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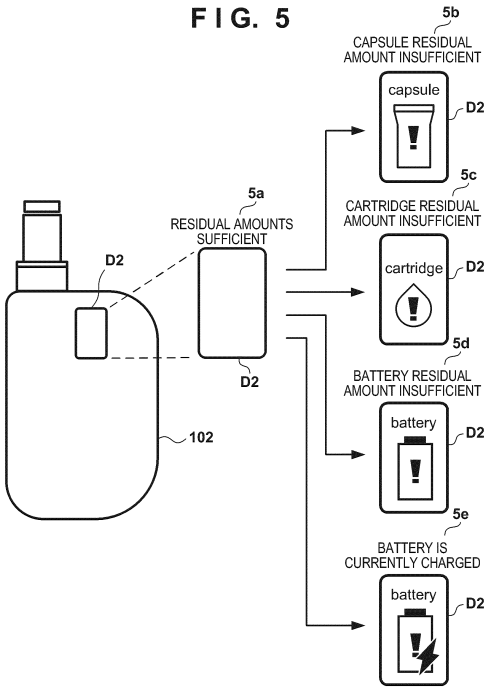
(54) CONTROLLER FOR SUCTION DEVICE

(57) This controller for a suction device, which is for carrying out an atomization process for heating and atomizing an aerosol source in response to receiving an atomization request from the aerosol source, comprises a processor for assessing whether a remaining capacity is insufficient for each of a plurality of elements used in the atomization process, and a display that is capable of displaying information for issuing notification that the remaining capacity is insufficient with respect to each of the plurality of elements, the display being configured such that, even when it is assessed by the processor that the remaining capacity is insufficient with respect to two or more elements among the plurality of elements, the display displays the information with respect to one element selected from among the two or more elements.

FIG. 5



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Description

TECHNICAL FIELD

[0001] The present invention relates to a controller for a suction apparatus.

BACKGROUND ART

[0002] PTL 1 discloses a suction apparatus including a display (GUI).

CITATION LIST

PATENT LITERATURE

[0003] PTL 1: US-2017-0304567

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004] In an aerosol generation apparatus (a controller for a suction apparatus), when displaying, on a display, information representing an insufficient residual amount with respect to each of a plurality of elements used for atomization processing of an aerosol source, it is desired to improve visibility while reducing power consumption from the viewpoint of user usability.

[0005] Accordingly, the present invention has as its object to provide a controller for a suction apparatus, that is advantageous in both reducing power consumption and improving visibility when displaying information representing an insufficient residual amount on a display.

SOLUTION TO PROBLEM

[0006] To achieve the above object, a controller for a suction apparatus according to an embodiment of the present invention is a controller for a suction apparatus, that performs atomization processing of heating and atomizing an aerosol source in response to reception of an atomization request of the aerosol source, comprising a processor configured to determine, for each of a plurality of elements used for the atomization processing, whether a residual amount is insufficient, and a display configured to display information for making a notification of an insufficient residual amount for each of the plurality of elements, wherein the display is configured to display, even in a case where the processor determines insufficient residual amounts for at least two elements among the plurality of elements, the information concerning one element selected from the at least two elements.

[0007] In the embodiment, in a case where the processor determines insufficient residual amounts for at least two elements among the plurality of elements, the processor selects the one element from the at least two elements in accordance with a predetermined condition concerning a priority order of displaying the information on the display.

[0008] In the embodiment, the predetermined condition includes a condition that an element for which a time required for recovery of the residual amount is longer is preferentially selected as the one element from the at least two elements.

[0009] In the embodiment, the predetermined condition includes a condition that an element that cannot be visually perceived by a user is preferentially selected as the one element from the at least two elements.

[0010] In the embodiment, the predetermined condition includes a condition that an element whose degree of influence on a flavor of a gas generated by the atomization processing is higher is preferentially selected as the one element from the at least two elements.

[0011] In the embodiment, the predetermined condition includes a condition that an element for which a timing of determining the insufficient residual amount is earlier is preferentially selected as the one element from the at least two elements.

[0012] In the embodiment, in a case where the residual amount of the one element is recovered, the processor displays, on the display, the information concerning another element of the at least two elements instead of the information concerning the one element.

