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(54) **AEROSOL GENERATING DEVICE AND OPERATION METHOD THEREOF**

AEROSOLERZEUGUNGSVORRICHTUNG UND BETRIEBSVERFAHREN DAFÜR

DISPOSITIF DE GÉNÉRATION D'AÉROSOL ET SON PROCÉDÉ DE FONCTIONNEMENT

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(56) References cited:

WO-A1-2014/102091 WO-A1-2018/192722
WO-A1-2019/115464 WO-A1-2019/122344
WO-A1-2019/206916 WO-A2-2013/098397
KR-A- 20190 024 880

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Description**Technical Field**

[0001] This invention relates to an aerosol generating device and an operation method thereof, and more particularly, to an aerosol generating device capable of ensuring stability in various use environments, and an operation method thereof.

Background Art

[0002] In recent years, a need for an alternative to traditional cigarettes has been growing. For example, many people use an aerosol generating device that generates an aerosol by heating an aerosol generating material, rather than smoking combustible cigarettes. Accordingly, research on a heating-type cigarette and a heating-type aerosol generating device is being actively conducted. WO 2019/115464 A1 presents an aerosol-generating device comprising: a heating element configured to heat an aerosol-forming substrate for generating an aerosol; a temperature sensor for measuring a temperature of the heating element; an aerosol monitoring means for measuring an aerosol property comprising at least one of a physical property and a chemical composition of the generated aerosol; and a controller configured to adjust a power supplied to the heating element based on: the measured heating element temperature in a first feedback control loop; and the measured aerosol property in a second feedback control loop.

Disclosure of Invention**Technical Problem**

[0003] An aerosol generating device generates an aerosol by using a heater for heating to a high temperature. In this case, there is a problem that a dangerous situation may occur due to overheating of a device, an overcurrent, a short circuit, and over discharging and overcharging of a battery in various use environments of an aerosol generating device.

[0004] The invention provides an aerosol generating device and an operation method of the aerosol generating device which prevent the aerosol generating device described above from being in a dangerous situation.

[0005] Problems to be solved by the invention are not limited to the above-described problem, and undescribed problems will be clearly understood by those skilled in the art to which the present disclosure belongs from the present specification and the accompanying drawings.

Solution to Problem

[0006] One or more objects of the present technique are achieved by the invention set out by the features of the independent claims.

[0007] According to one embodiment of the invention, it is provided an aerosol generating device according to claim 1.

[0008] According to a another embodiment, it is provided a method of controlling an aerosol generating device according to claim 8.

Advantageous Effects of Invention

[0009] Aerosol generating devices according to the embodiments may ensure stability when a dangerous situation occurs due to overheating, an overcurrent, a circuit short, over discharging and overcharging of a battery, and so on that may occur in various use environments.

[0010] Effects by the embodiments are not limited to the above-described effects, and effects that are not described will be clearly understood by those skilled in the art to which the present disclosure belongs from the present specification and the accompanying drawings.

Brief Description of Drawings**[0011]**

FIGS. 1 to 3 are diagrams illustrating examples in which a cigarette is inserted into an aerosol generating device;

FIG. 4 illustrates an example of a cigarette;

FIG. 5 is a schematic cross-sectional view of an aerosol generating device according to an embodiment;

FIG. 6 is a flowchart illustrating an exemplary operation method of the aerosol generating device according to the embodiment illustrated in FIG. 5; and

FIG. 7 is a flowchart illustrating another exemplary operation method of the aerosol generating device according to the embodiment illustrated in FIG. 5.

Mode for the Invention

[0012] With respect to the terms used to describe the various embodiments, general terms which are currently and widely used are selected in consideration of functions of structural elements in the various embodiments of the present disclosure. However, meanings of the terms can be changed according to intention, a judicial precedence, the appearance of new technology, and the like. In addition, in certain cases, a term which is not commonly used can be selected. In such a case, the meaning of the term will be described in detail at the corresponding portion in the description of the present disclosure. Therefore, the terms used in the various embodiments of the present disclosure should be defined based on the meanings of the terms and the descriptions provided herein.

[0013] In addition, unless explicitly described to the contrary, the word "comprise" and variations such as "comprises" or "comprising" will be understood to imply

the inclusion of stated elements but not the exclusion of any other elements. In addition, the terms "-er", "-or", and "module" described in the specification mean units for processing at least one function and/or operation and can be implemented by hardware components or software components and combinations thereof.

[0014] As used herein, expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list. For example, the expression, "at least one of a, b, and c," should be understood as including only a, only b, only c, both a and b, both a and c, both b and c, or all of a, b, and c.

[0015] It will be understood that when an element or layer is referred to as being "over," "above," "on," "connected to" or "coupled to" another element or layer, it can be directly over, above, on, connected or coupled to the other element or layer or intervening elements or layers may be present. In contrast, when an element is referred to as being "directly over," "directly above," "directly on," "directly connected to" or "directly coupled to" another element or layer, there are no intervening elements or layers present. Like numerals refer to like elements throughout.

[0016] Hereinafter, the present disclosure will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the present invention are shown such that one of ordinary skill in the art may easily work the present invention. The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein.

[0017] Hereinafter, embodiments of the present invention will be described in detail with reference to the drawings.

[0018] FIGS. 1 through 3 are diagrams showing examples in which a cigarette is inserted into an aerosol generating device.

[0019] Referring to FIG. 1, the aerosol generating device 10000 may include a battery 11000, a controller 12000, and a heater 13000. Referring to FIGS. 2 and 3, the aerosol generating device 10000 may further include a vaporizer 14000. Also, a cigarette 20000 may be inserted into an inner space of the aerosol generating device 10000.

[0020] FIGS. 1 through 3 illustrate components of the aerosol generating device 10000, which are related to the present embodiment. Therefore, it will be understood by one of ordinary skill in the art related to the present embodiment that other general-purpose components may be further included in the aerosol generating device 10000, in addition to the components illustrated in FIGS. 1 through 3.

[0021] Also, FIGS. 2 and 3 illustrate that the aerosol generating device 10000 includes the heater 13000. However, as necessary, the heater 13000 may be omitted.

[0022] FIG. 1 illustrates that the battery 11000, the con-

troller 12000, and the heater 13000 are arranged in series. Also, FIG. 2 illustrates that the battery 11000, the controller 12000, the vaporizer 14000, and the heater 13000 are arranged in series. Also, FIG. 3 illustrates that the vaporizer 14000 and the heater 13000 are arranged in parallel. However, the internal structure of the aerosol generating device 10000 is not limited to the structures illustrated in FIGS. 1 through 3. In other words, according to the design of the aerosol generating device 100, the battery 11000, the controller 12000, the heater 13000, and the vaporizer 14000 may be differently arranged.

[0023] When the cigarette 20000 is inserted into the aerosol generating device 100, the aerosol generating device 10000 may operate the heater 13000 and/or the vaporizer 14000 to generate aerosol from the cigarette 20000 and/or the vaporizer 14000. The aerosol generated by the heater 13000 and/or the vaporizer 14000 is delivered to a user by passing through the cigarette 20000.

[0024] As necessary, even when the cigarette 20000 is not inserted into the aerosol generating device 10000, the aerosol generating device 10000 may heat the heater 13000.

[0025] The battery 11000 supplies electric power to be used for the aerosol generating device 10000 to operate. For example, the battery 11000 may supply power to heat the heater 13000 or the vaporizer 14000, and may supply power for operating the controller 12000. Also, the battery 11000 may supply power for operation of a display, a sensor, a motor, etc. mounted in the aerosol generating device 10000.

[0026] The controller 12000 may generally control operation of the aerosol generating device 10000. In detail, the controller 12000 may control not only operation of the battery 11000, the heater 13000, and the vaporizer 14000, but also operation of other components included in the aerosol generating device 10000. Also, the controller 12000 may check a state of each of the components of the aerosol generating device 10000 to determine whether or not the aerosol generating device 10000 is able to operate.

