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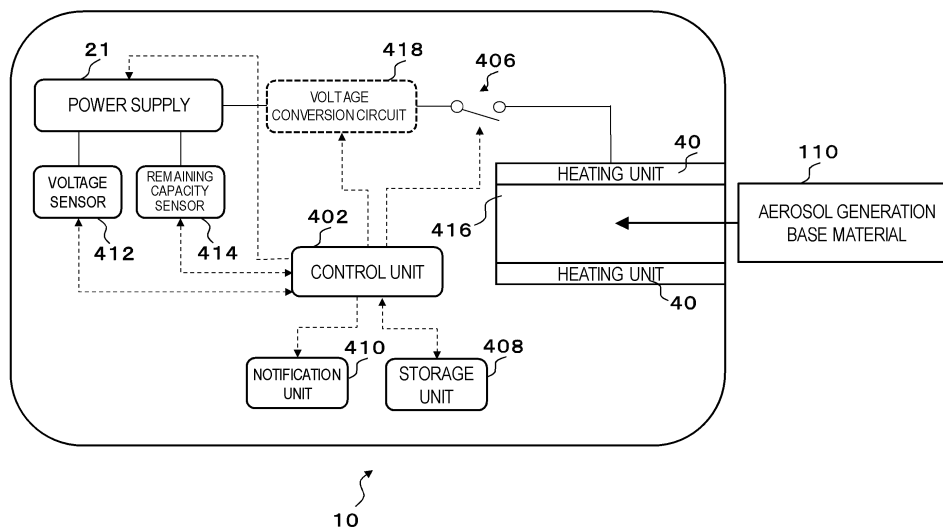
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(54) **ELECTRONIC DEVICE AND METHOD AND PROGRAM FOR OPERATING ELECTRONIC DEVICE**

(57) The present invention provides technology for improving decreases in user experience that can occur when the power supply of an electronic device such as an aerosol generation device is not sufficiently charged. An electronic device 10 according to an embodiment of the present invention is provided with a control unit 402 and a heating unit 40 that heats an aerosol generation

base material 110 by power supplied from a power supply 21. The control unit 402 is configured so that power is not supplied from the power supply 21 to the heating unit 40 when the voltage of the power supply 21 is less than a threshold voltage indicating that there is sufficient capacity remaining in the power supply 21 to use up one piece of unused aerosol generation base material 110.

Fig. 4A



## Description

### TECHNICAL FIELD

**[0001]** The present disclosure relates to an electronic device, and a method and a program for operating the electronic device. More specifically, the present disclosure relates to an electronic device for generating aerosol by heating an aerosol generation base material, a method of operating the electronic device, and a program for causing a processor to execute the method.

### BACKGROUND ART

**[0002]** PTL 1 discloses technology in which in an electrically heated smoking system including a primary power supply, and a secondary unit configured to receive and heat a smoking article, and generate aerosol, charging is performed from the primary power supply to a power supply of the secondary unit when the secondary unit is connected to the primary power supply, so that the power supply of the secondary unit has a sufficient capacity to smoke one smoking article.

**[0003]** However, PTL 1 does not disclose a problem of a decrease in user experience that may be encountered during smoking using the secondary unit that is not sufficiently charged, and technology that may solve such a problem.

### CITATION LIST

### PATENT LITERATURE

**[0004]** PTL 1: European Patent No. 2640205

### SUMMARY OF INVENTION

### TECHNICAL PROBLEM

**[0005]** The present disclosure has an object to provide technology for ameliorating a decrease in user experience that may be encountered when a power supply of an electronic device such as an aerosol generating device is not sufficiently charged.

### SOLUTION TO PROBLEM

**[0006]** According to an embodiment of the present disclosure, there is provided an electronic device including a control unit, and a heating unit that heats an aerosol generation base material with power supplied from a power supply. The control unit is configured so that the power is not supplied from the power supply to the heating unit when a voltage of the power supply is less than a threshold voltage indicating that a sufficient capacity to use up one unused aerosol generation base material remains in the power supply.

**[0007]** In an embodiment, the control unit is configured

to measure a voltage of the power supply during a duration of one voltage pulse generated separately from a voltage pulse for supplying the power from the power supply to the heating unit.

**[0008]** In an embodiment, the control unit is configured to measure the voltage of the power supply during the duration of first one voltage pulse among voltage pulses for supplying the power from the power supply to the heating unit.

**[0009]** In an embodiment, a width of the one voltage pulse is 100 ms or less.

**[0010]** In an embodiment, the one voltage pulse passes through the same path as a path used for supplying the power from the power supply to the heating unit.

**[0011]** In an embodiment, the heating unit has a shape such that the aerosol generation base material is heated from surroundings.

**[0012]** In an embodiment, the electronic device further includes a recess capable of receiving the aerosol generation base material.

**[0013]** In an embodiment, the electronic device further includes a switching element provided between the power supply and the heating unit. The control unit is configured to switch the switching element to an off state when supply of the power from the power supply to the heating unit is stopped.

**[0014]** In an embodiment, the control unit is configured to generate a signal for issuing notice to a user when the voltage of the power supply is less than the threshold voltage.

**[0015]** In an embodiment, the threshold voltage is set to change depending to a remaining capacity of the power supply.

**[0016]** In an embodiment, when the remaining capacity of the power supply is equal to or greater than a predetermined value, the threshold voltage is a first value, and when the remaining capacity of the power supply is less than the predetermined value, the threshold voltage is a second value greater than the first value.

**[0017]** In an embodiment, the first value is a stable operation voltage of a step-up DC/DC converter.

**[0018]** In an embodiment, the electronic device further includes the power supply.

**[0019]** In addition, according to an embodiment of the present disclosure, there is provided a method of operating an electronic device, the method including a step of heating an aerosol generation base material with power supplied from a power supply. The power is not supplied from the power supply for the heating when a voltage of the power supply is less than a threshold voltage indicating that a sufficient capacity to use up one unused aerosol generation base material remains in the power supply.

**[0020]** According to an embodiment of the present disclosure, there is provided a program which, when being executed by a processor, causes the processor to perform the above-described method.

## ADVANTAGEOUS EFFECTS OF INVENTION

**[0021]** According to an embodiment of the present disclosure, there can be provided technology for ameliorating a decrease in user experience that may be encountered when a power supply of an electronic device such as an aerosol generating device is not sufficiently charged.

## BRIEF DESCRIPTION OF DRAWINGS

**[0022]**

[Fig. 1A] Fig. 1A is an overall perspective view of an electronic device according to an embodiment of the present disclosure.

[Fig. 1B] Fig. 1B is an overall perspective view of the electronic device in a state where an aerosol generation base material is held, according to an embodiment of the present disclosure.

[Fig. 2] Fig. 2 is a cross-sectional view of a smoking article.

[Fig. 3] Fig. 3 is a cross-sectional view taken along line 3-3 illustrated in Fig. 1A.

[Fig. 4A] Fig. 4A is a block diagram schematically illustrating a configuration of the electronic device according to an embodiment of the present disclosure.

[Fig. 4B] Fig. 4B is a block diagram illustrating how a voltage of a power supply is measured in the electronic device according to the embodiment of Fig. 4A.

[Fig. 4C] Fig. 4C is a block diagram illustrating how the voltage of the power supply is measured in the electronic device according to the embodiment of Fig. 4A.

[Fig. 5] Fig. 5 is a flowchart illustrating an operation method of the electronic device according to an embodiment of the present disclosure.

[Fig. 6] Fig. 6 is a flowchart illustrating an operation method of the electronic device according to an embodiment of the present disclosure.

[Fig. 7A] Fig. 7A is a state transition diagram schematically illustrating transitions among a plurality of states that can be made by the electronic device according to an embodiment of the present disclosure.

[Fig. 7B] Fig. 7B is a state transition diagram schematically illustrating details of a normal state, an abnormal state, a charging state, and a heating state, and an example of transitions among a plurality of states.

[Fig. 7C] Fig. 7C is a state transition diagram schematically illustrating details of a normal state, an abnormal state, a charging state, and a smoking-disabled state, and an example of transitions among a plurality of states. DESCRIPTION OF EMBODIMENTS

sure will be described in detail with reference to the drawings.

**[0024]** Fig. 1A is an overall perspective view of an electronic device according to an embodiment of the present disclosure. Fig. 1B is an overall perspective view of the electronic device in a state where an aerosol generation base material is held, according to an embodiment of the present disclosure. In the present embodiment, an electronic device 10 is configured to generate aerosol containing flavor by heating the aerosol generation base material such as a smoking article that has a flavor generation base material such as a filler including an aerosol source and a flavor source, for example. Hereinafter, in the embodiment related to Figs. 1A to 3, a smoking article 110 is used as the aerosol generation base material.

**[0025]** As will be understood by those skilled in the art, the smoking article 110 is merely an example of the aerosol generation base material. The aerosol source included in the aerosol generation base material may be solid or liquid. The aerosol source may be liquid, for example, polyhydric alcohols such as glycerin or propylene glycol, or water. The aerosol source may contain a tobacco raw material or an extract derived from the tobacco raw material, which releases a smoking flavor component when it is heated. When the electronic device 10 is a medical inhaler such as a nebulizer, the aerosol source may contain a drug to be inhaled by a patient. Depending on the intended use, the aerosol generation base material does not necessarily include the flavor source.

**[0026]** As illustrated in Figs. 1A and 1B, the electronic device 10 includes a top housing 11A, a bottom housing 11B, a cover 12, a switch 13, and a lid 14. The top housing 11A and the bottom housing 11B are connected to each other, to form an outermost housing 11 of the electronic device 10. The housing 11 may be sized to fit into a user's hand. In this case, when the user uses the electronic device 10, the user can hold the electronic device 10 in the hand and suck the aerosol.

**[0027]** The top housing 11A has an opening (not illustrated), and the cover 12 is joined to the top housing 11A to close the opening. As illustrated in Fig. 1B, the cover 12 has an opening 12a through which the smoking article 110 can be inserted.

**[0028]** The lid 14 is configured to open and close the opening 12a of the cover 12. Specifically, the lid 14 is attached to the cover 12, and is configured to be movable along a surface of the cover 12 between a first position where the opening 12a is closed and a second position where the opening 12a is opened.

**[0029]** The switch 13 is used to switch on and off the operation of the electronic device 10. For example, when the user operates the switch 13 in a state where the smoking article 110 is inserted into the opening 12a as illustrated in Fig. 1B, power is supplied to a heating unit (not illustrated) from a battery (not illustrated), whereby the smoking article 110 can be heated without being combusted. When the smoking article 110 is heated, aerosol is generated from the aerosol source included in the

**[0023]** Hereinafter, embodiments of the present disclosure

smoking article 110, the flavor of the flavor source is drawn into the aerosol. The user can suck the aerosol containing the flavor by sucking a portion of the smoking article 110 (a portion illustrated in Fig. 1B) protruding from the electronic device 10. Note that in this specification, a direction in which the aerosol generation base material such as the smoking article 110 is inserted into the opening 12a is referred to as a longitudinal direction of the electronic device 10.

**[0030]** The configuration of the electronic device 10 illustrated in Figs. 1A and 1B is merely an example of a configuration of the electronic device according to the present disclosure. The electronic device according to the present disclosure can be configured in various forms in which the aerosol can be generated by heating the aerosol generation base material including the aerosol source, and the user can suck the generated aerosol source.

**[0031]** Next, as an example of the aerosol generation base material used in the electronic device 10 according to the present embodiment, the configuration of the smoking article 110 will be described. Fig. 2 is a cross-sectional view of the smoking article 110. In the embodiment illustrated in Fig. 2, the smoking article 110 includes a base material portion 110A that includes a filler 111 (corresponding to an example of the flavor generation base material) and first cigarette paper 112 to be wrapped around the filler 111, and a mouthpiece portion 110B that forms an end portion opposite to the base material portion 110A. The base material portion 110A and the mouthpiece portion 110B are connected to each other by second cigarette paper 113 different from the first cigarette paper 112. However, the base material portion 110A and the mouthpiece portion 110B can be connected to each other using the first cigarette paper 112 without using the second cigarette paper 113.