[0013] In the embodiment, the processor determines, for each of the plurality of elements, whether the residual amount is insufficient, based on whether the number responses to the atomization request with a current residual amount is equal to or greater than a threshold.

[0014] In the embodiment, the thresholds for at least two elements among the plurality of elements are set to different values.

[0015] In the embodiment, the controller for the suction apparatus is detachably attached with an atomizer including a container configured to hold the aerosol source and a heater configured to heat the aerosol source in the container, the plurality of elements include a first element as a power supply configured to supply electric power to the heater and a second element as the aerosol source in the container, and a second threshold as the threshold for determining whether the residual amount of the second element is insufficient is set to a value smaller than a first threshold as the threshold for determining whether the residual amount of the first element is insufficient.

[0016] In the embodiment, the controller for the suction apparatus is detachably attached with a capsule including a flavor source, the plurality of elements further include a third element as the flavor source in the capsule, and a third threshold as the threshold for determining whether the residual amount of the third element is insufficient is set to a value smaller than the second threshold.

[0017] In the embodiment, the controller for the suction apparatus is detachably attached with an atomizer including a container configured to hold the aerosol source and a heater configured to heat the aerosol source in the

container and with a capsule including a flavor source, and the plurality of elements include at least two of a first element as a power supply configured to supply electric power to the heater, a second element as the aerosol source in the container, and a third element as the flavor source in the capsule.

[0018] In the embodiment, the display is electronic paper.

ADVANTAGEOUS EFFECTS OF INVENTION

[0019] According to the present invention, it is possible to provide a controller for a suction apparatus, that is advantageous in both reducing power consumption and improving visibility when displaying information representing an insufficient residual amount on a display.

[0020] Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings. Note that the same reference numerals denote the same or like components throughout the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0021] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain principles of the invention.

Fig. 1 is an exploded view showing an example of the arrangement of a suction apparatus according to an embodiment;

Fig. 2 shows external views of the example of the arrangement of the suction apparatus according to the embodiment;

Fig. 3 is a schematic view showing the example of the arrangement of the suction apparatus according to the embodiment;

Fig. 4 is a schematic circuit diagram showing an example of the arrangement of an electrical component of a controller;

Fig. 5 is a view showing display examples of insufficient residual amount information on the second display;

Fig. 6 is a view showing examples of an operation mode of a processor;

Fig. 7 is a flowchart illustrating an example of display control processing concerning display control of the second display;

Fig. 8A is a flowchart illustrating the example of the display control processing concerning display control of the second display;

Fig. 8B is a flowchart illustrating the example of the display control processing concerning display control of the second display;

Fig. 9 is a view showing an example of the relationship between the possible number of suctions and a threshold with respect to each element;

Fig. 10 is a flowchart illustrating an example of rewrite processing #1 (replacement);

Fig. 11 is a flowchart illustrating an example of rewrite processing #2 (charging);

Fig. 12A is a flowchart illustrating an example of rewrite processing #3 (residual amount);

Fig. 12B is a flowchart illustrating the example of the rewrite processing #3 (residual amount);

Fig. 13 is a table showing an example of the characteristic of each element;

Fig. 14 is a table showing condition examples for selecting one element;

Fig. 15 is a timing chart showing Example 1 concerning rewrite of the display contents of the second display; and

Fig. 16 is a timing chart showing Example 2 concerning rewrite of the display contents of the second display.

DESCRIPTION OF EMBODIMENTS

[0022] Hereinafter, embodiments will be described in detail with reference to the attached drawings. Note, the following embodiments are not intended to limit the scope of the claimed invention, and limitation is not made to an invention that requires a combination of all features described in the embodiments. Two or more of the multiple features described in the embodiments may be combined as appropriate. Furthermore, the same reference numerals are given to the same or similar configurations, and redundant description thereof is omitted.

[0023] A suction apparatus 100 according to an embodiment of the present invention will be described. Figs. 1 to 3 show an example of the arrangement of the suction apparatus 100. Fig. 1 shows an exploded view of the suction apparatus 100, and Fig. 2 shows external views of the suction apparatus 100. Fig. 2 shows a front view of the suction apparatus 100, a side view of the suction apparatus 100, and a perspective view of the suction apparatus 100. Furthermore, Fig. 3 shows a schematic view of the suction apparatus 100.

