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(54) **CONTROL METHOD OF AN AEROSOL GENERATING DEVICE, AND ASSOCIATED CONTROL SYSTEM AND AEROSOL GENERATING SYSTEM**

(57) This invention relates to a method of control of supply power to the heating electrodes of an aerosol generating device comprising a heating space for receiving an electrically conductive aerosol generating pad (53) and two heating electrodes, opposite to each other so as to sandwich the heating space, wherein, the control method comprises: a step of performing a closed loop control, controlling the temperature (9) of the pad (53), based on measures of both voltage (U_{out}) and current (I_{out}) which are supplied to the heating electrodes, so as to heat the pad (53) to a temperature (9) which remains: sufficiently high so as to vapor the aerosol from the pad (53), sufficiently low so as to avoid combustion in the pad (53).

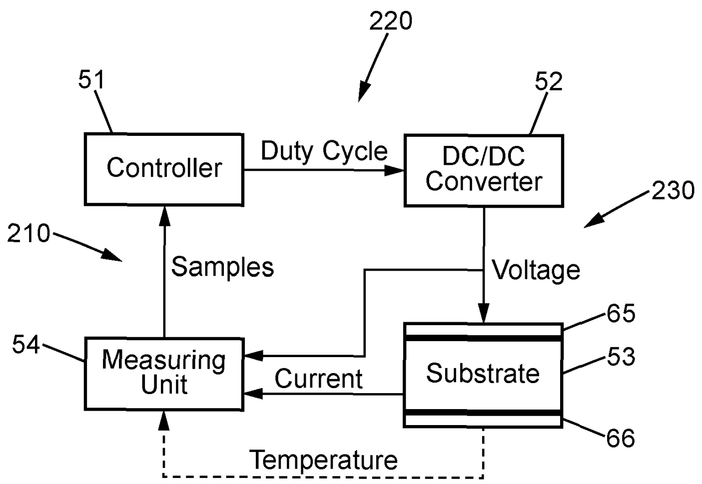

FIG. 3

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a control method for an aerosol generating device.

[0002] The invention also relates to a control system and an aerosol generating system associated to such a control method. Particularly, the control method according to the invention allows operation of an aerosol generating device to generate aerosol from an aerosol generating article.

BACKGROUND OF THE INVENTION

[0003] Some aerosol generating devices deliver an inhalable aerosol by supplying electrical power using electrodes that sandwich an aerosol generating article. In such a case, the aerosol generating article comprises a substrate formed of a mixture of tobacco material with charcoal or another conductive material which makes the substate electrically conductive. Electrical current is thus applied to the substrate through at least a pair of electrodes to directly heat the tobacco material contained therein to generate the inhalable aerosol. However, it has proven difficult so far to efficiently control power delivery to the electrically conductive substrate such that organoleptic properties of the tobacco material and aerosol generation capacity are not rapidly exhausted from the substrate due to excessive or permanent heating thereof due to inertia of the electrically conductive substrate and conductive material therein.

[0004] An aim of the present invention is to control efficiently aerosol generation in such type of aerosol generating devices.

SUMMARY OF THE INVENTION

[0005] Therefore, the present invention provides a control method of power supply of at least a pair of electrodes comprised in an aerosol generating device, the aerosol generating device further comprising a heating space for receiving an aerosol generating article, the electrodes being arranged opposite to each other to sandwich an electrically conductive substrate of the aerosol generating article when it is received in the heating space. The control method comprises performing of a closed loop control based on measurements of both voltage and current supplied to the electrodes, to produce aerosol from the electrically conductive substrate without combustion.

[0006] The control method according to the invention enables measurements of voltage and current passing through the electrically conductive substrate to control aerosol generation by the device. Particularly, the control method of the invention uses a closed loop control, based on feedback parameters which are voltage and current supplied to the electrically conductive substrate. Thus, temperature measurements in the substrate are no longer required to control operation of the device. Such temperature measurements in the substrate can be challenging in practice due to the need of providing temperature sensors arranged for measuring temperature of the aerosol generating substrate within the mass thereof, such as thermocouples for instance, or contactless temperature sensing arrangements to infer temperature in the aerosol generating substrate in a contactless fashion, which are not always accurate. The method according to the invention leads therefore to a resulting control which is more accurate than any existing method relying on substrate temperature measurements.

[0007] The closed loop control can perform a temperature control of the electrically conductive substrate, based on the measurements of voltage and current supplied to the electrodes. This is an indirect temperature control, since there is no need to measure the temperature of the electrically conductive substrate itself. This indirect temperature control is based on measuring and/or on assessing one or more parameters which are representative of this temperature while being different from this temperature. The temperature control of the electrically conductive substrate is performed by heating the electrically conductive substrate in such a way that the temperature of the electrically conductive substrate will simultaneously remain sufficiently high so as to generate the aerosol from the electrically conductive substrate, typically above 50°C, and sufficiently low so as to avoid combustion in the electrically conductive substrate, typically below 350°C.

[0008] Using the voltage and current measurements of the electrically conductive substrate over time, it is possible to determine a parameter such as its resistance, which is correlated with, thus representative of, its temperature. The control method according to the invention can thus be more accurate than a conventional method using only temperature measurements. Particularly, it is clear that the temperature measurements are necessarily related to the environment and not only to the substrate, whereas the voltage and current measurements can characterize accurately the substrate itself. Thus, a higher accuracy of control can be achieved.