[0027] The controller 12000 may include at least one processor. A processor can be implemented as an array of a plurality of logic gates or can be implemented as a combination of a general-purpose microprocessor and a memory in which a program executable in the microprocessor is stored. It will be understood by one of ordinary skill in the art that the processor can be implemented in other forms of hardware.

[0028] The heater 13000 may be heated by the power supplied from the battery 11000. For example, when the cigarette 20000 is inserted into the aerosol generating device 10000, the heater 13000 may be located outside the cigarette 20000. Thus, the heated heater 13000 may increase a temperature of an aerosol generating material in the cigarette 20000.

[0029] The heater 13000 may include an electro-resistive heater. For example, the heater 13000 may include

an electrically conductive track, and the heater 13000 may be heated when currents flow through the electrically conductive track. However, the heater 13000 is not limited to the example described above and may include any other heaters which may be heated to a desired temperature. Here, the desired temperature may be pre-set in the aerosol generating device 10000 or may be set by a user.

[0030] As another example, the heater 13000 may include an induction heater. In detail, the heater 13000 may include an electrically conductive coil for heating a cigarette in an induction heating method, and the cigarette may include a susceptor which may be heated by the induction heater.

[0031] For example, the heater 13000 may include a tube-type heating element, a plate-type heating element, a needle-type heating element, or a rod-type heating element, and may heat the inside or the outside of the cigarette 20000, according to the shape of the heating element.

[0032] Also, the aerosol generating device 10000 may include a plurality of heaters 13000. Here, the plurality of heaters 13000 may be inserted into the cigarette 20000 or may be arranged outside the cigarette 20000. Also, some of the plurality of heaters 13000 may be inserted into the cigarette 20000 and the others may be arranged outside the cigarette 20000. In addition, the shape of the heater 13000 is not limited to the shapes illustrated in FIGS. 1 through 3 and may include various shapes.

[0033] The vaporizer 14000 may generate aerosol by heating a liquid composition and the generated aerosol may pass through the cigarette 20000 to be delivered to a user. In other words, the aerosol generated via the vaporizer 14000 may move along an air flow passage of the aerosol generating device 10000 and the air flow passage may be configured such that the aerosol generated via the vaporizer 14000 passes through the cigarette 20000 to be delivered to the user.

[0034] For example, the vaporizer 14000 may include a liquid storage, a liquid delivery element, and a heating element, but it is not limited thereto. For example, the liquid storage, the liquid delivery element, and the heating element may be included in the aerosol generating device 10000 as independent modules.

[0035] The liquid storage may store a liquid composition. For example, the liquid composition may be a liquid including a tobacco-containing material having a volatile tobacco flavor component, or a liquid including a non-tobacco material. The liquid storage may be formed to be detachable from the vaporizer 14000 or may be formed integrally with the vaporizer 14000.

[0036] For example, the liquid composition may include water, a solvent, ethanol, plant extract, spices, flavorings, or a vitamin mixture. The spices may include menthol, peppermint, spearmint oil, and various fruit-flavored ingredients, but are not limited thereto. The flavorings may include ingredients capable of providing various flavors or tastes to a user. Vitamin mixtures may be a

mixture of at least one of vitamin A, vitamin B, vitamin C, and vitamin E, but are not limited thereto. Also, the liquid composition may include an aerosol forming substance, such as glycerin and propylene glycol.

[0037] The liquid delivery element may deliver the liquid composition of the liquid storage to the heating element. For example, the liquid delivery element may be a wick such as cotton fiber, ceramic fiber, glass fiber, or porous ceramic, but is not limited thereto.

[0038] The heating element is an element for heating the liquid composition delivered by the liquid delivery element. For example, the heating element may be a metal heating wire, a metal hot plate, a ceramic heater, or the like, but is not limited thereto. In addition, the heating element may include a conductive filament such as nichrome wire and may be positioned as being wound around the liquid delivery element. The heating element may be heated by a current supply and may transfer heat to the liquid composition in contact with the heating element, thereby heating the liquid composition. As a result, aerosol may be generated.

[0039] For example, the vaporizer 14000 may be referred to as a cartomizer or an atomizer, but it is not limited thereto.

[0040] The aerosol generating device 10000 may further include general-purpose components in addition to the battery 11000, the controller 12000, the heater 13000, and the vaporizer 14000. For example, the aerosol generating device 10000 may include a display capable of outputting visual information and/or a motor for outputting haptic information. Also, the aerosol generating device 10000 may include at least one sensor (e.g., a puff detecting sensor, a temperature detecting sensor, a cigarette insertion detecting sensor, etc.). Also, the aerosol generating device 10000 may be formed as a structure that, even when the cigarette 20000 is inserted into the aerosol generating device 10000, may introduce external air or discharge internal air.

[0041] Although not illustrated in FIGS. 1 through 3, the aerosol generating device 10000 and an additional cradle may form together a system. For example, the cradle may be used to charge the battery 11000 of the aerosol generating device 10000. Alternatively, the heater 13000 may be heated when the cradle and the aerosol generating device 10000 are coupled to each other.

[0042] A cigarette 20000 may be similar to a general combustible cigarette. For example, the cigarette 20000 may be divided into a first portion including an aerosol generating material and a second portion including a filter, etc. Alternatively, the second portion of the cigarette 20000 may also include an aerosol generating material. For example, an aerosol generating material made in the form of granules or capsules may be inserted into the second portion.

[0043] The entire first portion may be inserted into the aerosol generating device 10000, and the second portion may be exposed to the outside. Alternatively, only a portion of the first portion may be inserted into the aerosol

generating device 10000, or the entire first portion and a portion of the second portion may be inserted into the aerosol generating device 10000. The user may puff aerosol while holding the second portion by the mouth of the user. In this case, the aerosol is generated by the external air passing through the first portion, and the generated aerosol passes through the second portion and is delivered to the user's mouth.

[0044] For example, the external air may flow into at least one air passage formed in the aerosol generating device 10000. For example, opening and closing of the air passage and/or a size of the air passage formed in the aerosol generating device 10000 may be adjusted by the user. Accordingly, the amount of smoke and a smoking impression may be adjusted by the user. As another example, the external air may flow into the cigarette 20000 through at least one hole formed in a surface of the cigarette 20000.

[0045] Hereinafter, one embodiment will be described in detail with reference to FIG. 4.

[0046] FIG. 4 is a view illustrating an example of a cigarette.

[0047] Referring to FIG. 4, the cigarette 20000 may include a tobacco rod 21000 and a filter rod 22000. The first portion described above with reference to FIGS. 1 through 3 may include the tobacco rod 21000, and the second portion may include the filter rod 22000.

[0048] FIG. 4 illustrates that the filter rod 22000 includes a single segment, but is not limited thereto. In other words, the filter rod 22000 may include a plurality of segments. For example, the filter rod 22000 may include a first segment configured to cool an aerosol and a second segment configured to filter a certain component included in the aerosol. Also, as necessary, the filter rod 22000 may further include at least one segment configured to perform other functions.

[0049] The cigarette 20000 may be packaged by at least one wrapper 24000. The wrapper 24000 may have at least one hole through which external air may be introduced or internal air may be discharged. For example, the cigarette 20000 may be packaged by one wrapper 24000. As another example, the cigarette 20000 may be double-packaged by two or more wrappers 24000. For example, the tobacco rod 21000 may be packaged by a first wrapper, and the filter rod 22000 may be packaged by a second wrapper. Also, the tobacco rod 21000 and the filter rod 22000, which are respectively packaged by separate wrappers, may be coupled to each other, and the entire cigarette 20000 may be repackaged by a third wrapper. When each of the tobacco rod 21000 or the filter rod 22000 includes a plurality of segments, each segment may be packaged by a separate wrapper. Also, the entire cigarette 20000 including the plurality of segments, which are respectively packaged by the separate wrappers and are coupled to each other, may be re-packaged by another wrapper.

