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tion-heating of the susceptor included in the base material stored in the storage part; a monitoring module including a monitoring coil disposed at a position overlapping with a magnetic field generated from the heating coil; and a control part for determining a state of the aerosol generation system on the basis of a voltage applied to the monitoring module.

Description

TECHNICAL FIELD

[0001] The present disclosure relates to an aerosol generation system.

BACKGROUND ART

[0002] Inhalation devices that generate substances to be inhaled by users, such as electronic cigarettes, heated tobacco products and nebulizers, are in widespread use. For example, an inhalation device employs an aerosol source for generating an aerosol, and a substrate including a flavor source or the like for imparting a flavor component to the generated aerosol, to generate an aerosol to which the flavor component has been imparted. The user can enjoy the flavor by inhaling the aerosol to which the flavor component has been imparted, generated by the inhalation device. The action by which the user inhales the aerosol will also be referred to below as "puffing" or a "puffing action".

[0003] In recent years, inductively heated inhalation devices have been developed which inductively heat a susceptor and generate an aerosol by heating the aerosol source by means of the susceptor. For example, the following PTL 1 discloses a technique for measuring the temperature of a susceptor on the basis of the apparent resistance of a resonant circuit including an induction coil that inductively heats the susceptor.

CITATION LIST

PATENT LITERATURE

[0004] PTL 1 JP 6623175 B2

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] As disclosed in the above PTL 1, etc., techniques for measuring the temperature of the susceptor have been developed, but there is room for improvement in accuracy.

[0006] The present disclosure was devised in view of these problems, and the objective of the present disclosure is to provide a mechanism capable of further improving the quality of the user experience for a user using an inductively heated inhalation device.

SOLUTION TO PROBLEM

[0007] In order to solve the above problems, one aspect of the present invention provides an aerosol generation system for generating an aerosol, the aerosol generation system comprising: an accommodating unit capable of accommodating a substrate including an

aerosol source and a susceptor; a heating coil for inductively heating the susceptor included in the substrate accommodated in the accommodating unit; a monitoring module including a monitoring coil disposed in a position that is overlapped by a magnetic field generated by the heating coil; and a control unit for determining a state of the aerosol generation system on the basis of the voltage across the monitoring module.

[0008] The monitoring module may further comprise a rectifier circuit that generates and outputs a DC voltage by rectifying an AC voltage output from the monitoring coil, and the control unit may determine the state of the aerosol generation system on the basis of the DC voltage output from the rectifier circuit.

[0009] The rectifier circuit may be a full-wave rectifier circuit that performs full-wave rectification.

[0010] The rectifier circuit may be a half-wave rectifier circuit that performs half-wave rectification.

[0011] The monitoring module may further comprise a smoothing circuit for smoothing and outputting the DC voltage output from the rectifier circuit, and the control unit may determine the state of the aerosol generation system on the basis of the smoothed DC voltage output from the smoothing circuit.

[0012] The control unit may determine the state of the aerosol generation system on the basis of a divided DC voltage output from a voltage-dividing circuit.

[0013] The control unit may determine the state of the aerosol generation system additionally on the basis of a current flowing through the monitoring module.

[0014] As the determination of the state of the aerosol generation system, the control unit may perform at least one of the following: determining the temperature of the susceptor; determining whether or not the substrate is accommodated in the accommodating unit, and determining whether or not a fault has occurred in the aerosol generation system.

[0015] The inductance of the monitoring coil may be less than the inductance of the heating coil.

[0016] The number of turns of the monitoring coil may be less than the number of turns of the heating coil.

[0017] The diameter of the monitoring coil windings may be less than the diameter of the heating coil windings.

[0018] The monitoring coil and the heating coil may be arranged coaxially, and the windings of the monitoring coil may be arranged between the windings of the heating coil.

[0019] The monitoring coil and the heating coil may be arranged coaxially, and the monitoring coil may be disposed so as to surround the heating coil from the outside.

[0020] The aerosol generation system may further comprise a heat insulating member between the monitoring coil and the heating coil.

[0021] The winding direction of the monitoring coil and the winding direction of the heating coil may be the same.

ADVANTAGEOUS EFFECTS OF INVENTION

[0022] The present disclosure as described above provides a mechanism capable of further improving the quality of the user experience for a user using an inductively heated inhalation device.

BRIEF DESCRIPTION OF DRAWINGS

[0023]

Fig. 1 is a schematic diagram schematically showing a configuration example of an inhalation device.

Fig. 2 is a diagram showing an example of a circuit configuration of an inhalation device according to an embodiment of the present disclosure.

Fig. 3 is a diagram showing an example of an arrangement of an electromagnetic induction source and a monitoring coil according to the same embodiment.

Fig. 4 is a flowchart showing an example of the flow of processing executed by the inhalation device according to the same embodiment.

DESCRIPTION OF EMBODIMENTS

[0024] Preferred embodiments of the present disclosure will be described in detail below with reference to the appended drawings. It should be noted that components having substantially the same functional configuration will be assigned the same reference numbers in the description and drawings to avoid giving a duplicate description.

<1. Configuration example of inhalation device>

[0025] An inhalation device is a device for generating a substance to be inhaled by a user. Hereinafter, the substance generated by the inhalation device will be described as being an aerosol. Alternatively, the substance generated by the inhalation device may be a gas.

[0026] Fig. 1 is a schematic diagram schematically showing a configuration example of an inhalation device. As shown in fig. 1, an inhalation device 100 according to the present configuration example comprises a power source unit 111, a sensor unit 112, a notification unit 113, a memory unit 114, a communication unit 115, a control unit 116, an accommodating unit 140, and an electromagnetic induction source 162.

[0027] The power source unit 111 stores electric power. The power source unit 111 then supplies the electric power to each component of the inhalation device 100 in accordance with control performed by the control unit 116. The power source unit 111 may be configured, for example, by a rechargeable battery such as a lithium ion secondary battery. The power source unit 111 may supply a direct current to the other components. Alternatively, the power source unit 111 may supply an alternating

current converted by an inverter circuit to the other components.

[0028] The sensor unit 112 acquires various types of information relating to the inhalation device 100. As an example, the sensor unit 112 is configured by a pressure sensor such as a condenser microphone, a flow rate sensor or a temperature sensor, etc., and acquires values associated with inhalation by a user. As another example, the sensor unit 112 is configured by an input device, such as a button or switch, for accepting input of information from the user.

[0029] The notification unit 113 notifies the user of information. The notification unit 113 is configured by a light emitting device that emits light, a display device that displays images, a sound output device that outputs sound, or a vibrating device that vibrates, for example.