[0009] Advantageously, the heating space is designed for receiving an aerosol generating article comprising a solid electrically conductive substrate. Thus, the substrate can be sandwiched between the electrodes . The electrodes being arranged opposite to each other form a gap which is substantially constant, whatever the state of the substrate (never consumed, half consumed or exhausted for example). Additionally, the electrodes remain in contact with the substrate, whatever the state of the substrate.

[0010] The dimensions of the electrodes may be adapted to operate efficiently with the electrically conductive substrate of an aerosol generating article. Particularly, the electrodes may cover at least 25%, advantageously 50%, preferably 75% and even more preferably 100%, of the surface area of the electrically conductive substrate of an aerosol generating article provided in the gap between the electrodes as measured in a plane parallel to electrodes contact surfaces with the aerosol generating article. The broader the contact surface between the electrodes and the aerosol generating article, the more efficient the current can be conducted through the substrate to heat it and generate an inhalable aerosol therefrom.

[0011] Preferred embodiments comprise one or more of the following features, which can be taken separately or in combination.

[0012] According to some embodiments, the closed loop control does not include any substrate temperature feedback component. Preferably, the closed loop control is performed only based on measurements of voltage and current supplied to the electrodes.

[0013] Hence, control of the aerosol generation can be performed using a feedback on voltage and current that is more efficient than using a direct feedback on temperature. This leads to a more stable and more accurate feedback control.

[0014] According to some embodiments, the closed loop control comprises an electrical power feedback based on measurements of voltage and current supplied to the electrodes.

[0015] The electrical power value can be determined from the voltage and current measurements by a controller or directly by a measuring unit.

[0016] Preferably, the power input in the closed loop ranges from 5W to 80W.

[0017] This range of power is large enough to cause aerosol generation by different types, shapes and/or compositions of electrically conductive substrates.

[0018] According to some embodiments, the closed loop control comprises feedback based on a resistance value of the electrically conductive substrate corresponding to a ratio of the measurements of voltage to the measurements of current.

[0019] The resistance value can be determined from the voltage and current measurements by a controller or directly by a measuring unit.

[0020] According to some embodiments, the voltage supplied to the electrodes is generated by a DC/DC converter controlled by a PWM duty cycle.

[0021] The pulse width modulation (PWM) method is particularly advantageous to control a DC/DC converter such as a buck converter.

[0022] According to some embodiments, the PWM duty cycle is determined from the measurements of voltage and current supplied to the electrodes.

[0023] Other parameters can also be used to determine the PWM duty cycle such as a target power and/or an input voltage, as well as parameters characterizing user settings, type and composition of the electrically conductive substrate, its shape, duration of a vaping session, etc.

[0024] According to some embodiments, the closed loop control is further based on temperature measurements of the electrically conductive substrate.

[0025] These measurements can be used to be then correlated with the calculated resistance of the electrically conductive substrate to further adjust the resistance value.

[0026] According to some embodiments, the temperature measurements are used independently from the closed loop control. The temperature measurements can for example be used to carry out a safety feature. For example, when the temperature exceeds a predetermined threshold, substrate combustion may occur. In this case, the power supply may be cut to avoid combustion.

[0027] It may be considered that combustion is avoided, if CO emissions after a vaping session is highly reduced in comparison with a classical RMC cigarette. For example, these CO emissions can be at least 80%, advantageously 90% and preferably 95% less than CO emissions for a RMC cigarette. For example, CO emissions are measured at 31 mg per portion from a cigarette of type 1R6F. These emissions are thus less than 6,2 mg, advantageously 3,1 mg and preferably 1,55 mg when the substrate is not combusted.

[0028] Another object of the present invention is to provide a power supply control system of an aerosol generating device comprising at least a pair of electrodes and a heating space for receiving an aerosol generating article, the electrodes being arranged opposite to each other to sandwich an electrically conductive substrate of the aerosol generating article when it is received in the heating space;

wherein the control system is configured to perform a closed loop control based on measurements of both voltage and current supplied to the electrodes, to produce aerosol from the electrically conductive substrate without combustion.

[0029] Another object of the present invention is to provide an aerosol generating system, comprising:

- an aerosol generating article comprising an electrically conductive substrate;
- an aerosol generating device comprising a heating space for receiving an aerosol generating article and a pair of electrodes arranged opposite to each other to sandwich the electrically conductive substrate of the aerosol generating article when it is received in the heating space;

wherein the aerosol generating device further comprises a control system as defined above.

[0030] According to some embodiments, the electrically conductive substrate has a parallelepiped shape and its dimensions are chosen within following ranges: length comprised between 10 and 30 mm, preferably between 15 and 25 mm, width comprised between 5 and 20 mm, preferably 10 and 15mm, thickness comprised between 0,25 and 3mm, preferably between 0,5 and 2 mm.

[0031] Thus, the electrically conductive substrate can form a flat shape which is particularly advantageous for a fast and efficient aerosol generation during the whole vaping session. Advantageously, the electrodes are arranged to be in direct or indirect contact with wide sides of the electrically conductive substrate.

