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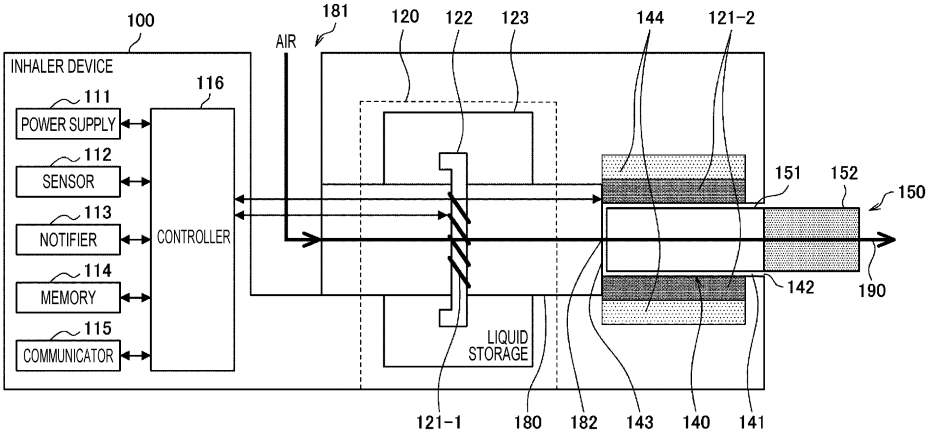
(54) **INHALING DEVICE, CONTROL METHOD, AND PROGRAM**

(57) Provided is a mechanism with which the performance of an inhaling device can be further improved. This inhaling device is provided with: a first heating unit for heating an aerosol source contained in a first substrate; a second heating unit for heating an aerosol source contained in a second substrate to generate an aerosol that passes through the first substrate; and a control unit for performing control such that the amount of the aerosol generated by the second heating unit increases with increasing elapsed time from the start of heating by the first heating unit.

FIG. 1



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Description

Technical Field

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

Background Art

[0002] Inhaler devices that generate substances to be inhaled by users, such as electronic cigarettes and nebulizers, are in widespread use. For example, such an inhaler device uses a substrate to generate an aerosol with a flavor component imparted thereto. The substrate includes parts such as an aerosol source for generating an aerosol, and a flavor source for imparting a flavor component to the generated aerosol. As a user inhales (to be referred to also as "puffs" hereinafter) the aerosol generated by the inhaler device and having the flavor component imparted thereto, the user can taste the flavor.

[0003] Inhaler devices generate an aerosol by methods that are roughly divided into liquid atomization and stick heating. With liquid atomization methods, an aerosol is generated by atomizing an aerosol source that is in liquid form. With stick heating methods, an aerosol is generated by heating a stick containing an aerosol source. Further, Patent Literature 1 below discloses a hybrid inhaler device that employs a combination of a liquid atomization method and a stick heating method.

Citation List

Patent Literature

[0004] Patent Literature 1: International Publication No. 2020/039589

Summary of Invention

Technical Problem

[0005] Such hybrid inhaler devices, however, are still in the early days of development, and it is hard to say that these devices have attained satisfactory performance.

[0006] The present invention has been made to address the above-mentioned problem, and accordingly it is an object of the present invention to provide a mechanism that makes it possible to improve the performance of inhaler devices.

Solution to Problem

[0007] In orderto solve the above problem, as aspect of the present invention provides an inhaler device including a first heater, a second heater, and a controller. The first heater heats an aerosol source contained in a first substrate. The second heater heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate. The controller performs control such that an amount of the aerosol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

[0008] The controller may perform control such that an amount of the aerosol generated by the second heater for each single occurrence of an inhaling action for inhaling the aerosol increases with increasing time that has elapsed since start of heating by the first heater.

[0009] The controller may perform control such that an amount of power supplied to the second heater for each single occurrence of the inhaling action increases with increasing time that has elapsed since start of heating by the first heater.

[0010] The controller may perform control such that a duration of time for which power is supplied to the second heater for each single occurrence of the inhaling action increases with increasing time that has elapsed since start of heating by the first heater.

[0011] The controller may perform control such that an amount of power supplied to the second heater per unit time for each single occurrence of the inhaling action increases with increasing time that has elapsed since start of heating by the first heater.

[0012] The controller may perform control such that an amount of power supplied to the second heater for each single occurrence of an inhaling action for inhaling the aerosol increases with increasing number of the inhaling actions.

[0013] The controller may perform control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed.

[0014] The controller may perform control such that heating by the first heater is performed in accordance with a heating profile, which defines a relationship between the time that has elapsed since start of heating by the first heater and a temperature of the first heater.

[0015] The controller may perform control such that, until the time that has elapsed since start of heating by the first heater reaches a first predetermined time, heating by the second heater is not performed even when an inhaling action for inhaling the aerosol is performed.

[0016] The controller may perform control such that, after the time that has elapsed since start of heating by the first heater reaches a second predetermined time, heating by the second heater is not performed even when an inhaling action for inhaling the aerosol is performed.

[0017] The controller may control the heating profile based on an input made by a user.

[0018] The controller may control, based on a type of the first substrate, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

[0019] The controller may identify the type of the first substrate based on identification information provided to

the first substrate.

[0020] The controller may control, based on a type of the second substrate, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

[0021] The controller may control, based on an input made by a user, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

[0022] The first substrate may contain a flavor source.

[0023] The second substrate may contain the aerosol source that is a liquid.

[0024] To solve the above problem, another aspect of the present invention provides a control method for controlling an inhaler device. The inhaler device includes a first heater, and a second heater. The first heater heats an aerosol source contained in a first substrate. The second heater heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate. The control method includes performing control such that an amount of the aerosol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

[0025] To solve the above problem, another aspect of the present invention provides a program for causing a computer to execute a process. The computer controls an inhaler device. The inhaler device includes a first heater, and a second heater. The first heater heats an aerosol source contained in a first substrate. The second heater heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate. The process includes performing control such that an amount of the aerosol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

[0026] To solve the above problem, another aspect of the present invention provides an inhaler device including a first heater, a second heater, and a controller. The first heater heats an aerosol source contained in a first substrate. The second heater heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate. The controller performs control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed. The controller performs control such that, until a time that has elapsed since start of heating by the first heater reaches a predetermined time, heating by the second heater is not performed even when the inhaling action is performed.

[0027] To solve the above problem, another aspect of the present invention provides an inhaler device including a first heater, a second heater, and a controller. The first heater heats an aerosol source contained in a first substrate. The second heater heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate. The controller performs control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed. The controller performs control such that, when the inhaling action is performed after heating by the first heater ends, heating by the second heater is not performed.

Advantageous Effects of Invention

[0028] As described above, the present invention provides a mechanism that makes it possible to improve the performance of inhaler devices.

Brief Description of Drawings

[0029]

[FIG. 1] FIG. 1 is a schematic diagram schematically illustrating a configuration example of an inhaler device according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is a graph illustrating an example of a heating profile and an atomization setting that are set for an inhaler device according to an embodiment of the present invention.

[FIG. 3] FIG. 3 is a flowchart illustrating an exemplary control procedure executed by the inhaler device according to the embodiment for controlling the amount of atomization for a cartridge-side aerosol.

[FIG. 4] FIG. 4 is a flowchart illustrating another exemplary control procedure executed by the inhaler device according to the embodiment for controlling the amount of atomization for the cartridge-side aerosol.

[FIG. 5] FIG. 5 represents graphs illustrating an example of how the inhaler device according to the embodiment switches atomization settings in accordance with substrate type.

[FIG. 6] FIG. 6 represents graphs illustrating an example of how the inhaler device according to the embodiment switch heating profiles in accordance with user's input.

Description of Embodiments

[0030] A preferred embodiment of the present invention will be described below in detail with reference to the attached drawings. In the specification and the drawings, components with substantially identical functions and configurations will be designated by the same reference signs to avoid repetitive description.

<1. Configuration Examples of Inhaler Device>

[0031] An inhaler device generates a substance to be inhaled by a user. The following description assumes that the substance to be generated by the inhaler device is an aerosol. Alternatively, the substance to be generated

by the inhaler device may be a gas. In the following description, user's inhalation of a substance generated by the inhaler device will be also referred to simply as "inhalation" or "puff". Reference is now made to various configuration examples of the inhaler device.

[0032] An inhaler device according to the present configuration example generates an aerosol by heating an aerosol source that is a liquid, and heating a substrate containing the aerosol source. Reference is now made to FIG. 1 to describe the configuration example.

[0033] FIG. 1 is a schematic diagram schematically illustrating a configuration example of an inhaler device according to an embodiment of the present invention. As illustrated in FIG. 1, an inhaler device 100 according to the present configuration example includes a power supply 111, a sensor 112, a notifier 113, a memory 114, a communicator 115, a controller 116, a liquid guide 122, a liquid storage 123, a heater 121-1, a heater 121-2, a holder 140, and a heat insulator 144. The inhaler device 100 has an airflow path 180 defined therein.

[0034] The heater 121-1, the liquid guide 122, and the liquid storage 123 are contained in a cartridge 120. The cartridge 120 is removable from the inhaler device 100. With the cartridge 120 attached to the inhaler device 100, and with a stick substrate 150 held by the holder 140, the user performs inhalation. Individual components are now described in sequence below.

[0035] The power supply 111 stores electric power. The power supply 111 supplies power to various components of the inhaler device 100. The power supply 111 may be a rechargeable battery such as a lithium ion secondary battery. The power supply 111 may be charged by connection to an external power supply via, for example, a Universal Serial Bus (USB) cable. The power supply 111 may be charged by wireless power transmission technology without being connected to a device at the transmitting side. In another example, the power supply 111 alone may be removable from the inhaler device 100, or may be replaceable with new one.

[0036] The sensor 112 detects various information related to the inhaler device 100. The sensor 112 outputs the detected information to the controller 116. In one example, the sensor 112 may be a pressure sensor such as a condenser microphone, a flow sensor, or a temperature sensor. In response to detecting a value associated with user's inhalation, the sensor 112 outputs information indicating that the user has performed inhalation to the controller 116. In another example, the sensor 112 is an input device that receives information input by the user, such as a button or a switch. In particular, the sensor 112 may include a button for indicating that aerosol generation be started/stopped. The sensor 112 outputs, to the controller 116, information input by the user. In another example, the sensor 112 is a temperature sensor that detects the temperature of the heater 121-2. For example, the temperature sensor detects the temperature of the heater 121-2 based on the electrical resistance of the conductive track of the heater 121-2. The sensor 112 may, based on the temperature of the heater 121-2, detect the temperature of the stick substrate 150 held by the holder 140.