**[0032]** The mouthpiece portion 110B in Fig. 2 includes a paper tube unit 114, a filter unit 115, and a hollow segment unit 116 that is arranged between the paper tube unit 114 and the filter unit 115. The hollow segment unit 116 includes, for example, a packed bed having one or a plurality of hollow channels, and a plug wrapper that surrounds the packed bed. Since the packing density of fibers in the packed bed is high, the air and aerosol flow only through the hollow channels and scarcely flow through the packed bed, when being sucked. In the smoking article 110, to reduce a decrease in aerosol delivery amount due to filtration of the aerosol components in the filter unit 115, shortening the length of the filter unit 115 so that the hollow segment unit 116 compensates for the shortened length is effective to increase the aerosol delivery amount.

**[0033]** In the embodiment of Fig. 2, the mouthpiece portion 110B is constituted by three segments. However, in another embodiment, the mouthpiece portion 110B may be constituted by one or two segments, or may be constituted by four or more segments. For example, the mouthpiece portion 110B may be also formed without

being provided with the hollow segment unit 116, so that the paper tube unit 114 and the filter unit 115 are arranged to be adjacent to each other.

**[0034]** In the embodiment illustrated in Fig. 2, the length in the longitudinal direction of the smoking article 110 is preferably 40 to 90 mm, more preferably 50 to 75 mm, and even more preferably 50 to 60 mm. The circumference of the smoking article 110 is preferably 15 to 25 mm, more preferably 17 to 24 mm or less, and even more preferably 20 to 22 mm. In the smoking article 110, the length of the base material portion 110A may be 20 mm, the length of the first cigarette paper 112 may be 20 mm, the length of the hollow segment unit 116 may be 8 mm, and the length of the filter unit 115 may be 7 mm. The length of each of these individual segments can be appropriately changed according to production suitability, required quality, and the like.

**[0035]** In the present embodiment, the filler 111 of the smoking article 110 may contain the aerosol source that is heated at a predetermined temperature to generate aerosol. The aerosol source may be of any type, and substances extracted from various natural products and/or their constituents can be selected depending on the intended use. Examples of the aerosol source include glycerin, propylene glycol, triacetin, 1,3-butanediol, and a mixture thereof. The content of the aerosol source in the filler 111 is not limited to a particular content, and is generally 5% by weight or more and preferably 10% by weight or more, and generally 50% by weight or less and preferably 20% by weight or less, from the viewpoint of sufficiently generating aerosol and imparting a good smoking flavor.

**[0036]** The filler 111 of the smoking article 110 in the present embodiment may contain shredded tobacco as the flavor source. The shredded tobacco may be made of any material, and known materials such as lamina and stems can be used. When the circumference of the smoking article 110 is 22 mm and the length thereof is 20 mm, the range of the content of the filler 111 in the smoking article 110 is, for example, 200 to 400 mg, and preferably 250 to 320 mg. The water content of the filler 111 is, for example, 8 to 18% by weight, and preferably 10 to 16% by weight. With such a water content, the occurrence of winding stain is suppressed, and the winding suitability at the time of manufacturing the base material portion 110A is improved. There are no particular restrictions on the size of the shredded tobacco used as the filler 111 and the method of preparing the shredded tobacco. For example, there may be used shredded tobacco obtained by shredding dried tobacco leaves to a width of 0.8 to 1.2 mm. Alternatively, there may be used shredded tobacco obtained by crushing the dried tobacco leaves to have an average particle size of about 20 to 200  $\mu\text{m}$  and making uniform the crushed leaves to form into a sheet, and then shredding the resultant sheet to the width of 0.8 to 1.2 mm. Alternatively, the above-described sheet may be subjected to the gathering process without being shredded, and the resultant product may be used as the

filler 111. Additionally, the filler 111 may contain one or two or more types of flavors. The flavors may be of any types, but from the viewpoint of imparting a good smoking flavor, the flavor is preferably menthol.

**[0037]** In the present embodiment, the first cigarette paper 112 and the second cigarette paper 113 of the smoking article 110 can be made of a base paper having a basis weight of, for example, 20 to 65 gsm, and preferably 25 to 45 gsm. The thickness of the first cigarette paper 112 and the second cigarette paper 113 is not limited to a particular value, but is 10 to 100  $\mu\text{m}$ , preferably 20 to 75  $\mu\text{m}$ , and more preferably 30 to 50  $\mu\text{m}$ , from the viewpoint of rigidity, air permeability, and ease of adjustment during papermaking.

**[0038]** In the present embodiment, the first cigarette paper 112 and the second cigarette paper 113 of the smoking article 110 may contain a filler. The content of the filler may be 10% by weight or more and less than 60% by weight, and preferably 15 to 45% by weight, with respect to the total weight of the first cigarette paper 112 and the second cigarette paper 113. In the present embodiment, it is preferable that the amount of the filler is 15 to 45% by weight, with respect to the preferable range of the basis weight (25 to 45 gsm). As the filler, for example, calcium carbonate, titanium dioxide, kaolin or the like can be used. Paper containing such a filler that is used as a cigarette paper of the smoking article 110 exhibits a bright white-based color that is preferable from the viewpoint of appearance, and can permanently maintain whiteness. When the cigarette paper contains a large amount of such a filler, for example, the ISO whiteness of the cigarette paper can be set to 83% or more. Furthermore, from the viewpoint of practical use as cigarette paper of the smoking article 110, it is preferable that the first cigarette paper 112 and the second cigarette paper 113 have a tensile strength of 8 N / 15 mm or more. This tensile strength can be increased by reducing the content of the filler. Specifically, the tensile strength can be increased when the content of the filler is made smaller than the upper limit of the content of the filler shown in the range of each basis weight described above.

**[0039]** Next, the internal structure of the electronic device 10 illustrated in Figs. 1A and 1B will be described. Fig. 3 is a cross-sectional view taken along line 3-3 illustrated in Fig. 1A. As illustrated in Fig. 3, the electronic device 10 includes a power supply unit 20, a circuit unit 30, and a heating unit 40 in an internal space of the housing 11. The circuit unit 30 may include a first circuit board 31, and a second circuit board 32 that is electrically connected to the first circuit board 31. The first circuit board 31 may be arranged to extend in the longitudinal direction as illustrated in the figure, for example. In this way, the power supply unit 20 and the heating unit 40 are partitioned by the first circuit board 31. As a result, the heat generated in the heating unit 40 can be prevented from being transferred to the power supply unit 20.

**[0040]** The second circuit board 32 may be arranged between the top housing 11A and the power supply unit

20, and extend in a direction orthogonal to the extending direction of the first circuit board 31. The switch 13 may be arranged to be adjacent to the second circuit board 32. When the user presses the switch 13, a part of the switch 13 may come into contact with the second circuit board 32.

**[0041]** The first circuit board 31 and the second circuit board 32 include, for example, a microprocessor and the like, and can control the supply of power from the power supply unit 20 to the heating unit 40. Accordingly, the first circuit board 31 and the second circuit board 32 can control the heating of the smoking article 110 by the heating unit 40.

**[0042]** The power supply unit 20 has a power supply 21 that is electrically connected to the first circuit board 31 and the second circuit board 32. The power supply 21 may be, for example, a rechargeable battery or a non-rechargeable battery. The power supply 21 is electrically connected to the heating unit 40 via at least one of the first circuit board 31 and the second circuit board 32. Thereby, the power supply 21 can supply the power to the heating unit 40 to appropriately heat the smoking article 110. Furthermore, as illustrated in the figure, the power supply 21 may be arranged to be adjacent to the heating unit 40 in a direction orthogonal to the longitudinal direction of the heating unit 40. This can prevent the electronic device 10 from being lengthened in the longitudinal direction even if the size of the power supply 21 is increased.

**[0043]** The electronic device 10 may have a terminal 22 that is connectable to an external power supply. The terminal 22 can be connected to a cable such as a micro-USB, for example. When the power supply 21 is a rechargeable battery, a current flows from the external power supply to the power supply 21 by connecting the external power supply to the terminal 22, whereby the power supply 21 can be charged. Furthermore, the data related to the operation of the electronic device 10 may be transmitted to an external device by connecting a data transmission cable such as a micro-USB to the terminal 22.

**[0044]** The heating unit 40 has a heating assembly 41 extending in the longitudinal direction, as illustrated in the figure. The heating assembly 41 is formed of a plurality of tubular members, and has a tubular body as a whole. The heating assembly 41 is configured so that a part of the smoking article 110 can be housed therein, and has a function of defining a flow path of air supplied to the smoking article 110 and a function of heating the smoking article 110 from the outer periphery.

**[0045]** A vent hole 15 through which air flows into the heating assembly 41 is formed in the bottom housing 11B. Specifically, the vent hole 15 is in fluid communication with one end portion (a left end portion in Fig. 2) of the heating assembly 41. Additionally, the electronic device 10 has a cap 16 that is attachable to or detachable from the vent hole 15. The cap 16 is configured so that the air can flow into the heating assembly 41 through the

vent hole 15 even in a state where the cap 16 is attached to the vent hole 15, and may have, for example, a through hole or a notch (not illustrated). When the cap 16 is attached to the vent hole 15, a substance generated from the smoking article 11 inserted into the heating assembly 41 can be prevented from falling from the vent hole 15 to the outside of the housing 11. When the cap 16 is detached, the interior of the heating assembly 41 or the inner side of the cap 16 can be also cleaned.

**[0046]** The other end portion (a right end portion in Fig. 2) of the heating assembly 41 is in fluid communication with the opening 12a illustrated in Fig. 1B. A substantially tubular outer fin 17 is provided between the lid 14 having the opening 12a and the other end portion of the heating assembly 41. When the smoking article 110 is inserted into the electronic device 10 through the opening 12a of the lid 14 as illustrated in Fig. 1B, the smoking article 110 passes through the outer fin 17, and a part of the smoking article 110 is arranged inside the heating assembly 41. Therefore, the outer fin 17 is preferably formed such that an opening thereof on the side closer to the lid 14 has a size larger than an opening thereof on the side closer to the other end portion of the heating assembly 41. This facilitates insertion of the smoking article 110 into the outer fin 17 through the opening 12a.

**[0047]** In a state where the smoking article 110 is inserted into the electronic device 10 through the opening 12a as illustrated in Fig. 1B, when the user sucks from the portion of the smoking article 110 protruding from the electronic device 10, that is, the filter unit 115 illustrated in Fig. 2, the air flows into the heating assembly 41 through the vent hole 15. The air having flowed thereinto passes through the inside of the heating assembly 41, and reaches the mouth of the user together with the aerosol generated from the smoking article 110. Therefore, the side closer to the vent hole 15 of the heating assembly 41 is referred to as an upstream side, and the side closer to the opening 12a of the heating assembly 41 (the side closer to the outer fin 17) is referred to as a downstream side.

**[0048]** Fig. 4A is a block diagram schematically illustrating a configuration of the electronic device according to an embodiment of the present disclosure. The electronic device 10 in this example includes a control unit 402, and the heating unit 40 that includes components such as the heating assembly 41. The electronic device 10 may further include the power supply 21. Alternatively, the electronic device 10 may be configured to be connected to another device including the power supply 21, without being provided with the power supply 21. The electronic device 10 may further include other components such as a switching element 406, a storage unit 408, a notification unit 410, a voltage sensor 412, and a remaining capacity sensor 414. The switching element 406 is provided between the power supply 21 and the heating unit 40. The remaining capacity sensor 414 may be mounted as an integrated circuit (IC) arranged in the electronic device 10. Alternatively, when the electronic

device 10 is provided with no power supply 21 and is connected to another device including the power supply 21, the remaining capacity sensor 414 may be mounted as the IC arranged in such another device. The electronic device 10 may further include a voltage conversion circuit 418 provided between the power supply 21 and the heating unit 40. The voltage conversion circuit 418 may be arranged between the power supply and the switching element 406. Alternatively, the voltage conversion circuit 418 may be arranged between the switching element 406 and the heating unit 40. As indicated by dotted arrows in Fig. 4A, the control unit 402 is configured to control the power supply 21, the switching element 406, the notification unit 410, the voltage conversion circuit 418, and the like. The control unit 402 is also configured to control the storage unit 408, the voltage sensor 412, the remaining capacity sensor 414, and the like, and exchange the information with these components.

