reference to Fig. 4 and relates to setting of thresholds relating to temperature ranges, the controller 120 may estimate the battery temperature from at least one of the date and the time of day at a point in time when checking is performed, and use a remaining-quantity threshold corresponding to the estimated temperature in the prechecking or the start-of-session checking, for judging whether a predetermined condition for removing restriction on heating has been satisfied. For example, with respect to each of the remaining-quantity thresholds R_{th0} and R_{th1}, the predetermined quantity ΔR_C, and the above thresholds used for judging whether the battery 140 has been fully charged, the memory 121 may store a value that should be used in a warm season and a value that should be used in a cool season. In the above case, the controller 120 may read, from the memory 121 and according to whether the date when checking is performed belongs to the warm season or the cool season, different remaining-quantity thresholds R_{th0} and R_{th1}, a different predetermined quantity ΔR_C, and different thresholds used for judging whether the battery 140 has been fully charged, and use them. In a different example, with respect to each of the remaining-quantity thresholds R_{th0} and Rth_1, the predetermined quantity ΔR_C, and the above thresholds used for judging whether the battery 140 has been fully charged, the memory 121 may store, in advance, a value that should be used in the daytime and a value that should be used in

the nighttime. In the above case, the controller 120 may read, from the memory 121 and according to whether the time of day when checking is performed belongs to the daytime or the nighttime, different remaining-quantity thresholds R_{th0} and R_{th1}, a different predetermined quantity ΔR_C, and different thresholds used for judging whether the battery 140 has been fully charged, and use them.

[0094] In the second variation, the controller 120 may estimate the battery temperature based on an output value from a thermistor arranged in a position close to the battery 140, and use a remaining-quantity threshold corresponding to the estimated temperature in the prechecking or the start-of-session checking, for judging whether a predetermined condition for removing restriction on heating has been satisfied.

2-8 Other Checking

[0095] The controller 120 may perform, at arbitrarily selected timing, checking for confirming whether abnormality with respect to each of various statues, other than the remaining quantity and the voltage of the battery 140, in the device has occurred. For example, one or more checking processes relating to the following checking items may be performed.

- The temperature of the heater 130 (Whether it represents abnormally high temperature)
- The temperature of the other part(s) (Whether it represents abnormally high temperature)
- The state of attaching of the front panel 102 (Whether it has been detached from the main body 101)
- The state of the battery 140 monitored by the remaining quantity meter 142 (Whether abnormality has been detected)

if the controller 120 detects an abnormality with respect to a checking item, the controller 120 makes the memory 121 store an error code representing the kind of detected abnormality, and the notifier 160 notifies a user of occurrence of the abnormality. If the abnormality remains, the controller 120 does not make the heater 130 start heating even if the first predetermined manipulation for requesting a start of heating is detected.

3 Flow of Process

[0096] In the present section, some examples of flows of processing performed in the above-explained flavor inhaler or the like 10 will be explained with reference to flow charts. In the following explanation, a processing step is abbreviated as S (step).

[0097] Regarding each flow chart, it should be reminded that processing steps for detecting abnormality, that have been explained in the above section, will not be shown in the figures for simplifying explanation. The abnormality detection may be performed periodically in a part of a regular control routine in the controller 120, or in a part of the prechecking or the start-of-session checking. Also, a detection circuit separate from the controller 120 may detects an abnormality, and inform the controller 120 of the detected abnormality (for example, by using an interrupt signal).

3-1 Schematic Flow

[0098] Fig. 7 is a flow chart which shows an example of a schematic flow of a process performed by the flavor inhaler or the like 10 according to the present embodiment.

[0099] The controller 120 continuously monitors, in a standby state, a user input and the state of charging of the battery 140 (S101, S103, S113). A user input may be detected by the input detector 122, the state detector 123, or the suction detector 124. For example, if the second predetermined action requesting performing of the prechecking is detected (S101 - Yes), the process proceeds to S105. On the other hand, if the first predetermined action requesting a start of heating is detected (S103 - Yes), the process proceeds to S107.

[0100] In S105, the controller 120 checks the remaining quantity of electric power in the battery 140 by performing the prechecking process, and makes the notifier 160 perform notification corresponding to a result of checking. A more tangible flow of the prechecking process performed herein will be further explained later.

[0101] In S107, the controller 120 performs the start-of-session checking process to determine whether the battery 140 is in a state wherein a session can be started. A more tangible flow of the start-of-session checking process performed herein will be further explained later.

[0102] In the start-of-session checking process, if it is determined that a quantity of electric power that is sufficient for consuming a flavor source or the like included in an article does not remain in the battery 140 (S109- Yes), the controller 120 returns to the standby state without starting a session.

[0103] On the other hand, in the start-of-session checking process, if it is determined that a quantity of electric power that is sufficient for consuming a flavor source or the like included in an article remains in the battery 140 (S109- No), the controller 120 makes the heater 130 start heating, and performs temperature control for a single session for realizing a temperature profile 40 such as that explained with reference to Fig. 4, in S111. In the above session, the heater 130 receives supply of electric power from the battery 140, and heats a tobacco stick 15 including a flavor source or the like to generate aerosol. In a suction allowable period following a preheating period, a user is allowed to perform plural number of times of suction actions to inhale aerosol.

[0104] In the standby state, a user may connect the flavor inhaler or the like 10 to an external electric power supply via the connection I/F 128 for charging the battery 140. After a start of charging of the battery 140 is detected

(S113 - Yes), the controller 120 updates in S115 the value of the insufficient-remaining-quantity flag to "0" that means false based on a determination that a predetermined condition has been satisfied (S114 - Yes). In this regard, in S115, if the value of the insufficient-remaining-quantity flag has already been set to "0," the controller 120 does not need to perform any operation. In a different configuration, it may be configured in such a manner that a step for judging whether the insufficient-remaining-quantity flag is "0" (that is not shown in the figure) is added and performed just before S113 or S114, and the process proceeds to S113 or S114 if it is determined that the insufficient-remaining-quantity flag is not "0," and the process returns to S101 otherwise. In any case, according to the steps including S113, S114, and S115, it will be understood that, if the insufficient-remaining-quantity flag is "1" instead of "0," wherein "1" means true that will be explained later, and that heating by the heater 130 is restricted accordingly, the value of the insufficient-remaining-quantity flag becomes "0" based on a predetermined condition being satisfied after a start of charging of the battery 140, and the restriction on hearting by the heater 130 is removed accordingly.

[0105] Further, the process performed by the flavor inhaler or the like 10 may comprise, in a part right after detecting of a start of charging of the battery 140 (S113 - Yes), a step for activating a timer for measuring time elapsed since charging of the battery 140 is started (that is not shown in the figure). Further, the step for judging whether a predetermined condition has been satisfied (S114) may comprise a step for obtaining, from the remaining quantity meter 142, a temperature value T_{BAT} that represents the temperature of the battery 140. In a different configuration, the step for judging whether a predetermined condition has been satisfied (S114) may comprise a step for estimating the battery temperature as explained above, or reading the stored battery temperature from the memory 121 as explained above. The step for judging whether a predetermined condition has been satisfied (S114) may comprise a step for obtaining, from the remaining quantity meter 142, the state of charge or the relative state of charge or the degree of deterioration of the battery 140.

3-2 Prechecking Process

[0106] Fig. 8 is a flow chart which shows an example of a flow of a prechecking process that may be performed in S105 in Fig. 7.

[0107] First, in S121, the controller 120 determines whether the insufficient-remaining-quantity flag shows "1" that means true. If the insufficient-remaining-quantity flag shows "1," the process proceeds to S145. On the other hand, if the insufficient-remaining-quantity flag shows "0," the process proceeds to S123.