[0032] According to some embodiments, the electrically conductive substrate of the aerosol generating article comprises tobacco. The tobacco can for example be compressed and mixed with any other material used to enhance vapor generation and/or taste such as water, glycerin, propylene glycol (PG), flavors, etc. The electrically conductive substrate further includes an electrically conductive material, such as charcoal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] Further features and advantages of the invention will appear from the following description of embodiments of the invention, given as non-limiting examples, with reference to the accompanying drawings listed hereunder.

Fig. 1 shows a schematic view of an aerosol generating system according to the invention, the aerosol generating system comprising an aerosol generating device;

Fig. 2 shows a schematic view of a control system integrated into the aerosol generating device of Fig. 1;

Fig. 3 shows a diagram explaining a control method according to the invention, the control method being carried out by the control system of Fig. 2;

Fig. 4 shows an exemplary process performed by the control system of Fig. 2 according to the control method;

Fig. 5 shows an example of relationship between temperature and resistance of an electrically conductive substrate over time; and

Fig. 6 shows an example of temperature control based on power applied to the electrically conductive substrate.

DETAILED DESCRIPTION OF THE INVENTION

[0034] Figure 1 shows schematically an example of an aerosol generating system 100 according to the invention. The aerosol generating system 100 comprises an aerosol generating device 70 and an aerosol generating article 50 configured to operate with the aerosol generating device 70.

[0035] The aerosol generating device 70 comprises a heating space 62 for receiving at least a part of the aerosol generating article 50, and a first and a second electrodes 65, 66 arranged opposite to each other to sandwich the received part of the aerosol generating article 50 inside the heating space 62. The heating space 62 defines a cavity delimited by opposite lateral walls 63, 64 and a bottom wall 69. The electrodes 65, 66 form at least partially the opposite lateral walls 63, 64 of the cavity. The heating space 62 is for example configured to receive the aerosol generating article 50 inserted along a direction parallel to the electrodes 65, 66, through an opening opposite to the bottom wall 69.

[0036] The aerosol generating device 70 further comprises a control system 49 configured to control power supply to the electrodes 65, 66 according to a control method explained in further details below. Particularly, the control system 49 connects electrically the electrodes 65, 66 to a power source such as a battery (not shown) and controls voltage applied to these electrodes 65, 66 as it will be explained in further details below.

[0037] As shown in Figure 1, the aerosol generating article 50 comprises an electrically conductive substrate 53 designed to be received in the heating space 62 and sandwiched between the electrodes 65, 66 as explained above. In some embodiments, the aerosol generating article 50 can further comprise a mouthpiece part extending the electrically conductive substrate 53 and designed to be in contact with a user's mouth during a vaping session or received inside a separate mouthpiece. In the latter case, the mouthpiece can be provided with the aerosol generating device 70. The mouthpiece part of the aerosol generating article 50 can for example comprise filtering and/or cooling means configured to filter and/or cool aerosol produced from the electrically conductive substrate 53. The aerosol generating article 50 may further comprise a wrapper wrapping the electrically conductive substrate 53 together with the mouthpiece part. In the embodiments where the aerosol generating article 50 is provided without the mouthpiece part, a wrapper may wrap only the electrically conductive substrate 53. In any case, the wrapper may be at least partially made from an electrically conductive material, such as aluminum or carbon sheet, to allow conduction of electrical current between the electrodes 65, 66 through the electrically conductive substrate 53.

[0038] The electrically conductive substrate 53 is for example flat-shaped. For example, it may have a cuboid or parallelepiped shape having a thickness (dimension intending to extend between the electrodes 65, 66) at least 5 times, advantageously 10 times smaller than its length (dimension intending to extend along the insertion direction into the heating space 62) and its width. In this case, the dimensions of the electrically conductive substrate 53 may be within the following ranges: length comprised between 15 mm and 20 mm, for example 18mm, width comprised between 10 mm and 15 mm, for example 12mm, thickness comprised between 0,5 mm and 3 mm, for example 1 mm.

[0039] The electrically conductive substrate 53 comprises a vaporizable material mixed with an electrically conductive material, such as charcoal, to conduct electrical current and heat the vaporizable material to form aerosol. The vaporizable material may comprise tobacco, for example compressed tobacco, and may further comprise any other material used to enhance vapor generation and/or taste such as water, glycerin, PG, flavors, etc. These elements can be bonded together by one or several binders. Advantageously, the proportion of the elements composing the electrically conductive substrate 53 is adapted to ensure aerosol generation through conduction of an electrical current through the substrate 53 by means of the electrodes and the electrically conductive material contained in the electrically conductive substrate. As an example, the proportion of the above-cited elements can be comprised withing the following ranges:

TOBACCO	between 20% and 30%
WATER	between 25% and 35%
GLYCERIN	between 10% and 20%
CHARCOAL	between 10% and 20%
PG	between 5% and 15%
BINDER	between 0,5% and 1,5%

[0040] In a general case, the composition of the electrically conductive substrate 53 may be determined according to any one of the examples disclosed in WO 2022189452 A1.