[0050] The tobacco rod 21000 may include an aerosol generating material. For example, the aerosol generating

material may include at least one of glycerin, propylene glycol, ethylene glycol, dipropylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, and oleyl alcohol, but it is not limited thereto. Also, the tobacco rod 21000 may include other additives, such as flavors, a wetting agent, and/or organic acid. Also, the tobacco rod 21000 may include a flavored liquid, such as menthol or a moisturizer, which is injected to the tobacco rod 21000.

[0051] The tobacco rod 21000 may be manufactured in various forms. For example, the tobacco rod 21000 may be formed as a sheet or a strand. Also, the tobacco rod 21000 may be formed as a pipe tobacco, which is formed of tiny bits cut from a tobacco sheet. Also, the tobacco rod 21000 may be surrounded by a heat conductive material. For example, the heat-conducting material may be, but is not limited to, a metal foil such as aluminum foil. For example, the heat conductive material surrounding the tobacco rod 21000 may uniformly distribute heat transmitted to the tobacco rod 21000, and thus, the heat conductivity applied to the tobacco rod may be increased and taste of the tobacco may be improved. Also, the heat conductive material surrounding the tobacco rod 21000 may function as a susceptor heated by the induction heater. Here, although not illustrated in the drawings, the tobacco rod 21000 may further include an additional susceptor, in addition to the heat conductive material surrounding the tobacco rod 21000.

[0052] The filter rod 22000 may include a cellulose acetate filter. Shapes of the filter rod 22000 are not limited. For example, the filter rod 22000 may include a cylinder-type rod or a tube-type rod having a hollow inside. Also, the filter rod 22000 may include a recess-type rod. When the filter rod 22000 includes a plurality of segments, at least one of the plurality of segments may have a different shape.

[0053] The filter rod 22000 may be formed to generate flavors. For example, a flavoring liquid may be injected onto the filter rod 22000, or an additional fiber coated with a flavoring liquid may be inserted into the filter rod 22000.

[0054] Also, the filter rod 22000 may include at least one capsule 23000. Here, the capsule 23000 may perform a function of generating flavor or a function of generating aerosol. For example, the capsule 23000 may have a configuration in which a liquid containing a flavoring material is wrapped with a film. For example, the capsule 23000 may have a spherical or cylindrical shape, but is not limited thereto.

[0055] When the filter rod 22000 includes a segment configured to cool the aerosol, the cooling segment may include a polymer material or a biodegradable polymer material. For example, the cooling segment may include pure polylactic acid alone, but the material for forming the cooling segment is not limited thereto. In some embodiments, the cooling segment may include a cellulose acetate filter having a plurality of holes. However, the cooling segment is not limited to the above-described example and is not limited as long as the cooling segment

cools the aerosol.

[0056] Meanwhile, although not shown in FIG. 4, the cigarette 20000 according to an embodiment may further include a front-end filter. The front-end filter is located on one side of the tobacco rod 21000, which is not facing the filter rod 22000. The front-end filter may prevent the tobacco rod 21000 from being detached and prevent a liquefied aerosol from flowing into the aerosol generating device 10000 (FIGS. 1 through 3) from the tobacco rod 21000, during smoking.

[0057] FIG. 5 is a schematic cross-sectional view of an aerosol generating device according to an embodiment. Hereinafter, content described above with respect to the aerosol generating device 10000 of FIGS. 1-4 may also be applied to an aerosol generating device which will be described below.

[0058] Referring to FIG. 5, an aerosol generating device 100 may include a housing 101, a battery 110, a printed circuit board 120, a heater 130, and temperature sensors 161, 162, 163, and 164.

[0059] The housing 101 forms an exterior of the aerosol generating device 100. In addition, an opening 102 into which a cigarette is inserted is formed at one side of the housing 101.

[0060] The printed circuit board 120 may include a controller. For example, the controller may be a microcontroller unit (MCU). The MCU is hardware that controls overall operation of the aerosol generating device 100. The MCU includes at least one processor. A processor may also be implemented by an array of a plurality of logic gates or may also be implemented by a combination of a general-purpose microprocessor and a memory in which a program executable in the microprocessor is stored. In addition, it may be understood by those skilled in the art to which the present embodiment belongs that the processor may be implemented by other types of hardware.

[0061] The MCU may control the overall operation of the heater 130. In an embodiment, the MCU may control power supplied to the heater 130 based on a value sensed by at least one sensor so that the operation of the heater 130 starts or ends. In addition, the MCU may control the amount of power supplied to the heater 130 and a time when power is supplied based on a value sensed by at least one sensor so that the heater 130 may be heated to a predetermined temperature or may maintain an appropriate temperature.

[0062] As will be described below, the MCU may monitor temperatures of internal components through at least one of the temperature sensors 161, 162, 163, and 164, and may prevent abnormal operation of the aerosol generating device 100 based on the temperatures of the internal components of the aerosol generating device 100.

[0063] The temperature sensors 161, 162, 163, and 164 may sense temperatures of internal components arranged inside the housing 101 of the aerosol generating device 100. For example, the internal components may include the battery 110, the printed circuit board 120 on

which a controller is arranged, and the heater 130. The internal components further include other components in addition to the above-described components.

[0064] The aerosol generating device 100 may include a first temperature sensor 161 that senses a temperature of the heater 130, a second temperature sensor 162 that senses a temperature of the printed circuit board 120, and a third temperature sensor 163 that is arranged inside the housing 101 and senses a temperature of the outside of the aerosol generating device 100, and a battery temperature sensor 164 that senses a temperature of the battery 110. In addition, the aerosol generating device 100 may further include another temperature sensor that senses temperatures of other components in addition to the above-described components.

[0065] The first temperature sensor 161 may be arranged on the heater 130 to sense a temperature of the heater 130. The first temperature sensor 161 may measure the temperature of the heater 130 in a contact or non-contact manner. For example, the first temperature sensor 161 may be a resistance temperature detector (RTD) sensor. If the aerosol generating device 100 heats a cigarette by using an induction heating method, the first temperature sensor 161 may be arranged on a susceptor to sense a temperature of the susceptor. Further, the first temperature sensor 161 may be a type of sensor that is not affected by a magnetic field applied by a coil.

[0066] The second temperature sensor 162 may sense an internal temperature of the aerosol generating device 100. For example, the second temperature sensor 162 may be a thermistor. The second temperature sensor 162 may be arranged at a point where heat generation is high in the aerosol generating device 100. For example, the second temperature sensor 162 may be arranged to sense a temperature of the printed circuit board 120. In particular, a temperature of a point adjacent to the heater 130 on the printed circuit board 120 may be the highest, and thus, the second temperature sensor 162 may sense the temperature of the point adjacent to the heater 130 on the printed circuit board 120.

[0067] The third temperature sensor 163 may sense a temperature of the external environment of the aerosol generating device 100. The third temperature sensor 163 may be installed at a point where heat generation is the lowest inside the aerosol generating device 100 and where a temperature is the closest to the external environment. For example, the third temperature sensor 163 may be arranged at the opposite side of the housing 101 from the opening 102 to sense an external temperature. In an embodiment, the third temperature sensor 163 may measure a temperature and humidity together as necessary.

[0068] The battery temperature sensor 164 may sense a temperature of the battery 110. For example, the battery temperature sensor 164 may be a negative temperature coefficient (NTC) sensor. The battery temperature sensor 164 may be arranged on a side surface, front surface, and/or rear surface of the battery 110 to sense a surface

temperature of the battery 110. Also, the battery temperature sensor 164 may be arranged around the battery 110 to sense a surface temperature of the battery 110.