[0108] In S123, the controller 120 obtains, from the remaining quantity meter 142, a remaining-quantity value R_C that represents the remaining quantity of electric power in the battery 142. In this regard, the prechecking process may include, in a part before or just before S123, a step for storing, in the memory 121, the remaining-quantity value R_C obtained in S123 as a remaining-quantity value R_{C_latest} used in a determination with respect to a predetermined condition for removing a restriction on heating. A previously stored remaining-quantity value R_{C_latest} may be updated by using a newly obtained remaining-quantity value R_{C_latest}. Next, in S125, the controller 120 obtains, from the remaining quantity meter 142, temperature T_{BAT} that represents the temperature of the battery 140. Next, in S127, the controller 120 obtains, from the memory 121, remaining-quantity thresholds R_{th0} and R_{th1} that have been associated with a temperature range to which the temperature T_{BAT} belongs. For example, the controller obtains one of R_{th0_low}, R_{th0_mid}, and R_{th0_high}, and one of R_{th1_low}, R_{th1_mid}, and R_{th1_high} shown in Fig. 6.

[0109] Next, in S129, the controller 120 compares the remaining-quantity value R_C with the remaining-quantity threshold R_{th0}. In this step, if $R_{th0} \leq R_C$ (S129 - No), the controller 120 further compares, in S131, the remaining-quantity value R_C with the remaining-quantity threshold R_{th1}.

[0110] If it is determined as a result of comparison in S129 and S131 that $R_{th1} \leq R_C$, the controller 120 determines, in S133, that a quantity of electric power that is sufficient for sucking two or more tobacco sticks 15 remains in the battery 140. In such a case, in S135, the controller 120 makes the notifier 160 notify a user of a battery's remaining quantity. For example, the notifier 160 makes a number of LEDs emit light, wherein the number in this case is that corresponds to the battery level or the number of tobacco sticks that can be consumed hereafter.

[0111] If it is determined as a result of comparison that $R_{th0} \leq R_C < R_{th1}$, the controller 120 determines, in S137, that a quantity of electric power that is sufficient for sucking a single tobacco stick 15 only remains in the battery 140. In such a case, in S139, the controller 120 makes the notifier 160 notify a user that only one more tobacco stick 15 can be sucked. For example, the notifier 160 makes an LED(s) emit light according to a preset characteristic light emission pattern, or makes a vibrator vibrate according to a characteristic vibration pattern.

[0112] If it is determined as a result of comparison that $R_C < R_{th0}$, the controller 120 determines, in S141, that a quantity of electric power that is sufficient for consuming a flavor source or the like included in one tobacco stick 15 does not remain in the battery 140. In such a case, in S143, the controller 120 updates the value of the insufficient-remaining-quantity flag to "1." Next, in S145, the controller 120 makes the notifier 160 notify a user hat the quantity of electric power remaining in the battery 140 is insufficient. For example, the notifier 160 makes an LED(s) emit light having a warning color for urging a user to perform recharging, or makes a vibrator vibrate according to a characteristic vibration pattern.

[0113] Further, a different example of the prechecking process may comprise, in place of or in addition to comparison between the remaining-quantity value R_C and the remaining-quantity threshold R_{th0} (S129), a step of determining that a sufficient quantity of electric power does not remain in the battery 140, based on comparison between a voltage threshold V_{th} and a voltage value V_{BAT} that is obtained by performing a voltage measuring process and represents an output voltage of the battery 140 (refer to the start-of-session checking process that will be explained later).

3-3 Start-of-Session Checking Process

[0114] Fig. 9 is a flow chart which shows an example of a flow of a start-of-session checking process that may be performed in S107 in Fig. 7.

[0115] First, in S151, the controller 120 determines whether the insufficient-remaining-quantity flag shows "1." If the insufficient-remaining-quantity flag shows "1," the process proceeds to S175. On the other hand, if the insufficient-remaining-quantity flag shows "0," the process proceeds to S153.

[0116] In S153, the controller 120 obtains, from the remaining quantity meter 142, a remaining-quantity value R_C that represents the remaining quantity of electric power in the battery 142. In this regard, the start-of-session checking process may include, in a part after or right after S153, a step for storing, in the memory 121, the remaining-quantity value R_C obtained in S153 as a remaining-quantity value R_{C_latest} used in a determination with respect to a predetermined condition for removing a restriction on heating. A previously stored remaining-quantity value R_{C_latest} may be updated by using a newly obtained remaining-quantity value $R_{C\_latest.}$ Next, in S155, the controller 120 obtains, from the remaining quantity meter 142, temperature T_{BAT} that represents the temperature of the battery 140. Next, in S157, the controller 120 obtains, from the memory 121, a remaining-quantity thresholds R_{th0} that has been associated with a temperature range to which the temperature T_{BAT} belongs. For example, the controller obtains one of R_{th0_low}, R_{th0_mid}, and R_{th0_high} shown in Fig. 6.

[0117] Next, in S159, the controller 120 compares the remaining-quantity value R_C with the remaining-quantity threshold R_{th0}. In this step, the process proceeds to S161 if $R_{th0} \leq R_C$ (S159 - No), and the process proceeds to S171 if $R_C < R_{th0}$ (S159-Yes).

[0118] In S161, the controller 120 obtains a voltage threshold V_{th} from the memory 121. Next, in S163, the controller 120 obtains a voltage value V_{BAT} that represents an output voltage of the battery 140, by performing a voltage measuring process. A more tangible flow of the voltage measuring process performed herein will be further explained later. Next, in S165, the controller 120 compares the voltage value V_{BAT} with the voltage threshold V_{th}. In this step, the process proceeds to S167 if $V_{th} \leq V_{BAT}$ (S165 - No), and the process proceeds to S171 if $V_{BAT} < V_{th}$ (S165 - Yes).

[0119] In S167, as a result of double checking that is based on the remaining-quantity value and the voltage value, the controller 120 determines that a session can be started, since a quantity of electric power that is sufficient to continue the session, without stopping the session in the middle thereof, remains in the battery 140. In such a case, the controller 120 makes the heater 130 start heating and performs temperature control of the single session, in S111 in Fig. 7.

[0120] On the other hand, in S171, the controller 120 determines that a sufficient quantity of electric power does not remain in the battery 140. In S173, the controller 120 updates the value of the insufficient-remaining-quantity flag to "1." Thereafter, in S175, the controller 120 makes the notifier 160 notify a user that the quantity of electric power remaining in the battery 140 is insufficient. In such a case, the controller 120 returns to the standby state at the beginning of Fig. 7 without making the heater 130 start heating.

[0121] Further, in a different example of the start-of-session checking process, it may be possible to omit one of the step for comparing the remaining-quantity value R_C with the remaining-quantity threshold R_{th0} (S159) and the step for comparing the voltage value V_{BAT} with the voltage threshold V_{th} (S165), when determining that a sufficient quantity of electric power does not remain in the battery 140.

3-4 Voltage Measurement Process

[0122] Fig. 10 is a flow chart which shows an example of a flow of a voltage measuring process that may be performed in S163 in Fig. 9.

[0123] First, in S181, the controller 120 makes the battery 140 start outputting of voltage pulses to the heater 130, by turning on the first switch 131 and the second switch 132.

[0124] Next, in S183, the controller 120 measures an output voltage of the battery 140, by converting the level of the voltage inputted via the boosting circuit 141 by performing digital-analog conversion. The above measurement is performed plural times at constant time intervals.

[0125] Next, in S185, the controller 120 makes the battery 140 terminate outputting of voltage pulses to the heater 130, by turning off the first switch 131 and the second switch 132.

[0126] Next, in S187, the controller 120 calculates, as a voltage value V_{BAT} that is to be compared with a voltage threshold, an average value of the output voltages measured in S183.

4 Conclusion

[0127] In the above description, various embodiments and variations of the present disclosure have been explained with reference to Figs. 1-10. In a flavor inhaler or

the like which receives, by its heater, supply of electric power from an electric power supply to heat an article including a flavor source or the like to thereby generate flavor or the like, according to the technique of the present disclosure, if it is determined, in response to a user input for requesting a start of heating, that a quantity of electric power that is sufficient to consume a flavor source or the like included in a single article does not remain in an electric power supply, heating is not started, i.e., restricted, and, instead thereof, information representing insufficiency of the remaining quantity is reported to a user. In addition to the above, checking with respect to whether the sufficient quantity of electric power remains in the electric power supply is performed in response to a user input that is different from the user input for requesting a start of heating, and a result of the checking is reported to a user. Accordingly, by simply performing a manipulation for requesting a start of heating, a user can start inhalation of aerosol without a risk of stopping of a session in the middle thereof, and know a check result with respect to the remaining quantity of electric power regardless of a place where the user stays. Further, if the remaining quantity of electric power is insufficient when heating is being restricted, the restriction is not removed, so that unnecessary repetition of the process for restricting heating is prevented.