[0041] In reference to Figure 2, the control system 49 comprises a controller 51, a DC/DC converter 52 and a measuring unit 54. The DC/DC converter 52 is configured to supply the electrodes 65, 66 with electrical power delivered by the battery, according to commands provided by the controller 51. For example, the DC/DC converter 52 is a buck converter designed to be controlled over a PWM (PWM = pulse width modulation) duty cycle generated by the controller 51. The DC/DC converter 52 can be implemented at least partially or entirely by software. The measuring unit 54 is configured to measure current and voltage passing through the electrically conductive substrate 53 and to provide these measurements to the controller 51. The measuring unit 54 may comprise for this purpose voltage and current sensors arranged in contact with the electrically conductive substrate 53. According to another embodiment, the sensors are arranged in contact with the electrodes 65, 66. According to a particular embodiment, the measuring unit 54 further comprises a temperature sensor arranged adjacent to the electrically conductive substrate 53 and able to provide the controller 51 with temperature measurements representing an average temperature of the electrically conductive substrate 53. The controller 51 is for example a microcontroller configured to process the measurements provided by measuring unit 54 to generate commands to the DC/DC convertor 52. As mentioned above, these commands may correspond to a PWM duty cycle. The controller 51 may also carry out other functionalities of the aerosol generating device 70 such as setting user options, monitoring and charging of the battery, etc.

[0042] The control method carried out by the control system 49 is explained below in reference to Figure 3. The control method is intended to control power supply to the electrodes 65, 66 to allow internal heating of the electrically conductive substrate 53 through conduction of an electrical current by means of the electrically conductive material contained therein and between the electrodes. The generated heat causes aerosol generation by the electrically conductive substrate 53 without combusting it. For this purpose, the control method performs a closed loop control based on measurements of both voltage U_{out} and current I_{out} supplied to the electrodes 65, 66.

[0043] Particularly, during step 210, the measuring unit 54 provides to the controller 51 measurements of voltage U_{out} and current I_{out} supplied to the electrodes 65, 66. These measurements can be determined further to one or several samplings. According to some embodiments, the number of samplings can be adapted based on the type of the vaporizable material and/or conductive material used in the substrate 53, and/or size and shape of the substrate 53. In some embodiments, the number of samplings is defined by the controller 51. In the further description, the measurements of voltage U_{out} and current I_{out} used for further processing are denoted as feedback current I_{t-1} and feedback voltage U_{t-1}. In case of several samplings, each feedback value can for example be determined as an averaged value of the corresponding samplings.

[0044] During step 220, the controller 51 determines a PWM duty cycle for controlling the DC/DC converter 52, using the feedback current I_{t-1} and feedback voltage U_{t-1}, as well as a target power P_{set} and an input voltage U_{in}. The input voltage U_{in} corresponds to the voltage provided by the battery. The target power P_{set} can correspond to a predetermined value which is memorized by the controller 51. According to another embodiment, the target power P_{set} is determined by the controller 51 once or before each vaping session or during a vaping session. This target power P_{set} can be determined based on various parameters, as for example user settings, type and composition of the electrically conductive substrate 53, its shape, duration of a vaping session, etc.

[0045] According to an embodiment, the PWM duty cycle D is determined by the controller 51 using the following expression:

$$D = \frac{\sqrt{P_{set}\, R_{t-1}}}{U_{in}}$$

where R_{t-1} is a feedback resistance determined from the feedback current I_{t-1} and the feedback voltage U_{t-1} as

$R_{t-1} = U_{t-1} / I_{t-1}$.

[0046] According to another embodiment, a more complex process can be used by the controller 51 to determine the PWM duty cycle. Such a process in schematically shown in Figure 4.

[0047] Referring to this Figure 4, the controller 51 determines first a feedback power value P_{t-1} by multiplying the feedback current I_{t-1} with the feedback voltage U_{t-1}, and an entrance power P_e by subtracting the feedback power value P_{t-1} from the target power P_{set}. Then, the controller 51 performs a summing process where a monitored power Pt is obtained from the entrance power P_e and a plurality of parameters KI. The parameters KI are coefficient of the integral part and can be set to constant values. For example, all parameters KI can be set to a same constant value, for example 0,5. Then, the controller 51 uses both monitored power Pt and feedback resistance R_{t-1} to determine the PWM duty cycle D. Particularly, as shown in Figure 4, other voltage values representing voltage through some components of the control system 49 can be used for this purpose.

[0048] According to a particular embodiment, the feedback resistance R_{t-1} is correlated with temperature measurements acquired by the measuring unit 54. In this case, a more accurate value characterizing the resistance of the electrically conductive substrate 53 can be obtained. The correlation can be performed using for example a relationship between the resistance of the electrically conductive substrate 53 and its temperature. Such a relationship can for example be determined empirically.

[0049] According to another embodiment, the temperature measurements are used independently from the closed loop control. The temperature measurements can for example be used to carry out a safety feature.

[0050] Figure 5 shows an example of a relationship between the resistance of the electrically conductive substrate 53 and its temperature. According to this example, the measured temperature, expressed in Celsius degrees, is plotted as a function of time in seconds, by the curve 40, and the resistance of the electrically conductive substrate 53, expressed in ohms, is plotted as a function of time in seconds, by the curve 41. Thus, it can be observed that the resistance can be derived from the substrate temperature.

[0051] At the end of step 220, the controller 51 sends the PWM duty cycle D to the DC/DC converter 52.

[0052] During step 230, the DC/DC converter 52 generates an output voltage U_{out} on the electrodes 65, 66, using the du the PWM duty cycle D and the input voltage U_{in}. The output voltage U_{out} is applied on the electrically conductive substrate 53. Thus, the temperature of the electrically conductive substrate 53 can be controlled to generate aerosol without combusting the electrically conductive substrate 53.