[0030] The memory unit 114 stores various types of information for the operation of the inhalation device 100. The memory unit 114 is configured by a non-volatile storage medium such as a flash memory, for example.

[0031] The communication unit 115 is a communication interface capable of performing communication conforming to any wired or wireless communication standard. Examples of communication standards that may be used include standards that employ Wi-Fi (registered trademark), Bluetooth (registered trademark), BLE (Bluetooth Low Energy) (registered trademark), NFC (Near-Field Communication), or LPWA (Low Power Wide Area), for example.

[0032] The control unit 116 functions as an arithmetic processing device and a control device, and controls overall operation within the inhalation device 100 in accordance with various programs. The control unit 116 is realized by a CPU (central processing unit) or an electronic circuit such as a microprocessor, for example.

[0033] The accommodating unit 140 has an internal space 141, and holds a stick-type substrate 150 while accommodating a portion of the stick-type substrate 150 in the internal space 141. The accommodating unit portion 140 has an opening 142 allowing the internal space 141 to communicate with the outside, and accommodates the stick-type substrate 150 that has been inserted into the internal space 141 through the opening 142. For example, the accommodating unit 140 is a cylindrical body comprising the opening 142 and a bottom portion 143 serving as a bottom surface, and defines the columnar internal space 141. An air flow passage for supplying air to the internal space 141 is connected to the accommodating unit 140. An air inflow hole, which is an inlet for air into the air flow passage, is disposed in a side surface of the inhalation device 100, for example. An air outflow hole, which is an outlet for air from the air flow passage to the internal space 141, is disposed in the bottom portion 143, for example.

[0034] The stick-type substrate 150 comprises a substrate portion 151 and a mouthpiece portion 152. The substrate portion 151 contains an aerosol source. The aerosol source comprises a tobacco-derived or non-to-

bacco-derived flavor component. If the inhalation device 100 is a medical inhaler such as a nebulizer, the aerosol source may include a drug. The aerosol source may, for example, be a liquid such as water or a polyhydric alcohol, for example glycerol or propylene glycol, containing the tobacco-derived or non-tobacco-derived flavor component, or may be a solid including the tobacco-derived or non-tobacco-derived flavor component. In a state in which the stick-type substrate 150 is being held in the accommodating portion 140, at least a portion of the substrate portion 151 is accommodated in the internal space 141, and at least a portion of the mouthpiece portion 152 protrudes from the opening 142. Then, when the user holds the mouthpiece portion 152 protruding from the opening 142 in their mouth and inhales, air flows into the internal space 141 via the air flow passage, which is not illustrated in the drawings, and reaches the inside of the user's mouth together with the aerosol generated from the substrate portion 151.

[0035] Furthermore, the stick-type substrate 150 comprises a susceptor 161. The susceptor generates heat by electromagnetic induction. The susceptor 161 is made of an electrically conductive material, such as a metal. Furthermore, it is desirable that the susceptor 161 is magnetic. As an example, the susceptor 161 may be configured as a metal plate or a metal rod. The susceptor 161 is disposed in thermal proximity to the aerosol source. That is, the susceptor 161 is disposed in a position at which heat generated in the susceptor 161 is transferred to the aerosol source. In the example shown in fig. 1, the susceptor 161 is included in the substrate portion 151 of the stick-type substrate 150. The configuration may be such that the susceptor 161 cannot be touched from the outside of the stick-type substrate 150. For example, the susceptor 161 may be distributed in a central part of the stick-type substrate 150 and not distributed near the outer periphery.

[0036] The electromagnetic induction source 162 inductively heats the susceptor 161. The electromagnetic induction source 162 generates a varying magnetic field (more specifically, an alternating magnetic field) when an alternating current is applied thereto. The electromagnetic induction source 162 is disposed in a position at which the generated varying magnetic field overlaps the internal space 141 of the accommodating unit 140, more specifically a position at which the varying magnetic field overlaps the susceptor 161 of the stick-type substrate 150 accommodated in the accommodating unit 140. The electromagnetic induction source 162 comprises, for example, a coil-shaped conductor, and is disposed so as to be wound around the outer periphery of the accommodating unit 140. Thus, when a varying magnetic field is generated in a state in which the stick-type substrate 150 is accommodated in the accommodating unit 140, the varying magnetic field generated from the electromagnetic induction source 162 penetrates the susceptor 161 located in the internal space 141 of the accommodating unit 140 and inductively heats the susceptor 161. More

specifically, eddy current losses occur in the susceptor 161, and if the susceptor 161 is magnetic, magnetic hysteresis losses also occur in the susceptor 161, causing the temperature of the susceptor 161 to increase. The aerosol source contained in the stick-type substrate 150 is then heated and atomized by the inductively heated susceptor 161, generating an aerosol. As an example, electricity may be supplied to the electromagnetic induction source 162 when the sensor unit 112 detects that the user has started inhaling and/or that predetermined information has been input. The supply of electricity to the electromagnetic induction source 162 may then be stopped when the sensor unit 112 detects that the user has finished inhaling and/or that predetermined information has been input.

<2. Technical Problem>

[0037] If the susceptor 161 is contained in the stick-type substrate 150, it is difficult to provide a temperature sensor in the vicinity of the susceptor 161. Therefore, a technique for accurately measuring the temperature of the susceptor 161 is required.

[0038] As disclosed in the above PTL 1, the temperature of the susceptor 161 can be measured on the basis of the apparent resistance of a resonant circuit that includes the electromagnetic induction source 162. This is because the apparent resistance of the resonant circuit including the electromagnetic induction source 162 has a substantially linear relationship with the temperature of the susceptor 161, since as the electromagnetic induction source 162 and the susceptor 161 are inductively coupled.

[0039] However, there is room for improvement in the measurement accuracy of the technique disclosed in the above PTL 1. This is because the apparent resistance of the resonant circuit including the electromagnetic induction source 162 is affected by various circuits, such as an inverter circuit, connected to the resonant circuit, and therefore in some cases may not accurately reflect the temperature of the susceptor 161. In addition, with the technique disclosed in the above PTL 1, it is difficult to add further noise countermeasures, and there are thus limits to the noise countermeasures.

[0040] Accordingly, in the present embodiment, a mechanism is provided that enables the temperature of the susceptor 161 to be measured in a non-contact manner and more accurately. As a result, the quality of the user experience for a user using the inhalation device 100 can be further improved.