[0037] The notifier 113 provides the user with notification of information. In one example, the notifier 113 is a light-emitting device such as a light emitting diode (LED). In that case, the notifier 113 emits light in different light emission patterns for different situations, such as when the power supply 111 is in need of charging, when the power supply 111 is being charged, and when an abnormality has occurred in the inhaler device 100. The term light emission pattern as used herein conceptually includes, for example, color and light-on/light-off timing. Examples of the notifier 113 may include, in addition to or instead of a light-emitting device, a display device that displays an image, a sound output device that outputs sound, and a vibration device that vibrates. In another example, the notifier 113 may provide information notifying that it has become possible for the user to inhale. The information notifying that it has become possible for the user to inhale is provided when the stick substrate 150 heated by the heater 121-2 has reached a predetermined temperature.

[0038] The memory 114 stores various information for operation of the inhaler device 100. The memory 114 is, for example, a non-volatile storage medium such as flash memory. An example of information stored in the memory 114 is information related to the operating system (OS) of the inhaler device 100, such as information representing how the controller 116 controls various components. Another example of information stored in the memory 114 is information related to user's inhalation, such as the number of inhalations, the time of inhalation, and the cumulative duration of inhalation.

[0039] The communicator 115 is a communication interface for transmission and reception of information between the inhaler device 100 and another device. The communicator 115 is capable of communication in conformity with any wired or wireless communication standard. A suitable example of such communication standard may be wireless local area network (LAN), wired LAN, Wi-Fi (registered trademark), or Bluetooth (registered trademark). In one example, the communicator 115 transmits information related to user's inhalation to a smartphone to display, on the smartphone, the information related to user's inhalation. In another example, the communicator 115 receives new OS information from a server to update the OS information stored in the memory 114.

[0040] The controller 116 functions as an arithmetic processing unit and a control unit, and controls the overall internal operation of the inhaler device 100 in accordance with various programs. The controller 116 is implemented by, for example, an electronic circuit such as a central processing unit (CPU) or a microprocessor. The controller 116 may additionally include a read only memory (ROM) for storing information such as programs and arithmetic parameters to be used, and a random access

memory (RAM) for temporarily storing parameters that change as appropriate. The inhaler device 100 executes various processes under control by the controller 116. Exemplary processes to be controlled by the controller 116 include: supply of power from the power supply 111 to other components; charging of the power supply 111; detection of information by the sensor 112; notification of information provided by the notifier 113; storage and readout of information by the memory 114; and transmission/reception of information by the communicator 115. Other processes to be executed by the inhaler device 100, such as input of information to various components, and processes based on information output from various components, are also controlled by the controller 116.

[0041] The liquid storage 123 stores an aerosol source. The aerosol source is atomized by heating to generate an aerosol. The aerosol source is, for example, a liquid such as polyhydric alcohol or water. Examples of the polyhydric alcohol include glycerol and propylene glycol. The aerosol source may further include a tobacco raw material, or an extract derived from a tobacco raw material. The tobacco raw material or the extract derived therefrom releases a flavor component when heated. The aerosol source may further include nicotine. If the inhaler device 100 is a medical inhaler such as a nebulizer, the aerosol source may include a medicine for inhalation by a patient.

[0042] The liquid guide 122 guides, from the liquid storage 123, a liquid aerosol source stored in the liquid storage 123, and holds the aerosol source. The liquid guide 122 is, for example, a wick formed by twisting a fibrous material such as glass fiber or a porous material such as porous ceramic. The liquid guide 122 is in liquid communication with the liquid storage 123. Thus, the aerosol source stored in the liquid storage 123 spreads over the entire liquid guide 122 through capillary action.

[0043] The heater 121-1 heats the aerosol source to atomize the aerosol source and generate an aerosol. The heater 121-1 is made of any material such as metal or polyimide in any form such as a coil, a film, or a blade. The heater 121-1 is disposed in proximity to the liquid guide 122. In the example illustrated in FIG. 1, the heater 121-1 is in the form of a coil made of metal and wound around the liquid guide 122. Thus, when the heater 121-1 generates heat, the aerosol source held by the liquid guide 122 is heated and atomized to generate an aerosol. The heater 121-1 generates heat in response to supply of power from the power supply 111. In one example, power may be supplied for aerosol generation during the period of time in which an inhalation taken by the user is being detected by the sensor 112. In another example, power may be supplied for aerosol generation in response to the sensor 112 detecting that a predetermined user input (e.g., the user depressing a button for indicating that aerosol generation be started/stopped) has been made. Subsequently, the supply of power may be stopped in response to the sensor 112 detecting that a predetermined user input (e.g., the user depressing again the button for indicating that aerosol generation be started/stopped) has been made.

[0044] The holder 140 has an internal space 141. The holder 140 holds the stick substrate 150 with a portion of the stick substrate 150 being accommodated in the internal space 141. The holder 140 has an opening 142 that allows the internal space 141 to communicate with an external environment. The holder 140 holds the stick substrate 150 that is inserted into the internal space 141 through the opening 142. For example, the holder 140 is a tubular body having the opening 142 and a bottom 143 on its bases, and defines the internal space 141 having a columnar shape. The holder 140 is designed to have, in at least a portion of its tubular body in the height direction, an inner diameter smaller than the outer diameter of the stick substrate 150. This allows the holder 140 to hold the stick substrate 150 such as by pressing against the outer circumference of the stick substrate 150 inserted in the internal space 141. The holder 140 also serves to define a flow path for air passing through the stick substrate 150. For example, the bottom 143 has an air inlet hole through which air passes into the flow path. The opening 142 serves as an air outlet hole through which air exits the flow path.

[0045] The stick substrate 150 is a stick-shaped component. The stick substrate 150 includes a substrate 151, and an inhalation port 152.

[0046] The substrate 151 includes an aerosol source. The aerosol source is atomized by heating to generate an aerosol. The aerosol source may be, for example, a tobacco-derived material, such as a processed material obtained by forming shredded tobacco or a tobacco raw material into granular, sheet, or powder form. The aerosol source may include a non-tobacco-derived material made from a plant other than tobacco (e.g., mint or herb). In one example, the aerosol source may contain a flavor component such as menthol. If the inhaler device 100 is a medical inhaler, the aerosol source may include a medicine for inhalation by a patient. The aerosol source may not necessarily be a solid. Alternatively, for example, the aerosol source may be a liquid such as polyhydric alcohol or water. Examples of the polyhydric alcohol include glycerol and propylene glycol. With the stick substrate 150 held by the holder 140, the substrate 151 is at least partially accommodated in the internal space 141 of the holder 140.

[0047] The inhalation port 152 is a component on which the user sucks during inhalation. With the stick substrate 150 held by the holder 140, the inhalation port 152 at least partially protrudes from the opening 142. As the user sucks and inhales on the inhalation port 152 protruding from the opening 142, air flows into the holder 140 through an air inlet hole (not illustrated). After entering the holder 140, the air passes through the internal space 141 of the holder 140, that is, through the substrate 151, and reaches the inside of the user's mouth together with an aerosol generated from the substrate 151.

[0048] The heater 121-2 heats the aerosol source to

atomize the aerosol source and generate an aerosol. The heater 121-2 is made of any material such as metal or polyimide. For example, the heater 121-2 is in the form of a film, and positioned to surround the outer circumference of the holder 140. When the heater 121-2 generates heat, the aerosol source contained in the stick substrate 150 is heated from the outer circumference of the stick substrate 150. The aerosol source is thus atomized to generate an aerosol. The heater 121-2 generates heat in response to supply of power from the power supply 111. In one example, power may be supplied for aerosol generation in response to the sensor 112 detecting that a predetermined user input has been made. It becomes possible for the user to inhale when the stick substrate 150 heated by the heater 121-2 has reached a predetermined temperature. Subsequently, the supply of power may be stopped in response to the sensor 112 detecting that a predetermined user input has been made. In another example, power may be supplied for aerosol generation during the period of time in which an inhalation taken by the user is being detected by the sensor 112.

[0049] The bottom 143 of the holder 140 is provided with an air outlet hole 182 for the airflow path 180. The internal space 141 of the holder 140, and the airflow path 180 communicate with each other via the air outlet hole 182.

[0050] The airflow path 180 is a flow path of air to be inhaled by the user. The airflow path 180 has a tubular structure having an air inlet hole 181 and the air outlet hole 182 at opposite ends. The air inlet hole 181 serves as an inlet through which air enters the airflow path 180. The air outlet hole 182 serves as an outlet through which air exits the airflow path 180. As the user inhales, air flows into the airflow path 180 through the air inlet hole 181, and air flows out of the air outlet hole 182 into the internal space 141 of the holder 140. In one example, the air inlet hole 181 is positioned at any location in the inhaler device 100. The air outlet hole 182 is positioned at the bottom 143 of the holder 140. The liquid guide 122 is disposed at some point along the airflow path 180. An aerosol generated by the heater 121-1 is mixed with air entering through the air inlet hole 181. Subsequently, as the user inhales, the fluid mixture of the aerosol and the air is transported to the internal space 141 of the holder 140 via the air outlet hole 182 as indicated by an arrow 190. After being transported to the internal space 141 of the holder 140, the fluid mixture of the aerosol and the air reaches the inside of the user's mouth together with an aerosol generated by the heater 121-2.

[0051] According to the present configuration example, an aerosol may be generated through vibration or induction heating, instead of heating by the heater 121-1.

[0052] If an aerosol is to be generated through vibration, the inhaler device 100 includes a vibrator instead of the heater 121-1. For example, the vibrator is in the form of a plate-shaped component including a piezo-ceramic element that serves as an ultrasonic transducer. When the vibrator vibrates, an aerosol source guided by the liquid guide 122 onto the surface of the vibrator is atomized by ultrasonic waves that are generated as the vibrator vibrates. An aerosol is thus generated.

[0053] If an aerosol is to be generated through induction heating, the inhaler device 100 includes, instead of the heater 121-1, a susceptor and an electromagnetic induction source. The susceptor generates heat through electromagnetic induction. The susceptor is made of a conductive material such as metal. The susceptor is disposed in proximity to the liquid guide 122. For example, the susceptor is made of a metallic conductor wire and wound around the liquid guide 122. The electromagnetic induction source causes the susceptor to generate heat through electromagnetic induction. The electromagnetic induction source is made of, for example, a coiled conductor wire. The electromagnetic induction source generates a magnetic field in response to supply of an alternating current from the power supply 111. The electromagnetic induction source is disposed at a location where the susceptor overlaps a magnetic field generated by the electromagnetic induction source. Thus, generation of a magnetic field causes eddy currents to be generated in the susceptor, which gives rise to Joule heat. Due to the Joule heat, the aerosol source held by the liquid guide 122 is heated and atomized to generate an aerosol.