[0053] Figure 6 shows an example of temperature control based on power applied over time on the electrodes 65, 66. The temperature, expressed in Celsius degrees, is plotted as a function of time in seconds, by the curve 30, and the power, expressed in watts, is plotted as a function of time in seconds, by the curve 31 for the target power and by the curve 32 for the effectively measured power. The power can be controlled by setting a desired set point, via the curve 31. The control system 49 will then try to follow this curve 31 as well as possible, as is shown by the curve 32. As a result, the temperature θ will change in a fairly integral way:

$$\theta(t) = f(\int P\, dt).$$

Claims

1. A control method of power supply of at least a pair of electrodes (65, 66) comprised in an aerosol generating device (70), the aerosol generating device further comprising a heating space (62) for receiving an aerosol generating article (50), the electrodes (65, 66) being arranged opposite to each other to sandwich an electrically conductive substrate (53) of the aerosol generating article (50) when it is received in the heating space (62);
wherein the control method comprises performing of a closed loop control based on measurements of both voltage (U_{out}) and current (I_{out}) supplied to the electrodes (65, 66), to produce aerosol from the electrically conductive substrate (53) without combustion.

2. The control method according to claim 1, wherein the closed loop control comprises determining a parameter representative of a temperature of the electrically conductive substrate (53), based on the measurements of voltage (U_{out}) and current (I_{out}) supplied to the electrodes (65, 66).

3. The control method according to claim 1 or 2, wherein the closed loop control comprises an electrical power (Pt-1) feedback based on measurements of voltage (Uout) and current (Iout) supplied to the electrodes (65, 66).

4. The control method according to any of the preceding claims, wherein a power (Pt) input in the closed loop ranges from 5W to 80W.

5. The control method according to any of the preceding claims, wherein the closed loop control comprises feedback based on a resistance value (R_{t-1}) of the electrically conductive substrate (53) corresponding to a ratio of the measurements of voltage (U_{out}) to the measurements of current (I_{out}).

6. The control method according to any of preceding claims, wherein the voltage (U_{out}) supplied to the electrodes (65, 66) is generated by a DC/DC con-

verter (52) controlled by a PWM duty cycle.

7. The control method according to claim 6, wherein the PWM duty cycle is determined from the measurements of voltage (U_{out}) and current (I_{out}) supplied to the electrodes (65, 66).

8. The control method according to any of preceding claims, wherein the closed loop control is further based on temperature measurements of the electrically conductive substrate (53).

9. A power supply control system (49) of an aerosol generating device (70) comprising at least a pair of electrodes (65, 66) and a heating space (62) for receiving an aerosol generating article (50), the electrodes (65, 66) being arranged opposite to each other to sandwich an electrically conductive substrate (53) of the aerosol generating article (50) when it is received in the heating space (62);
wherein the control system (49) is configured to perform a closed loop control based on measurements of both voltage (U_{out}) and current (I_{out}) supplied to the electrodes (65, 66), to produce aerosol from the electrically conductive substrate (53) without combustion.

10. An aerosol generating system (100) comprising:

- an aerosol generating article (50) comprising an electrically conductive substrate (53);
- an aerosol generating device (70) comprising a heating space (62) for receiving an aerosol generating article (50) and a pair of electrodes (65, 66) arranged opposite to each other to sandwich the electrically conductive substrate (53) of the aerosol generating article (50) when it is received in the heating space (62);

wherein the aerosol generating device (70) further comprises a control system (49) according to claim 9.

11. The aerosol generating system (100) according to claim 10, wherein the electrically conductive substrate (53) of the aerosol generating article (50) has a cuboid shape and its dimensions are chosen within the following ranges:

o length comprised between 10 and 30 mm, preferably between 15 and 25 mm,
o width comprised between 5 and 20mm, preferably 10 and 15mm,
o thickness comprised between 0,25 and 3mm, preferably between 0,5 and 2mm.

12. The aerosol generating system (100) according to claim 11, wherein the electrically conductive substrate (53) of the aerosol generating article (52) comprises tobacco and an electrically conductive material.