[0069] Meanwhile, the temperature sensors 161, 162, 163, and 164 are not limited to the above-described types, and other types of temperature sensors may be installed in the aerosol generating device 100 as needed.

[0070] FIG. 6 is a flowchart illustrating an exemplary operation method of the aerosol generating device according to the embodiment illustrated in FIG. 5.

[0071] Referring to 6, in step S101, when the aerosol generating device 100 enters a power-on state, a controller (e.g., an MCU) begins a stable operation procedure for preventing abnormal operation of the aerosol generating device based on the temperatures of internal components of the aerosol generating device 100.

[0072] In step S102, the first temperature sensor 161 (for example, an RTD sensor) may sense a temperature of the heater 130 and transmit temperature data of the heater 130 to the MCU. Accordingly, the MCU may monitor the temperature of the heater 130.

[0073] In step S103, the second temperature sensor 162 (for example, a thermistor) may sense a temperature of the printed circuit board 120 and transmit temperature data of the printed circuit board 120 to the MCU. Accordingly, the MCU may monitor the temperature of the printed circuit board 120. In addition, the third temperature sensor 163 (for example, a thermo-hygrometer) may sense an external temperature of the housing 101 of the aerosol generating device 100, and transmit data of the sensed temperature to the MCU. Therefore, the MCU may monitor the external temperature. In FIG. 6, step S102 and step S103 are illustrated as sequential steps, but the order of performing the steps are not limited thereto. For example, the first temperature sensor 161 through the third temperature sensor 163 may simultaneously sense temperatures of internal components. Also, step 103 may be performed after step 102.

[0074] In step S104, the MCU determines whether or not the temperature sensed by each of the temperature sensors 161, 162, and 163 is higher than or equal to a preset first temperature. In this case, the first temperature may indicate a temperature that is measured when the components are overheated.

[0075] In step S104, when temperatures of one or more of the internal components are higher than or equal to the preset first temperature, the procedure may proceed to step S105. However, when temperature of the respective internal components are less than the first temperature, the MCU repeats step S 104 until it is determined that temperatures of one or more of the internal components are higher than or equal to the first temperature.

[0076] In step S105, the MCU determines whether or not the temperatures sensed by the respective temperature sensors 161, 162, and 163 are higher than or equal to a preset second temperature. In this case, the second temperature is higher than the first temperature described above and may indicate that the aerosol gener-

ating device 100 is operating abnormally beyond being overheated.

[0077] In step S105, when temperatures of one or more of the internal components are higher than or equal to the present second temperature, the method may proceed to step S107. In step S107, the MCU determines that the aerosol generating device 100 operates abnormally. Also, the MCU may output a notification of termination of the aerosol generating device 100 to a user, and stop operation of the aerosol generating device 100. In addition, the aerosol generating device 100 may also be reset to solve the generated problem.

[0078] The MCU may apply an enable signal to at least one low-dropout regulator (LDO) (not illustrated) for controlling supply of a voltage or a current to internal components that consume power to operate the aerosol generating device 100. The LDO may indicate hardware that provides regulated voltage/current to internal components that consume power by using power delivered from the battery 110.

[0079] In order to stop operation of the aerosol generating device 100, for example, the MCU may not apply an enable signal to at least one LDO. Accordingly, at least one LDO may be disabled, and an electrical connection between the battery 110 and internal components that consume power connected through each of at least one LDO may be cut off. Internal components that are connected to each of at least one LDO and consume power may be deactivated as the electrical connection with the battery 110 is cut off, and accordingly, operation of the aerosol generating device 100 may stop.

[0080] In step S105, when temperatures of the respective internal components are less than the second temperature, the procedure may proceed to step S106. In this case, one or more of the internal components does not reach an abnormal operation temperature but is still higher than a normal operating temperature. Therefore, an overheating notification is output to a user. For example, the overheating notification may be output by a display capable of outputting the visual information described above and/or by a motor capable of outputting tactile information. Accordingly, a user may recognize that the aerosol generating device 100 is in an overheated state, and the user may take appropriate measures such as temporarily stopping use of the aerosol generating device 100 or lowering a temperature of the heater 130. After the overheating notification is output in step S106, the MCU repeats step S105 to monitor temperatures of the respective internal components again.

[0081] In the above-described embodiment, temperatures of internal components of the aerosol generating device 100 are determined based on an overheating temperature and an abnormal temperature, and an overheating notification is output to a user before an abnormal operation notification. Therefore, the aerosol generating device 100 may operate stably.

[0082] FIG. 7 is a flowchart illustrating another exemplary operation method of the aerosol generating device

according to the embodiment illustrated in FIG. 5.

[0083] Referring to FIG. 7, in step S201, when the aerosol generating device 100 enters a power-on state, an MCU begins a stable battery operation procedure for preventing abnormal operation of the aerosol generating device 100 based on the temperature of the battery 110.

[0084] When the battery 110 is damaged for some reason, the temperature of the battery 110 becomes higher than the temperature during normal operation. Accordingly, when the battery outputs an overcurrent or when the battery is overcharged, overly discharged, short-circuited, or overheated, the MCU may begin a stable battery operation procedure based on the sensed temperature.

[0085] In step S202, the battery temperature sensor 164 (for example, an NTC sensor) may sense the temperature of the battery 110 and transmit temperature data of the battery 110 to an MCU. Accordingly, the MCU may monitor the temperature of the battery 110.

[0086] In step S203, the MCU determines whether or not the temperature sensed by the battery temperature sensor 164 is higher than or equal to a preset first battery temperature. In this case, the first battery temperature may indicate a temperature that is above a temperature range of the battery 110 during normal operation.

[0087] When the temperature of the battery 110 is higher than or equal to the preset first battery temperature in step S203, the procedure may proceed to the step S204. However, when the temperature of the battery 110 is less than the first battery temperature, the MCU repeats step S203 until it is determined that the temperature of the battery 110 is higher than or equal to the first battery temperature.

[0088] In step S204, the MCU determines whether or not the temperature sensed by the battery temperature sensor 164 is higher than or equal to a preset second battery temperature. In this case, the second battery temperature is higher than the first battery temperature described above, and may indicate that the battery 110 (or the aerosol generating device 100) is operating abnormally beyond being overheated.

[0089] When the temperature of the battery 110 is higher than or equal to the preset second battery temperature in step S204, the processing may proceed to step S206. In step S206, the MCU determines that the battery 110 operates abnormally. Therefore, the MCU may stop use of the battery 110 and operation of the aerosol generating device 100. In addition, the aerosol generating device 100 may also be reset to solve the generated problem.

[0090] However, when the temperature of the battery 110 is less than the second battery temperature in step S204, the procedure may proceed to step S205. In this case, the battery 110 does not reach an abnormal operation temperature but is still overheated. Thus, an overheating notification of the battery is output to a user. For example, the overheating notification of the battery may be output by a display capable of outputting the visual information described above and/or a motor capable of

outputting tactile information. Accordingly, a user may recognize that the battery 110 is in an overheated state, and the user may take an appropriate measure, such as temporarily stopping use of the aerosol generating device 100, etc. After the overheating notification of the battery 110 is output in step S205, the MCU repeats step S204 to monitor the temperature of the battery 110 again.