[0054] Likewise, according to the present configuration example, an aerosol may be generated through induction heating, instead of heating by the heater 121-2.

[0055] In that case, the stick substrate 150 further includes a susceptor. The susceptor generates heat through electromagnetic induction. The susceptor is made of a conductive material such as metal. In one example, the susceptor is a strip of metal. The susceptor is disposed in proximity to the aerosol source. For example, the susceptor is included in the substrate 151 of the stick substrate 150.

[0056] Further, the inhaler device 100 includes an electromagnetic induction source instead of the heater 121-2. For example, the electromagnetic induction source is in the form of a coiled conductor wire, and wound around the outer circumference of the holder 140. The electromagnetic induction source generates a magnetic field in response to supply of an alternating current from the power supply 111. The electromagnetic induction source is disposed at a location where the internal space 141 of the holder 140 overlaps a magnetic field generated by the electromagnetic induction source. Thus, when a magnetic field is generated with the stick substrate 150 being held by the holder 140, eddy currents are generated in the susceptor, which gives rise to Joule heat. Due to the Joule heat, the aerosol source contained in the stick substrate 150 is heated and atomized to generate an aerosol.

[0057] Configuration examples of the inhaler device 100 have been described above. Of course, the inhaler device 100 is not limited to the above-mentioned configurations but may take various exemplary configurations as presented below.

[0058] In one example, the heater 121-2 may be in the form of a blade, and disposed so as to protrude from the bottom 143 of the holder 140 toward the internal space 141. In that case, the heater 121-2 in the form of a blade is inserted into the substrate 151 of the stick substrate 150 to heat the substrate 151 of the stick substrate 150 from the inside. In another example, the heater 121-2 may be disposed so as to cover the bottom 143 of the holder 140. In still another example, the heater 121-2 may be implemented as a combination of two or more selected from the group consisting of a heater that covers the outer circumference of the holder 140, a heater that is in the form of a blade, and a heater that covers the bottom 143 of the holder 140.

[0059] In another example, the holder 140 may include an opening/closing mechanism such as a hinge for opening and closing a portion of an outer shell that defines the internal space 141. The stick substrate 150 inserted in the internal space 141 may be retained by the holder 140 through opening and closing of the outer shell. In that case, the heater 121-2 may be disposed at a location where the holder 140 retains the stick substrate 150, and may heat the stick substrate 150 while pressing against the stick substrate 150.

[0060] Means for generating an aerosol is not limited to heating. For example, means for generating an aerosol may be vibratory atomization or induction heating.

<2. Technical Features>

(1) Basic Operation of Inhaler Device 100

[0061] The inhaler device 100 generates an aerosol, which is a substance to be inhaled by the user. A user's action of trying to inhale, with the inhaler device 100, an aerosol generated by the inhaler device 100 will be also referred to simply as inhalation (puff) or inhaling action hereinafter. An example of a puff is sucking and inhaling on the inhalation port 152 of the stick substrate 150 inserted into the inhaler device 100. By taking a puff, the user is able to inhale the aerosol generated by the inhaler device 100.

[0062] The heater 121-2 is an example of a first heater that heats an aerosol source contained in a first substrate. The stick substrate 150 is an example of the first substrate. The stick substrate 150 contains a flavor source that, when heated, releases a flavor component. An example of the flavor component is an extract of tobacco leaves. The heater 121-2 will be referred to also as stick heater 121-2 hereinafter.

[0063] The heater 121-1 is an example of a second heater that heats an aerosol source contained in a second substrate to generate an aerosol that passes through the first substrate. The cartridge 120 is an example of the second substrate containing a liquid aerosol source. The cartridge 120 may contain a flavor source that, when heated, releases a flavor component. An example of the flavor component is menthol. The heater 121-1 will be referred to also as cartridge heater 121-1 hereinafter.

[0064] The aerosol generated by the stick heater 121-2 will be referred to also as stick-side aerosol. The aerosol generated by the cartridge heater 121-1 will be referred to also as cartridge-side aerosol. For cases where there is no particular need to distinguish between the stick-side aerosol and the cartridge-side aerosol, these aerosols will be also generically referred to simply as aerosol.

[0065] When a puff is taken, the cartridge-side aerosol passes through the stick substrate 150 and reaches the inside of the user's mouth. When passing through the stick substrate 150, the cartridge-side aerosol takes in a flavor component from the flavor source contained in the stick substrate 150. Further, when passing through the stick substrate 150, the cartridge-side aerosol is mixed with the stick-side aerosol. This allows the user to inhale an aerosol to which a flavor component derived from the stick substrate 150 has been imparted.

[0066] When the aerosol source contained in the stick substrate 150 becomes depleted, the stick substrate 150 is removed to replace the old stick substrate 150 with new one.

[0067] Likewise, when the aerosol source contained in the cartridge 120 becomes depleted, the cartridge 120 is removed to replace the old cartridge 120 with new one.

- Control of Stick Heater 121-2

[0068] The controller 116 performs control such that the stick heater 121-2 performs heating in accordance with a heating profile. A heating profile represents information defining the relationship between the time that has elapsed since the start of heating by the stick heater 121-2 and the temperature of the stick heater 121-2. The controller 116 controls the heater 121 such that temperature changes similar to those defined in the heating profile are achieved by the stick heater 121-2. The stick heater 121-2 may include a conducting track including a resistor, and the sensor 112 may detect the temperature of the stick heater 121-2 based on the electrical resistance of the conducting track. The control of the stick heater 121-2 may be implemented by, for example, controlling the supply of power from the power supply 111 to the stick heater 121-2. The supply of power may be controlled by means of, for example, pulse width modulation (PWM).

[0069] Heating executed by the stick heater 121-2 may be classified into pre-heating and main heating. Pre-heating refers to heating executed until a predetermined time elapses from the start of heating according to a heating profile, or until the stick heater 121-2 reaches a predetermined temperature. Main heating refers to heating executed after the pre-heating. The PWM control to be performed may be the same or different between the pre-heating and the main heating. For example, the duty ratio may be the same or different between the pre-heating and the main heating.

[0070] It is assumed that at the end of the pre-heating,

the stick substrate 150 generates a sufficient amount of aerosol. The user is thus able to inhale a sufficient amount of aerosol by sucking and inhaling on the stick substrate 150 after the pre-heating (that is, during the main heating). It is to be noted that an aerosol may be generated from the stick substrate 150 even during the pre-heating.

[0071] The controller 116 causes the heating by the stick heater 121-2 to be started when a predetermined condition is met. An example of the predetermined condition is the sensor 112 detecting that a predetermined user operation has been made. An example of the predetermined user operation is depression of a button provided to the inhaler device 100. Such a button will be referred to also as power button hereinafter.

- Control of Cartridge Heater 121-1

[0072] The controller 116 controls the cartridge heater 121-1 such that the cartridge heater 121-1 performs heating in accordance with a predetermined atomization setting. The atomization setting refers to information defining the amount of atomization per puff. The amount of atomization in this case refers to the amount of the cartridge-side aerosol generated. The amount of atomization depends on the amount of heating (i.e., amount of power supply). Accordingly, the control of the cartridge heater 121-1 can be implemented by, for example, controlling the supply of power from the power supply 111 to the cartridge heater 121-1. The supply of power is controlled by controlling the amount of power supplied per puff. The amount of power supplied per puff is calculated by the product of the duration of power supply and the amount of power supplied per unit time. Accordingly, the atomization setting may be defined by the duration of power supply for each puff and the amount of power supplied per unit time for each puff.

[0073] The controller 116 performs control such that the heating by the cartridge heater 121-1 is performed when a predetermined condition is met. For example, the controller 116 causes power to be supplied to the cartridge heater 121-1 when a predetermined condition is met. An example of the predetermined condition is the occurrence of a puff. This configuration enables efficient aerosol generation by allowing an aerosol to be generated only at the timing of puff occurrence. Further, examples of the predetermined condition may include that the time elapsed since the start of the pre-heating has not yet reached a second predetermined time after reaching a first predetermined time. This configuration will be described in detail later.

[0074] The occurrence of a puff can be detected by the sensor 112 based on, for example, a value associated with user's inhalation and acquired by a pressure sensor such as a condenser microphone, a flow sensor, a temperature sensor, or other sensor.

(2) Technical Issues

[0075] In the latter half of the heating profile, that is, as the time that has elapsed since the start of heating by the stick heater 121-2 (i.e., the pre-heating) increases, the amount of the flavor source contained in the stick substrate 150 decreases. This is because as time elapses from the start of the pre-heating, the cumulative amount of the stick-side aerosol generated increases, which in turn causes an increase in the cumulative amount of the flavor component taken into the stick-side aerosol. Further, as time elapses from the start of the pre-heating, the number of puffs taken by the user also increases, which in turn causes an increase in the cumulative amount of the flavor component taken into the cartridge-side aerosol. As the cumulative amount of the flavor component taken into the aerosol increases, the amount of the flavor source contained in the stick substrate 150 decreases.

[0076] A decrease in the amount of the flavor source contained in the stick substrate 150 results in a decrease in the amount of the flavor component contained in the aerosol inhaled by the user with each single puff. This makes it impossible for the user to sufficiently taste the flavor. Although Patent Literature 1 above discloses a control for making the amount of the flavor component contained in the aerosol constant, no mention is made of a specific method for implementing the control. In view of this, the embodiment is directed to providing a specific mechanism for allowing the user to sufficiently taste the flavor even in the latter half of the heating profile.