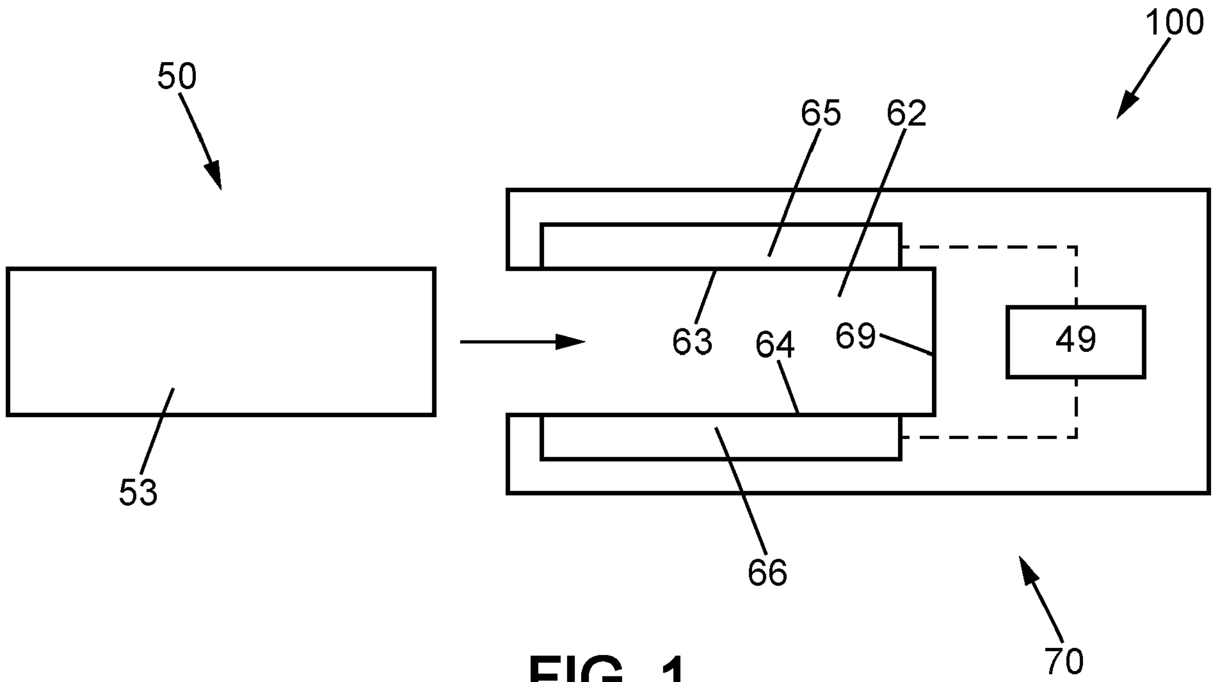


FIG. 1

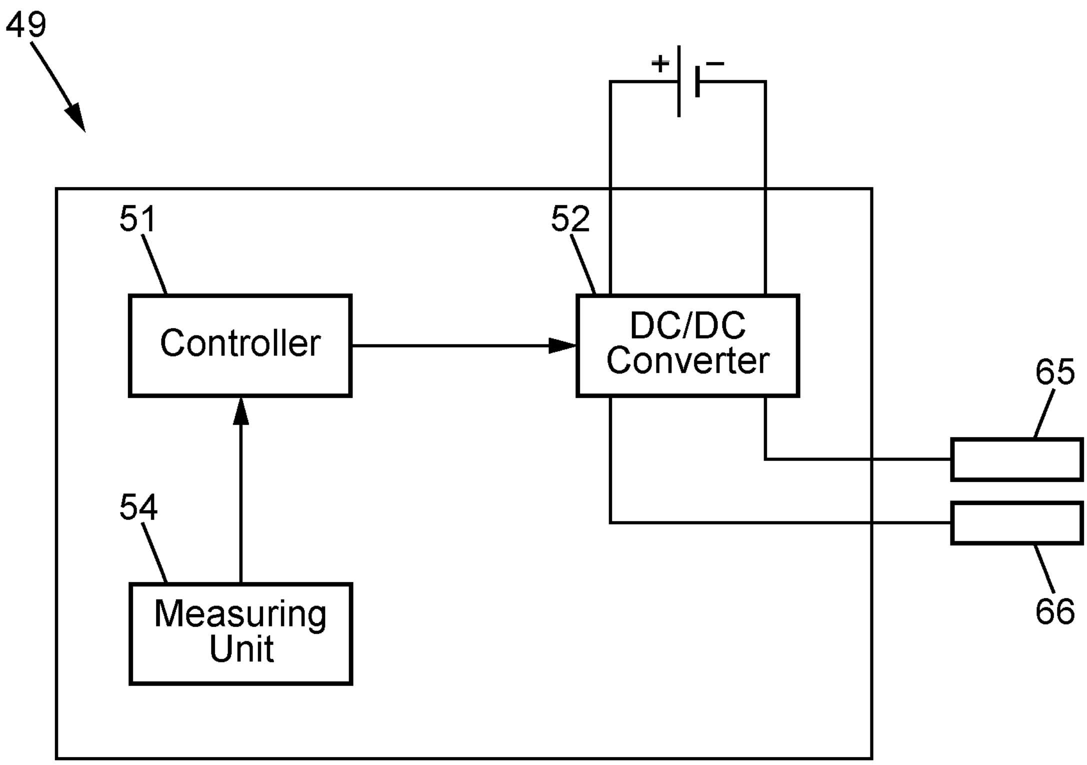
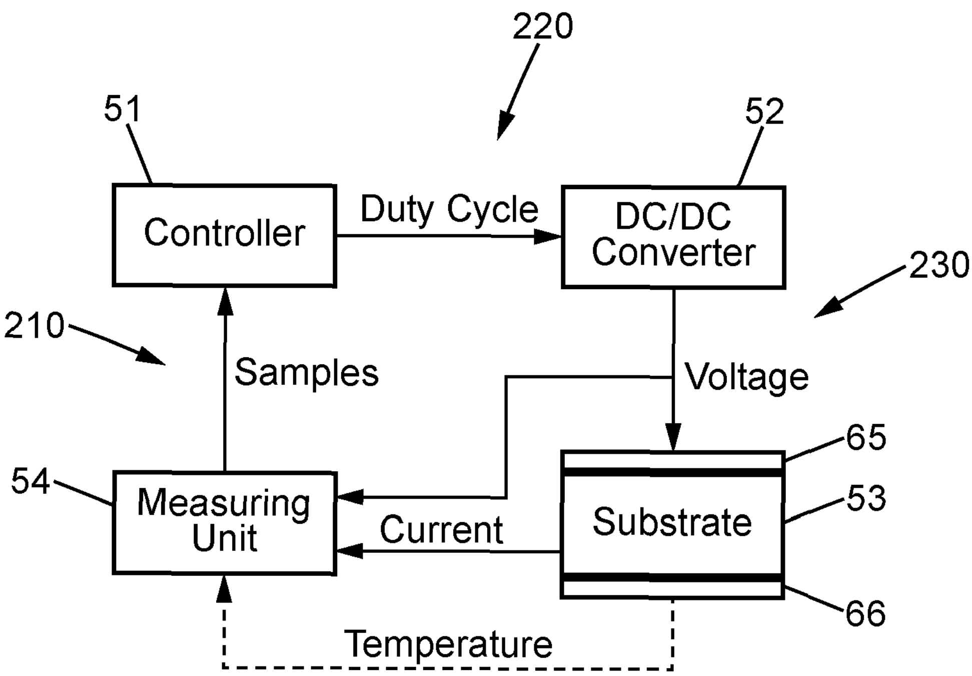