[0091] At least one of the components, elements, modules or units (collectively "components" in this paragraph) represented by a block in the drawings such as the controller 12000, may be embodied as various numbers of hardware, software and/or firmware structures that execute respective functions described above, according to an exemplary embodiment. For example, at least one of these components may use a direct circuit structure, such as a memory, a processor, a logic circuit, a look-up table, etc. that may execute the respective functions through controls of one or more microprocessors or other control apparatuses. Also, at least one of these components may be specifically embodied by a module, a program, or a part of code, which contains one or more executable instructions for performing specified logic functions, and executed by one or more microprocessors or other control apparatuses. Further, at least one of these components may include or may be implemented by a processor such as a central processing unit (CPU) that performs the respective functions, a microprocessor, or the like. Two or more of these components may be combined into one single component which performs all operations or functions of the combined two or more components. Also, at least part of functions of at least one of these components may be performed by another of these components. Further, although a bus is not illustrated in the above block diagrams, communication between the components may be performed through the bus. Functional aspects of the above exemplary embodiments may be implemented in algorithms that execute on one or more processors. Furthermore, the components represented by a block or processing steps may employ any number of related art techniques for electronics configuration, signal processing and/or control, data processing and the like.

[0092] One embodiment may also be implemented in the form of a recording medium including instructions executable by a computer, such as a program module executable by the computer. A computer-readable medium may be any available medium that is accessible by a computer and includes both volatile and nonvolatile media, and removable and non-removable media. In addition, the computer-readable medium may include both a computer storage medium and a communication medium. The computer storage medium includes all of volatile and nonvolatile, and removable and non-removable media implemented by any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. The communication medium typically includes computer-readable instructions, data structures, other data in mod-

ulated data signals such as program modules, or other transmission mechanisms, and includes any information transfer media.

[0093] Those skilled in the technical field relating to the present embodiment will appreciate that the present embodiment may be implemented in a modified form without departing from the essential characteristics of the description. Therefore, the disclosed methods should be considered in a descriptive sense only and not for purposes of limitation. The scope of the present invention is defined by the appended claims.

Claims

1. An aerosol generating device (100) comprising:

a housing (101) that forms an exterior of the aerosol generating device (100) and includes an opening (102) configured to receive a cigarette; a heater (130) configured to heat the cigarette; a battery (110) configured to supply power to the heater (130);

a temperature sensor (161, 162, 163, 164) configured to sense a temperature of an internal component of the aerosol generating device (100); and

a controller configured to detect abnormal operation of the aerosol generating device (100) based on the temperature of the internal component sensed by the temperature sensor (161, 162, 163, 164);

characterized in that the controller is configured:

to output a notification of overheating based on the temperature of the internal component being higher than or equal to a first temperature; and to stop operation of the aerosol generating device (100) based on the temperature of the internal component being higher than or equal to a second temperature that is higher than the first temperature.

2. The aerosol generating device (100) of claim 1, further comprising a printed circuit board (120) on which the controller is arranged,

wherein the temperature sensor (161, 162, 163, 164) includes a first temperature sensor (161) configured to sense a temperature of the heater (130), a second temperature sensor (162) configured to sense a temperature of the printed circuit board (120), and a third temperature sensor (163) that is arranged inside the housing (101) and configured to sense an external temperature, and wherein the controller is configured to control

the internal component based on a temperature sensed by at least one of the first temperature sensor (161), the second temperature sensor (162), and the third temperature sensor (163).

3. The aerosol generating device (100) of claim 2, wherein the second temperature sensor (162) is configured to sense a temperature of a point adjacent to the heater (130) on the printed circuit board (120), and the third temperature sensor (163) is configured to sense a temperature of a point on an opposite side of the housing (101) from the opening (102).

4. The aerosol generating device (100) of claim 1, wherein the internal component includes the battery (110), wherein the temperature sensor (161, 162, 163, 164) includes a battery temperature sensor (164) configured to sense a temperature of the battery (110), and wherein the controller is configured to detect the abnormal operation of the aerosol generating device (100) based on the temperature of the battery (110) sensed by the battery temperature sensor (164).

5. The aerosol generating device (100) of claim 4, wherein the controller is configured to output a notification of battery overheating based on the temperature of the battery (110).

6. The aerosol generating device (100) of claim 5, wherein the controller is configured to output the notification of battery overheating based on the temperature of the battery (110) being higher than or equal to a first temperature.

7. The aerosol generating device (100) of claim 6, wherein the controller is configured to stop operation of the aerosol generating device (100) based on the temperature of the battery (110) being higher than or equal to a second battery temperature higher than the first battery temperature.

8. A method of controlling an aerosol generating device (100) according to any one of the preceding claims, the method comprising:

sensing a temperature of an internal component of the aerosol generating device (100) by using the temperature sensor; and detecting, by the controller, abnormal operation of the aerosol generating device (100) based on the temperature of the internal component sensed by the temperature sensor (161, 162, 163, 164);

characterized in that the method further comprising:

outputting, by the controller, a notification of overheating based on the temperature of the internal component being higher than or equal to a first temperature; and

stopping, by the controller, operation of the aerosol generating device (100) based on the abnormal operation of the aerosol generating device (100) being detected, wherein the detecting of the abnormal operation of the aerosol generating device (100) comprises determining that the aerosol generating device (100) is in a state of the abnormal operation state based on the temperature of the internal component being higher than or equal to a second temperature that is higher than the first temperature.

9. The method of claim 8, wherein the temperature of the internal component includes at least one of a temperature of a heater (130) of the aerosol generating device (100), a temperature of a printed circuit board (120) on which a controller of the aerosol generating device (100) is arranged, and an external temperature sensed by a temperature sensor arranged inside the aerosol generating device (100).

10. The method of claim 8, wherein the temperature of the internal component includes a temperature of a battery (110) arranged in the aerosol generating device (100).

Patentansprüche

1. Aerosolerzeugende Vorrichtung (100), die Folgendes umfasst:

ein Gehäuse (101), das ein äußeres Erscheinungsbild der aerosolerzeugenden Vorrichtung (100) bildet, und eine Öffnung (102) umfasst, die konfiguriert ist, eine Zigarette aufzunehmen; eine Heizvorrichtung (130), die konfiguriert ist, die Zigarette zu erhitzen;

eine Batterie (110), die konfiguriert ist, der Heizvorrichtung (130) Leistung zuzuführen;

einen Temperatursensor (161, 162, 163, 164), der konfiguriert ist, eine Temperatur einer inneren Komponente der aerosolerzeugenden Vorrichtung (100) zu messen; und

eine Steuerung, die konfiguriert ist, einen anomalen Betrieb der aerosolerzeugenden Vorrichtung (100) auf der Basis der Temperatur der inneren Komponente, die durch den Temperatursensor (161, 162, 163, 164) gemessen wird, zu detektieren;

dadurch gekennzeichnet, dass die Steuerung

konfiguriert ist zum:

Ausgeben einer Benachrichtigung über eine Überhitzung basierend darauf, dass die Temperatur der inneren Komponente gleich einer ersten Temperatur oder höher ist; und

Stoppen des Betriebs der aerosolerzeugenden Vorrichtung (100) basierend darauf, dass die Temperatur der inneren Komponente gleich einer zweiten Temperatur, die höher als die erste Temperatur ist, oder höher ist.

2. Aerosolerzeugende Vorrichtung (100) nach Anspruch 1, die ferner eine Leiterplatte (120) umfasst, auf der die Steuerung angeordnet ist,

wobei der Temperatursensor (161, 162, 163, 164) einen ersten Temperatursensor (161), der konfiguriert ist, eine Temperatur der Heizvorrichtung (130) zu messen, einen zweiten Temperatursensor (162), der konfiguriert ist, eine Temperatur der Leiterplatte (120) zu messen, und einen dritten Temperatursensor (163), der im Gehäuse (101) angeordnet ist und konfiguriert ist, eine Außentemperatur zu messen, umfasst, und

wobei die Steuerung konfiguriert ist, die innere Komponente basierend auf einer Temperatur, die durch den ersten Temperatursensor (161), den zweiten Temperatursensor (162) und/oder den dritten Temperatursensor (163) gemessen wird, zu steuern.