**[0049]** The electronic device 10 may also include a recess 416 capable of receiving the aerosol generation base material 110 such as the smoking article. The heating unit 40 may have a shape such that the aerosol generation base material 110 can be heated from surroundings. The heating unit 40 heats a portion of the aerosol generation base material 110 received in the recess 416 with power supplied from the power supply 21.

**[0050]** The control unit 402 may be configured to switch on/off the supply of power from the power supply 21 to the heating unit 40 in response to the switching on/off of the switching element 406. In an example, the control unit 402 may be configured to switch the switching element 406 to the off state, to stop the supply of power from the power supply 21 to the heating unit 40.

**[0051]** The voltage sensor 412 is used to measure a voltage of the power supply 21. For example, the voltage sensor 412 may include a resistor connected between output terminals of the power supply 21, and a sensor that detects the voltage applied across the resistor. The control unit 402 can obtain the information about the voltage of the power supply 21 from the voltage sensor 412. This is merely an example of the voltage sensor 412. It will be understood by those skilled in the art that the voltage sensor 412 can have various configurations.

**[0052]** The remaining capacity sensor 414 is used to measure the remaining capacity of the power supply 21. For example, the remaining capacity sensor 414 may include a circuit or the like configured to store an integrated value of the current flowing from the power supply 21 and calculate the ratio of the current capacity to the capacity in a fully charged state of the power supply 21 based on the integrated value. The control unit 402 can obtain, from the remaining capacity sensor 414, the information about the capacity remaining in the power supply 21. This is merely an example of the remaining capacity sensor 414. It will be understood by those skilled in the art that the remaining capacity sensor 414 can have various configurations.

**[0053]** The voltage conversion circuit 418 is configured

to convert the voltage of the power supply 21. The converted voltage is used for the supply of power to the heating unit 40. The voltage conversion circuit 418 may be a step-up DC/DC converter. Alternatively, the electronic device 10 may be configured not to include the voltage conversion circuit 418.

**[0054]** In the case where the electronic device 10 includes the voltage conversion circuit 418, the switching element 406 may be included in the voltage conversion circuit 418, without being provided separately from the voltage conversion circuit 418.

**[0055]** The notification unit 410 operates to issue notice to the user. In an example, the notification unit 410 may include one or a plurality of LEDs configured to emit light in one or a plurality of colors. The notification unit 410 may also include a speaker configured to issue notice by sound. The notification unit 410 may also include a display configured to issue notice by a display on the display.

**[0056]** The storage unit 408 can store various data related to the operation of the electronic device 10. For example, the storage unit 408 may store the information obtained from the voltage sensor 412 and the remaining capacity sensor 414. The storage unit 408 may also store the information about a heating procedure of the heating unit 40 suitable for the electronic device 10.

**[0057]** In an example, each of the control unit 402, the switching element 406, the storage unit 408, the notification unit 410, the voltage sensor 412 and the remaining capacity sensor 414 may be included in any of the first circuit board 31 and the second circuit board 32 illustrated in Fig. 3.

**[0058]** Fig. 4B is a block diagram illustrating how the voltage of the power supply 21 is measured in the electronic device according to the embodiment of Fig. 4A. The control unit 402 may generate a voltage pulse (or a current pulse) different from a voltage pulse (or a current pulse) that is used for supplying the power to the heating unit 40 to heat the aerosol generation base material 110 and measure the voltage of the power supply 21 during the duration of the voltage pulse. In an example, the control unit 402 causes the switching element 406 to be in an on state for a predetermined period of time  $\Delta t_1$  (for example, 60 ms). After a lapse of  $\Delta t_1$ , the control unit 402 causes the switching element 406 to be in an off state. A value of  $\Delta t_1$  may be stored in the storage unit 408 in advance. In this way, as illustrated in the figure, the voltage pulse of the duration  $\Delta t_1$  is generated, and passes through a path from the power supply 21 to the heating unit 40. The control unit 402 measures the voltage of the power supply 21 using the voltage sensor 412 during the duration  $\Delta t_1$  of the voltage pulse. In this example, the number and duration of voltage pulses to be generated are set so that the temperature of the heating unit 40 is hardly increased. For example, the number of voltage pulses is preferably one, and the duration of the voltage pulse is preferably 100 ms or less. It will be understood by those skilled in the art that in the embodiment of the

present disclosure, the above-described number and duration of the voltage pulses to be generated can be appropriately set.

**[0059]** Fig. 4C is a block diagram illustrating how the voltage of the power supply 21 is measured in the electronic device according to the embodiment of Fig. 4A. The control unit 402 may measure the voltage of the power supply 21 during the duration of first one voltage pulse among the voltage pulses (or the current pulses) that are used for supplying the power to the heating unit 40 to heat the aerosol generation base material 110. In an example, the control unit 402 turns on/off the switching element 406, whereby a series of voltage pulses used for heating the heating unit 40 can be generated. The control unit 402 may repeat the control for causing the switching element 406 to be in the on state for a predetermined period of time  $\Delta t_2$  (for example, 60 ms), and causing the switching element 406 to be in the off state after a lapse of  $\Delta t_2$ . A value of  $\Delta t_2$  may be stored in the storage unit 408 in advance. Alternatively, the control unit 402 may adjust the value of  $\Delta t_2$  so that the temperature of the heating unit 40 becomes a desired value. This control enables the series of voltage pulses each having the duration  $\Delta t_2$  to pass through the path from the power supply 21 to the heating unit 40, as illustrated in the figure. The control unit 402 may measure the voltage of the power supply 21 using the voltage sensor 412 during the duration  $\Delta t_2$  of the first voltage pulse (the pulse indicated by a bold line in Fig. 4C) among the series of voltage pulses. The duration of the voltage pulse is preferably 100 ms or less. In another example, the control unit 402 may measure the voltage of the power supply 21 during the duration of a first plurality (for example, two, three or the like) of voltage pulses among the series of voltage pulses.

**[0060]** Hereinafter, details of operation of the electronic device 10 according to the embodiment of the present disclosure will be further described.

**[0061]** Fig. 5 is a flowchart illustrating an operation method of the electronic device 10 according to an embodiment of the present disclosure. The process in Fig. 5 corresponds to the example of Fig. 4B. All the steps will be described as being performed by the control unit 402 of the electronic device 10. However, it should be noted that at least some of the steps may be performed by another component in the electronic device 10. Additionally, it will be appreciated that the present embodiment, when being executed by a processor such as the control unit 402, can be implemented as a program that causes the processor to perform the method or as a computer readable storage medium storing the same program. The same can also apply to the example described in the context of Fig. 6 which will be described later.

**[0062]** The process starts at step 502. The control unit 402 determines whether an aerosol generation request is detected. In an example, when the switch 13 is pressed, the control unit 402 may determine that the aerosol generation request is detected. In another example, the electronic device 10 may be configured to determine

that the aerosol generation request is detected based on detecting user's suction. For example, the electronic device 10 may include the pressure sensor, and the control unit 402 may detect the user's suction based on a change in the pressure detected by the pressure sensor.

**[0063]** When the aerosol generation request is not detected ("N" in step 502), the process returns to the point before step 502. When the aerosol generation request is detected ("Y" in step 502), the process proceeds to step 504.

**[0064]** In step 504, the control unit 402 generates a voltage pulse different from the voltage pulse for supplying the power to the heating unit 40. In an example, the control unit 402 may cause the switching element 406 to be in the on state for a predetermined period of time. In this way, the voltage pulse having a duration is generated, the duration being equal to the predetermined period of time. The predetermined period of time is preferably 100 ms or less, and is, for example, 60 ms. The information about the predetermined period of time may be stored in the storage unit 408. The control unit 402 may acquire the information about the predetermined period of time from the storage unit 408, and generate the above-described voltage pulse based on the acquired information. As can be appreciated from the example of Fig. 4B, the generated voltage pulse passes through the same path as the path used for supplying the power from the power supply 21 to the heating unit 40.

**[0065]** The process proceeds to step 506, and the control unit 402 measures the voltage of the power supply 21 during the above-described duration of the voltage pulse. In an example, the voltage sensor 412 may include the resistor connected between the output terminals of the power supply 21. The control unit 402 acquires a voltage across the resistor as the voltage of the power supply 21. The control unit 402 may measure the voltage of the power supply 21 one or a plurality of times during the duration. The control unit 402 can obtain the voltage of the power supply 21 when the current actually flows between the power supply 21 and the heating unit 40, by measuring the voltage of the power supply 21 during the duration of the voltage pulse. Accordingly, the voltage of the power supply 21 can be measured accurately in the same situation as when the power is supplied from the power supply 21 to the heating unit 40 and the aerosol generation base material 110 is heated by the heating unit 40, as compared with the case where the voltage of the power supply 21 is simply measured without generating the voltage pulse.

**[0066]** The process processes to step 508, and the control unit 402 determines whether the voltage of the power supply 21 measured in step 506 is less than a threshold voltage indicating that the sufficient capacity to use up one unused aerosol generation base material 110 remains in the power supply 21.

**[0067]** In an example, the above-described threshold voltage may be a fixed value stored in the storage unit 408. The tests on heating of the aerosol generation base

material 110 by the electronic device 10 and user's suction may be preliminarily performed under various environments in which the ambient temperature ranges from a low temperature (for example, 0°C) to a high temperature (for example, 40°C). As a result of the tests, the voltage of the power supply 21 when the sufficient capacity to use up one unused aerosol generation base material 110 remains in the power supply 21 in any environment may be set as the above-described fixed value.

**[0068]** The above-described threshold voltage may be set to change depending on the remaining capacity of the power supply 21. As described above, the remaining capacity of the power supply 21 may be measured using the remaining capacity sensor 414. When the remaining capacity of the power supply 21 is equal to or greater than a predetermined value, the threshold voltage may be a first value. When the remaining capacity of the power supply 21 is less than the predetermined value, the threshold voltage may be a second value greater than the first value.

**[0069]** In an example, when the remaining capacity of the power supply 21 is equal to or greater than 25%, the control unit 402 may set the threshold voltage to the first value (for example, 2282 mV). When the electronic device 10 includes the voltage conversion circuit 418 and the voltage conversion circuit 418 is a step-up DC/DC converter, the above-described first value may be a stable operation voltage of the step-up DC/DC converter. This can prevent the operation of the electronic device 10 including the step-up DC/DC converter from being unstable, when the remaining capacity of the power supply 21 is sufficient to use up one unused aerosol generation base material 110.

**[0070]** When the remaining capacity of the power supply 21 is less than 25%, the control unit 402 may also set the threshold voltage to the second value (for example, 2408 mV). The second value may be a value enabling one unused aerosol generation base material 110 to be used up even under high temperature environment.

**[0071]** When the voltage of the power supply 21 is less than the threshold voltage ("Y" in step 508), the process proceeds to step 510. In step 510, the control unit 402 operates not to supply the power from the power supply 21 to the heating unit 40. For example, the control unit 402 may control so that the switching element 406 does not reach the on state (the switching element 406 is kept in the off state). At this time, the control unit 402 may generate a signal for issuing the notice to the user. In an example, the control unit 402 may control the notification unit 410 to issue, to the user, the notice that the sufficient capacity to use up one aerosol generation base material 110 does not remain in the power supply 21. The notice may be issued in various forms such as light emission from an LED or the like, voice output from a speaker or the like, vibration by a vibrator, and display on a display.

**[0072]** When the voltage of the power supply 21 is equal to or greater than the threshold voltage ("N" in step

508), the process proceeds to step 512. In step 512, the control unit 402 operates to supply the power from the power supply 21 to the heating unit 40, and heat the aerosol generation base material 110 to generate the aerosol.

**[0073]** According to the embodiment of Fig. 5, when the sufficient capacity to use up one of unused aerosol generation base material 110 (for example, one smoking article) does not remain in the power supply 21, the user can know it in advance. Accordingly, the user does not have to experience such a discomfort that the aerosol is no longer generated before the aerosol generation base material 110 is used up. In this way, according to the present embodiment, a decrease in user experience that may be encountered when the power supply 21 of the electronic device 10 such as an aerosol generating device is not sufficiently charged can be prevented or ameliorated.