<3. Technical Features>

(1) Circuit configuration

[0041] The circuit configuration of the inhalation device 100 will now be described with reference to fig. 2. Fig. 2 is a diagram showing an example of the circuit configura-

tion of the inhalation device 100 according to the present embodiment. In fig. 2, graphs 301 to 305 are shown accompanying the circuit configuration. Graphs 301 to 305 show the waveforms of voltages across each part of the circuit illustrated in fig. 2. The vertical axis of the graphs 301 to 305 represents the voltage, the horizontal axis represents time, and the dashed line indicates zero voltage.

[0042] As shown in fig. 2, the inhalation device 100 according to the present embodiment comprises the electromagnetic induction source 162, an inverter circuit 170, and capacitors 181 to 183. These components constitute a circuit for inductively heating the susceptor 161, to thereby heat the stick-type substrate 150 (more specifically, the aerosol source contained in the stick-type substrate 150).

[0043] The electromagnetic induction source 162 is formed by winding a conducting wire, and inductively heats the susceptor 161 contained in the stick-type substrate 150 accommodated in the accommodating unit 140. For convenience of explanation, the electromagnetic induction source 162 will also be referred to as a heating coil 162 hereinafter. The windings of the heating coil 162 may be litz wire or may be enameled wire (i.e., solid wire).

[0044] The inverter circuit 170 is configured to convert a direct current into an alternating current and output the alternating current. The inverter circuit 170 shown in fig. 2 is a half-bridge circuit having field-effect transistors (FETs) 171 and 172 as switching elements. The inverter circuit 170 generates an alternating current by opening and closing these switching elements. Of course, the configuration of the inverter circuit 170 is not limited to the example shown in fig. 2, and various configurations may be adopted, such as a full-bridge circuit.

[0045] The heating coil 162 and the capacitors 181 to 183 are connected to the inverter circuit 170. The alternating current output from the inverter circuit 170 is supplied to these components. Then, when the alternating current is supplied to the heating coil 162, the heating coil 162 generates an alternating magnetic field and inductively heats the susceptor 161. The heating coil 162, the susceptor 161 that is inductively coupled with the electromagnetic induction source 162, the capacitor 182 and the capacitor 183 constitute an RLC resonant circuit. The capacitor 181 suppresses large voltage fluctuations that may occur instantaneously when the inverter circuit 170 is driven. Graph 301 shows the waveform of the voltage across the heating coil 162. As shown in graph 301, an AC voltage is applied across the heating coil 162.

[0046] As shown in fig. 2, the inhalation device 100 has a monitoring module 200 in addition to the circuit for heating the stick-type substrate 150 discussed hereinabove. The monitoring module 200 is a component for monitoring (i.e., measuring) the temperature of the inhalation device 100. The current flowing through the monitoring module 200 is supplied to an MCU (Micro

Controller Unit). The MCU is a component corresponding to the control unit 116 described with reference to fig. 1. A voltage corresponding to the temperature of the susceptor 161 is applied to the monitoring module 200. The MCU, which is the control unit 116, therefore measures the temperature of the susceptor 161 on the basis of the voltage applied to the monitoring module 200. With this configuration, the temperature of the susceptor 161 can be measured using the monitoring module 200 configured independently of the circuit for heating the stick-type substrate 150. As such, the influence of various circuits, such as the inverter circuit 170, can be eliminated, allowing the temperature of the susceptor 161 to be measured accurately. Furthermore, by configuring the monitoring module 200 independently of the circuit for heating the stick-type substrate 150, noise countermeasures can be easily added. The addition of noise countermeasures allows the temperature of the susceptor 161 to be measured even more accurately.

[0047] As shown in fig. 2, the monitoring module 200 comprises a monitoring coil 210, a rectifier circuit 220, a smoothing circuit 230, and a voltage-dividing circuit 240.

[0048] The monitoring coil 210 is a coil disposed in a position that is overlapped by the magnetic field generated by the heating coil 162. For example, the monitoring coil 210 is disposed so as to be wound around the outer periphery of the accommodating unit 140, in the same manner as the heating coil 162. The windings of the monitoring coil 210 may be litz wire or may be enameled wire. When a magnetic field is generated from the heating coil 162, an alternating current corresponding to the magnetic field flows through the monitoring coil 210 due to mutual induction, thereby generating an inductive electromotive force. The AC voltage generated in the monitoring coil 210 is then output from the monitoring coil 210. Graph 302 shows the waveform of the voltage output from the monitoring coil 210, i.e. the voltage across the monitoring coil 210. As shown in graph 302, an AC voltage is applied across the monitoring coil 210.

[0049] The rectifier circuit 220 is configured to generate and output a DC voltage by rectifying the AC voltage. As shown in fig. 2, the rectifier circuit 220 is connected to the monitoring coil 210. Then, the rectifier circuit 220 rectifies the AC voltage output from the monitoring coil 210 and outputs a DC voltage. As a result, a DC voltage corresponding to the rectified DC voltage output from the rectifier circuit 220 is applied to the MCU. This enables the MCU to measure the temperature of the susceptor 161 on the basis of the DC voltage. Graph 303 shows the waveform of the voltage output from the rectifier circuit 220. As shown in graph 303, the voltage output from the rectifier circuit 220 is a pulse wave voltage that varies periodically on the positive side.

[0050] The rectifier circuit 220 may be a full-wave rectifier circuit that performs full-wave rectification. The rectifier circuit 220 shown in fig. 3 is a bridge rectifier circuit in which a bridge is formed using four diodes. Alternatively, the rectifier circuit 220 may be configured

as a center-tapped full wave rectifier circuit. In this case, a center tap is provided midway along the monitoring coil 210. With this configuration, the AC voltage can be converted to a DC voltage with a higher efficiency than when the rectifier circuit 220 is configured as a half-wave rectifier circuit.

[0051] The smoothing circuit 230 is configured to smooth an input voltage and output the smoothed voltage. As shown in fig. 2, the smoothing circuit 230 is connected to the rectifier circuit 220. Then, the smoothing circuit 230 smooths the DC voltage (i.e., the pulse wave voltage) output from the rectifier circuit 220, and outputs the smoothed voltage. As a result, a DC voltage corresponding to the smoothed DC voltage output from the smoothing circuit 230 is applied to the MCU. With this configuration, the pulsation of the DC voltage applied to the MCU can be flattened out, making it possible to stabilize the operation of the MCU. In the example shown on fig. 2, the smoothing circuit 230 comprises a resistor 231 and a capacitor 232. Various configurations may be adopted for the smoothing circuit 230, such as a capacitor input type, a choke input type, or a π type. Graph 304 shows the waveform of the voltage output from the smoothing circuit 230. As shown in graph 304, the pulse wave voltage is smoothed by the smoothing circuit 230 and a flat voltage is output.