3. Aerosolerzeugende Vorrichtung (100) nach Anspruch 2, wobei der zweite Temperatursensor (162) konfiguriert ist, eine Temperatur an einem Punkt nahe bei der Heizvorrichtung (130) auf der Leiterplatte (120) zu messen, und der dritte Temperatursensor (163) konfiguriert ist, eine Temperatur an einem Punkt auf einer Seite des Gehäuses (101), die der Öffnung (102) gegenüberliegt, zu messen.

4. Aerosolerzeugende Vorrichtung (100) nach Anspruch 1,

wobei die innere Komponente die Batterie (110) umfasst,

wobei der Temperatursensor (161, 162, 163, 164) einen Batterietemperatursensor (164) umfasst, der konfiguriert ist, eine Temperatur der Batterie (110) zu messen, und

wobei die Steuerung konfiguriert ist, den anomalen Betrieb der aerosolerzeugenden Vorrichtung (100) auf der Basis der Temperatur der Batterie (110), die durch den Batterietemperatursensor (164) gemessen wird, zu detektieren.

5. Aerosolerzeugende Vorrichtung (100) nach Anspruch 4, wobei die Steuerung konfiguriert ist, auf der Basis der Temperatur der Batterie (110) eine Mitteilung über eine Batterieüberhitzung auszugeben.
6. Aerosolerzeugende Vorrichtung (100) nach Anspruch 5, wobei die Steuerung konfiguriert ist, die Mitteilung über eine Batterieüberhitzung basierend darauf auszugeben, dass die Temperatur der Batterie (110) einer ersten Temperatur gleich oder höher ist.
7. Aerosolerzeugende Vorrichtung (100) nach Anspruch 6, wobei die Steuerung konfiguriert ist, den Betrieb der aerosolerzeugenden Vorrichtung (100) basierend darauf zu stoppen, dass die Temperatur der Batterie (110) gleich oder höher ist als eine zweite Batterietemperatur, die höher als die erste Batterietemperatur ist.
8. Verfahren zum Steuern einer aerosolerzeugenden Vorrichtung (100) nach einem der vorhergehenden Ansprüche, wobei das Verfahren die folgenden Schritte umfasst:
- Messen einer Temperatur einer inneren Komponente der aerosolerzeugenden Vorrichtung (100) unter Verwendung des Temperatursensors; und
- Detektieren eines anomalen Betriebs der aerosolerzeugenden Vorrichtung (100) durch die Steuerung basierend auf der Temperatur der inneren Komponente, die durch den Temperatursensor (161, 162, 163, 164) gemessen wird; **dadurch gekennzeichnet, dass** das Verfahren ferner die folgenden Schritte umfasst:
- Ausgeben einer Mitteilung über eine Überhitzung durch die Steuerung basierend darauf, dass die Temperatur der inneren Komponente gleich einer ersten Temperatur oder höher ist; und
- Stoppen des Betriebs der aerosolerzeugenden Vorrichtung (100) durch die Steuerung basierend darauf, dass der anomale Betrieb der aerosolerzeugenden Vorrichtung (100) detektiert worden ist, wobei das Detektieren des anomalen Betriebs der aerosolerzeugenden Vorrichtung (100) das Feststellen umfasst, dass sich die aerosolerzeugende Vorrichtung (100) in einem Zustand des anomalen Betriebszustands befindet, basierend darauf, dass die Temperatur der inneren Komponente gleich oder höher ist als eine zweite Temperatur, die höher als die erste Temperatur ist.
9. Verfahren nach Anspruch 8, wobei die Temperatur

der inneren Komponente eine Temperatur einer Heizvorrichtung (130) der aerosolerzeugenden Vorrichtung (100), eine Temperatur einer Leiterplatte (120), auf der eine Steuerung der aerosolerzeugenden Vorrichtung (100) angeordnet ist, und/oder eine Außentemperatur, die durch einen Temperatursensor gemessen wird, der in der aerosolerzeugenden Vorrichtung (100) angeordnet ist, umfasst.

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10. Verfahren nach Anspruch 8, wobei die Temperatur der inneren Komponente eine Temperatur einer Batterie (110) umfasst, die in der aerosolerzeugenden Vorrichtung (100) angeordnet ist.

Revendications

1. Dispositif de production d'aérosol (100) comportant :

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un boîtier (101) qui forme un extérieur du dispositif de production d'aérosol (100) et inclut une ouverture (102) configurée pour recevoir une cigarette ;

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un élément chauffant (130) configuré pour chauffer la cigarette ;

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une batterie (110) configurée pour fournir de l'énergie à l'élément chauffant (130) ;

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un capteur de température (161, 162, 163, 164) configuré pour détecter une température d'un composant interne du dispositif de production d'aérosol (100) ; et

une commande configurée pour détecter un fonctionnement anormal du dispositif de production d'aérosol (100) sur la base de la température du composant interne détectée par le capteur de température (161, 162, 163, 164) ;

caractérisé en ce que la commande est configurée pour :

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délivrer une notification de surchauffe basée sur la température du composant interne étant supérieure ou égale à une première température ; et

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arrêter le fonctionnement du dispositif de production d'aérosol (100) sur la base de la température du composant interne étant supérieure ou égale à une seconde température qui est supérieure à la première température.

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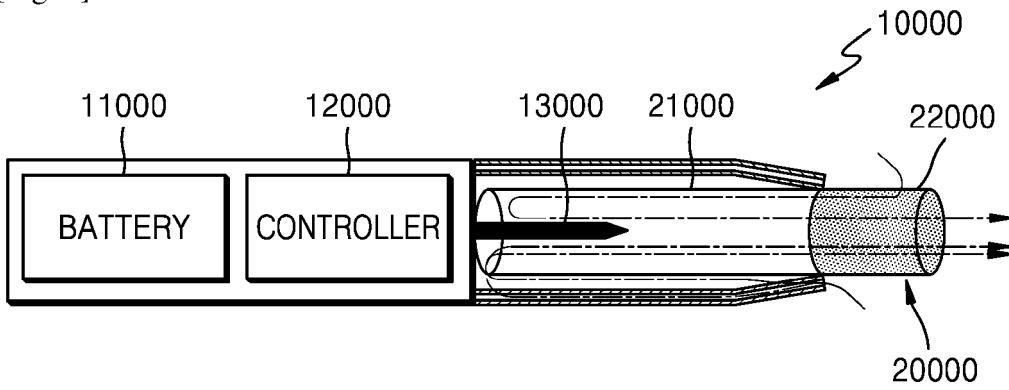
2. Dispositif de production d'aérosol (100) selon la revendication 1, comportant en outre une carte à circuit imprimé (120) sur laquelle la commande est agencée,

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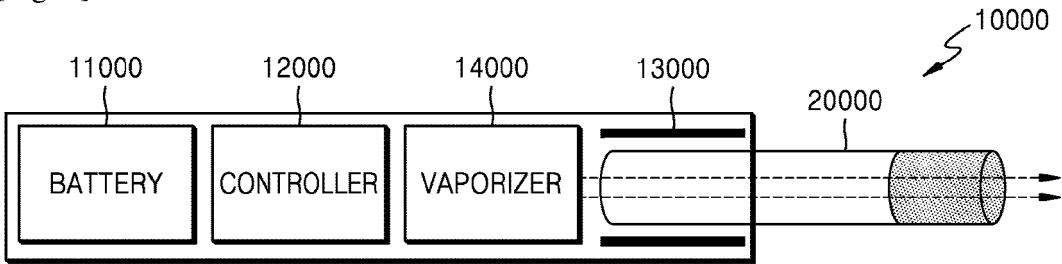
dans lequel le capteur de température (161, 162, 163, 164) inclut un premier capteur de température (161) configuré pour détecter une tempé-