**[0074]** Fig. 6 is a flowchart illustrating an operation method of the electronic device 10 according to an embodiment of the present disclosure. The process in Fig. 6 corresponds to the example of Fig. 4C. The process of step 602 is the same as the process of step 502 in Fig. 5.

**[0075]** In step 604, the control unit 402 generates the voltage pulse for supplying the power to the heating unit 40. The control unit 402 may repeat causing the switching element 406 to be in the on state for a certain period of time and causing the switching element 406 to be in the off state for a certain period of time. In this way, a series of voltage pulses as illustrated in Fig. 4C are generated, and supplied to the heating unit 40 to generate the aerosol. In this case, the duration of one voltage pulse is equal to the above-described period of time. The duration of the voltage pulse may change depending on an operation status of the electronic device 10. For example, the control unit 402 may adjust the duty ratio of the voltage pulse so that the temperature of the heating unit 40 becomes a desired temperature. When the duty ratio of the voltage pulse is adjusted, the duration of the voltage pulse also changes. The information about the duration may be stored in the storage unit 408. The information about the duration stored in the storage unit 408 may be updated each time the duration changes. In another example, the duration of voltage pulse generated first in step 604 may be a fixed value. The fixed value is preferably 100 ms or less, and is, for example, 60 ms. The information about the fixed value may be stored in the storage unit 408. In this case, the control unit 402 may acquire the information about the fixed value from the storage unit 408, and generate the above-described first voltage pulse based on this information.

**[0076]** In step 606, the control unit 402 measures the voltage of the power supply 21 during the duration of the first voltage pulse among the series of voltage pulses generated for supplying the power to the heating unit 40. A method of measuring the voltage of the power supply 21 is as described above. In another example, the control unit 402 may measure the voltage of the power supply

21 during the duration of a plurality of (for example, two, three or the like) first voltage pulses among the series of voltage pulses.

**[0077]** The process of steps 608 to 612 is the same as the process of steps 508 to 512 in Fig. 5.

**[0078]** Similarly to the embodiment of Fig. 5, according to the embodiment of Fig. 6, a decrease in user experience that may be encountered when the power supply 21 of the electronic device 10 such as an aerosol generating device is not sufficiently charged can be prevented or ameliorated.

**[0079]** Fig. 7A is a state transition diagram schematically illustrating transitions among a plurality of states that can be made by the electronic device 10 (or the control unit 402 of the electronic device 10) according to an embodiment of the present disclosure.

**[0080]** As illustrated in the figure, the states of the electronic device 10 may include a normal state 702, an abnormal state 704, a charging state 706, a heating state 708, and a smoking-disabled state 710. The normal state 702 is a normal stand-by state. The abnormal state 704 is a state where any error occurs and thus the electronic device 10 does not operate normally. The charging state 706 is a state where the power supply 21 of the electronic device 10 is charged. The heating state 708 is a state where the heating unit 40 is heated with the power supplied from the power supply 21 to the heating unit 40. The smoking-disabled state 710 is a state where one aerosol generation base material (for example, one smoking article) cannot be used up.

**[0081]** Various arrows illustrated in the figure each indicate an example of a trigger for making the transition from a certain state to another state. These are merely examples. It will be understood by those skilled in the art that other various triggers can be used for the state transitions.

**[0082]** When the temperature abnormality such as too high temperature of the heating unit 40 is detected when the electronic device 10 is in the normal state 702, the electronic device 10 makes the transition to the abnormal state 704 (arrow A1). When the normalization of the temperature is confirmed, the electronic device 10 makes the transition from the abnormal state 704 to the normal state 702 (arrow A2). When any system error is detected as another trigger, the electronic device 10 makes the transition from the normal state 702 to the abnormal state 704 (arrow A3). When the system state is reset, the electronic device 10 makes the transition from the abnormal state 704 to the normal state 702 (arrow A4). In an example, the state reset may be performed by pressing an action button such as the switch 13 for a period of time longer than that of a normal long press.

**[0083]** When the connection of an element such as a micro-USB cable which is used for charging the power supply 21 of the electronic device 10 is detected when the electronic device 10 is in the normal state 702, the electronic device 10 makes the transition to the charging state 706 (arrow A5). When the detachment of the micro-

USB cable or the like is detected or the state reset is detected, the electronic device 10 makes the transition from the charging state 706 to the normal state 702 (arrow A6).

**[0084]** When a slide cover such as the cover 12 is opened and the action button is pressed long when the electronic device 10 is in the normal state 702, the electronic device 10 makes the transition to the heating state 708 (arrow A7). When there is detected completion of smoking (aerosol suction), a cancelling operation, long pressing of the action button, a state reset, connection of the micro-USB cable, or the like, the electronic device 10 makes the transition from the heating state 708 to the normal state 702 (arrow A8). In an example, the cancelling operation may be performed by opening or closing the slide cover, connecting the micro-USB cable, or the like.

**[0085]** When it is detected the remaining capacity of the power supply 21 is insufficient when the electronic device 10 is in the normal state 702, the electronic device 10 makes the transition to the smoking-disabled state 710 (arrow A9). The transition indicated by the arrow A9 is related to the process of step 510 in the embodiment of Fig. 5. When the reset is detected, the electronic device 10 makes the transition from the smoking-disabled state 710 to the normal state 702 (arrow A10).

**[0086]** When it is detected the remaining capacity of the power supply 21 is insufficient when the electronic device 10 is in the heating state 708, the electronic device 10 makes the transition to the smoking-disabled state 710 (arrow A11). The transition indicated by the arrow A11 is related to the process of step 610 in the embodiment of Fig. 6. When the system error is detected, the electronic device 10 makes the transition from the heating state 708 to the abnormal state 704 (arrow A12).

**[0087]** When the connection of the micro-USB cable is detected when the electronic device 10 is in the smoking-disabled state 710, the electronic device 10 makes the transition to the charging state 706 (arrow A13). When the system error, the temperature abnormality, or the like is detected, the electronic device 10 makes the transition from the smoking-disabled state 710 to the abnormal state 704 (arrow A14).

**[0088]** When the system error, the temperature abnormality, or the like is detected when the electronic device 10 is in the charging state 706, the electronic device 10 makes the transition to the abnormal state 704 (arrow A15).

**[0089]** Fig. 7B is a state transition diagram schematically illustrating details of the normal state 702, the abnormal state 704, the charging state 706, and the heating state 708, and an example of transitions among a plurality of states.

**[0090]** The normal state 702 may include states such as a sleep 702A, a stand-by (IDLE) 702B, a set state display mode 702C, and a preheating stand-by state 702D. The abnormal state 704 may include states such as a temporary use-disabled state 704A, and an auto-

matic return impossible state 704B. The charging state 706 may include states such as a battery-(power supply) charging state 706A. In the battery-charging state 706A, the electronic device 10 may make a display related to the charging state. The heating state 708 may include states such as a preheating 708A, and a smoking mode 708B. In the preheating 708A, the electronic device 10 may make a display related to a preheating time. In the smoking mode 708B, the electronic device 10 may make a display related to a smoking time.

**[0091]** When the temperature abnormality or the like is detected when the electronic device 10 is in the normal state 702, the electronic device 10 makes the transition to the temporary use-disabled state 704A (arrow B1). When the normalization of the temperature is confirmed, the electronic device 10 makes the transition from the temporary use-disabled state 704A to the normal state 702 (arrow B2). When the system error is detected when the electronic device 10 is in the normal state 702, the electronic device 10 makes the transition to the automatic return impossible state 704B (arrow B3). When the reset is detected, the electronic device 10 makes the transition to the normal state 702 (arrow B4).

**[0092]** When the connection of the micro-USB cable is detected when the electronic device 10 is in the normal state 702, the electronic device 10 makes the transition to the charging state 706 (arrow B5). When the detachment of the micro-USB cable is detected, the electronic device 10 makes the transition to the normal state 702 (arrow B6).

**[0093]** When the reset is detected when the electronic device 10 is in the charging state 706, the electronic device 10 makes the transition to the normal state (arrow B7).

**[0094]** When an instruction to start the preheating is issued by long pressing of the action button when the electronic device 10 is in the preheating stand-by state 702D, the electronic device 10 makes the transition to the preheating 708A (arrow B8). When the action button is pressed long in the state of the preheating 708A, the electronic device 10 makes the transition to the preheating stand-by state 702D (arrow B9).

**[0095]** When there is detected opening/closing of the slide cover, pressing of the action button, connection of the micro-USB cable, or the like when the electronic device 10 is in the state of sleep 702A, the electronic device 10 makes the transition to the state of the stand-by 702B (arrow B10). When a predetermined period of time (for example, 15 sec.) lapses, the electronic device 10 makes the transition from the state of the stand-by 702B to the state of the sleep 702A (arrow B11).

**[0096]** When the slide cover is opened when the electronic device 10 is in the state of the sleep 702A or the stand-by 702B, the electronic device 10 makes the transition to the preheating stand-by state 702D (arrow B12). When the cancelling operation is performed, the electronic device 10 makes the transition from the preheating stand-by state 702D to the state of the sleep 702A or the

stand-by 702B (arrow B13). Alternatively, when a predetermined period of time (for example, 5 min.) lapses, the electronic device 10 makes the transition from the preheating stand-by state 702D to the state of the sleep 702A (arrow B14).

**[0097]** When short pressing of the action button is detected when the electronic device 10 is in the state of the sleep 702A or the stand-by 702B, the electronic device 10 makes the transitions to the set state display mode 702C (arrow B15). When the cancelling operation is detected, the electronic device 10 makes the transition from set state display mode 702C to the state of the sleep 702A or the stand-by 702B (arrow B16). Alternatively, when the display of the set state is completed or short pressing or long pressing of the action button is detected, the electronic device 10 makes the transition from set state display mode 702C to the state of the sleep 702A or the stand-by 702B (arrow B17).

**[0098]** When the preheating is completed when the electronic device 10 is in the state of the preheating 708A, the electronic device 10 makes the transition to the smoking mode 708B (arrow B18). When there is detected a predetermined number of times (for example, 14 times) of puff actions, a lapse of a predetermined period of time (for example, 210 sec.), long pressing of the action button, or the like, the electronic device 10 makes the transition from the smoking mode 708B to the preheating stand-by state 702D (arrow B19).

**[0099]** When the cancelling operation is detected when the electronic device 10 is in the state of the preheating 708A, the electronic device 10 makes the transitions to the state of the sleep 702A or the stand-by 702B (arrow B20). When the reset is detected when the electronic device 10 is in the heating state 708, the electronic device 10 makes the transition to the normal state 702 (arrow B21). When the cancelling operation is detected when the electronic device 10 is in the smoking mode 708B, the electronic device 10 makes the transition to the state of the sleep 702A or the stand-by 702B (arrow B22).

**[0100]** Fig. 7C is a state transition diagram schematically illustrating details of a normal state 702, an abnormal state 704, a charging state 706, and a smoking-disabled state 710, and an example of transitions among a plurality of states.

**[0101]** The smoking-disabled state 710 may include states such as a sleep 710A, a stand-by (IDLE) 710B, and a set state display mode 710C.

**[0102]** When the temperature abnormality or the like is detected when the electronic device 10 is in the smoking-disabled state 710, the electronic device 10 makes the transition to the temporary use-disabled state 704A (arrow C1). When the normalization of the temperature is detected, the electronic device 10 makes the transition from the temporary use-disabled state 704A to the smoking-disabled state 710 (arrow C2). When the system error is detected when the electronic device 10 is in the smoking-disabled state 710, the electronic device 10 makes the transition to the automatic return impossible state

704B (arrow C3). When the connection of the micro-USB cable is detected, the electronic device 10 makes the transition from the smoking-disabled state 710 to the charging state 706 (arrow C4).

**[0103]** When the detachment of the micro-USB cable is detected when the electronic device 10 is in the charging state 706, the electronic device 10 makes the transition to the normal state 702 (arrow C5). When the system error is detected when the electronic device 10 is in the charging state 706, the electronic device 10 makes the transition to the abnormal state 704 (arrow C7).