(3) Control of Amount of Atomization for Cartridge-Side Aerosol

[0077] The controller 116 performs control such that the amount of aerosol generated by the cartridge heater 121-1 increases with increasing time that has elapsed since the start of the pre-heating. This configuration allows more cartridge-side aerosol to be generated as more time elapses from the start of the pre-heating. A decrease in the amount of the flavor source contained in the stick substrate 150 results in a decrease in the amount of the flavor component derived from the stick substrate 150 that is imparted per unit amount of the cartridge-side aerosol. In this regard, the above-mentioned configuration makes it possible to increase the total amount of the cartridge-side aerosol. This increase leads to a corresponding increase in the amount of the flavor component derived from the stick substrate 150 that is taken in by the aerosol during its passage through the stick substrate 150. This makes it possible to prevent or reduce a decrease in the amount of the flavor component for the cartridge-side aerosol as a whole. That is, the decrease in the amount of the flavor component derived from the stick substrate 150 that is contained per unit amount of aerosol can be offset by the increase in the total amount of aerosol to thereby prevent or reduce a

decrease in the amount of the flavor component that reaches the inside of the user's mouth. This makes it possible for the user to sufficiently taste the flavor even in the latter half of the heating profile.

[0078] In particular, the controller 116 performs control such that the amount of aerosol generated per puff by the cartridge heater 121-1 increases with increasing time that has elapsed since the start of the pre-heating. This configuration allows the amount of the cartridge-side aerosol generated per puff to increase with increasing time that has elapsed since the start of the pre-heating. A decrease in the amount of the flavor source contained in the stick substrate 150 results in a decrease in the amount of the flavor component derived from the stick substrate 150 that is imparted per unit amount of the cartridge-side aerosol generated per puff. In this regard, the above-mentioned configuration makes it possible to increase the total amount of the cartridge-side aerosol generated per puff. This increase leads to a corresponding increase in the amount of the flavor component derived from the stick substrate 150 that is taken in by the aerosol during its passage through the stick substrate 150. This makes it possible to prevent or reduce a decrease in the amount of the flavor component for the cartridge-side aerosol generated per puff as a whole. That is, the decrease in the amount of the flavor component derived from the stick substrate 150 that is contained per unit amount of aerosol can be offset by the increase in the total amount of aerosol to thereby prevent or reduce a decrease in the amount of the flavor component that reaches the inside of the user's mouth in each puff. This makes it possible for the user to sufficiently taste the flavor in each puff even in the latter half of the heating profile.

[0079] Specifically, the controller 116 performs control such that the amount of power supplied to the cartridge heater 121-1 per puff increases with increasing time that has elapsed since the start of the pre-heating. As the amount of power supply increases, the amount of heating provided increases, which leads to an increase in the amount of the cartridge-side aerosol generated.

[0080] In one example, the controller 116 may perform control such that the duration of power supply to the cartridge heater 121-1 per puff increases with increasing time that has elapsed since the start of the pre-heating. The amount of power supplied per puff is determined by the product of the duration of power supply and the amount of power supplied per unit time. In this regard, according to the above-mentioned configuration, the duration of power supply is increased to increase the amount of power supplied per puff, which makes it possible to increase the amount of the cartridge-side aerosol generated.

[0081] In another example, the controller 116 may perform control such that the amount of power supplied per unit time to the cartridge heater 121-1 per puff increases with increasing time that has elapsed since the start of the pre-heating. The amount of power supplied per puff is determined by the product of the duration of power supply and the amount of power supplied per unit time. In this regard, according to the above-mentioned configuration, the amount of power supplied per unit time is increased to increase the amount of power supplied per puff, which makes it possible to increase the amount of the cartridge-side aerosol generated.

[0082] The controller 116 may control either one or both of the duration of power supply and the amount of power supplied per unit time. If both of these values are to be controlled, the controller 116 may control both of the duration of power supply and the amount of power supplied per unit time such that these values increase with increasing time that has elapsed since the start of the pre-heating. Alternatively, as long as the product of the duration of power supply and the amount of power supplied per unit time increases, the controller 116 may decrease one of the duration of power supply and the amount of power supplied per unit time, and increase the other one of these values.

[0083] The controller 116 may perform control such that, until the time that has elapsed since the start of the pre-heating reaches the first predetermined time, heating by the cartridge heater 121-1 is not performed even when a puff is taken. That is, the controller 116 may cause no power to be supplied to the cartridge heater 121-1 even when a puff is taken, until the time that has elapsed since the start of the pre-heating reaches the first predetermined time. An example of the timing at which the time that has elapsed since the start of the pre-heating reaches the first predetermined time is when the pre-heating ends. This configuration ensures that no cartridge-side aerosol is generated until the temperature of the stick substrate 150 is sufficiently increased. Therefore, the above-mentioned configuration makes it possible to avoid a situation such as where, as the cartridge-side aerosol passes through the stick substrate 150, the cartridge-side aerosol is cooled and condenses, resulting in wetting and consequent degradation of the stick substrate 150. The above-mentioned configuration further makes it possible to reduce power consumption.

[0084] The controller 116 may perform control such that after the time that has elapsed since the start of the pre-heating reaches the second predetermined time, heating by the cartridge heater 121-1 is not performed even when a puff is taken. That is, the controller 116 may cause no power to be supplied to the cartridge heater 121-1 even when a puff is taken, after the time that has elapsed since the start of the pre-heating reaches the second predetermined time. An example of the timing at which the time that has elapsed since the start of the pre-heating reaches the second predetermined time is when the main heating ends. That is, the controller 116 performs control such that when a puff is taken after the heating by the stick heater 121-2 ends, heating by the cartridge heater 121-1 is not performed. This configuration makes it possible to avoid a situation such as where, after the main heating ends and the flavor source in the stick substrate 150 becomes completely depleted, an

aerosol containing an extremely small amount of the flavor component is inhaled by the user. The above-mentioned configuration further makes it possible to reduce power consumption.

[0085] In view of the foregoing, the controller 116 may perform control such that, during the period of time between when the time that has elapsed since the start of the pre-heating reaches the first predetermined time and when the elapsed time reaches the second predetermined time, heating by the cartridge heater 121-1 is performed when a puff is taken. That is, the controller 116 may perform control such that, during the period of time between when the time that has elapsed since the start of the pre-heating reaches the first predetermined time and when the elapsed time reaches the second predetermined time, supply of power to the cartridge heater 121-1 is performed when a puff is taken. This configuration makes it possible to provide the user with an aerosol containing a sufficient amount of the flavor line segment while preventing degradation of the stick substrate 150.

[0086] The function of the sensor 112 to detect a puff may be enabled during the period of time between when the time that has elapsed since the start of the pre-heating reaches the first predetermined time and when the elapsed time reaches the second predetermined time. In other words, the function of the sensor 112 to detect a puff may be disabled for the period of time before the time that has elapsed since the start of the pre-heating reaches the first predetermined time, and for the period of time after the elapsed time reaches the second predetermined time. This is because, for the period of time before the time that has elapsed since the start of the pre-heating reaches the first predetermined time and for the period of time after the elapsed time reaches the second predetermined time, heating by the cartridge heater 121-1 is not executed even when a puff is detected. This configuration makes it possible to reduce power consumption.

[0087] Reference is now made to FIG. 2 to describe a specific example of a heating profile and an atomization setting. FIG. 2 is a graph illustrating an example of a heating profile and an atomization setting that are set for the inhaler device 100 according to the embodiment. The horizontal axis in the graph represents the time that has elapsed since the start of the pre-heating. A line 10 represents the heating profile. With regard to the line 10, the vertical axis in the graph represents the temperature of the stick heater 121-2. A line 20 represents the atomization setting. With regard to the line 20, the vertical axis in the graph represents the amount of atomization per puff. Symbol ti represents an example of the first predetermined time. Symbol t_2 represents an example of the second predetermined time.

[0088] As illustrated in FIG. 2, the pre-heating is performed until the time that has elapsed since the start of the pre-heating reaches ti. With reference to the line 10, during this period, the temperature of the stick heater 121-2 rises to TMP_{MAX}. With reference to the line 20, during this period, the cartridge heater 121-1 does not generate the cartridge-side aerosol.

[0089] The main heating is performed during the period of time between when the time that has elapsed since the start of the pre-heating reaches ti and when the elapsed time reaches t_2. With reference to the line 10, during this period, the temperature of the stick heater 121-2 is maintained constant at TMP_{MAX}. With reference to the line 20, during this period, the cartridge heater 121-1 generates the cartridge-side aerosol. In particular, as the time that has elapsed since the start of the pre-heating increases, the amount of atomization per puff increases. For example, the amount of atomization per puff increases from the initial value G_{MIN} at the start of the main heating to G_{MAX} at the end of the main heating.

[0090] After the time has elapsed since the start of the pre-heating reaches t_2, the temperature of the stick heater 121-2 gradually decreases, and then heating ends. Heating ends. During this period, the cartridge heater 121-1 does not generate the cartridge-side aerosol.

[0091] Reference is now made to FIG. 3 and FIG. 4 to describe an exemplary procedure related to control of the amount of atomization for the cartridge-side aerosol.

[0092] FIG. 3 is a flowchart illustrating an exemplary control procedure executed by the inhaler device 100 according to the embodiment for controlling the amount of atomization for the cartridge-side aerosol.

[0093] As illustrated in FIG. 3, first, the controller 116 determines whether depression of the power button has been detected by the sensor 112 (step S102). If depression of the power button is determined to have not been detected (step S102: NO), the controller 116 waits until depression of the power button is detected.

[0094] If depression of the power button is determined to have been detected (step S102: YES), the controller 116 starts supply of power to the stick heater 121-2 to start the pre-heating (step S104).

[0095] Subsequently, the controller 116 determines whether the time ti has elapsed since the start of the pre-heating (step S106). If the time ti is determined to have not elapsed since the start of the pre-heating (step S106: NO), the controller 116 waits until the time ti elapses from the start of the pre-heating.

[0096] If the time ti is determined to have elapsed since the start of the pre-heating (step S106: YES), the controller 116 starts the main heating (step S108).

[0097] Subsequently, the controller 116 determines whether a puff has been detected by the sensor 112 (step S110).

[0098] If a puff is determined to have not been detected (step S110: NO), the process proceeds to step S114.

[0099] If a puff is determined to have been detected (step S110: YES), the controller 116 controls the power supply 111 such that power is supplied to the cartridge heater 121-1 for (T_A + T_B) seconds (step S112). In this case, T_A is a positive constant (e.g., 2 seconds). T_B represents a value that increases with the time that has elapsed since the start of the pre-heating. In one exam-

ple, T_B may be such that $T_B = Tc(t - ti)$. "Tc" is a positive constant. "t" represents the time that has elapsed since the start of the pre-heating. "t - ti" represents the time that has elapsed since the start of the main heating. The process then proceeds to step S114.

[0100] At step S114, the controller 116 determines whether a time t_2 has elapsed since the start of the pre-heating. If the time t_2 is determined to have not elapsed since the start of the pre-heating (step S114: NO), the process returns to step S110 again. If the time t_2 is determined to have elapsed since the start of the pre-heating (step S114: YES), the process ends.