- rature de l'élément chauffant (130), un deuxième capteur de température (162) configuré pour détecter une température de la carte à circuit imprimé (120), et un troisième capteur de température (163) qui est agencé à l'intérieur du boîtier (101) et configuré pour détecter une température externe, et
dans lequel la commande est configurée pour commander le composant interne sur la base d'une température détectée par le au moins un capteur parmi le premier capteur de température (161), le deuxième capteur de température (162) et le troisième capteur de température (163).
3. Dispositif de production d'aérosol (100) selon la revendication 2, dans lequel le deuxième capteur de température (162) est configuré pour détecter une température d'un point adjacent à l'élément chauffant (130) sur la carte à circuit imprimé (120), et le troisième capteur de température (163) est configuré pour détecter une température d'un point sur un côté opposé du boîtier (101) par rapport à l'ouverture (102).
4. Dispositif de production d'aérosol (100) selon la revendication 1,
dans lequel le composant interne inclut la batterie (110),
dans laquelle le capteur de température (161, 162, 163, 164) inclut un capteur de température de batterie (164) configuré pour détecter une température de la batterie (110), et
dans lequel la commande est configurée pour détecter le fonctionnement anormal du dispositif de production d'aérosol (100) sur la base de la température de la batterie (110) détectée par le capteur de température de batterie (164).
5. Dispositif de production d'aérosol (100) selon la revendication 4, dans lequel la commande est configurée pour délivrer une notification de surchauffe de batterie basée sur la température de la batterie (110).
6. Dispositif de production d'aérosol (100) selon la revendication 5, dans lequel la commande est configurée pour délivrer la notification de surchauffe de batterie basée sur la température de la batterie (110) étant supérieure ou égale à une première température.
7. Dispositif de production d'aérosol (100) selon la revendication 6, dans lequel la commande est configurée pour arrêter le fonctionnement du dispositif de production d'aérosol (100) sur la base de la température de la batterie (110) étant supérieure ou égale
- à une seconde température de batterie supérieure à une première température de batterie.
8. Procédé de commande d'un dispositif de production d'aérosol (100) selon l'une quelconque des revendications précédentes, le procédé comportant les étapes consistant à :
- détecter une température d'un composant interne du dispositif de production d'aérosol (100) en utilisant le capteur de température ; et
détecter, par la commande, un fonctionnement anormal du dispositif de production d'aérosol (100) sur la base de la température du composant interne détectée par le capteur de température (161, 162, 163, 164) ;
caractérisé en ce que le procédé comporte en outre les étapes consistant à :
- délivrer, par la commande, une notification de surchauffe basée sur la température du composant interne étant supérieure ou égale à une première température ; et
arrêter, par la commande, le fonctionnement du dispositif de production d'aérosol (100) sur la base du fonctionnement anormal du dispositif de production d'aérosol (100) étant détectée, dans lequel la détection du fonctionnement anormal du dispositif de production d'aérosol (100) comporte de déterminer que le dispositif de production d'aérosol (100) est dans un état de l'état de fonctionnement anormal basé sur la température du composant interne étant supérieure ou égale à une seconde température qui est supérieure à la première température.
9. Procédé selon la revendication 8, dans lequel la température du composant interne inclut au moins une température parmi une température d'un élément chauffant (130) du dispositif de production d'aérosol (100), une température d'une carte à circuit imprimé (120) sur laquelle une commande du dispositif de production d'aérosol (100) est agencée, et une température externe détectée par un capteur de température agencé à l'intérieur du dispositif de production d'aérosol (100).
10. Procédé selon la revendication 8, dans lequel la température du composant interne inclut une température d'une batterie (110) agencée dans le dispositif de production d'aérosol (100).

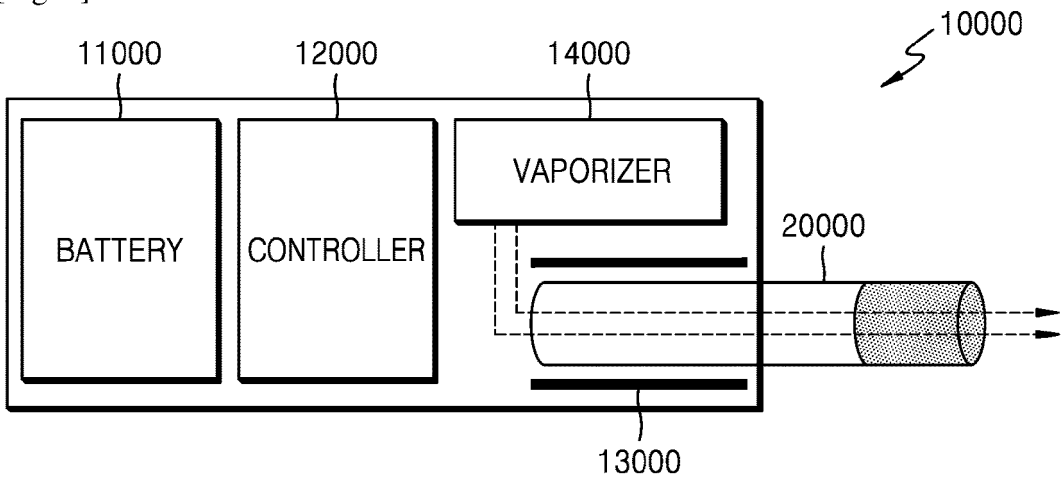
[Fig. 1]



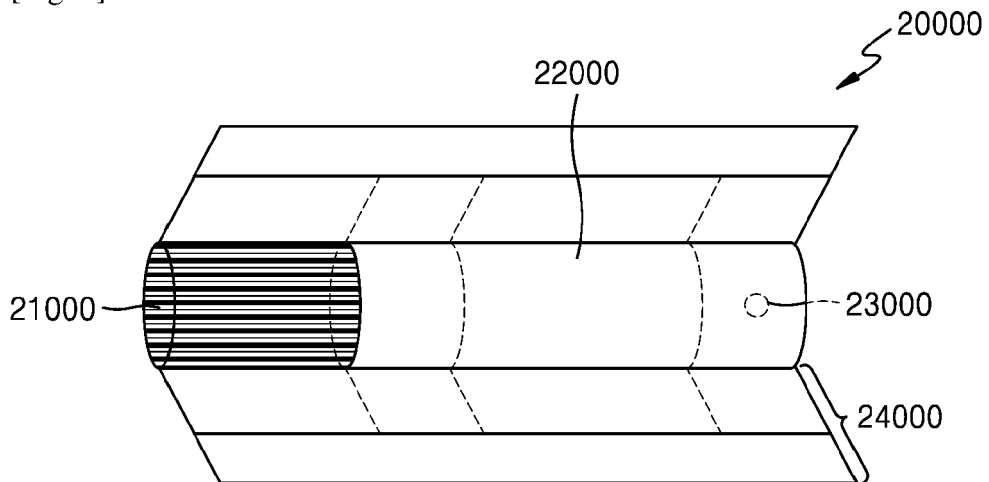
[Fig. 2]



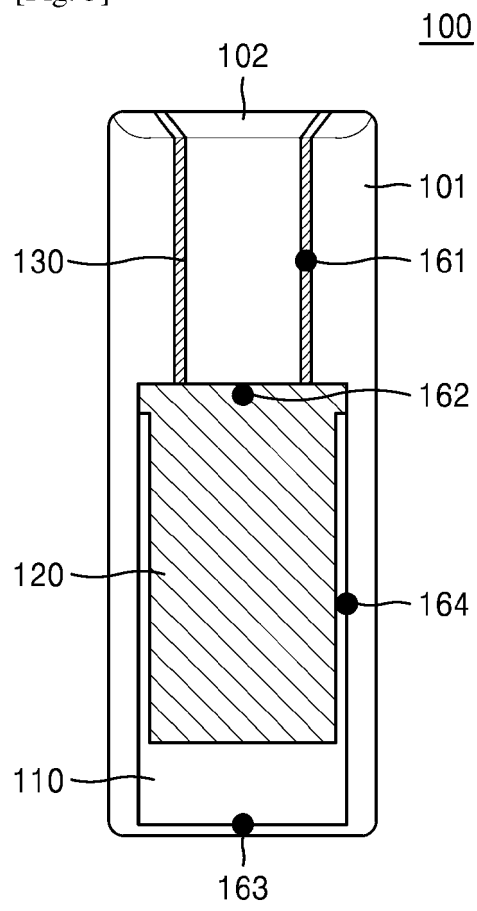
[Fig. 3]