[0052] The voltage-dividing circuit 240 is configured to divide the input voltage and output the divided voltage. As shown in fig. 2, the voltage-dividing circuit 240 is connected to the smoothing circuit 230. Then, the voltage-dividing circuit 240 divides the smoothed DC voltage output from the smoothing circuit 230 and outputs the divided voltage. The divided DC voltage output from the voltage-dividing circuit 240 is then applied to the MCU. With this configuration, it is possible to reduce the DC voltage applied to the MCU to a level that is acceptable for the MCU. Graph 305 shows the waveform of the voltage output from the voltage-dividing circuit 240 and applied to the MCU. As shown in graph 305, the attenuated DC voltage after voltage division is applied to the MCU.

[0053] In the example shown in fig. 2, the voltage-dividing circuit 240 is obtained by connecting a 10 k Ω resistor 241 and a 1 k Ω resistor 242 in series, with the resistor 242 on the GND side, and connecting an intermediate position to the MCU. With this configuration, the divided DC voltage applied to the MCU can be made to be 1/11 of the DC voltage applied to the voltage-dividing circuit 240. Of course, the resistance values of the resistors 241 and 242 are merely examples, and resistors with any resistance value may be employed in the voltage-dividing circuit 240. It should be noted that resistors having a small tolerance are preferably employed as the resistor 241 and the resistor 242 used in the voltage-dividing circuit 240 in order to ensure the accuracy of the voltage change.

[0054] The control unit 116 measures the temperature of the susceptor 161 on the basis of the DC voltage applied to the monitoring module 200. More specifically,

the MCU measures the temperature of the susceptor 161 on the basis of the DC voltage output from the monitoring module 200 and applied to the MCU. As described above, there is a substantially linear relationship between the apparent resistance of the resonant circuit that includes the heating coil 162 and the temperature of the susceptor 161. For similar reasons, there is a substantially linear relationship between the voltage across the monitoring coil 210 and the temperature of the susceptor 161. The control unit 116 therefore measures the temperature of the susceptor 161 on the basis of the DC voltage after voltage division by the voltage-dividing circuit 240, which corresponds to the voltage across the monitoring coil 210. The relationship between the DC voltage after voltage division by the voltage-dividing circuit 240 and the temperature of the susceptor 161 may be measured in advance before the inhalation device 100 is shipped, and stored in the memory unit 114, and the control unit 116 may measure the temperature of the susceptor 161 by referring to information stored in the memory unit 114.

(2) Detailed configuration of monitoring coil 210

[0055] The detailed configuration of the monitoring coil 210 will next be described with reference to fig. 3. Fig. 3 is a diagram showing an example of the arrangement of the heating coil 162 and the monitoring coil 210 according to the present embodiment.

[0056] As shown in fig. 3, the monitoring coil 210 and the heating coil 162 may be arranged coaxially. For example, each of the monitoring coil 210 and the heating coil 162 may be wrapped around the outside of the accommodating unit 140. With this configuration, an AC voltage similar to the AC voltage generated across the heating coil 162 can be generated across the monitoring coil 210. As a result, the measurement accuracy of the temperature of the susceptor 161 can be improved.

[0057] As shown in fig. 3, the windings of the monitoring coil 210 may be arranged between the windings of the heating coil 162. In other words, the windings of the monitoring coil 210 and the windings of the heating coil 162 may be arranged to overlap in the radial direction of the accommodating unit 140 (i.e., in a direction perpendicular to the insertion/removal direction of the stick-type substrate 150). With this configuration, the inhalation device 100 can be made more compact by being made thinner in the radial direction of the accommodating unit 140 than when the monitoring coil 210 is arranged outside or inside the heating coil 162, for example.

[0058] As shown in fig. 3, the winding direction of the monitoring coil 210 and the winding direction of the heating coil 162 may be the same. In this case, the AC voltage generated across the monitoring coil 210 and the AC voltage generated across the heating coil 162 can be made to be in-phase. This is expected to improve the measurement accuracy of the temperature of the susceptor 161.

[0059] Here, it is desirable that the inductance of the

monitoring coil 210 is less than the inductance of the heating coil 162. With this configuration, a decrease in heating efficiency due to the arrangement of the monitoring coil 210 can be suppressed.

[0060] Specifically, the number of turns of the monitoring coil 210 may be less than the number of turns of the heating coil 162. This configuration allows the above-mentioned inductance relationship between the monitoring coil 210 and the heating coil 162 to be established, and allows the inhalation device 100 to be made more compact.

[0061] As shown in fig. 3, the diameter of the windings of the monitoring coil 210 may be less than the diameter of the windings of the heating coil 162. With this configuration, the current flowing through the monitoring coil 210 can be reduced, and therefore a reduction in heating efficiency due to the arrangement of the monitoring coil 210 can be suppressed.

(3) Processing flow

[0062] Fig. 4 is a flowchart showing an example of the flow of processing executed by the inhalation device 100 according to the present embodiment.

[0063] As shown in fig. 4, the inhalation device 100 first detects an indication to start heating (step S102). For example, the control unit 116 may detect, as the indication to start heating, that a predetermined user operation, such as a button press, has been input, or that a stick-type substrate 150 has been accommodated in the accommodating unit 140.

[0064] Next, the inhalation device 100 starts heating the stick-type substrate 150 (step S104). For example, the control unit 116 drives the inverter circuit 170 to supply an alternating current to the heating coil 162. As a result, an alternating magnetic field is generated from the heating coil 162, and the susceptor 161 contained in the stick-type substrate 150 that is accommodated in the accommodating unit 140 is inductively heated.

[0065] Next, the inhalation device 100 measures the temperature of the susceptor 161 on the basis of the DC voltage output from the monitoring module 200 (step S106). For example, the control unit 116 measures the temperature of the susceptor 161 on the basis of the DC voltage after voltage division by the voltage-dividing circuit 240, which corresponds to the voltage across the monitoring coil 210.

[0066] Next, the inhalation device 100 controls the heating of the stick-type substrate 150 on the basis of the measured temperature of the susceptor 161 (step S108). For example, the control unit 116 may control the temperature of the susceptor 161 on the basis of a heating profile defining a time series transition of a target value (hereinafter also referred to as a target temperature) of the temperature of the susceptor 161. That is, the control unit 116 may control the alternating current supplied to the heating coil 162 such that the measured temperature of the susceptor 161 transitions in a similar

manner to the time series transition of the target temperature defined in the heating profile.

[0067] Next, the control unit 100 determines whether or not an end condition has been met (step S110). An example of the end condition is that a predetermined time has elapsed since the start of heating. Another example of the end condition is that the number of detected puffs has reached a predetermined number.

[0068] If it is determined that the end condition has not been met (step S110: NO), the processing returns to step S106.