[0128] The invention is not limited by the above-explained embodiments, and can be modified/changed in various ways within the scope of the gist of the invention.

[0129] Further, and finally, some of the characteristics of the present disclosure will be shown in the following description.

[Characteristic 1]

[0130] A device that is a flavor inhaler or an aerosol generation device, comprising:

a heater configured to heat a flavor source and/or an aerosol source;
a power supply for supplying electric power to the heater; and
a controller configured to restrict heating performed by the heater if a remaining quantity in the power supply is insufficient, wherein
the controller is further configured to remove, if the heating performed by the heater is restricted, the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

[Characteristic 2]

[0131] The device as recited in Characteristic 1, wherein the controller is further configured to perform, in response to a first predetermined manipulation applied to the device to start heating performed by the heater, a first determination with respect to whether the remaining quantity in the power supply is insufficient.

[Characteristic 3]

[0132] The device as recited in Characteristic 2, wherein the first determination includes:

measuring the remaining quantity in the power supply; and/or
temporarily supplying electric power from the power supply to the heater to measure an operating voltage of the power supply.

[Characteristic 4]

[0133] The device as recited in Characteristic 2 or 3, wherein the controller is further configured to perform, in response to a second predetermined manipulation that is different from the first predetermined manipulation and is applied to the device, a second determination with respect to whether the remaining quantity in the power supply is insufficient.

[Characteristic 5]

[0134] The device as recited in Characteristic 4, wherein

the controller is further configured to set, if it is determined that the remaining quantity in the power supply is insufficient, an insufficient-remaining-quantity state; and
the second determination comprises:
determining whether the insufficient-remaining-quantity state has been set,
performing a measuring process if it is not determined that the insufficient-remaining-quantity state has been set, the measuring process comprising:

measuring the remaining quantity in the power supply; and/or
temporarily supplying electric power from the power supply to the heater to measure an operating voltage of the power supply; and
omitting the measuring process if it is determined that the insufficient-remaining-quantity state has been set.

[Characteristic 6]

[0135] The device as recited in any one of Characteristic 1-5, wherein the predetermined condition is a condition that the remaining quantity in the power supply has increased by a predetermined quantity or more with reference to the remaining quantity in the power supply that was measured before a start of charging of the power supply.

[Characteristic 7]

[0136] The device as recited in Characteristic 6, wherein the predetermined quantity is a quantity that is sufficient to perform a determination with respect to whether the remaining quantity in the power supply is insufficient.

[Characteristic 8]

[0137] The device as recited in Characteristic 6, wherein

the device is configured in such a manner that a base material comprising the flavor source and/or the aerosol source can be replaced, and
the predetermined quantity is a quantity that is sufficient for consuming at least one base material.

[Characteristic 9]

[0138] The device as recited in Characteristic 8, wherein the controller is further configured to determine, based on temperature of the power supply, the quantity that is sufficient for consuming the at least one base material.

[Characteristic 10]

[0139] The device as recited in Characteristic 6, configured to allow a user to set the predetermined quantity.

[Characteristic 11]

[0140] The device as recited in Characteristic 6, wherein the controller is further configured to determine, based on history of use of the device by a user, the predetermined quantity.

[Characteristic 12]

[0141] The device as recited in Characteristics 6, configured in such a manner that the predetermined quantity is rewritable.

[Characteristic 13]

[0142] The device as recited in any one of Characteristics 1-5, wherein the predetermined condition is a condition that the power supply has been fully charged.

[Characteristic 14]

[0143] The device as recited in any one of Characteristics 1-5, wherein the predetermined condition is a condition that a predetermined time or more has elapsed since a start of charging of the power supply.

[Characteristic 15]

[0144] The device as recited in Characteristic 14, wherein the controller is further configured to:

determine a type of an external device connected to the device for charging the power supply; and
determine the predetermined time based on the determined type of the external device.

[Characteristic 16]

[0145] The device as recited in Characteristics 14, configured in such a manner that the predetermined time is rewritable.

[Characteristic 17]

[0146] The device as recited in any one of Characteristics 1-16, wherein restricting by the controller the heating performed by the heater comprises restricting the heating so as to prevent the heater from starting the heating.

[Characteristic 18]

[0147] A method performed by a controller in a device, the device being a flavor inhaler or an aerosol generation device, and comprising a heater configured to heat a flavor source and/or an aerosol source, and a power supply for supplying electric power to the heater, wherein the method comprises steps of:

restricting heating performed by the heater if a remaining quantity in the power supply is insufficient; and
removing the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

[Characteristic 19]

[0148] A program causing a controller in a device to perform steps, the device being a flavor inhaler or an aerosol generation device, and comprising a heater configured to heat a flavor source and/or an aerosol source, and a power supply for supplying electric power to the heater, wherein the steps comprises:

restricting heating performed by the heater if the remaining quantity in the power supply is insufficient; and
removing the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

REFERENCE SIGNS LIST

[0149]

10 Flavor inhaler or the like
15 Tobacco stick (Article)
101 Main body
102 Front panel
103 Display window
104 Slider
106 Opening
107 Insertion hole
120 Controller
121 Memory
122 Input detector
123 State detector
130 Heater
140 Battery (Power supply)
142 Remaining quantity meter
160 Notifier

Claims

1. A device that is a flavor inhaler or an aerosol generation device, comprising:

a heater configured to heat a flavor source and/or an aerosol source;
a power supply for supplying electric power to the heater; and
a controller configured to restrict heating performed by the heater if a remaining quantity in the power supply is insufficient, wherein
the controller is further configured to remove, if the heating performed by the heater is restricted, the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

2. The device as recited in Claim 1, wherein the controller is further configured to perform, in response to a first predetermined manipulation applied to the device to start heating performed by the heater, a first determination with respect to whether the remaining quantity in the power supply is insufficient.

3. The device as recited in Claim 2, wherein the first determination includes:

measuring the remaining quantity in the power supply; and/or
temporarily supplying electric power from the power supply to the heater to measure an operating voltage of the power supply.

4. The device as recited in Claim 2 or 3, wherein the controller is further configured to perform, in response to a second predetermined manipulation that is different from the first predetermined manipulation and is applied to the device, a second determination with respect to whether the remaining quantity in the power supply is insufficient.

5. The device as recited in Claim 4, wherein

the controller is further configured to set, if it is determined that the remaining quantity in the power supply is insufficient, an insufficient-remaining-quantity state; and
the second determination comprises:

determining whether the insufficient-remaining-quantity state has been set,
performing a measuring process if it is not determined that the insufficient-remaining-quantity state has been set, the measuring process comprising:

measuring the remaining quantity in the power supply; and/or
temporarily supplying electric power from the power supply to the heater to measure an operating voltage of the power supply; and

omitting the measuring process if it is determined that the insufficient-remaining-quantity state has been set.

6. The device as recited in any one of Claims 1-5, wherein the predetermined condition is a condition that the remaining quantity in the power supply has increased by a predetermined quantity or more with reference to the remaining quantity in the power supply that was measured before a start of charging of the power supply.

7. The device as recited in Claim 6, wherein the predetermined quantity is a quantity that is sufficient to perform a determination with respect to whether the remaining quantity in the power supply is insufficient.

8. The device as recited in Claim 6, wherein

the device is configured in such a manner that a base material comprising the flavor source and/or the aerosol source can be replaced, and
the predetermined quantity is a quantity that is sufficient for consuming at least one base material.