[0101] FIG. 4 is a flowchart illustrating another exemplary control procedure executed by the inhaler device 100 according to the embodiment for controlling the amount of atomization for the cartridge-side aerosol. Steps 202 to S210, and step S214 in the flowchart illustrated in FIG. 4 are the same as steps S102 to S110 and step S114 in the flowchart illustrated in FIG. 3, and thus will not be described below in further detail.

[0102] At step S212, the controller 116 controls the power supply 111 such that the power supply 111 supplies $(W_A + W_B)$ watts of power per unit time to the cartridge heater 121-1. In this case, W_A is a positive constant (e.g., 1 watt). W_B represents a value that increases with the time that has elapsed since the start of the pre-heating. In one example, W_B may be such that $W_B = Wc(t - ti)$. "W_C" is a positive constant. "t" represents the time that has elapsed since the start of the pre-heating. "t - ti" represents the time that has elapsed since the start of the main heating. The process then proceeds to step S214.

(4) Setting According to Type of Substrate

[0103] The appropriate amount of the cartridge-side aerosol to pass through the stick substrate 150 may vary in accordance with the type of the stick substrate 150. Accordingly, the controller 116 may control, based on the type of the stick substrate 150, the relationship between the time that has elapsed since the start of the pre-heating and the amount of the cartridge-side aerosol generated. The relationship between the time that has elapsed since the start of the pre-heating and the amount of the cartridge-side aerosol generated refers to the atomization setting mentioned above. In one example, the controller 116 may control how much the amount of the cartridge-side aerosol generated increases with the time that has elapsed since the start of the pre-heating (i.e., the gradient of the line 20 illustrated in FIG. 2). In another example, the controller 116 may control the amount of the cartridge-side aerosol generated at the start of the main heating (i.e., the initial value G_{MIN} illustrated in FIG. 2). Such configuration makes it possible to use an appropriate atomization setting according to the type of the stick substrate 150.

[0104] Reference is now made to FIG. 5 to describe a specific example of how atomization settings are switched in accordance with substrate type. FIG. 5 represents graphs illustrating an example of how the inhaler device 100 according to the embodiment switches atomization settings in accordance with substrate type. A graph 30A represents an example of a heating profile and an atomization setting that are set for a case where the stick substrate 150 containing no menthol component is inserted in the inhaler device 100. A graph 30B represents an example of a heating profile and an atomization setting that are set for a case where the stick substrate 150 containing a menthol component is inserted in the inhaler device 100.

[0105] The horizontal axis in each graph represents the time that has elapsed since the start of the pre-heating. A line 10A and a line 10B each represent a heating profile. With regard to the line 10A and the line 10B, the vertical axis in each graph represents the temperature of the stick heater 121-2. A line 20A and a line 20B each represent an atomization setting. With regard to the line 20A and the line 20B, the vertical axis in the graph represents the amount of atomization per puff. Symbol ti represents an example of the first predetermined time. Symbol t_2 represents an example of the second predetermined time.

[0106] Referring to FIG. 5, the heating profile represented by the line 10A, and the heating profile represented by the line 10B are identical. In contrast, the atomization setting represented by the line 20A, and the atomization setting represented by the line 20B are identical in the initial value G_{MIN} but different in gradient. Specifically, the line 20B has a smaller gradient than the line 20A. The above-mentioned configuration helps to ensure that for the stick substrate 150 containing a menthol component, the amount of the menthol component inhaled by the user does not increase excessively.

[0107] There are various conceivable methods for identifying the type of the stick substrate 150. For example, the stick substrate 150 may be provided with identification information representing the type of the stick substrate 150. In that case, the controller 116 may be able to identify the type of the stick substrate 150 based on the identification information provided to the stick substrate 150. Examples of such identification information include colored lines and barcodes. The sensor 112 may include an image sensor for reading identification information. The controller 116 identifies the type of the stick substrate 150 based on identification information included in an image obtained by the image sensor. The above-mentioned configuration makes it possible to automatically identify the type of the stick substrate 150.

[0108] Likewise, the controller 116 may control, based on the type of the cartridge 120, the relationship between the time that has elapsed since the start of the pre-heating and the amount of the cartridge-side aerosol generated. Such configuration makes it possible to use an appropriate atomization setting according to the type of the cartridge 120. The type of the cartridge 120 may be identified based on, for example, identification information provid-

ed to the cartridge 120.

(5) Setting According to User Input

[0109] Different users may have different preferences regarding the amount of the flavor component contained in the aerosol. Accordingly, the controller 116 may, based on an input made by the user, control the relationship between the time that has elapsed since the start of the pre-heating and the amount of the cartridge-side aerosol generated. An example of an input made by the user is depression of a button provided to the inhaler device 100. An input by the user may be made via another device such as a smartphone. This configuration makes it possible to use an appropriate atomization setting according to the user's preference. This in turn makes it possible to provide enhanced satisfaction to the user.

[0110] For the same reason as mentioned above, the controller 116 may control the heating profile based on an input made by the user. This configuration makes it possible to use an appropriate heating profile according to the user's preference. This in turn makes it possible to provide enhanced satisfaction to the user.

[0111] Reference is now made to FIG. 6 to describe a specific example of how heating profiles are switched in accordance with user's input. FIG. 6 represents graphs illustrating an example of how the inhaler device 100 according to the embodiment switch heating profiles in accordance with user's input. The horizontal axis in each graph represents the time that has elapsed since the start of the pre-heating. The vertical axis in each graph represents the temperature of the stick heater 121-2. Lines 10A, 10B, and 10C each represent a heating profile. One of these heating profiles is set via user input.

[0112] As represented by the line 10A, a heating profile may be set in which the temperature of the stick heater 121-2 is constant during the period of the main heating. As represented by the line 10B, a heating profile may be set in which the temperature of the stick heater 121-2 decreases at some point during the period of the main heating. As represented by the line 10C, a heating profile may be set in which the temperature of the stick heater 121-2 increases at some point during the period of the main heating. In another example, at least one of t_1 and t_2 may be changed.

<3. Supplemental Remarks>

[0113] Although a preferred embodiment of the present invention has been described above in detail with reference to the accompanying drawings, this is not intended to limit the invention to the specific example disclosed. Those having ordinary knowledge in the technical field to which the invention belongs would obviously conceive of various modifications and alterations within the scope of the technical ideas recited in the claims, and it is to be understood that such modifications and alterations also obviously fall within the technical scope of the present invention.

[0114] For example, although the foregoing description of the embodiment is directed to an example of control in which the amount of power supplied to the cartridge heater 121-1 increases with increasing time that has elapsed since the start of the pre-heating, the present invention is not limited to such an example. For example, together with or instead of this control, the controller 116 may perform control such that the amount of power supplied to the cartridge heater 121-1 increases with increasing number of puffs. More specifically, the controller 116 may perform control such that the amount of power supplied to the cartridge heater 121-1 per puff increases with increasing number of puffs. This configuration allows the amount of the cartridge-side aerosol generated per puff to increase with increasing number of puffs. As the number of puffs increases, the amount of the flavor source contained in the stick substrate 150 decreases. The decrease in the amount of the flavor source causes a decrease in the amount of the flavor component imparted per unit amount of the cartridge-side aerosol. In this regard, according to the above-mentioned configuration, the decrease in the amount of the flavor component contained per unit amount of aerosol can be offset by the increase in the total amount of aerosol to thereby prevent or reduce a decrease in the amount of the flavor component that reaches the inside of the user's mouth in each puff. This allows the user to sufficiently taste the flavor even after taking a large number of puffs.

[0115] The series of processes to be executed by individual devices described herein may be implemented by any one of software, hardware, and a combination of software and hardware. Programs constituting software are, for example, pre-stored in recording media (non-transitory media) disposed inside or outside the individual devices. Each program is, for example, loaded into a RAM at the time of execution by a computer, and executed by a processor such as a CPU. Examples of the recording media mentioned above include magnetic disks, optical disks, magneto-optical disks, and flash memories. The above-mentioned computer program may be, for example, distributed via a network without use of a recording medium.

[0116] The processes described herein with reference to flowcharts and sequence diagrams may not necessarily be executed in the order illustrated. Some of the process steps may be executed in parallel. Additional process steps may be used, or part of process steps may be omitted.

[0117] The configurations described below also belong to the technical scope of the present invention.

(1) An inhaler device including:

a first heater that heats an aerosol source contained in a first substrate;
a second heater that heats an aerosol source contained in a second substrate, and generates

an aerosol that passes through the first substrate; and

a controller that performs control such that an amount of the aerosol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

(2) The inhaler device according to the item (1), wherein the controller performs control such that an amount of the aerosol generated by the second heater for each single occurrence of an inhaling action for inhaling the aerosol increases with increasing time that has elapsed since start of heating by the first heater.

(3) The inhaler device according to the item (2) above, wherein the controller performs control such that an amount of power supplied to the second heater for each single occurrence of the inhaling action increases with increasing time that has elapsed since start of heating by the first heater.

(4) The inhaler device according to the item (3) above, wherein the controller performs control such that a duration of time for which power is supplied to the second heater for each single occurrence of the inhaling action increases with increasing time that has elapsed since start of heating by the first heater.

(5) The inhaler device according to the item (3) or (4) above, wherein the controller performs control such that an amount of power supplied to the second heater per unit time for each single occurrence of the inhaling action increases with increasing time that has elapsed since start of heating by the first heater.

(6) The inhaler device according to any one of the items (1) to (5) above, wherein the controller performs control such that an amount of power supplied to the second heater for each single occurrence of an inhaling action for inhaling the aerosol increases with increasing number of the inhaling actions.

(7) The inhaler device according to any one of the items (1) to (6) above, wherein the controller performs control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed.

(8) The inhaler device according to any one of the items (1) to (7) above, wherein the controller performs control such that heating by the first heater is performed in accordance with a heating profile, the heating profile defining a relationship between the time that has elapsed since start of heating by the first heater and a temperature of the first heater.

(9) The inhaler device according to any one of the items (1) to (8) above, wherein the controller performs control such that, until the time that has elapsed since start of heating by the first heater reaches a first predetermined time, heating by the second heater is not performed even when an inhaling action for inhaling the aerosol is performed.

(10) The inhaler device according to any one of the items (1) to (9) above, wherein the controller performs control such that, after the time that has elapsed since start of heating by the first heater reaches a second predetermined time, heating by the second heater is not performed even when an inhaling action for inhaling the aerosol is performed.