**[0104]** When the reset is detected when the electronic device 10 is in the smoking-disabled state 710, the electronic device 10 makes the transition to the normal state 702 (arrow C6). When there is detected opening/closing of the slide cover, pressing of the action button, connection of the micro-USB cable, or the like when the electronic device 10 is in the state of the sleep 710A, the electronic device 10 makes the transitions to the state of the stand-by 710B (arrow C8). When a predetermined period of time (for example, 15 sec.) lapses, the electronic device 10 makes the transition from the state of the stand-by 710B to the state of the sleep 710A (arrow C9).

**[0105]** When short pressing of the action button is detected when the electronic device 10 is in the state of the sleep 710A or the stand-by 710B, the electronic device 10 makes the transitions to the set state display mode 710C (arrow C10). When the cancelling operation is detected, the electronic device 10 makes the transition from set state display mode 710C to the state of the sleep 710A or the stand-by 710B (arrow C11). Alternatively, when the display of the set state is completed or short pressing or long pressing of the action button is detected, the electronic device 10 makes the transition from set state display mode 710C to the state of the sleep 710A or the stand-by 710B (arrow C12).

**[0106]** When there is detected opening/closing of the slide cover, pressing of the action button, connection of the micro-USB cable, or the like when the electronic device 10 is in the state of sleep 702A, the electronic device 10 makes the transition to the state of the stand-by 702B (arrow C13). When a predetermined period of time (for example, 15 sec.) lapses, the electronic device 10 makes the transition from the state of the stand-by 702B to the state of the sleep 702A (arrow C14).

**[0107]** Although the embodiments of the present disclosure have been described above, it is to be understood that the embodiments are merely examples, and do not limit the scope of the present disclosure. It should be understood that modifications, addition, improvements, and the like of the embodiments can be appropriately made without departing from the spirit and scope of the present disclosure. The scope of the present disclosure should not be limited by any of the above-described embodiments, and should be limited only by the appended claims and their equivalents.

## REFERENCE SIGNS LIST

**[0108]** 10 ... Electronic device, 11 ... Housing, 11A ... Top housing, 11B ... Bottom housing, 12 ... Cover, 12a ... Opening, 13 ... Switch, 14 ... Lid, 15 ... Vent hole, 16 ... Cap, 17 ... Outer fin, 20 ... Power supply unit, 21 ... Power supply, 22 ... Terminal, 30 ... Circuit unit, 31 ... First circuit board, 32 ... Second circuit board, 40 ... Heating unit, 41 ... Heating assembly, 110 ... Aerosol generation base material or smoking article, 110A ... Base material portion, 110B ... Mouthpiece portion, 111 ... Filler, 112 ... First cigarette paper, 113 ... Second cigarette paper, 114 ... Paper tube unit, 115 ... Filter unit, 116 ... Hollow segment unit, 402 ... Control unit, 406 ... Switching element, 408 ... Storage unit, 410 ... Notification unit, 412 ... Voltage sensor, 414 ... Remaining capacity sensor, 416 ... Recess, 418 ... Voltage conversion circuit, 702 ... Normal state, 704 ... Abnormal state, 706 ... Charging state, 708 ... Heating state, 710 ... Smoking-disabled state, 702A ... Sleep, 702B ... Stand-by, 702C ... Set state display mode, 702D ... Preheating stand-by state, 704A ... Temporary use-disabled state, 704B ... Automatic return impossible state, 706A ... Battery-charging state, 708A ... Preheating, 708B ... Smoking mode, 710A ... Sleep, 710B ... Stand-by, 710C ... Set state display mode

## Claims

## 1. An electronic device, comprising:

a control unit; and  
a heating unit that heats an aerosol generation base material with power supplied from a power supply,  
wherein the control unit is configured so that the power is not supplied from the power supply to the heating unit when a voltage of the power supply is less than a threshold voltage indicating that a sufficient capacity to use up one unused aerosol generation base material remains in the power supply.

2. The electronic device according to claim 1, wherein the control unit is configured to measure a voltage of the power supply during a duration of one voltage pulse generated separately from a voltage pulse for supplying the power from the power supply to the heating unit.

3. The electronic device according to claim 1, wherein the control unit is configured to measure the voltage of the power supply during the duration of first one voltage pulse among voltage pulses for supplying the power from the power supply to the heating unit.

4. The electronic device according to claim 2 or 3,

wherein

a width of the one voltage pulse is 100 ms or less.

5. The electronic device according to claim 2, wherein the one voltage pulse passes through the same path as a path used for supplying the power from the power supply to the heating unit.

6. The electronic device according to any one of claims 1 to 5, wherein the heating unit has a shape such that the aerosol generation base material is heated from surroundings.

7. The electronic device according to any one of claims 1 to 6, further comprising:  
a recess capable of receiving the aerosol generation base material.

8. The electronic device according to any one of claims 1 to 7, further comprising:

a switching element provided between the power supply and the heating unit,  
wherein the control unit is configured to switch the switching element to an off state when supply of the power from the power supply to the heating unit is stopped.

9. The electronic device according to any one of claims 1 to 8, wherein the control unit is configured to generate a signal for issuing notice to a user when the voltage of the power supply is less than the threshold voltage.

10. The electronic device according to any one of claims 1 to 9, wherein the threshold voltage is set to change depending on a remaining capacity of the power supply.

11. The electronic device according to any one of claims 1 to 10, wherein when the remaining capacity of the power supply is equal to or greater than a predetermined value, the threshold voltage is a first value, and when the remaining capacity of the power supply is less than the predetermined value, the threshold voltage is a second value greater than the first value.

12. The electronic device according to claim 11, wherein the first value is a stable operation voltage of a step-up DC/DC converter.

13. The electronic device according to any one of claims 1 to 12, further comprising:  
the power supply.

14. A method of operating an electronic device, compris-

ing:

heating an aerosol generation base material  
with power supplied from a power supply,  
wherein the power is not supplied from the power 5  
supply to the heating unit when a voltage of the  
power supply is less than a threshold voltage  
indicating that a sufficient capacity to use up one  
unused aerosol generation base material re-  
mains in the power supply. 10

15. A program, when being executed by a processor,  
causing the processor to perform the method accord-  
ing to claim 14.