9. The device as recited in Claim 8, wherein the controller is further configured to determine, based on temperature of the power supply, the quantity that is sufficient for consuming the at least one base mate-

rial.

10. The device as recited in Claim 6, configured to allow a user to set the predetermined quantity.

11. The device as recited in Claim 6, wherein the controller is further configured to determine, based on history of use of the device by a user, the predetermined quantity.

12. The device as recited in Claim 6, configured in such a manner that the predetermined quantity is rewritable.

13. The device as recited in any one of Claims 1-5, wherein the predetermined condition is a condition that the power supply has been fully charged.

14. The device as recited in any one of Claims 1-5, wherein the predetermined condition is a condition that a predetermined time or more has elapsed since a start of charging of the power supply.

15. The device as recited in Claim 14, wherein the controller is further configured to:

determine a type of an external device connected to the device for charging the power supply; and
determine the predetermined time based on the determined type of the external device.

16. The device as recited in Claim 14, configured in such a manner that the predetermined time is rewritable.

17. The device as recited in any one of Claims 1-16, wherein restricting by the controller the heating performed by the heater comprises restricting the heating so as to prevent the heater from starting the heating.

18. A method performed by a controller in a device, the device being a flavor inhaler or an aerosol generation device, and comprising a heater configured to heat a flavor source and/or an aerosol source, and a power supply for supplying electric power to the heater, wherein the method comprises steps of:

restricting heating performed by the heater if a remaining quantity in the power supply is insufficient; and
removing the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

19. A program causing a controller in a device to perform steps, the device being a flavor inhaler or an aerosol generation device, and comprising a heater configured to heat a flavor source and/or an aerosol source, and a power supply for supplying electric power to the heater, wherein the steps comprises:

restricting heating performed by the heater if the remaining quantity in the power supply is insufficient; and
removing the restriction based on a predetermined condition having been satisfied after a start of charging of the power supply.

Fig.1

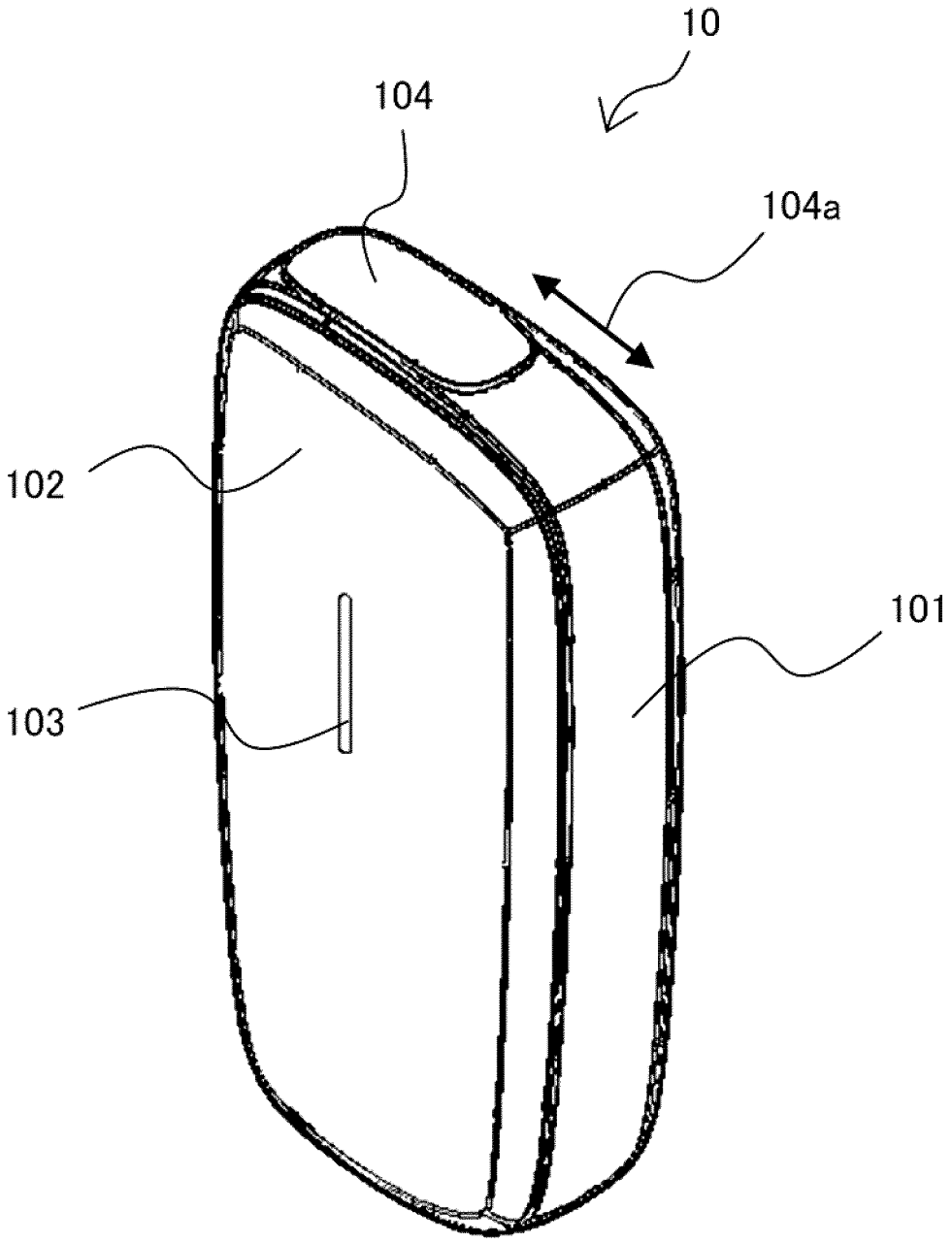
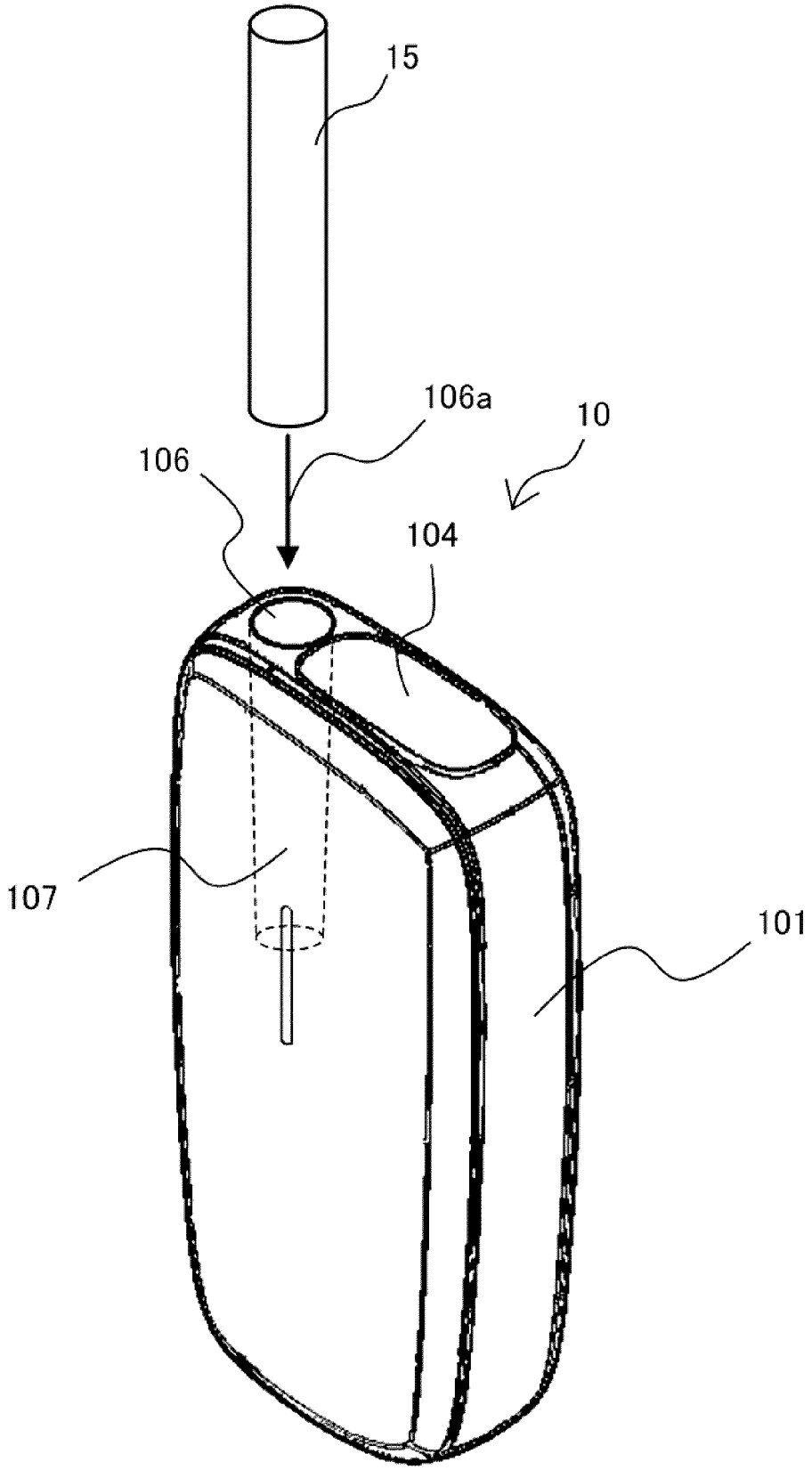