(11) The inhaler device according to the item (8) above, wherein the controller controls the heating profile based on an input made by a user.

(12) The inhaler device according to any one of the items (1) to (11), wherein the controller controls, based on a type of the first substrate, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

(13) The inhaler device according to the item (12) above, wherein the controller identifies the type of the first substrate based on identification information provided to the first substrate.

(14) The inhaler device according to any one of the items (1) to (13) above, wherein the controller controls, based on a type of the second substrate, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

(15) The inhaler device according to any one of the items (1) to (14) above, wherein the controller controls, based on an input made by a user, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

(16) The inhaler device according to any one of the items (1) to (15) above, wherein the first substrate contains a flavor source.

(17) The inhaler device according to any one of the items (1) to (16) above, wherein the second substrate contains the aerosol source that is a liquid.

(18) A control method for controlling an inhaler device, the inhaler device including a first heater and a second heater, the first heater being configured to heat an aerosol source contained in a first substrate, the second heater being configured to heat an aerosol source contained in a second substrate and generate an aerosol that passes through the first substrate, the control method including

performing control such that an amount of the aerosol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

(19) A program for causing a computer to execute a process, the computer being configured to control an inhaler device, the inhaler device including a first heater and a second heater, the first heater being configured to heat an aerosol source contained in a first substrate, the second heater being configured to heat an aerosol source contained in a second substrate and generate an aerosol that passes through the first substrate, the process including

performing control such that an amount of the aerosol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

(20) An inhaler device including:

a first heater that heats an aerosol source contained in a first substrate;

a second heater that heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate; and

a controller that performs control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed,

wherein the controller performs control such that, until a time that has elapsed since start of heating by the first heater reaches a predetermined time, heating by the second heater is not performed even when the inhaling action is performed.

(21) An inhaler device including:

a first heater that heats an aerosol source contained in a first substrate;

a second heater that heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate; and

a controller that performs control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed,

wherein the controller performs control such that, when the inhaling action is performed after heating by the first heater ends, heating by the second heater is not performed.

Reference Signs List

[0118]

100	inhaler device
111	power supply
112	sensor
113	notifier
114	memory
115	communicator
116	controller
120	cartridge
121-1	heater (cartridge heater)
121-2	heater (stick heater)
122	liquid guide
123	liquid storage
140	holder
141	internal space
142	opening
143	bottom
144	heat insulator
150	stick substrate
151	substrate
152	inhalation port
180	airflow path
181	air inlet hole
182	air outlet hole

Claims

1. An inhaler device comprising:

a first heater that heats an aerosol source contained in a first substrate;

a second heater that heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate; and

a controller that performs control such that an amount of the aerosol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

2. The inhaler device according to claim 1,
wherein the controller performs control such that an amount of the aerosol generated by the second heater for each single occurrence of an inhaling action for inhaling the aerosol increases with increasing time that has elapsed since start of heating by the first heater.

3. The inhaler device according to claim 2,
wherein the controller performs control such that an amount of power supplied to the second heater for each single occurrence of the inhaling action increases with increasing time that has elapsed since start of heating by the first heater.

4. The inhaler device according to claim 3,
wherein the controller performs control such that a duration of time for which power is supplied to the second heater for each single occurrence of the in-

haling action increases with increasing time that has elapsed since start of heating by the first heater.

5. The inhaler device according to claim 3 or 4, wherein the controller performs control such that an amount of power supplied to the second heater per unit time for each single occurrence of the inhaling action increases with increasing time that has elapsed since start of heating by the first heater.

6. The inhaler device according to any one of claims 1 to 5, wherein the controller performs control such that an amount of power supplied to the second heater for each single occurrence of an inhaling action for inhaling the aerosol increases with increasing number of the inhaling actions.

7. The inhaler device according to any one of claims 1 to 6, wherein the controller performs control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed.

8. The inhaler device according to any one of claims 1 to 7, wherein the controller performs control such that heating by the first heater is performed in accordance with a heating profile, the heating profile defining a relationship between the time that has elapsed since start of heating by the first heater and a temperature of the first heater.

9. The inhaler device according to any one of claims 1 to 8, wherein the controller performs control such that, until the time that has elapsed since start of heating by the first heater reaches a first predetermined time, heating by the second heater is not performed even when an inhaling action for inhaling the aerosol is performed.

10. The inhaler device according to any one of claims 1 to 9, wherein the controller performs control such that, after the time that has elapsed since start of heating by the first heater reaches a second predetermined time, heating by the second heater is not performed even when an inhaling action for inhaling the aerosol is performed.

11. The inhaler device according to claim 8, wherein the controller controls the heating profile based on an input made by a user.

12. The inhaler device according to any one of claims 1 to 11, wherein the controller controls, based on a type of the first substrate, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

13. The inhaler device according to claim 12, wherein the controller identifies the type of the first substrate based on identification information provided to the first substrate.

14. The inhaler device according to any one of claims 1 to 13, wherein the controller controls, based on a type of the second substrate, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

15. The inhaler device according to any one of claims 1 to 14, wherein the controller controls, based on an input made by a user, a relationship between the time that has elapsed since start of heating by the first heater and the amount of the aerosol generated by the second heater.

16. The inhaler device according to any one of claims 1 to 15, wherein the first substrate contains a flavor source.

17. The inhaler device according to any one of claims 1 to 16, wherein the second substrate contains the aerosol source that is a liquid.

18. A control method for controlling an inhaler device, the inhaler device including a first heater and a second heater, the first heater being configured to heat an aerosol source contained in a first substrate, the second heater being configured to heat an aerosol source contained in a second substrate and generate an aerosol that passes through the first substrate, the control method comprising
performing control such that an amount of the aerosol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

19. A program for causing a computer to execute a process, the computer being configured to control an inhaler device, the inhaler device including a first heater and a second heater, the first heater being configured to heat an aerosol source contained in a first substrate, the second heater being configured to heat an aerosol source contained in a second substrate and generate an aerosol that passes through the first substrate, the process comprising
performing control such that an amount of the aero-

sol generated by the second heater increases with increasing time that has elapsed since start of heating by the first heater.

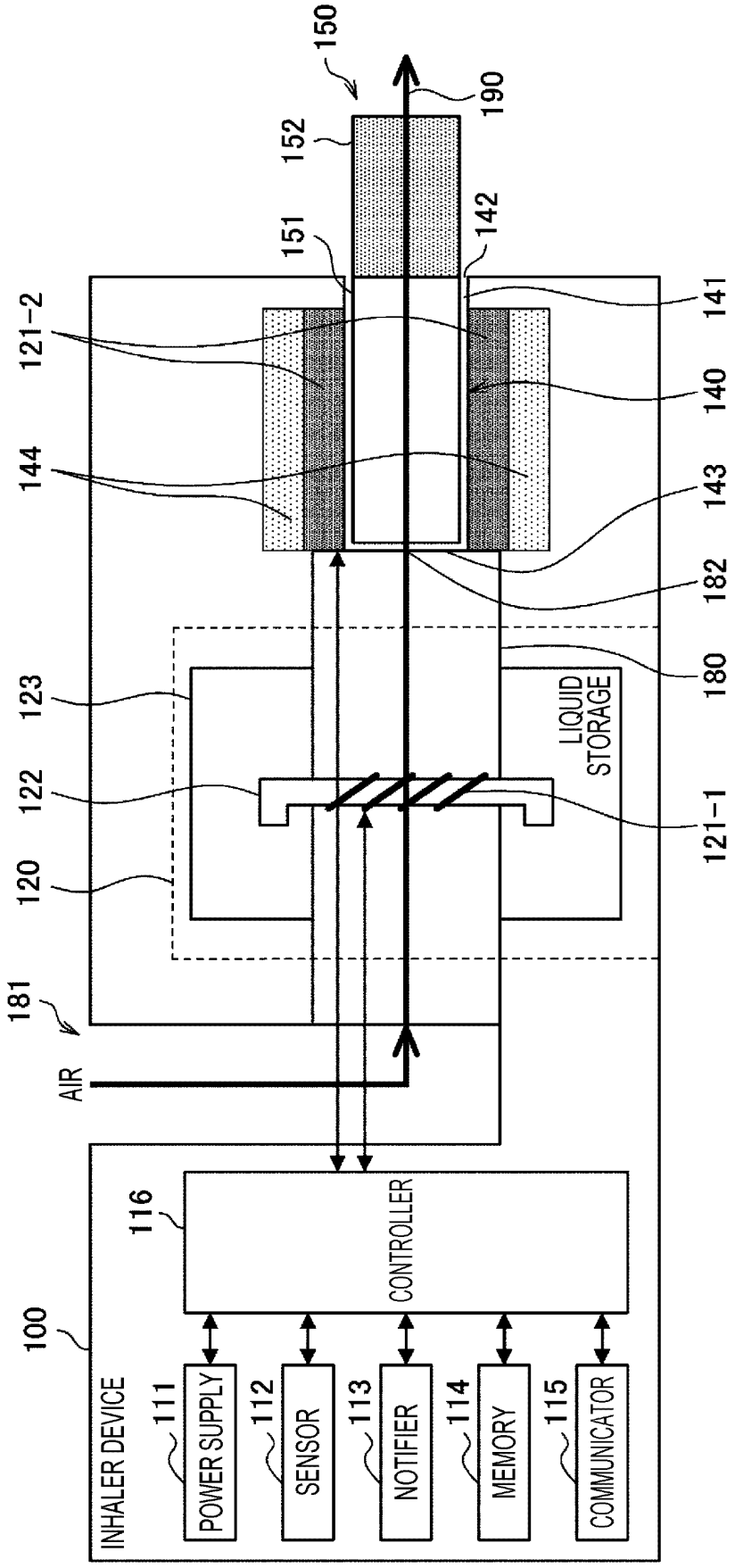
20. An inhaler device comprising:

a first heater that heats an aerosol source contained in a first substrate;
a second heater that heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate; and
a controller that performs control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed,
wherein the controller performs control such that, until a time that has elapsed since start of heating by the first heater reaches a predetermined time, heating by the second heater is not performed even when the inhaling action is performed.

21. An inhaler device comprising:

a first heater that heats an aerosol source contained in a first substrate;
a second heater that heats an aerosol source contained in a second substrate, and generates an aerosol that passes through the first substrate; and
a controller that performs control such that heating by the second heater is performed when an inhaling action for inhaling the aerosol is performed,
wherein the controller performs control such that, when the inhaling action is performed after heating by the first heater ends, heating by the second heater is not performed.