[0069] If it is determined that the end condition has been met (step S110: YES), the inhalation device 100 ends the heating of the stick-type substrate (step S112). The processing then ends.

<4. Supplementary information>

[0070] A preferred embodiment of the present disclosure has been described in detail above with reference to the appended drawings, but the present disclosure is not limited to such an example. It is obvious that a person having ordinary knowledge in the technical field to which the present disclosure belongs will be able to conceive of a number of variant examples or modified examples within the scope of the technical concept disclosed in the claims, and any such variant examples or modified examples are naturally understood to fall within the technical scope of the present disclosure.

[0071] An example has been described above in which the rectifier circuit 220 is configured as a full-wave rectifier circuit, but the present disclosure is not limited to such an example. For example, the rectifier circuit 220 may be a half-wave rectifier circuit that performs half-wave rectification. With this configuration, it is possible to reduce the size of the rectifier circuit 220 and consequently reduce the size of the inhalation device 100 compared to a case in which the rectifier circuit 220 is configured as a full-wave rectifier circuit.

[0072] An example has been described above in which the control unit 116 measures the temperature of the susceptor 161 on the basis of the voltage applied to the monitoring module 200, but the present disclosure is not limited to such an example. A current corresponding to the temperature of the susceptor 161 may flow through the monitoring module 200. Therefore, the control unit 116 may measure the temperature of the susceptor 161 on the basis of the current flowing through the monitoring module 200 in addition to or instead of the voltage applied to the monitoring module 200. With regard to the circuit configuration shown in fig. 2, the MCU may measure the temperature of the susceptor 161 on the basis of at least one of the voltage and the current output from the voltage-dividing circuit 240 to the MCU. In particular, it is desirable that the control unit 116 measures the temperature of the susceptor 161 on the basis of both the voltage applied to the monitoring module 200 and the current flowing through the monitoring module

200. Such a configuration makes it possible to improve the measurement accuracy compared to a case in which the temperature of the susceptor 161 is measured on the basis solely of the voltage applied to the monitoring module 200.

[0073] An example has been described above in which the monitoring module 200 is configured to measure the temperature of the susceptor 161, but the present disclosure is not limited to such an example. The monitoring module 200 should monitor the state of the inhalation device 100, but the target of monitoring is not limited to the temperature of the susceptor 161.

[0074] As an example, the monitoring module 200 may monitor whether or not the stick-type substrate 150 is accommodated in the accommodating unit 140. Specifically, the control unit 116 may determine whether or not the stick-type substrate 150 is accommodated in the accommodating unit 140 on the basis of at least one of the voltage applied to the monitoring module 200 and the current flowing through the monitoring module 200. The inductance of the heating coil 162 when an AC voltage is applied to the heating coil 162 differs depending on whether or not the susceptor 161 is being inductively heated, i.e., whether or not a stick-type substrate 150 is accommodated in the accommodating unit 140. Accordingly, the voltage and current output from the monitoring module 200 when an AC voltage is applied to the heating coil 162 also differ depending on whether or not a stick-type substrate 150 is accommodated in the accommodating unit 140. Therefore, the control unit 116 may determine whether or not a stick-type substrate 150 is accommodated in the accommodating unit 140 on the basis of the voltage and current output from the monitoring module 200 when an AC voltage is applied to the heating coil 162.

[0075] As another example, the monitoring module 200 may monitor whether or not a fault has occurred in the inhalation device 100. Specifically, the control unit 116 may determine whether or not a fault has occurred in the inhalation device 100 on the basis of at least one of the voltage applied to the monitoring module 200 and the current flowing through the monitoring module 200. For example, the control unit 116 may determine that a fault has not occurred in the inhalation device 100 when the current and voltage output from the monitoring module 200 are within normal ranges, and may determine that a fault has occurred in the inhalation device 100 when the current and voltage are not within the normal ranges.

[0076] An example has been described above in which the winding direction of the monitoring coil 210 and the winding direction of the heating coil 162 are the same, but the present disclosure is not limited to such an example. The winding direction of the monitoring coil 210 and the winding direction of the heating coil 162 may be opposite to one another.

[0077] An example has been described above in which the windings of the monitoring coil 210 are arranged between the windings of the heating coil 162, but the

present disclosure is not limited to such an example. The windings of the monitoring coil 210 and the windings of the heating coil 162 may be arranged offset in the radial direction of the accommodating unit 140. As an example, the monitoring coil 210 may be disposed so as to surround the heating coil 162 from the outside. With this configuration, the monitoring coil 210 can be made less susceptible to the effects of heat from the susceptor 161. As a result, it is possible to suppress a deterioration in the measurement accuracy of the temperature of the susceptor 161 that would accompany an increase in the temperature of the monitoring coil 210. As another example, the monitoring coil 210 may be surrounded from the outside by the heating coil 162, that is, disposed between the heating coil 162 and the accommodating unit 140. Alternatively, the windings of the monitoring coil 210 and the windings of the heating coil 162 may be arranged offset in the axial direction of the accommodating unit 140 (i.e., in the insertion/removal direction of the stick-type substrate 150). For example, the heating coil 162 may be disposed on the opening 142 side of the accommodating unit 140 and the monitoring coil 210 may be disposed on the bottom portion 143 side of the accommodating unit 140.

[0078] In addition, the inhalation device 100 may further comprise a heat insulating member between the monitoring coil 210 and the heating coil 162. The heat insulating member is a member that blocks heat. For example, the heat insulating member may be made of a glass material, a vacuum heat insulating material, or an aerogel heat insulating material, for example. As an example, at least one of the windings of the monitoring coil 210 and the windings of the heating coil 162 may be coated with the heat insulating member. As another example, after one of the monitoring coil 210 or the heating coil 162 has been wrapped around the accommodating unit 140, the heat insulating member, configured in the form of a sheet, may be wrapped thereon, and the other of the monitoring coil 210 or the heating coil 162 may then be wrapped over the heat insulating member. With this configuration, the monitoring coil 210 can be made less susceptible to the effects of heat from the susceptor 161. As a result, it is possible to suppress a deterioration in the measurement accuracy of the temperature of the susceptor 161 that would accompany an increase in the temperature of the monitoring coil 210.

[0079] In the above embodiment, an example was described in which the monitoring module 200 includes the rectifier circuit 220, the smoothing circuit 230 and the voltage-dividing circuit 240, but the present disclosure is not limited to such an example. At least some of these components may be omitted from the monitoring module 200 as appropriate. For example, the monitoring module 200 does not need to include the smoothing circuit 230. In this case, the control unit 116 may perform the smoothing process using software.