Fig. 2



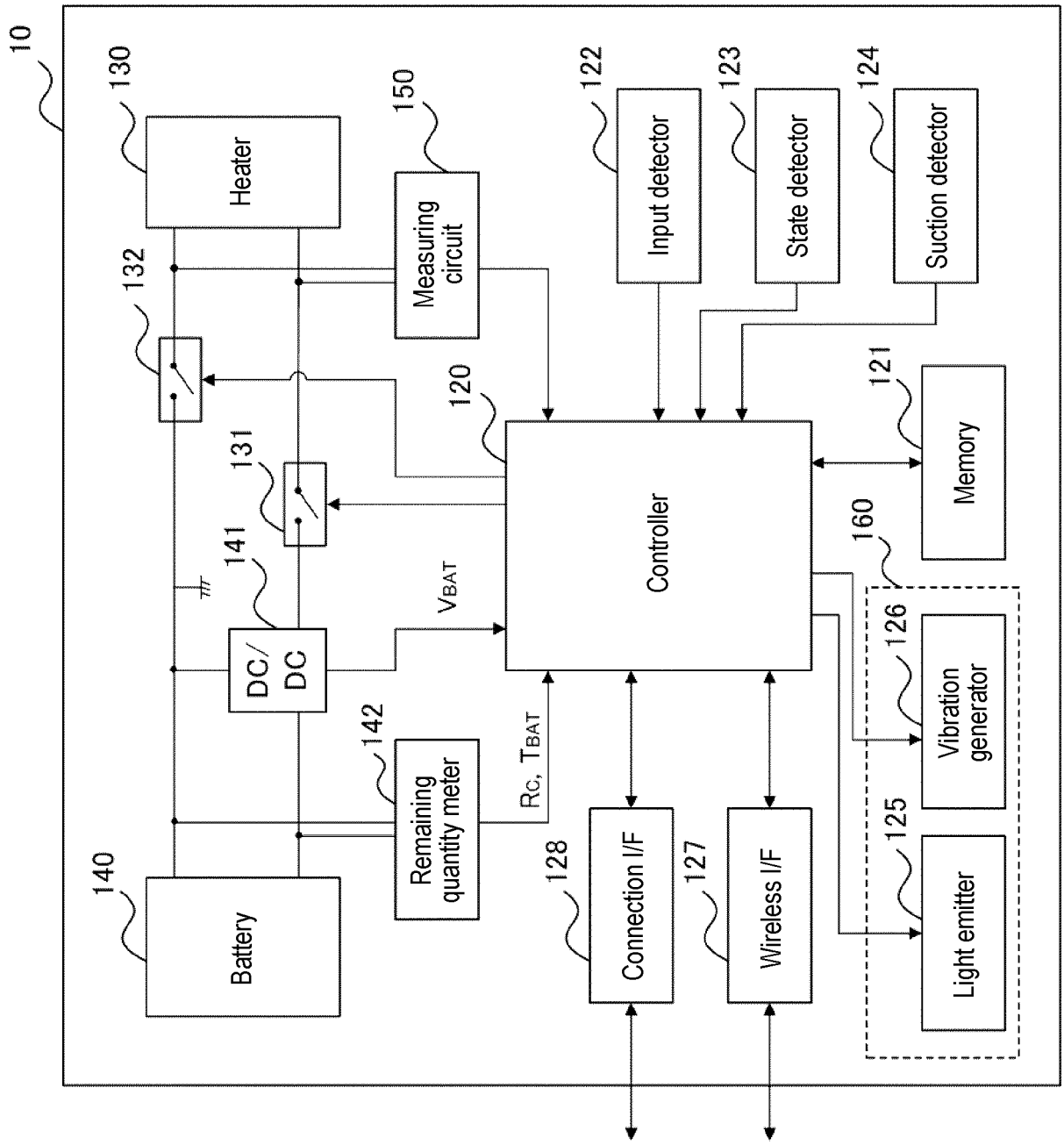

10
130
Heater
150
Measuring circuit
122
Input detector
123
State detector
124
Suction detector
132
120
121
Memory
131
Controller
141
DC/DC
V_{BAT}
160
126
Vibration generator
142
Remaining quantity meter
R_C, T_{BAT}
125
Light emitter
140
Battery
128
Connection I/F
127
Wireless I/F