[0024] The suction apparatus 100 can be configured to provide, to a user via a mouthpiece portion 130, a gas containing aerosol, a gas containing aerosol and a flavor material, aerosol, or aerosol containing a flavor material in accordance with an operation of requesting atomization of an aerosol source (to be also referred to as an "atomization request" hereinafter) such as a suction operation by the user. The suction apparatus 100 can include a controller 102 for the suction apparatus, and an atomizer 104. The atomizer 104 is detachably be held by a holding portion 103 provided in the controller 102 for the suction apparatus, and can be configured to atomize an aerosol source under the control of the controller 102 for the suction apparatus. The aerosol source can be, for example, a liquid such as a polyhydric alcohol such as glycerin or propylene glycerol. Alternatively, the

aerosol source may contain a drug. The aerosol source may be a liquid, a solid, or a mixture of a liquid and a solid. A vapor source such as water may be used in place of the aerosol source. Note that the controller 102 for the suction apparatus will sometimes simply be referred to as the controller 102 hereinafter and the atomizer 104 will sometimes be referred to as the cartridge 104 hereinafter.

[0025] The suction apparatus 100 can include a capsule holder 105 that holds, in a detachable state, a capsule 106 including a flavor source 131. The capsule holder 105 is configured to engage (threadably engage) with the tubular holding portion 103, and is attached to the holding portion 103 in a state in which the cartridge 104 is inserted into the holding portion 103, as shown in Figs. 1 and 3. This can prevent the cartridge 104 from dropping from the holding portion 103 of the controller 102, and maintain a state in which the electrical contact of the controller 102 and that of the cartridge 104 are in contact with each other. That is, the capsule holder 105 can function as a lock mechanism for fixing the cartridge 104 to the holding portion 103 of the controller 102. The flavor source 131 can be, for example, a molded body formed by molding a tobacco material. Alternatively, the flavor source 131 may be formed by a plant (for example, mint, herb, Chinese herb, coffee bean, and the like) other than tobacco. A flavor such as menthol may be added to the flavor source. The flavor source 131 may be added to the aerosol source. Note that the cartridge 104 and the capsule holder 105 are formed separately in this embodiment but may be formed integrally.

[0026] The controller 102 can include an electrical component 110 with a battery (power supply) BAT. The battery BAT may be formed by a secondary battery such as a lithium-ion secondary battery or an electric double-layer capacitor such as a lithium-ion capacitor. The electrical component 110 can include a user interface 116. Alternatively, the controller 102 may be understood to include the electrical component 110 and the user interface 116. Furthermore, as shown in Fig. 2, the controller 102 is provided with, on its outer surface, a window portion W formed by a light transmitting member. This allows the user to visually perceive (visually confirm), from the outside of the controller 102 via the window portion W, the residual amount of the aerosol source in the cartridge 104 held by the holding portion 103.

[0027] The user interface 116 can include, for example, an operation unit B that accepts a user operation and providing units D1 and D2 that provide information to the user. The operation unit B is, for example, a button switch (to be sometimes referred to as the button B hereinafter), but another switch, a touch display, or the like may be used.

[0028] The providing unit D1 is a display (display unit) for displaying the residual amount information of the battery BAT, the cartridge 104, and/or the capsule 106 stepwise, and will sometimes be referred to as the first display D1 hereinafter. For example, an Organic Light Emitting Diode or Organic EL (OLED) can be used as the first display D1. Note that in this embodiment, the first display D1 is provided between the holding portion 103 and the button B on the outer surface of the controller 102, as shown in Fig. 2. However, the present invention is not limited to this, and the first display D1 may be provided at an arbitrary position on the controller 102. Furthermore, the controller 102 need not include the first display D1.

[0029] The providing unit D2 is a display (display unit) for displaying information for making a notification of an insufficient residual amount of the battery BAT, the cartridge 104, and/or the capsule 106, and will sometimes be referred to as the second display D2 hereinafter. As the second display D2, a display that consumes electric power only to rewrite the display contents, such as electronic paper (for example, e-ink®), can be used. Note that in this embodiment, the second display D2 is provided on the front surface of the controller 102, as shown in Fig. 2. However, the present invention is not limited to this, and the second display D2 may be provided at an arbitrary position on the controller 102.