FIG. 2


220
51
52
Controller
Duty Cycle
DC/DC Converter
230
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Samples
Voltage
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54
Measuring Unit
Substrate
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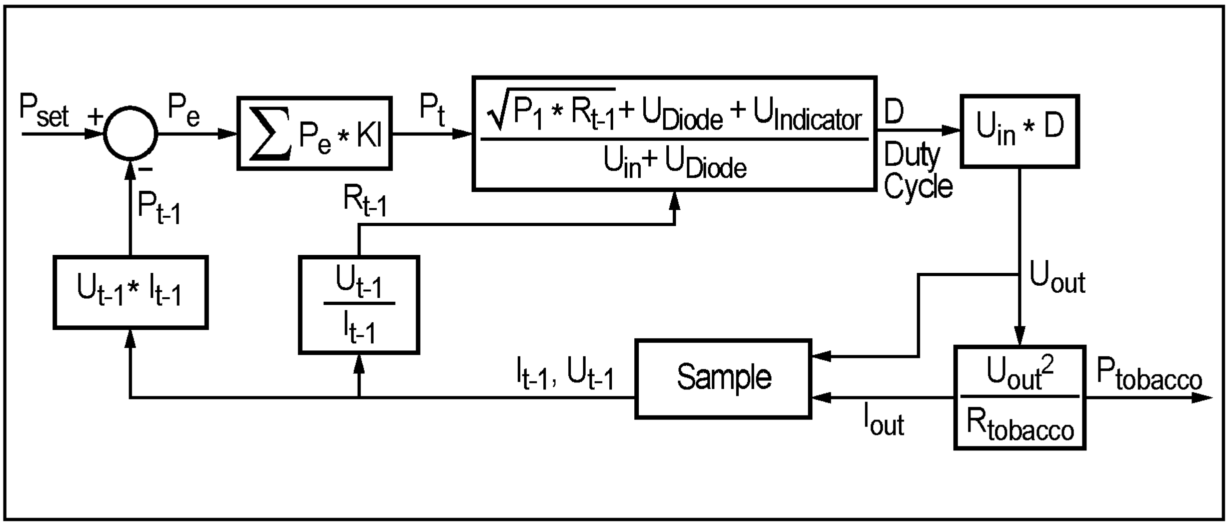
Current
66
Temperature

FIG. 3



P_{set}
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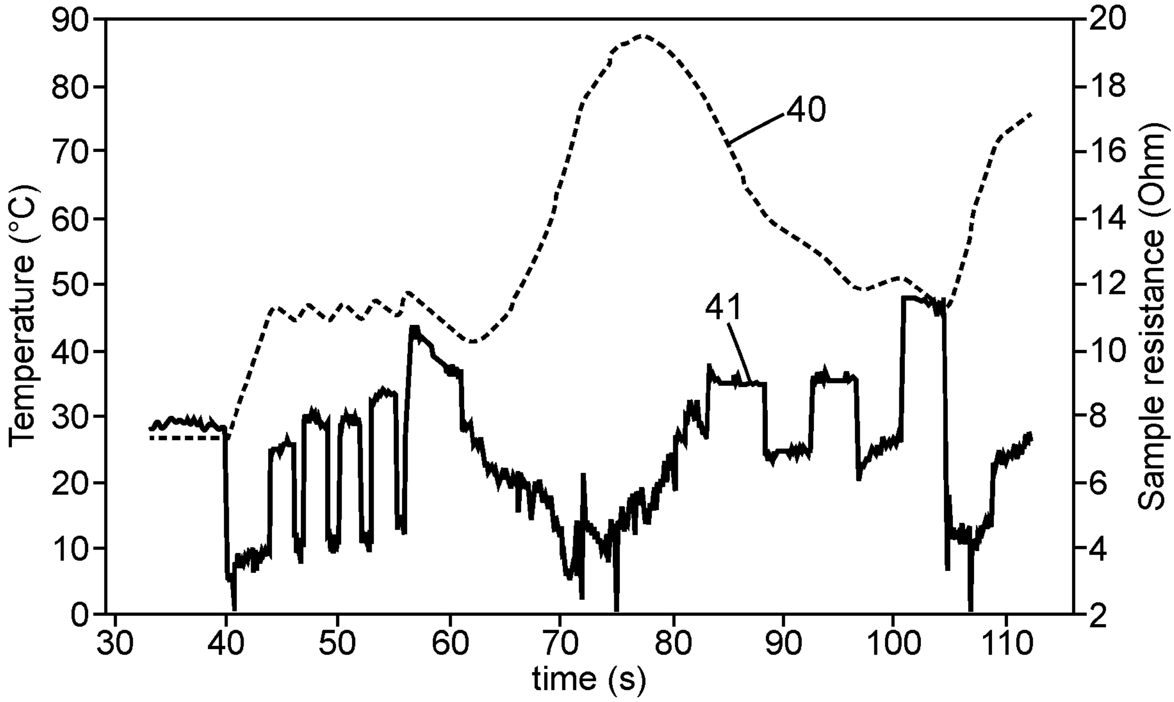
−
P_e
$\sum P_e * KI$
P_t
$\frac{\sqrt{P_1 * R_{t-1}} + U_{Diode} + U_{Indicator}}{U_{in} + U_{Diode}}$
D
Duty Cycle
$U_{in} * D$
P_{t-1}
R_{t-1}
$U_{t-1} * I_{t-1}$
$\frac{U_{t-1}}{I_{t-1}}$
U_{out}
I_{t-1}, U_{t-1}
Sample
I_{out}
$\frac{U_{out}^2}{R_{tobacco}}$
$P_{tobacco}$