Fig. 3

Fig. 4

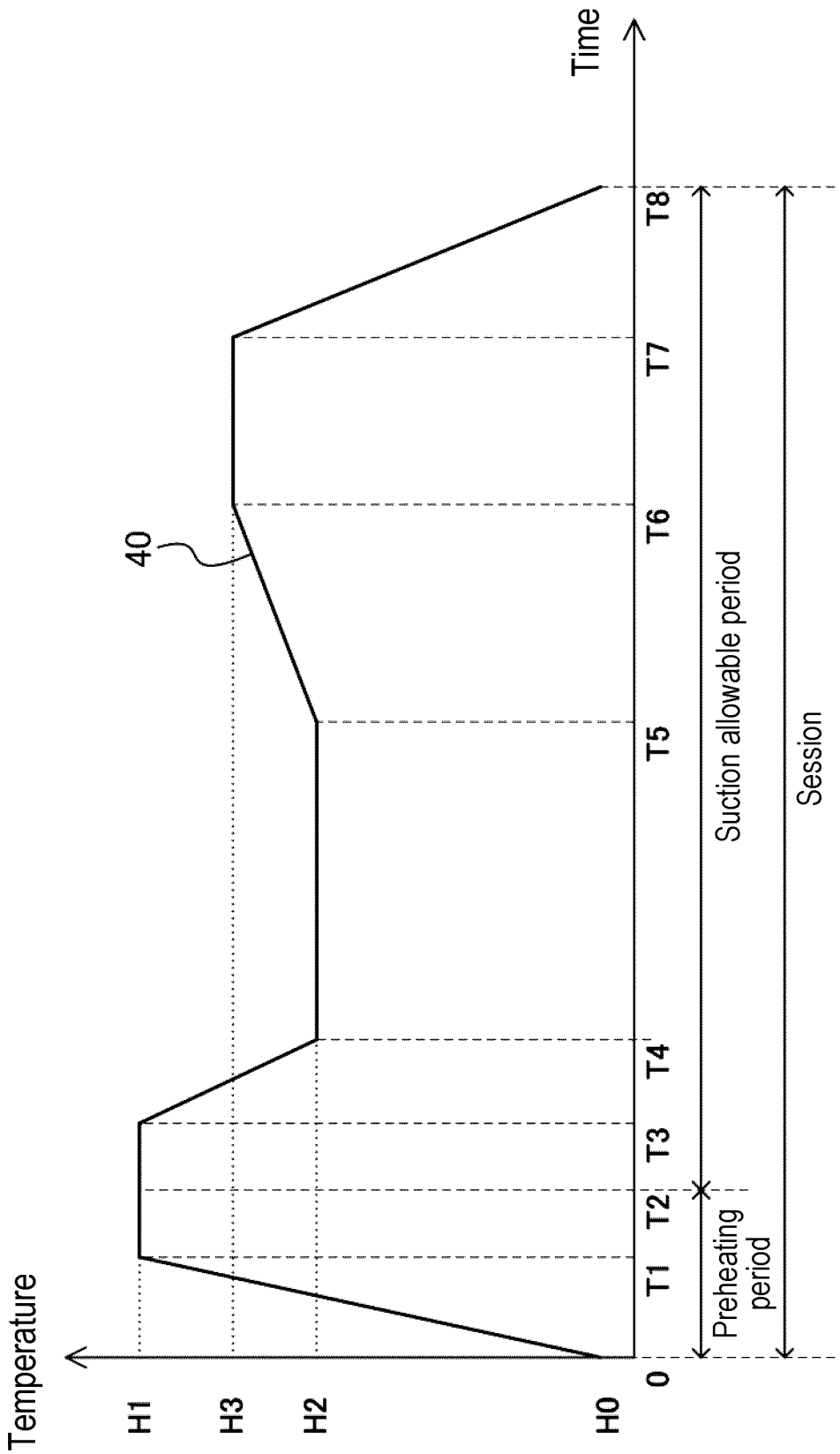

Temperature
Time
H1
H3
H2
H0
0
T1
T2
T3
T4
T5
T6
T7
T8
40
Preheating period
Suction allowable period
Session

Fig. 5

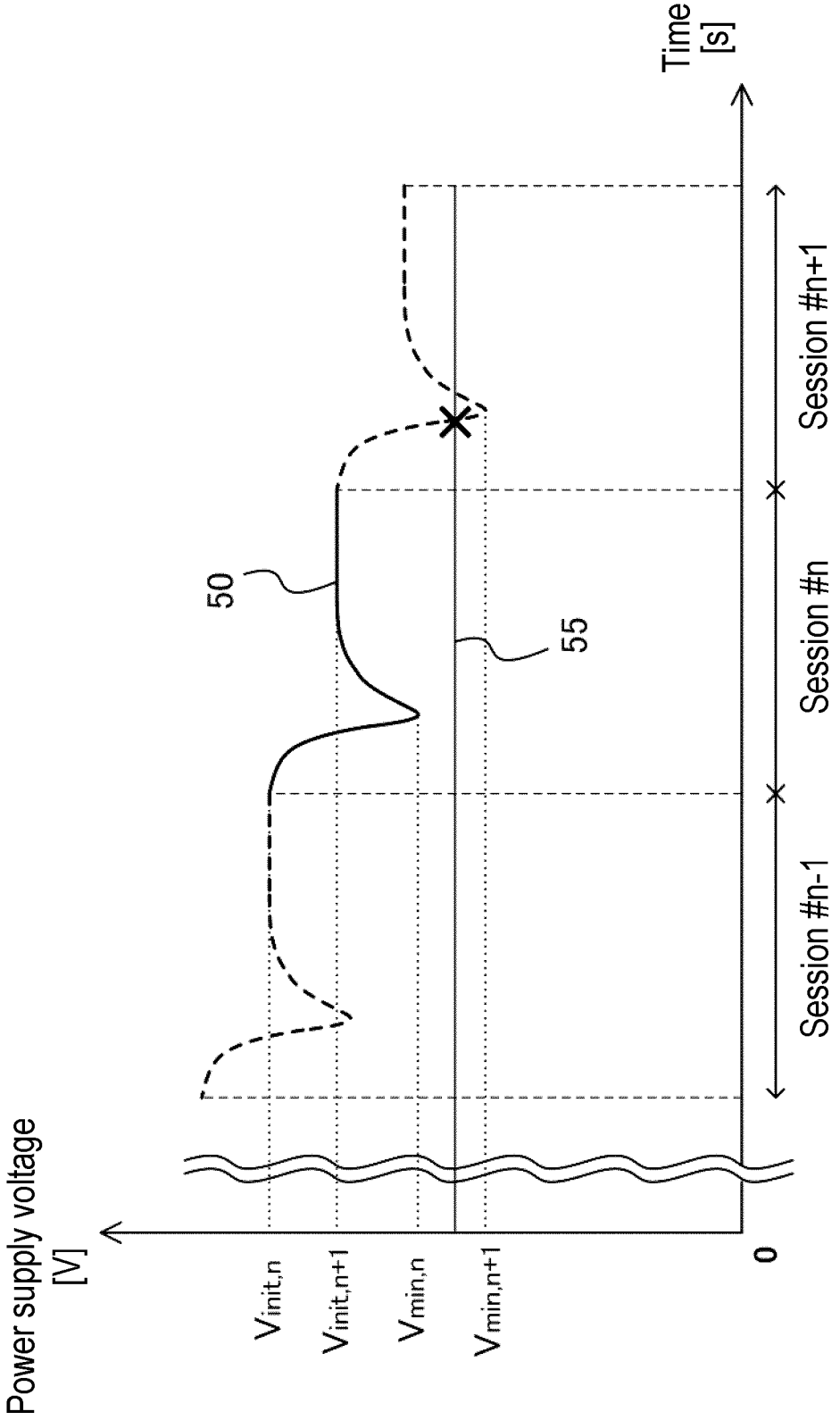

Power supply voltage [V]
Time [s]
0
$V_{init,n}$
$V_{init,n+1}$
$V_{min,n}$
$V_{min,n+1}$
50
55
Session #n-1
Session #n
Session #n+1

Fig. 6

Battery temperature	Category	C1	C2	C3
	Range	$T_{BAT} < 10°C$	$10°C \leqq T_{BAT} < 20°C$	$20°C \leqq T_{BAT}$
Remaining-quantity threshold [mAh]	R_{th1}	R_{th1_low}	R_{th1_mid}	R_{th1_high}
	R_{th0}	R_{th0_low}	R_{th0_mid}	R_{th0_high}
Voltage threshold [V]	V_{th}	V_{th}		