[0080] In the above embodiment, an example was described in which the stick-type substrate 150 contains

the susceptor 161, but the present disclosure is not limited to such an example. The susceptor 161 may be provided in the inhalation device 100. As an example, the inhalation device 100 may have the susceptor 161 disposed outside the internal space 141. More specifically, the accommodating unit 140 may be made of a material that is electrically conductive and magnetic, and may function as the susceptor 161. The accommodating unit 140 serving as the susceptor 161 is in contact with the outer periphery of the substrate portion 151, and can therefore be in thermal proximity with the aerosol source contained in the substrate portion 151. As another example, the inhalation device 100 may have the susceptor 161 disposed inside the internal space 141. More specifically, the susceptor 161 configured in a blade-like shape may be disposed so as to protrude into the internal space 141 from the bottom portion 143 of the accommodating unit 140. When the stick-type substrate 150 is inserted into the internal space 141 of the accommodating unit 140, the blade-like susceptor 161 pierces the substrate portion 151 of the stick-type substrate 150 and is inserted into the inside of the stick-type substrate 150. This allows the blade-like susceptor 161 to be in thermal proximity with the aerosol source contained in the substrate portion 151. In this way, even if the susceptor 161 is provided in the inhalation device 100, the provision of the monitoring module 200 described in the above embodiment allows for accurate measurement of the temperature of the susceptor 161 without contact with the susceptor 161.

[0081] The inhalation device 100 described above is an example of an aerosol generation device, which is a device for generating an aerosol. The inhalation device 100 may be regarded as an aerosol generation system, which is a collection of various components for generating an aerosol. Furthermore, the combination of the inhalation device 100 and the stick-type substrate 150 may be regarded as an aerosol generation system.

[0082] It should be noted that the series of processes performed by each device described in the present description may be realized by using software, hardware, or any combination of software and hardware. Programs constituting the software are prestored on a recording medium (more specifically, a non-transitory computer-readable storage medium) provided internally or externally to each device, for example. Then, when the programs are executed, for example, by a computer for controlling each device described in the present description, the programs are read into a RAM and executed by means of a processing circuit such as a CPU. The recording medium is, for example, a magnetic disk, an optical disk, a magneto-optical disk, or a flash memory, etc. Furthermore, the computer programs may be distributed via a network, for example, without the use of a recording medium. Furthermore, the computer may be an application-specific integrated circuit such as ASIC, a general-purpose processor which executes functions by reading software programs, or a computer on a server

used for cloud computing, etc. Furthermore, the series of processes performed by each device described in the present description may be processed centrally by a single computer, or may be processed in a distributed manner by multiple computers. In addition, in the embodiments described above, two or more communication means present in a single device may be physically realized by a single medium.

[0083] Furthermore, the processing described using flowcharts or sequence diagrams in the present description need not necessarily be implemented in the order depicted. Some processing steps may be implemented in parallel. Furthermore, additional processing steps may be employed and some processing steps may be omitted.

[0084] The following configurations also fall within the technical scope of the present disclosure.

(1) An aerosol generation system for generating an aerosol, the aerosol generation system comprising:

an accommodating unit capable of accommodating a substrate including an aerosol source and a susceptor;
a heating coil for inductively heating the susceptor included in the substrate accommodated in the accommodating unit;
a monitoring module including a monitoring coil disposed in a position that is overlapped by a magnetic field generated by the heating coil; and
a control unit for determining a state of the aerosol generation system on the basis of a voltage across the monitoring module.

(2) The aerosol generation system as set forth in (1), wherein: the monitoring module further comprises a rectifier circuit that generates and outputs a DC voltage by rectifying an AC voltage output from the monitoring coil; and

the control unit determines the state of the aerosol generation system on the basis of the DC voltage output from the rectifier circuit.

(3) The aerosol generation system as set forth in (2), wherein the rectifier circuit is a full-wave rectifier circuit that performs full-wave rectification.

(4) The aerosol generation system as set forth in (2), wherein the rectifier circuit is a half-wave rectifier circuit that performs half-wave rectification.

(5) The aerosol generation system as set forth in any one of (2) to (4), wherein: the monitoring module further comprises a smoothing circuit for smoothing and outputting the DC voltage output from the rectifier circuit; and

the control unit determines the state of the aerosol generation system on the basis of the smoothed DC voltage output from the smoothing circuit.

(6) The aerosol generation system as set forth in (5), wherein: the monitoring module further comprises a

voltage-dividing circuit for dividing the smoothed DC voltage output from the smoothing circuit; and the control unit determines the state of the aerosol generation system on the basis of a divided DC voltage output from the voltage-dividing circuit.

(7) The aerosol generation system as set forth in any one of (1) to (6), wherein the control unit determines the state of the aerosol generation system additionally on the basis of a current flowing through the monitoring module.

(8) The aerosol generation system as set forth in any one of (1) to (7), wherein, as the determination of the state of the aerosol generation system, the control unit performs at least one of the following: determining the temperature of the susceptor; determining whether or not the substrate is accommodated in the accommodating unit, and determining whether or not a fault has occurred in the aerosol generation system.

(9) The aerosol generation system as set forth in any one of (1) to (8), wherein the inductance of the monitoring coil is less than the inductance of the heating coil.

(10) The aerosol generation system as set forth in (9), wherein the number of turns of the monitoring coil is less than the number of turns of the heating coil.

(11) The aerosol generation system as set forth in any one of (1) to (10), wherein the diameter of the monitoring coil windings is less than the diameter of the heating coil windings.

(12) The aerosol generation system as set forth in any one of (1) to (11), wherein the monitoring coil and the heating coil are arranged coaxially, and the windings of the monitoring coil are arranged between the windings of the heating coil.

(13) The aerosol generation system as set forth in any one of (1) to (11), wherein the monitoring coil and the heating coil are arranged coaxially, and the monitoring coil is disposed so as to surround the heating coil from the outside.

(14) The aerosol generation system as set forth in any one of (1) to (13), wherein the aerosol generation system further comprises a heat insulating member between the monitoring coil and the heating coil.

(15) The aerosol generation system as set forth in any one of (1) to (14), wherein the winding direction of the monitoring coil and the winding direction of the heating coil are the same.