FIG. 4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18
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Sample resistance (Ohm)
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90
100
110
time (s)
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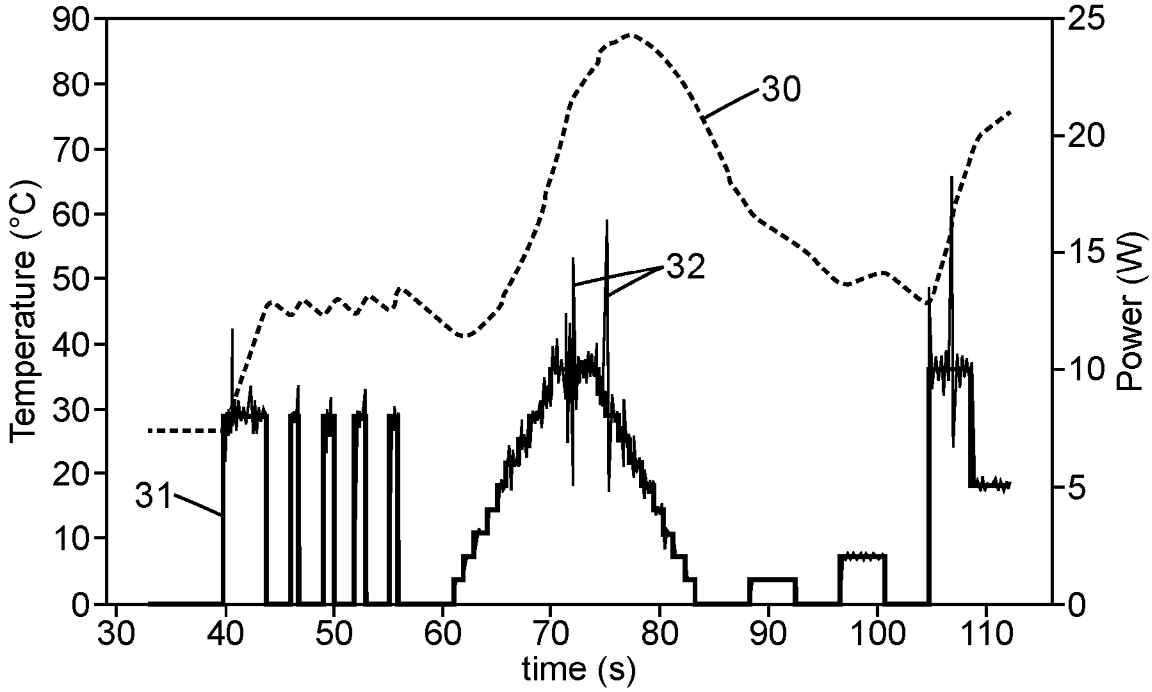
FIG. 5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time (s)
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31
32

FIG. 6

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 20 7142

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	WO 2018/202403 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 8 November 2018 (2018-11-08) * page 11, line 4 - page 12, line 21; figures 1,2 * * page 4, line 1 - line 6 * -----	9 1-8, 10-12	INV. A24F40/57 A24F40/46 ADD. A24F40/20 A24D1/20 A61M15/06
X Y	CA 3 103 713 A1 (JUUL LABS INC [US]) 23 April 2020 (2020-04-23) * paragraph [0080] - paragraph [0088]; figure 2 * -----	9 1-8, 10-12	
Y,D A	WO 2022/189452 A1 (JT INT SA [CH]) 15 September 2022 (2022-09-15) * page 12, line 8 - page 15, line 10; figures 1-2 * -----	1-8, 10-12 9	

TECHNICAL FIELDS SEARCHED (IPC)

A24F
A24D
A61M

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	20 April 2023	Dobbs, Harvey

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