Fig. 7

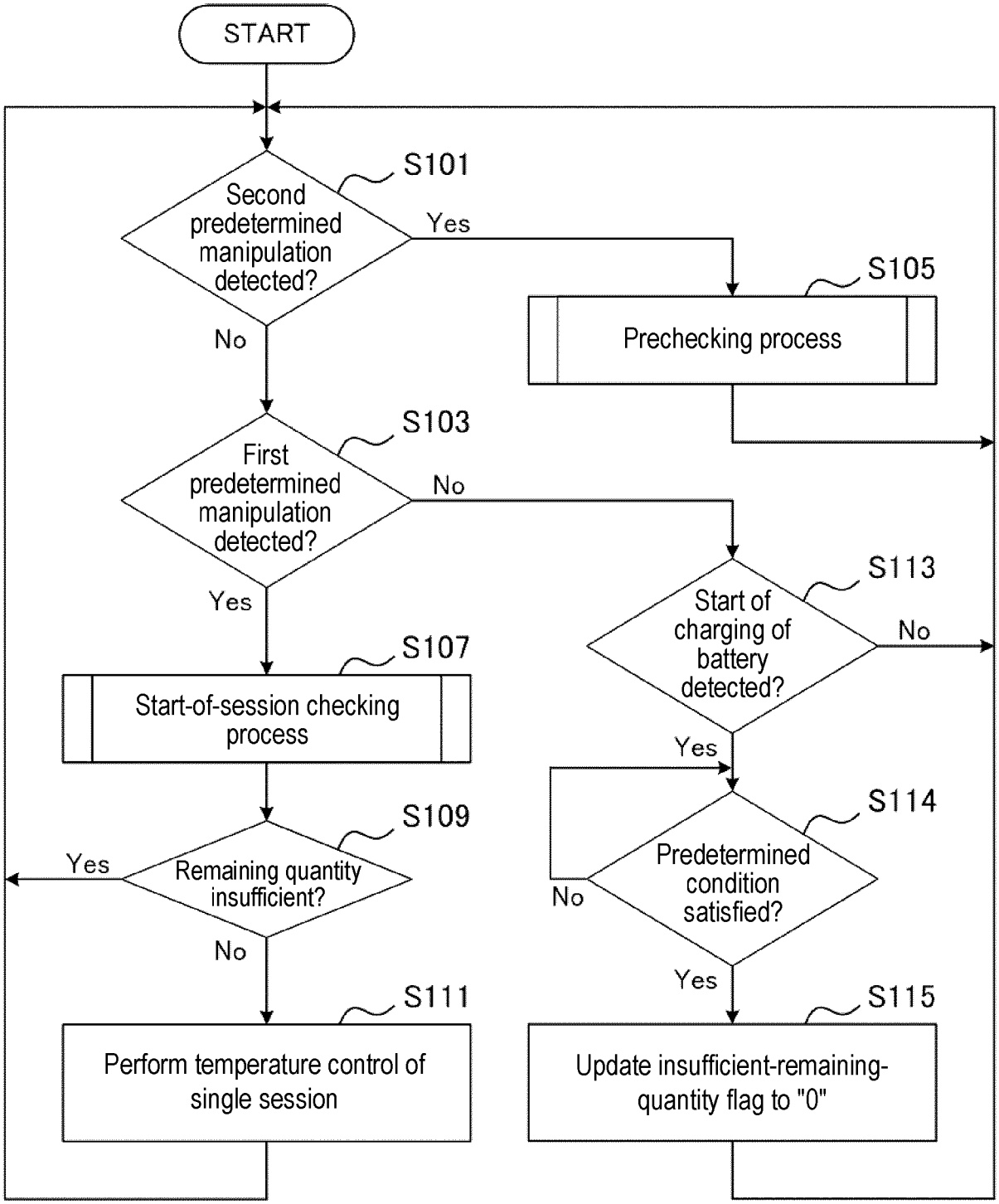

START
S101
Second predetermined manipulation detected?
Yes
No
S105
Prechecking process
S103
First predetermined manipulation detected?
No
Yes
S113
Start of charging of battery detected?
No
Yes
S107
Start-of-session checking process
S109
Remaining quantity insufficient?
Yes
No
S114
Predetermined condition satisfied?
No
Yes
S111
Perform temperature control of single session
S115
Update insufficient-remaining-quantity flag to "0"

Fig. 8

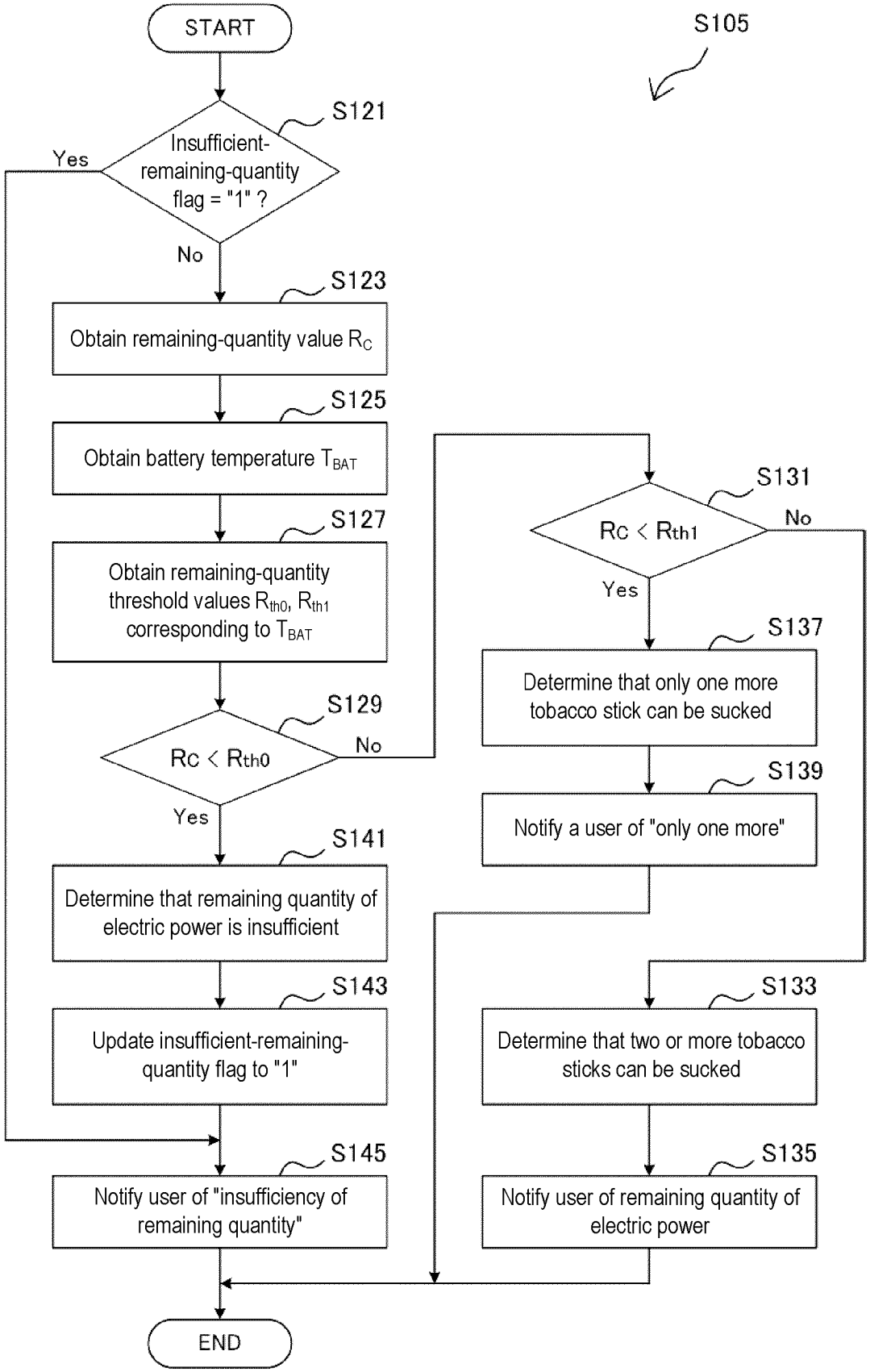

START
S105
S121
Insufficient-remaining-quantity flag = "1" ?
Yes
No
S123
Obtain remaining-quantity value R_C
S125
Obtain battery temperature T_{BAT}
S127
Obtain remaining-quantity threshold values R_{th0}, R_{th1} corresponding to T_{BAT}
S129
$R_C < R_{th0}$
No
Yes
S131
$R_C < R_{th1}$
No
Yes
S137
Determine that only one more tobacco stick can be sucked
S139
Notify a user of "only one more"
S141
Determine that remaining quantity of electric power is insufficient
S143
Update insufficient-remaining-quantity flag to "1"
S133
Determine that two or more tobacco sticks can be sucked
S145
Notify user of "insufficiency of remaining quantity"
S135
Notify user of remaining quantity of electric power
END