REFERENCE SIGNS LIST

[0085]

100 Inhalation device
111 Power source unit
112 Sensor unit
113 Notification unit
114 Memory unit

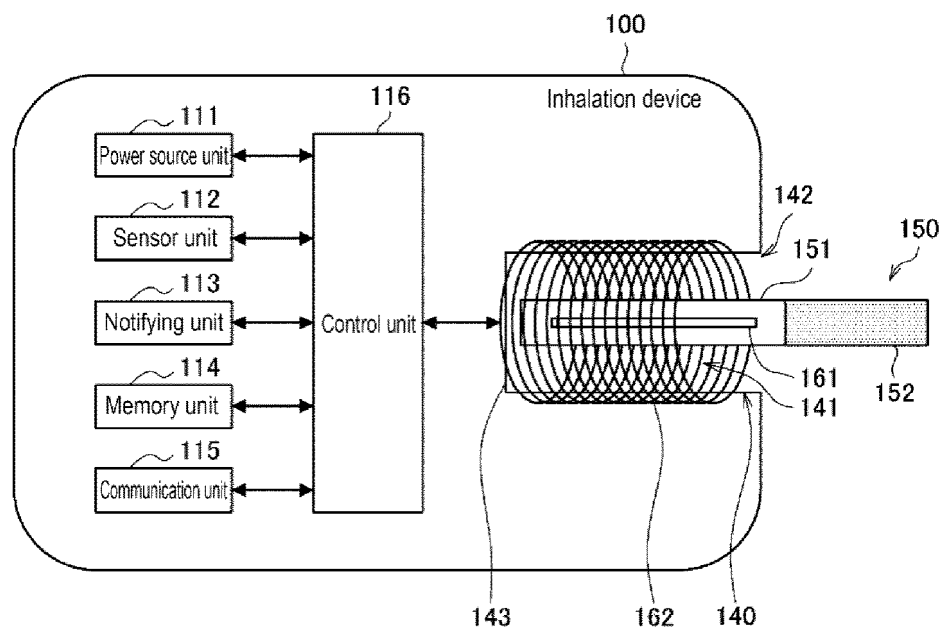
115 Communication unit
116 Control unit
140 Accommodating unit
141 Internal space
142 Opening
143 Bottom portion
150 Stick-type substrate
151 Substrate portion
152 Mouthpiece portion
161 Susceptor
162 Electromagnetic induction source (heating coil)
170 Inverter circuit
181 Capacitor
182 Capacitor
183 Capacitor
200 Monitoring module
210 Monitoring coil
220 Rectifier circuit
230 Smoothing circuit
240 Voltage-dividing circuit

Claims

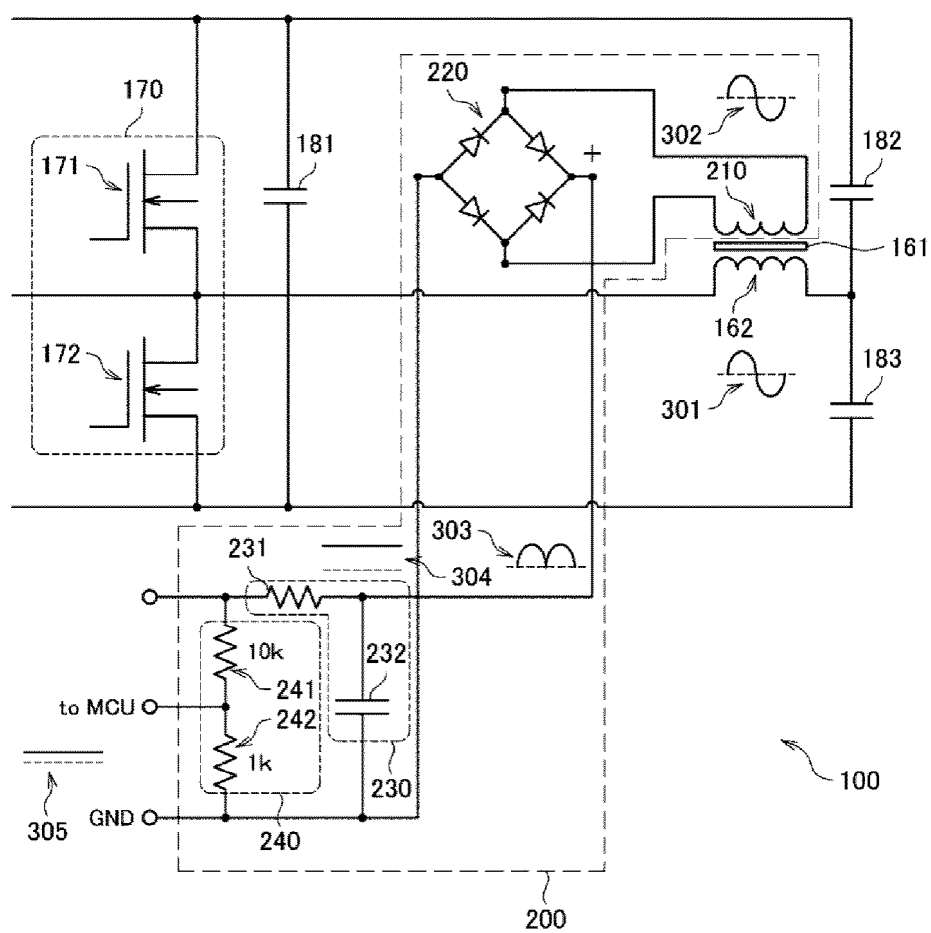
1. An aerosol generation system for generating an aerosol, the aerosol generation system comprising:
 - an accommodating unit capable of accommodating a substrate including an aerosol source and a susceptor;
 - a heating coil for inductively heating the susceptor included in the substrate accommodated in the accommodating unit;
 - a monitoring module including a monitoring coil disposed in a position that is overlapped by a magnetic field generated by the heating coil; and
 - a control unit for determining a state of the aerosol generation system on the basis of a voltage across the monitoring module.
2. The aerosol generation system as claimed in claim 1, wherein: the monitoring module further comprises a rectifier circuit that generates and outputs a DC voltage by rectifying an AC voltage output from the monitoring coil; and the control unit determines the state of the aerosol generation system on the basis of the DC voltage output from the rectifier circuit.
3. The aerosol generation system as claimed in claim 2, wherein the rectifier circuit is a full-wave rectifier circuit that performs full-wave rectification.
4. The aerosol generation system as claimed in claim 2, wherein the rectifier circuit is a half-wave rectifier circuit that performs half-wave rectification.
5. The aerosol generation system as claimed in any