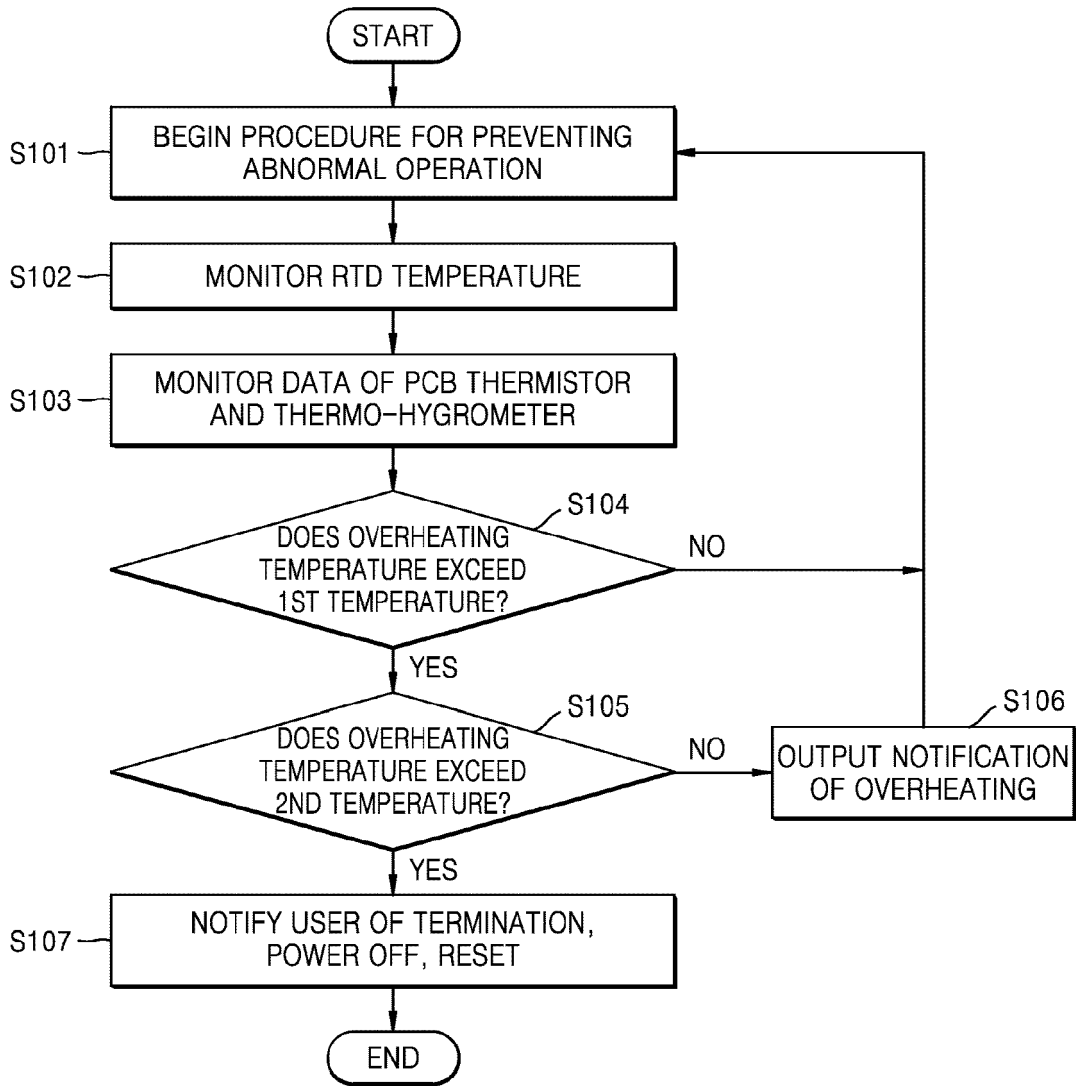
[Fig. 4]



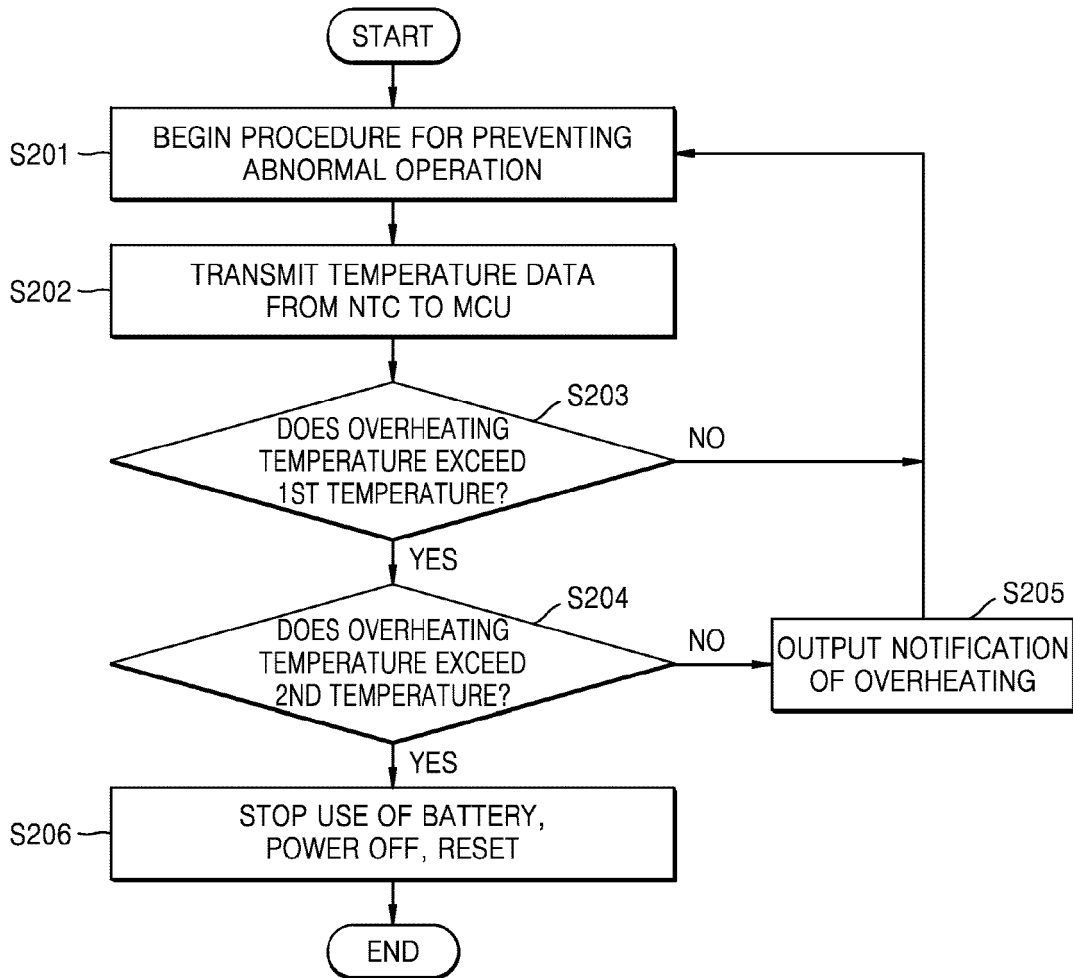
[Fig. 5]



[Fig. 6]



[Fig. 7]



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2019115464 A1 [0002]