Fig. 9

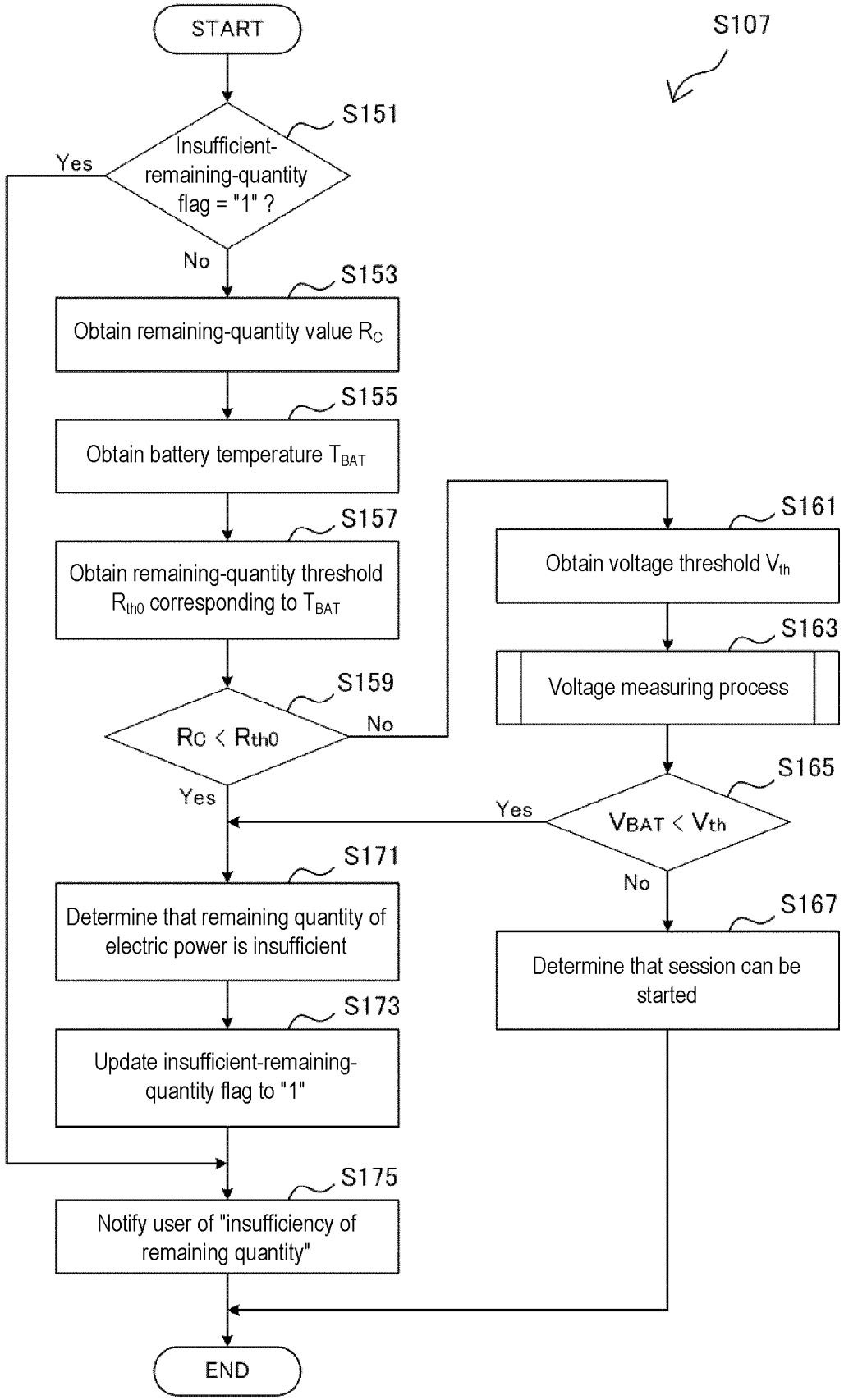
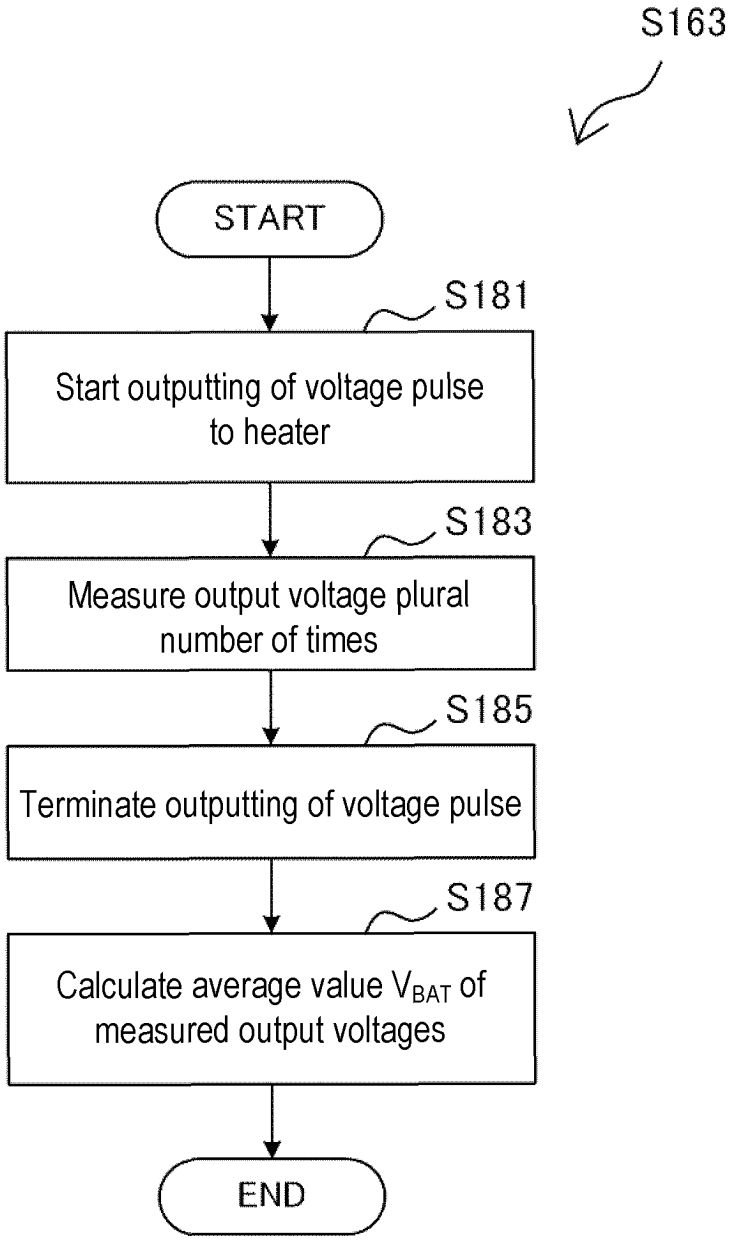

START
S107
S151
Insufficient-remaining-quantity flag = "1" ?
Yes
No
S153
Obtain remaining-quantity value R_C
S155
Obtain battery temperature T_{BAT}
S157
Obtain remaining-quantity threshold R_{th0} corresponding to T_{BAT}
S159
$R_C < R_{th0}$
No
Yes
S161
Obtain voltage threshold V_{th}
S163
Voltage measuring process
S165
$V_{BAT} < V_{th}$
Yes
No
S167
Determine that session can be started
S171
Determine that remaining quantity of electric power is insufficient
S173
Update insufficient-remaining-quantity flag to "1"
S175
Notify user of "insufficiency of remaining quantity"
END

Fig. 10


S163
START
S181
Start outputting of voltage pulse to heater
S183
Measure output voltage plural number of times
S185
Terminate outputting of voltage pulse
S187
Calculate average value V_{BAT} of measured output voltages
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/023042

A. CLASSIFICATION OF SUBJECT MATTER

A24F 40/50(2020.01)i; ***A24F 40/90***(2020.01)i
FI: A24F40/90; A24F40/50

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)

A24F40/50; A24F40/90

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 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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.
X	WO 2020/084757 A1 (JAPAN TOBACCO INC) 30 April 2020 (2020-04-30) paragraphs [0060]-[0072], fig. 1B, 5	1-4, 6-8, 13-14, 17-19
A	JP 2020-156500 A (JAPAN TOBACCO INC) 01 October 2020 (2020-10-01) entire text, all drawings	1-19

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

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"E" earlier application or patent but published on or after the international filing date
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 July 2022	**09 August 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/023042

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2020/084757 A1	30 April 2020	EP 3871534 A1 paragraphs [0061]-[0073], fig. 1B, 5 CN 113056209 A	
JP 2020-156500 A	01 October 2020	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2020084757 A **[0004]**