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Fig. 1A

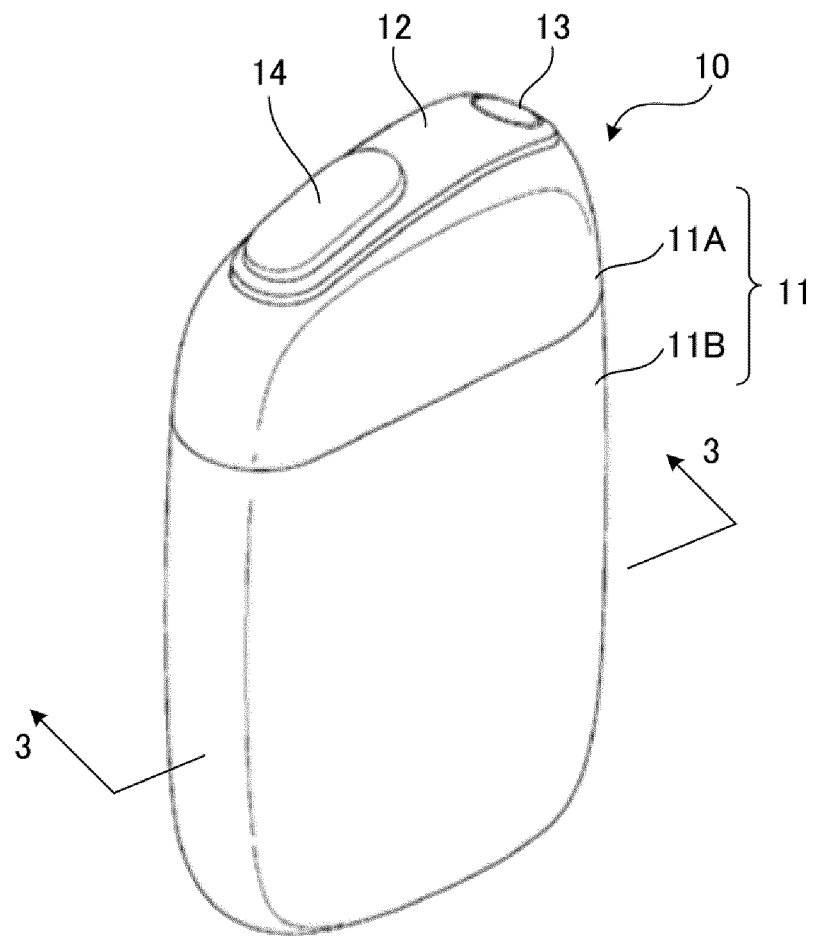


Fig. 1B

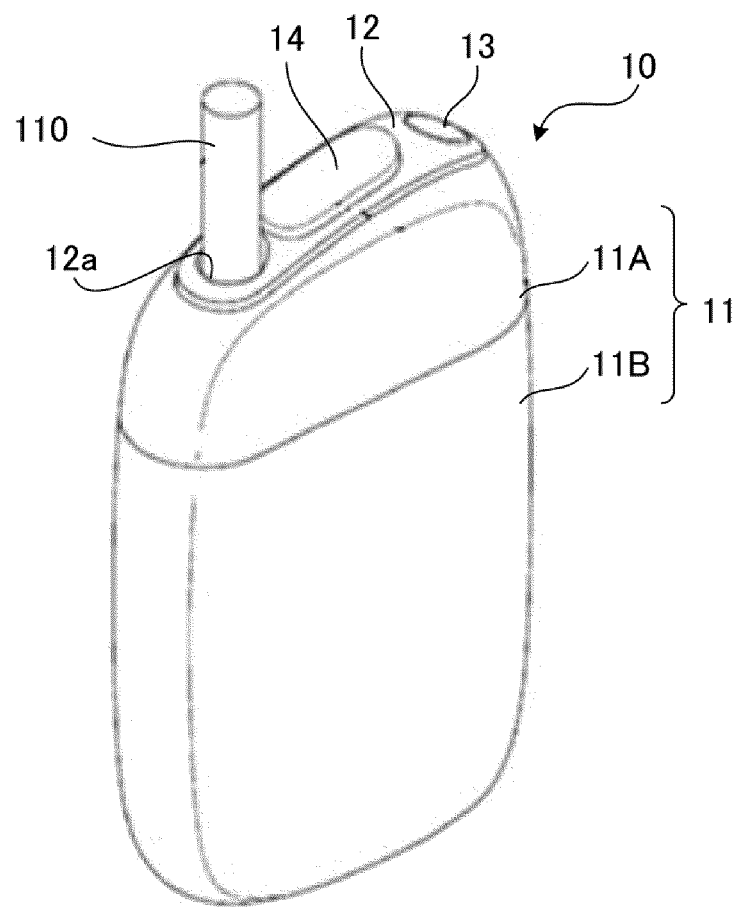


Fig. 2

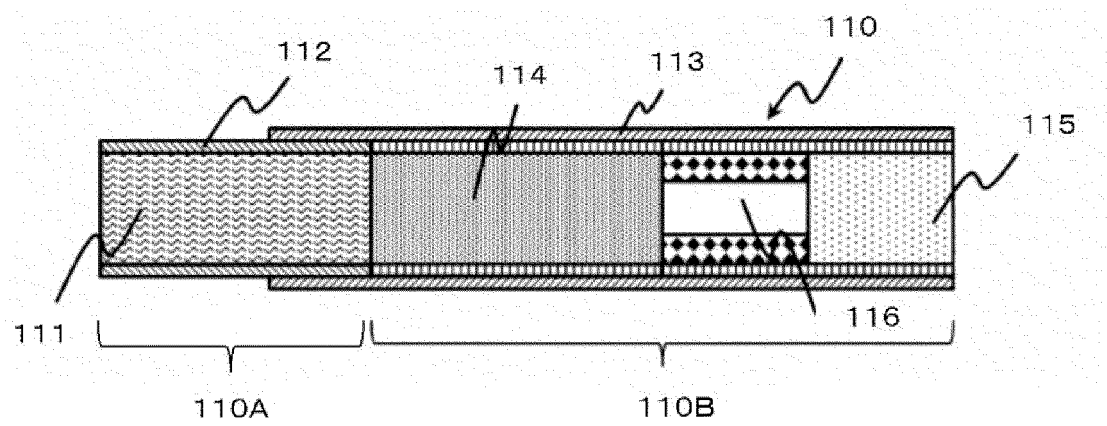


Fig. 3

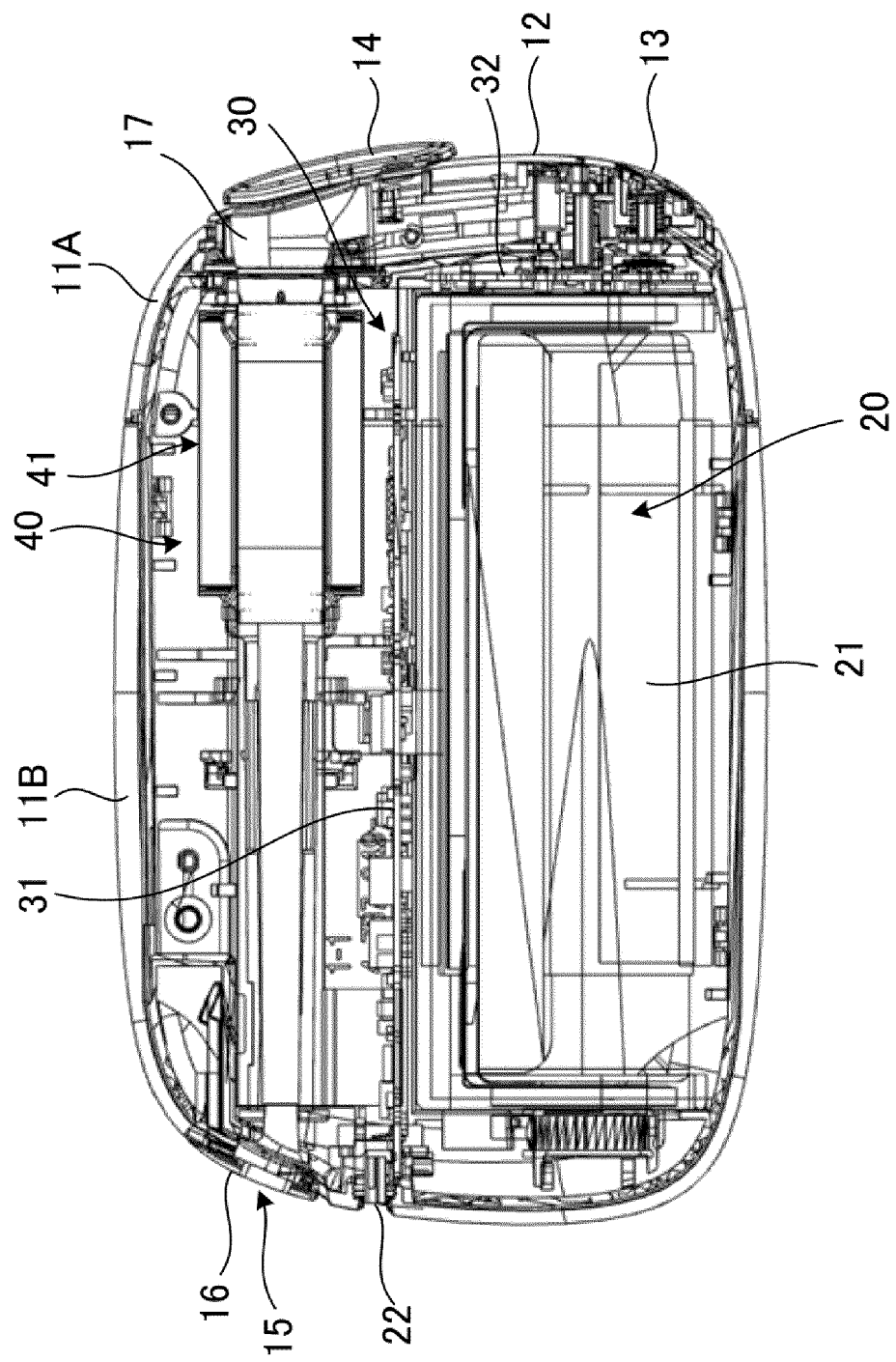


Fig. 4A

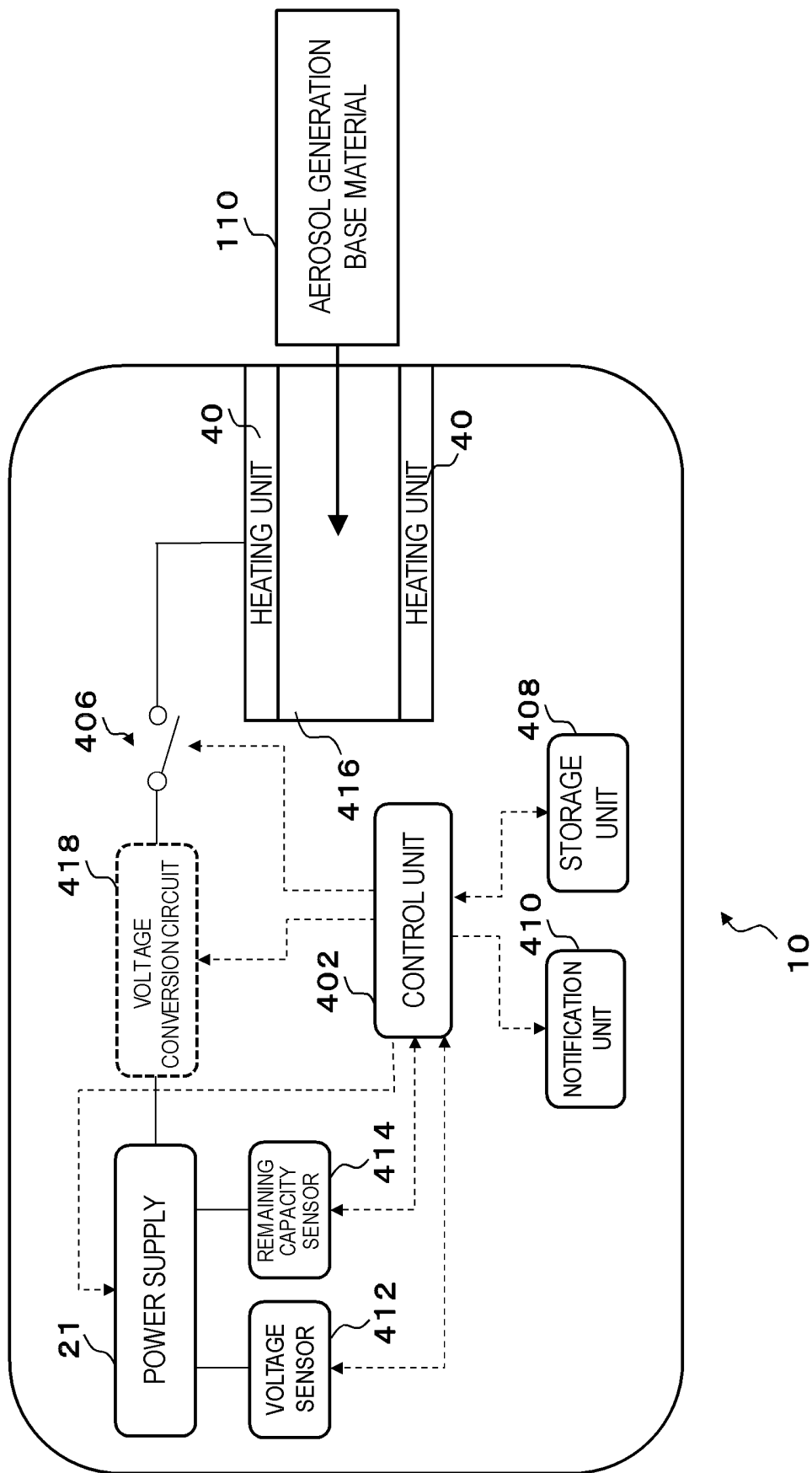


Fig. 4B

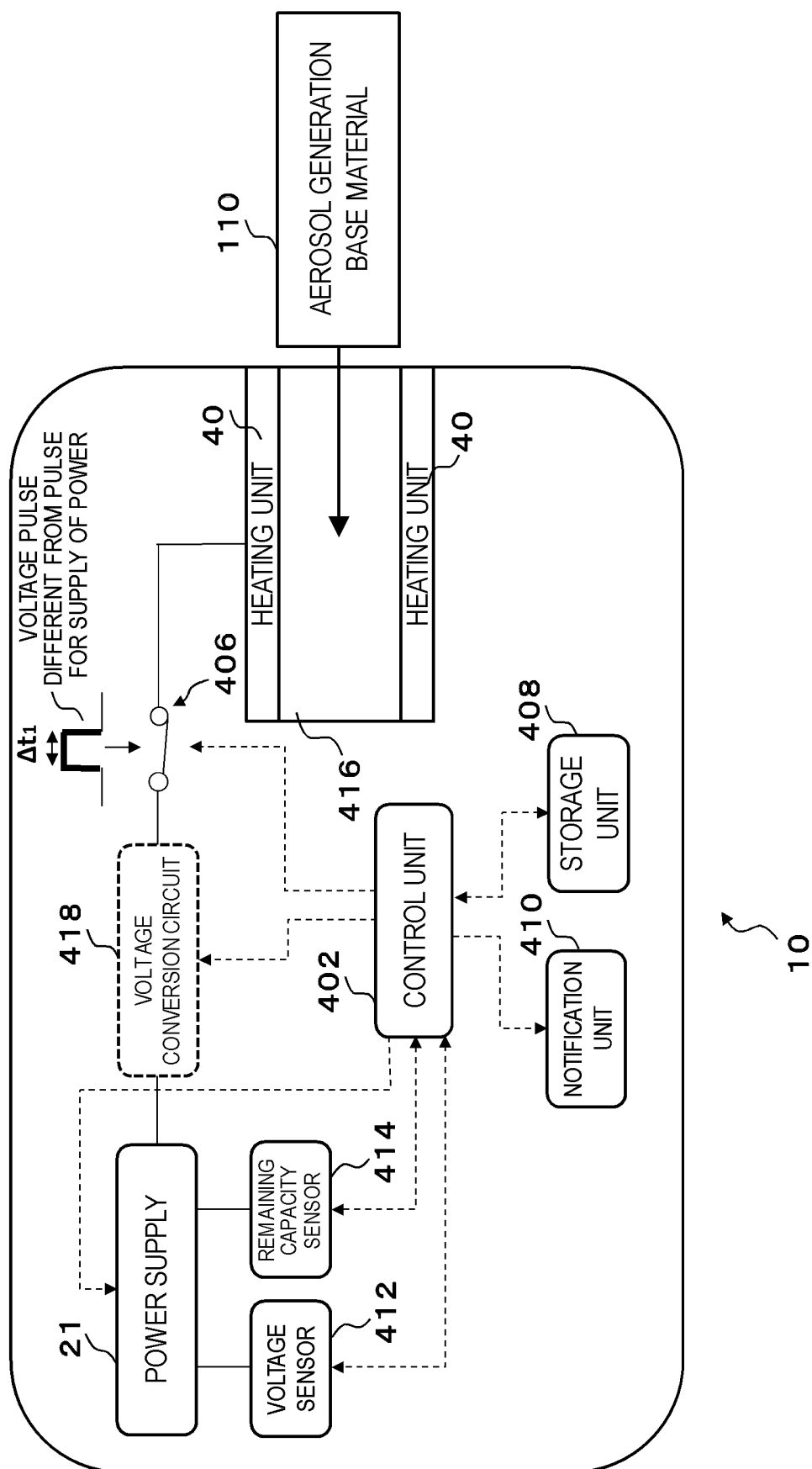


Fig. 4C

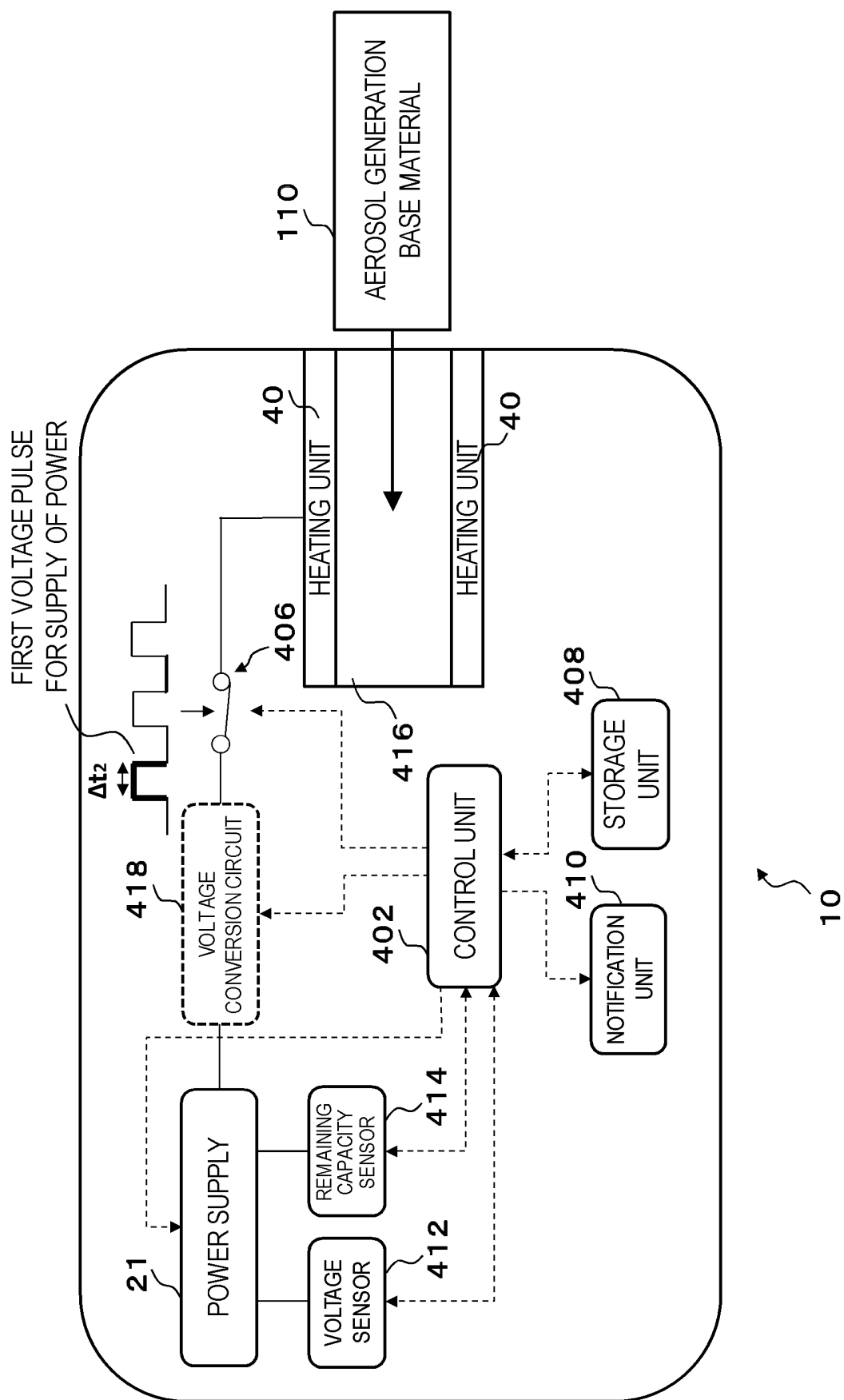


Fig. 5

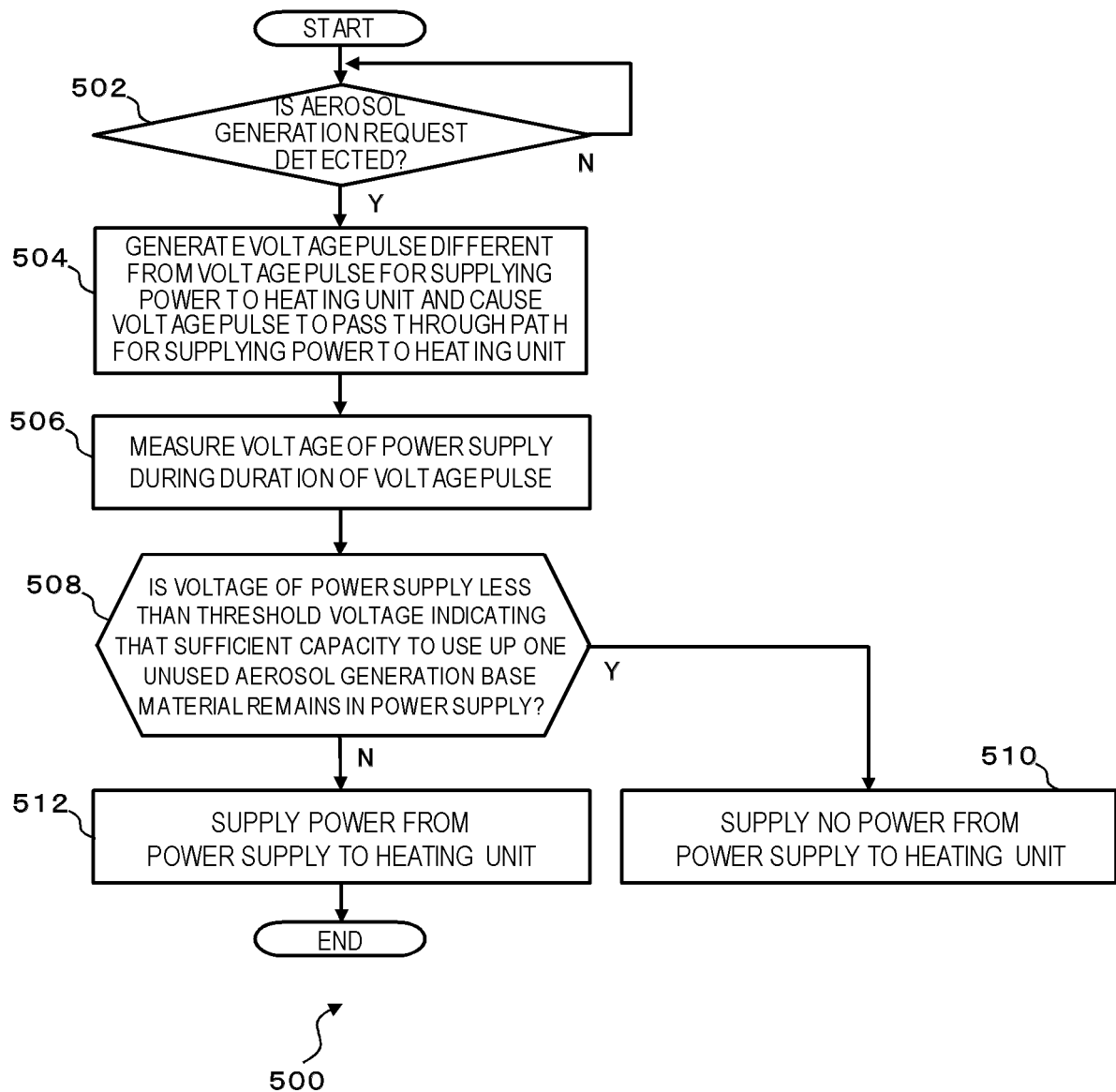


Fig. 6

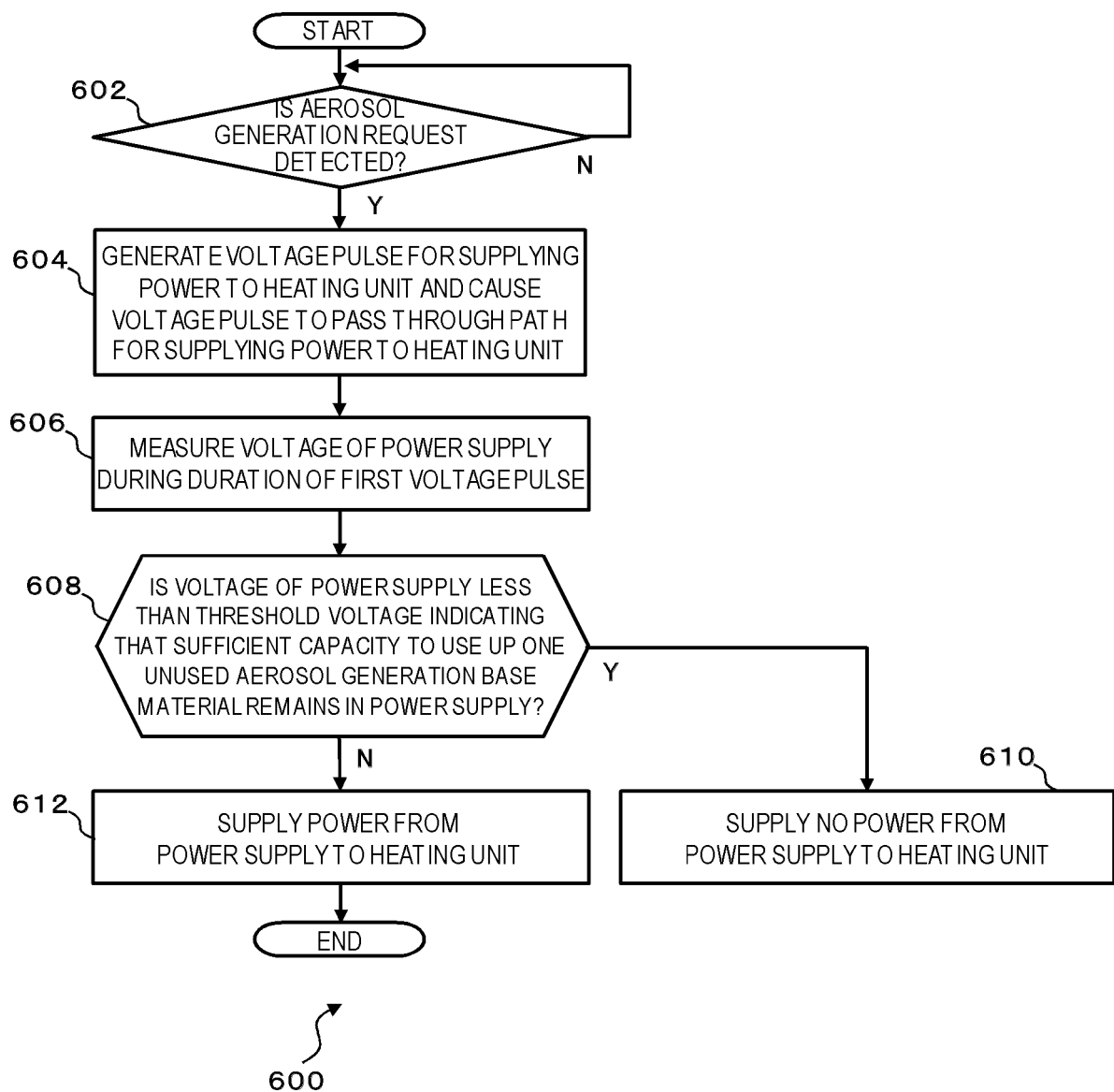


Fig. 7A

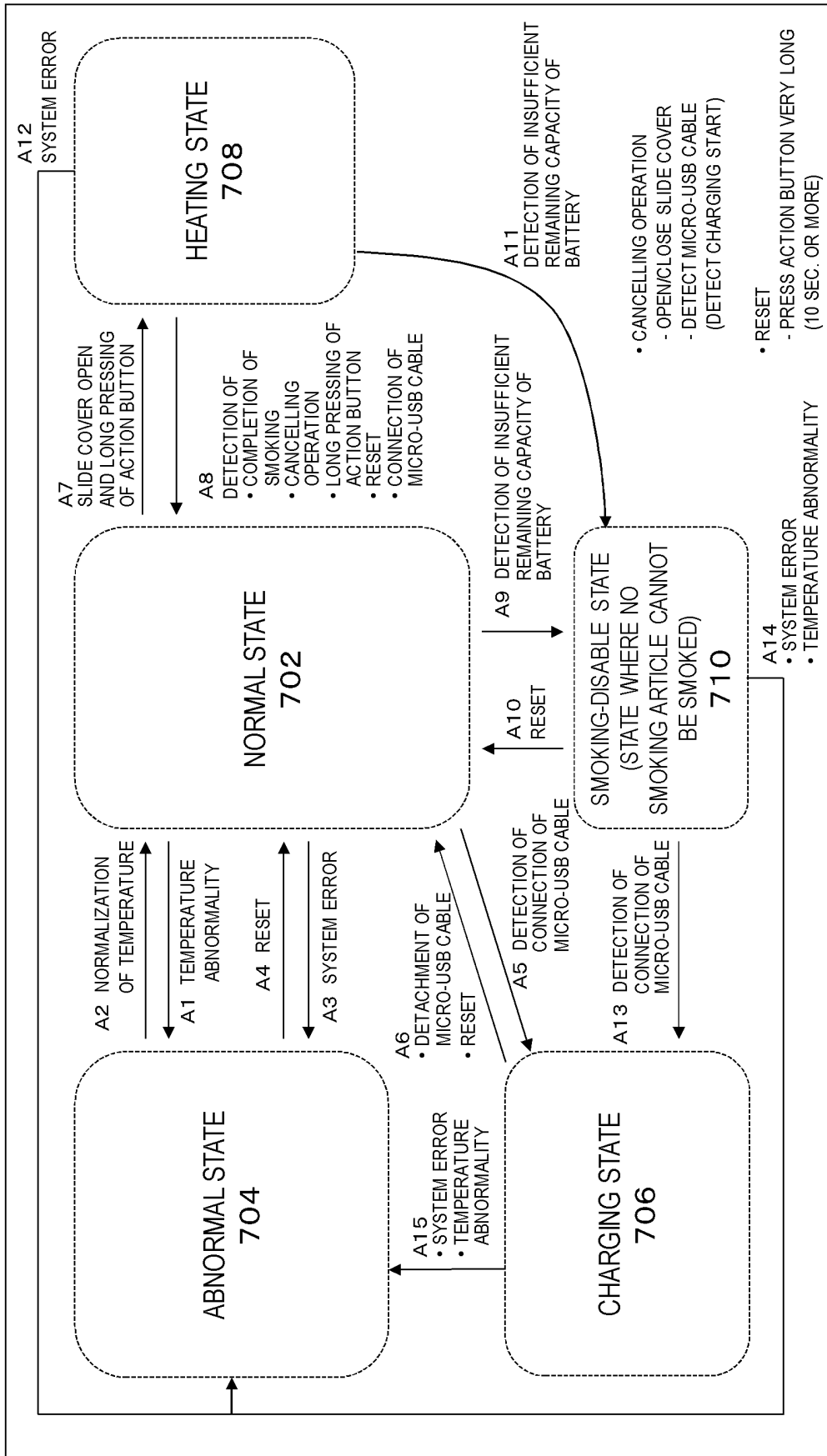
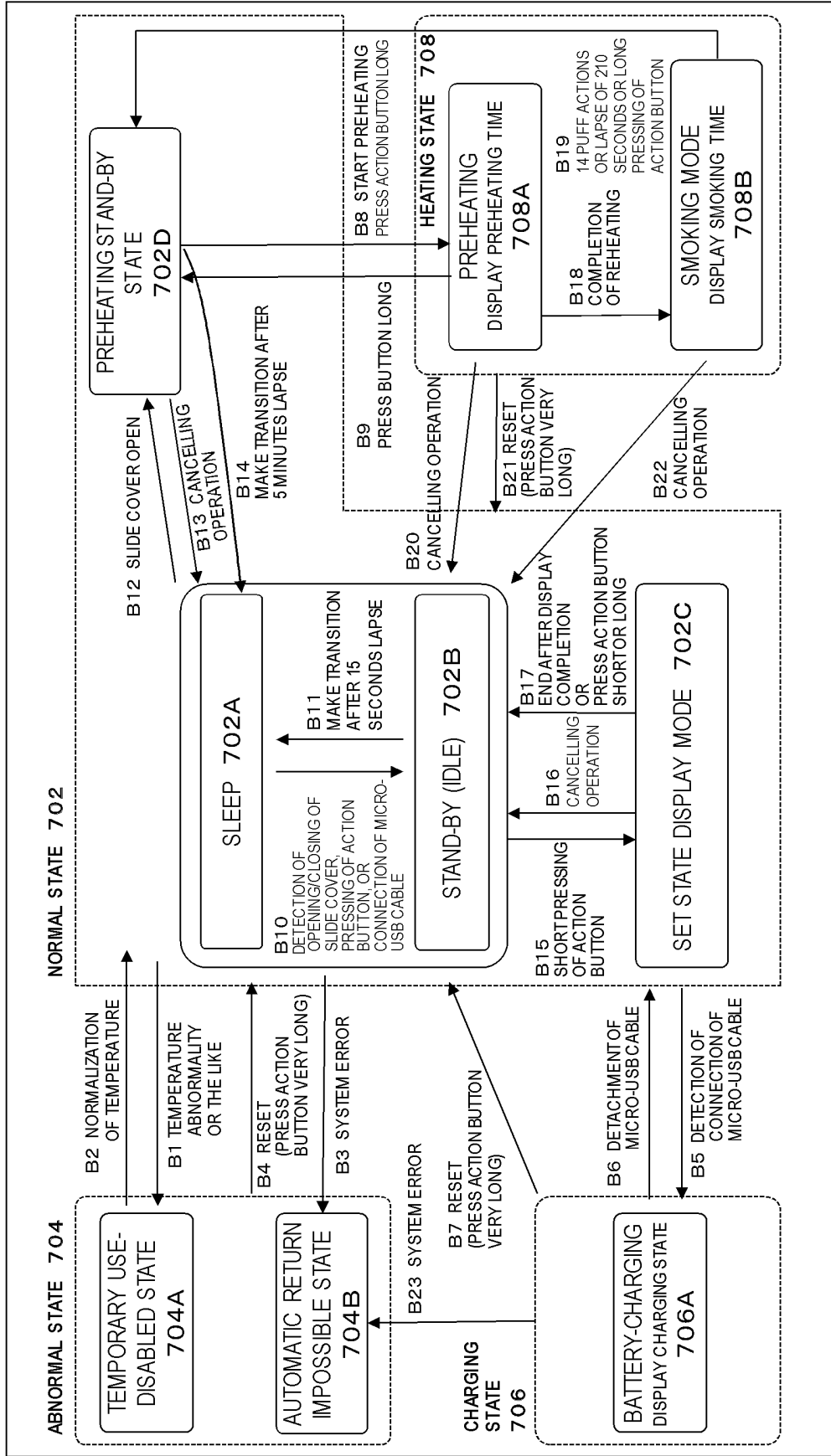
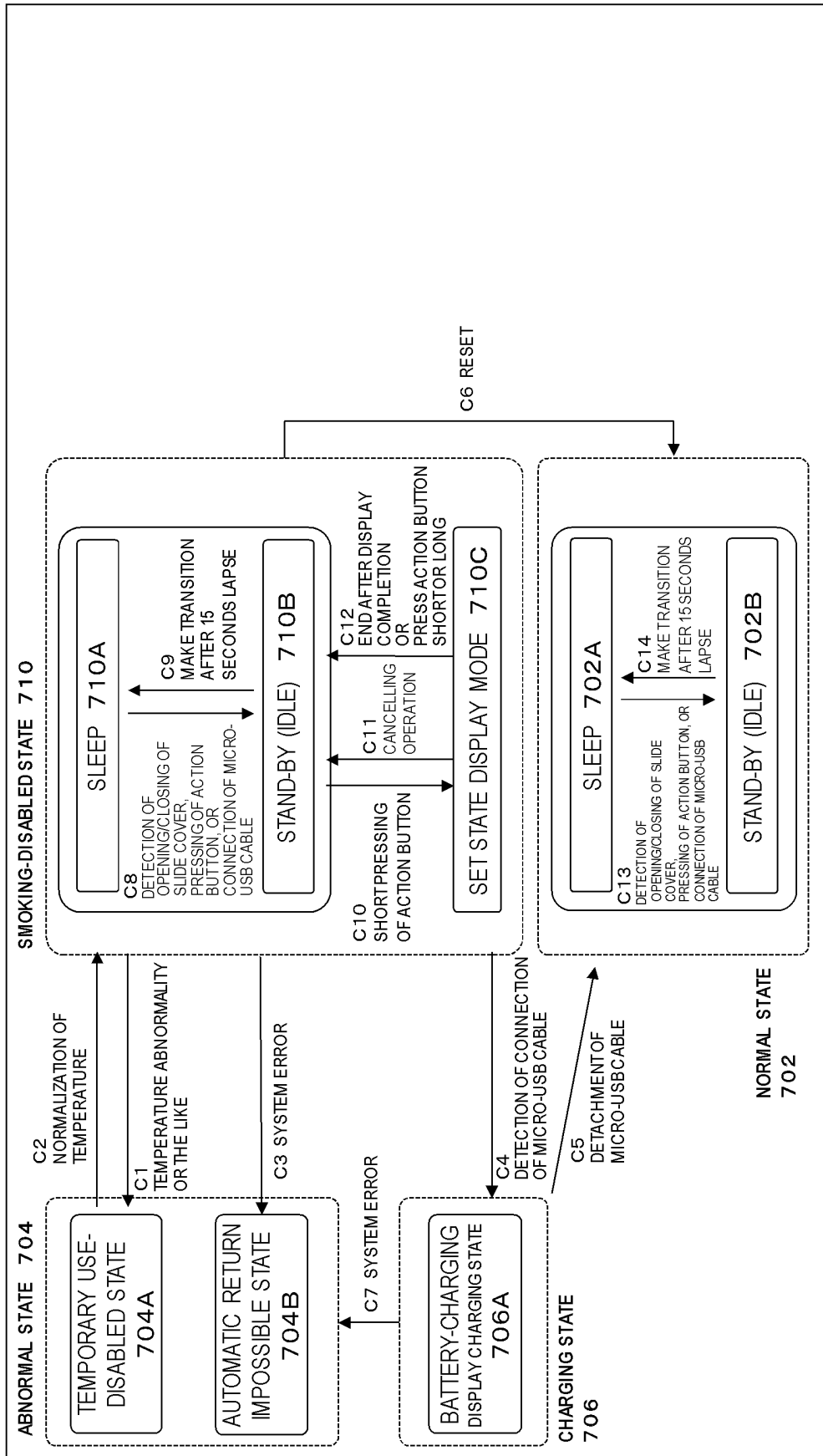


Fig. 7B



700B

Fig. 7C



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/039854