- one of claims 2 to 4, wherein: the monitoring module further comprises a smoothing circuit for smoothing and outputting the DC voltage output from the rectifier circuit; and
the control unit determines the state of the aerosol generation system on the basis of the smoothed DC voltage output from the smoothing circuit. 5
6. The aerosol generation system as claimed in claim 5, wherein: the monitoring module further comprises a voltage-dividing circuit for dividing the smoothed DC voltage output from the smoothing circuit; and the control unit determines the state of the aerosol generation system on the basis of a divided DC voltage output from the voltage-dividing circuit. 10 15
7. The aerosol generation system as claimed in any one of claims 1 to 6, wherein the control unit determines the state of the aerosol generation system additionally on the basis of a current flowing through the monitoring module. 20
8. The aerosol generation system as claimed in any one of claims 1 to 7, wherein, as the determination of the state of the aerosol generation system, the control unit performs at least one of the following: determining the temperature of the susceptor; determining whether or not the substrate is accommodated in the accommodating unit, and determining whether or not a fault has occurred in the aerosol generation system. 25 30
9. The aerosol generation system as claimed in any one of claims 1 to 8, wherein the inductance of the monitoring coil is less than the inductance of the heating coil. 35
10. The aerosol generation system as claimed in claim 9, wherein the number of turns of the monitoring coil is less than the number of turns of the heating coil. 40
11. The aerosol generation system as claimed in any one of claims 1 to 10, wherein the diameter of the monitoring coil windings is less than the diameter of the heating coil windings. 45
12. The aerosol generation system as claimed in any one of claims 1 to 11, wherein the monitoring coil and the heating coil are arranged coaxially, and the windings of the monitoring coil are arranged between the windings of the heating coil. 50
13. The aerosol generation system as claimed in any one of claims 1 to 11, wherein the monitoring coil and the heating coil are arranged coaxially, and the monitoring coil is disposed so as to surround the heating coil from the outside. 55
14. The aerosol generation system as claimed in any one of claims 1 to 13, wherein the aerosol generation system further comprises a heat insulating member between the monitoring coil and the heating coil.
15. The aerosol generation system as claimed in any one of claims 1 to 14, wherein the winding direction of the monitoring coil and
the winding direction of the heating coil are the same.
The aerosol-generating system as claimed in any one of claims 1 to 14, further comprising the battery.

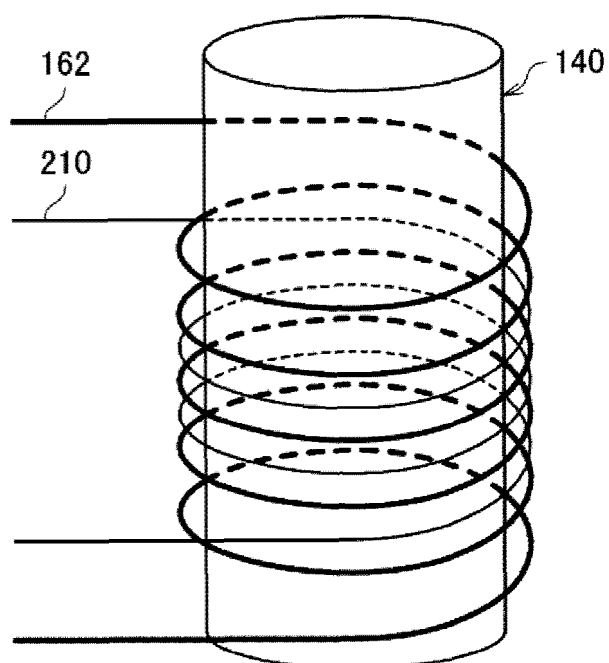
[Figure 1]



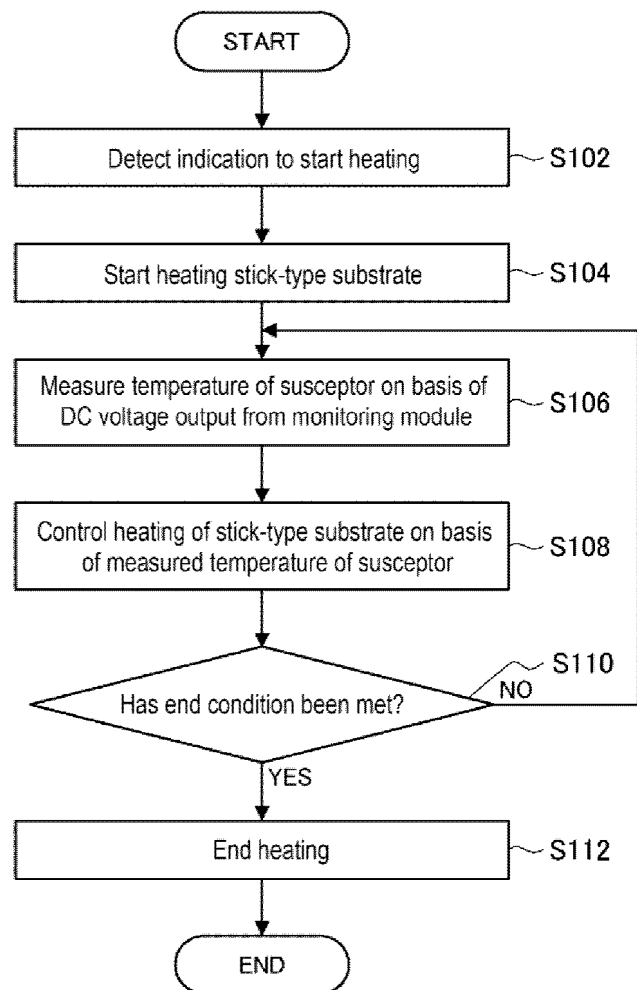
[Figure 2]



[Figure 3]



[Figure 4]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/014628

A. CLASSIFICATION OF SUBJECT MATTER

A24F 40/465(2020.01)i; H05B 6/06(2006.01)i
FI: A24F40/465; H05B6/06

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)

A24F40/465; H05B6/06

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 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	JP 2021-534792 A (NICOVENTURES TRADING LIMITED) 16 December 2021 (2021-12-16) paragraphs [0042], [0048], [0055]	1
Y		2-6, 8-12, 15
A		7, 13-14
X	CN 113907424 A (SHENZHEN MAISHI TECHNOLOGY CO., LTD.) 11 January 2022 (2022-01-11) paragraphs [0041]-[0044], fig. 1	1
Y		8-12, 15
A		7, 13-14
Y	JP 58-198890 A (FUTABA SANGYO KK) 18 November 1983 (1983-11-18) specification, page 2, upper left column, lines 15-16, page 2, upper right column, lines 5-11	2-6, 8-12, 15
A		7, 13-14

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

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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	

Date of the actual completion of the international search

30 May 2023

Date of mailing of the international search report

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Name and mailing address of the ISA/IP

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Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/014628

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A		7, 13-14
A	JP 2022-522594 A (KT&G CORPORATION) 20 April 2022 (2022-04-20) entire text, all drawings	1-15

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2023/014628

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