FIG. 1


150
190
152
151
142
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121-2
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144
143
182
180
123
122
121-1
120
LIQUID STORAGE
181
AIR
116
CONTROLLER
100
INHALER DEVICE
111
POWER SUPPLY
112
SENSOR
113
NOTIFIER
114
MEMORY
115
COMMUNICATOR

FIG. 2

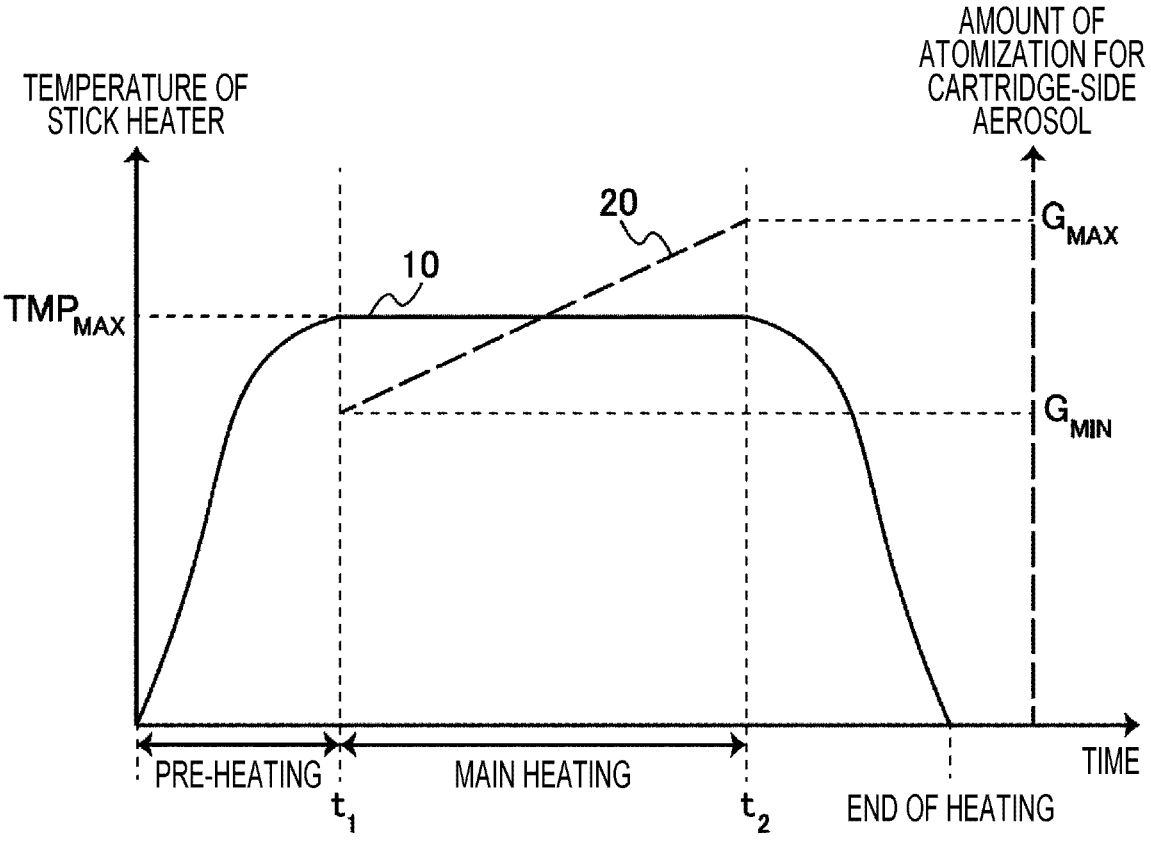

TEMPERATURE OF STICK HEATER
AMOUNT OF ATOMIZATION FOR CARTRIDGE-SIDE AEROSOL
20
10
G_{MAX}
TMP_{MAX}
G_{MIN}
PRE-HEATING
MAIN HEATING
TIME
t_1
t_2
END OF HEATING

FIG. 3

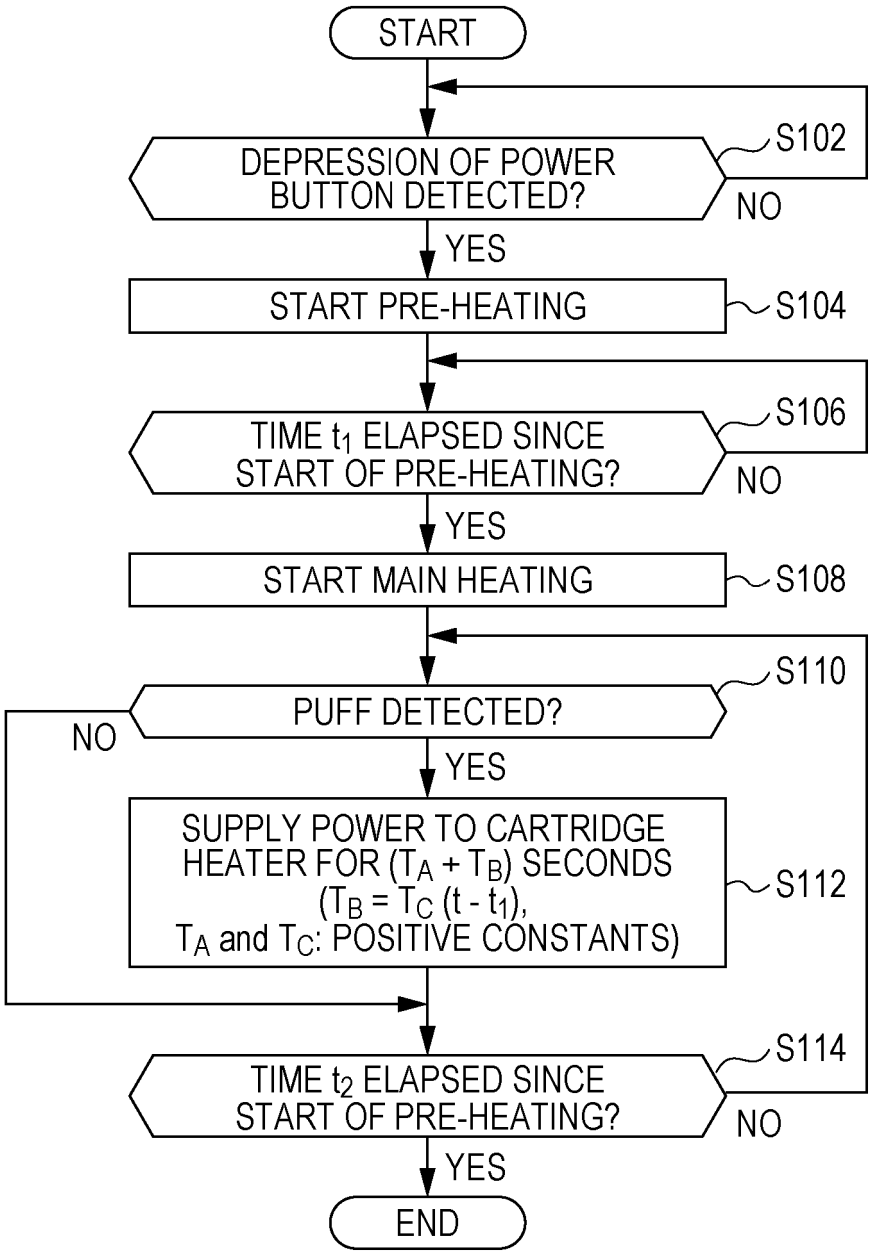

START
DEPRESSION OF POWER BUTTON DETECTED?
S102
NO
YES
START PRE-HEATING
S104
TIME t_1 ELAPSED SINCE START OF PRE-HEATING?
S106
NO
YES
START MAIN HEATING
S108
PUFF DETECTED?
S110
NO
YES
SUPPLY POWER TO CARTRIDGE HEATER FOR (T_A + T_B) SECONDS (T_B = T_C (t - t_1), T_A and T_C: POSITIVE CONSTANTS)
S112
TIME t_2 ELAPSED SINCE START OF PRE-HEATING?
S114
NO
YES
END