## A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. A24F47/00 (2006.01) i

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)

Int.Cl. A24F47/00

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 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

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

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category*   | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                  | Relevant to claim No.         |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| X<br>Y<br>A | JP 2015-534458 A (PHILIP MORRIS PRODUCTS S.A.) 03<br>December 2015, paragraphs [0027], [0028], [0044],<br>fig. 1, 7 & US 2015/0181942 A1, paragraphs [0096]-<br>[0099], [0125], [0126], fig. 1, 7 & WO 2014/029880<br>A2 & EP 2701268 A1 & KR 10-2015-0045448 A & CN<br>104584366 A | 1, 14, 15<br>2-9, 13<br>10-12 |



Further documents are listed in the continuation of Box C.



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28 November 2018 (28.11.2018)Date of mailing of the international search report  
11 December 2018 (11.12.2018)Name and mailing address of the ISA/  
Japan Patent Office  
3-4-3, Kasumigaseki, Chiyoda-ku,  
Tokyo 100-8915, Japan

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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| Y         | WO 2018/001910 A1 (PHILIP MORRIS PRODUCTS S. A.)<br>04 January 2018, specification, page 14, lines 5-14, page 17, lines 26-32, page 18, line 35 to page 19, line 13, fig. 1-3 & TW 201800020 A                           | 2-9, 13               |
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- EP 2640205 A [0004]