FIG. 4

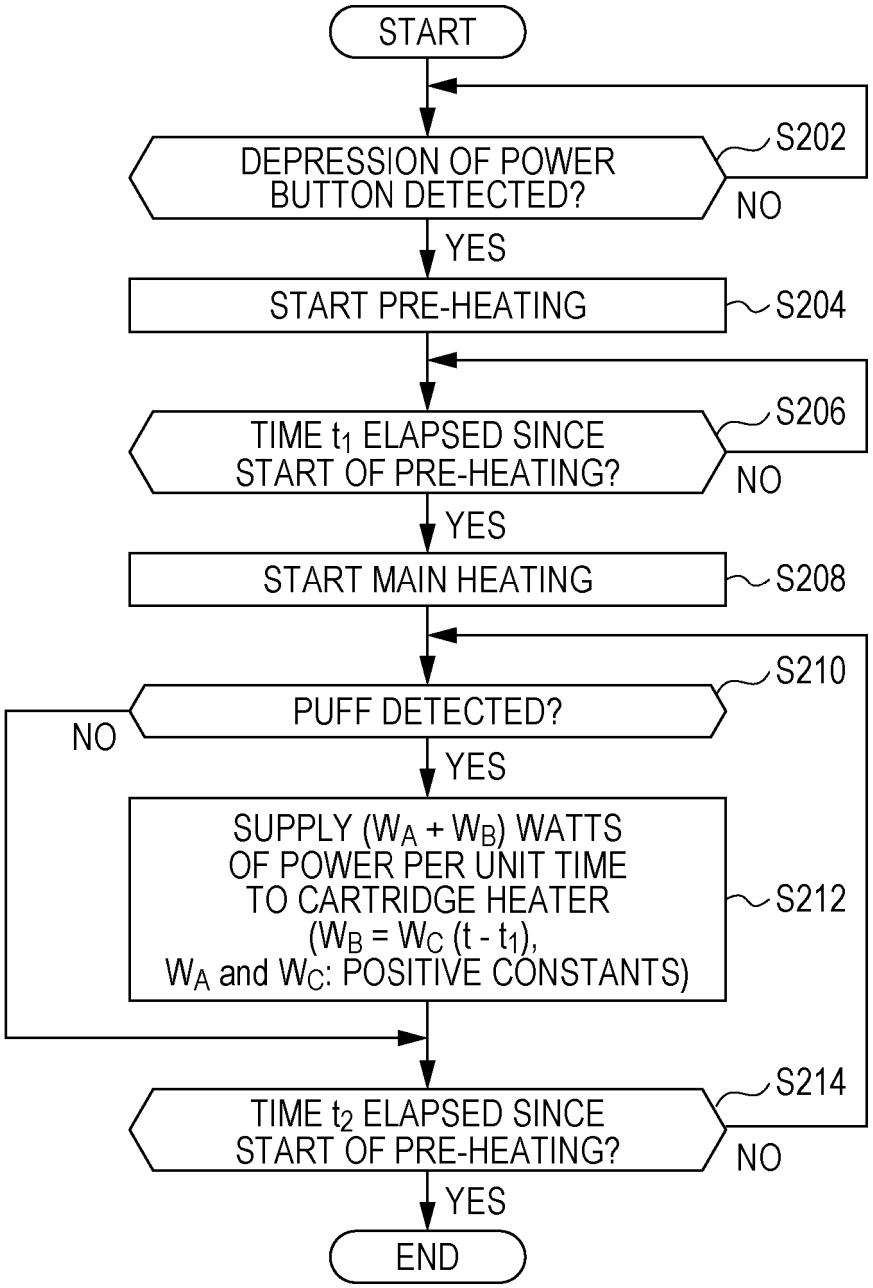

START
DEPRESSION OF POWER BUTTON DETECTED?
S202
NO
YES
START PRE-HEATING
S204
TIME t_1 ELAPSED SINCE START OF PRE-HEATING?
S206
NO
YES
START MAIN HEATING
S208
PUFF DETECTED?
S210
NO
YES
SUPPLY (W_A + W_B) WATTS OF POWER PER UNIT TIME TO CARTRIDGE HEATER (W_B = W_C (t - t_1), W_A and W_C: POSITIVE CONSTANTS)
S212
TIME t_2 ELAPSED SINCE START OF PRE-HEATING?
S214
NO
YES
END

FIG. 5

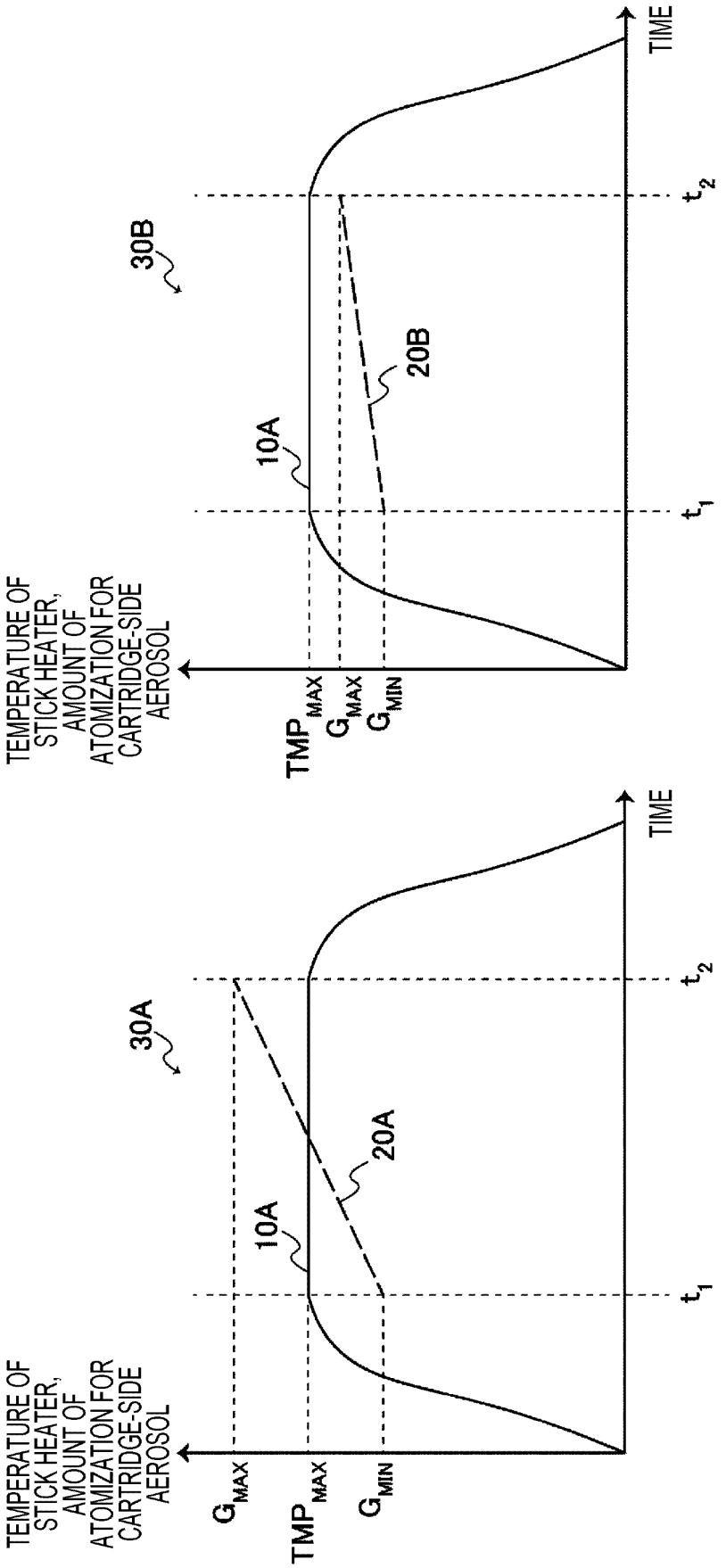
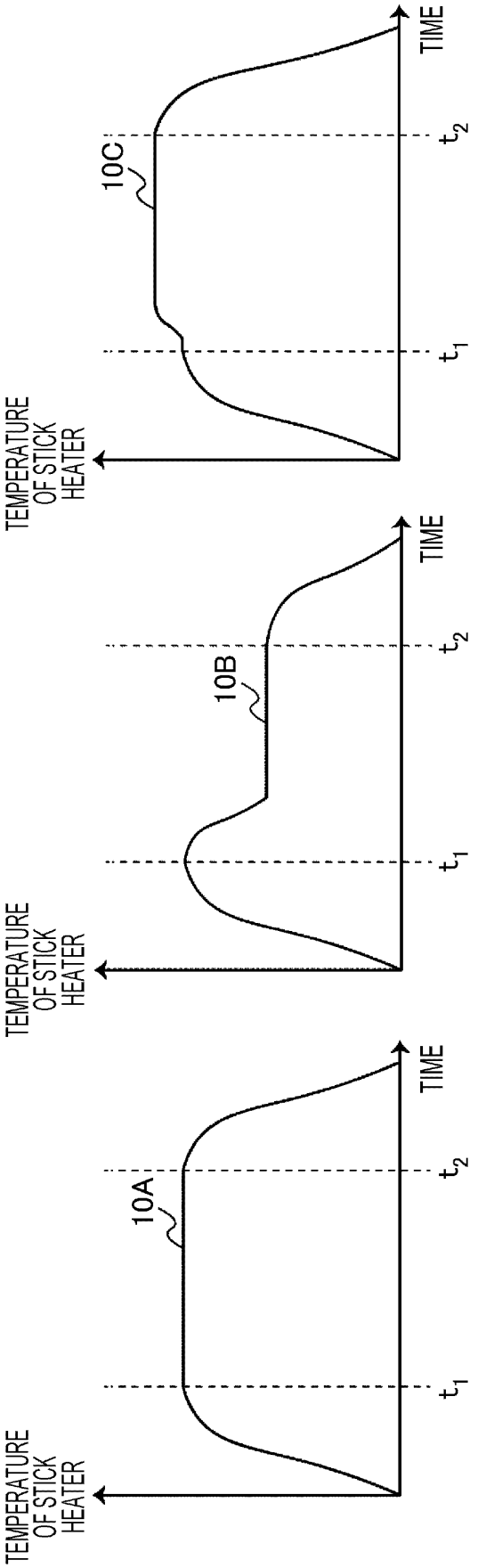

TEMPERATURE OF STICK HEATER, AMOUNT OF ATOMIZATION FOR CARTRIDGE-SIDE AEROSOL
TIME
30A
10A
20A
G_{MAX}
TMP_{MAX}
G_{MIN}
t_1
t_2
30B
10A
20B
TMP_{MAX}
G_{MAX}
G_{MIN}
t_1
t_2

FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/025061

A. CLASSIFICATION OF SUBJECT MATTER
A24F 40/50(2020.01)i
FI: 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

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	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO 2017/141358 A1 (JAPAN TOBACCO INC.) 24 August 2017 (2017-08-24) paragraphs [0034]-[0037], [0043]-[0045], [0048]-[0055], [0109]-[0111], fig. 2	1, 7-8, 11, 14-19 2-6, 9-10, 12-13, 20-21
Y	WO 2018/224823 A1 (NICOVENTURES HOLDINGS LIMITED) 13 December 2018 (2018-12-13) page 9, line 14 to page 12, line 25	1, 7-8, 11, 14-19
A	JP 2019-535242 A (PHILIP MORRIS PRODUCTS S.A.) 12 December 2019 (2019-12-12) entire text, all drawings	1-21
A	JP 2019-534023 A (BRITISH AMERICAN TOBACCO (INVESTMENTS) LIMITED) 28 November 2019 (2019-11-28) entire text, all drawings	1-21

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

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 September 2020 (03.09.2020)	15 September 2020 (15.09.2020)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/025061

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2017/141358 A1	24 Aug. 2017	US 2018/0352863 A1 paragraphs [0046]-[0049], [0055]-[0057], [0060]-[0070], [0129]-[0131], fig. 2 EP 3400815 A1 CN 108601404 A KR 10-2018-0111880 A	
WO 2018/224823 A1	13 Dec. 2018	JP 2020-522272 A paragraphs [0033]-[0044] US 2020/0163387 A1 EP 3634161 A1 CN 110719739 A KR 10-2019-0140477 A	
JP 2019-535242 A	12 Dec. 2019	US 2019/0269174 A1 entire text, all drawings WO 2018/091627 A1 EP 3542591 A1 CN 109792801 A KR 10-2019-0078638 A	
JP 2019-534023 A	28 Nov. 2019	US 2019/0289901 A1 entire text, all drawings WO 2018/087164 A1 EP 3537899 A1 KR 10-2019-0058657 A CN 109922673 A	

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 2020039589 A **[0004]**