[0030] The holding portion 103 of the controller 102 can include a first electrical contact 111 and a second electrical contact 112. In a state in which the cartridge 104 is held by the holding portion 103, the first electrical contact 111 of the holding portion 103 can contact a third electrical contact 113 of the cartridge 104 and the second electrical contact 112 of the holding portion 103 can contact a fourth electrical contact 114 of the cartridge 104. The controller 102 can supply electric power to a heater HT of the cartridge 104 via the first electrical contact 111 and the second electrical contact 112.

[0031] As described above, the cartridge 104 can include the third electrical contact 113 and the fourth electrical contact 114. Furthermore, the cartridge 104 can include the heater HT that heats and atomizes the aerosol source, a container 125 that holds (accommodates) the aerosol source, and a transport portion (wick) 126 that transports the aerosol source held in the container 125 to a heating area of the heater HT and holds the aerosol source in the heating area. At least a part of the heating area can be arranged in a channel 128 provided in the cartridge 104. The first electrical contact 111, the third electrical contact 113, the heater HT, the fourth electrical contact 114, and the second electrical contact 112 form a current path configured to flow a current to the heater HT. The transport portion 126 can be made of, for example, a fiber material such as glass fiber, a porous material such as ceramic, or a combination thereof. Note that the means for transporting the aerosol source held in the container 125 to the heating area is not limited to the wick, and a spraying device such as a spray or a transporting means such as a pump may be used instead.

[0032] The capsule 106 is attached to the controller 102 (or the cartridge 104) so that a part of the capsule 106 is accommodated by the capsule holder 105 attached to the holding portion 103 of the controller 102

and another part including the mouthpiece portion 130 is exposed. The user can hold, in their mouth, the mouthpiece portion 130 and inhale aerosol or a gas containing aerosol. When the detachable capsule 106 includes the mouthpiece portion 130, the suction apparatus 100 can be kept clean.

[0033] If the user holds the mouthpiece portion 130 in the mouth and performs a suction operation, air flows into the channel 128 of the cartridge 104 through an opening (not shown), as exemplified by a broken arrow in Fig. 3. When the heater HT heats the aerosol source, the vaporized and/or aerosolized aerosol source is transported toward the mouthpiece portion 130 by air. In the process in which the aerosol source is transported toward the mouthpiece portion 130, the vaporized and/or aerosolized aerosol source is cooled to form fine liquid droplets, thereby promoting aerosolization. In the arrangement in which the flavor source 131 is arranged, a flavor material generated from the flavor source 131 is added to the aerosol, and the resultant aerosol is transported to the mouthpiece portion 130, and sucked into the user's mouth. Since the flavor material generated from the flavor source 131 is added to the aerosol, the flavor material can efficiently be transported to the lungs of the user without staying in the oral cavity of the user.

[0034] Next, the arrangement of the electrical component 110 of the controller 102 will be described. Fig. 4 schematically shows an example of the arrangement of the electrical component 110 of the controller 102. Fig. 4 also shows the heater HT of the cartridge 104 attached to the controller 102. A connecting portion between the first electrical contact 111 of the controller 102 and the third electrical contact 113 of the cartridge 104 is represented by "R_{c+}" and a connecting portion between the second electrical contact 112 of the controller 102 and the fourth electrical contact 114 of the cartridge 104 is represented by "R_{c-}". In addition, Fig. 4 shows a GND terminal and a V_{BUS} terminal of a connector (for example, a USB port) connected to an external power supply (for example, a charger) (not shown). The V_{BUS} terminal and the GND terminal are represented by "V_{BUS}" and "GND", respectively, in Fig. 4.

[0035] The electrical component 110 can include, for example, the battery BAT, a power supply unit that supplies electric power to the cartridge 104 (the heater HT thereof), a detection unit that detects the resistance value of the heater HT, and an energization control unit that controls energization of the heater HT in accordance with information obtained using the detection unit. Furthermore, the electrical component 110 can include a detection unit that detects a user operation and an atomization request, and a notification control unit that controls a notification of information to the user. The heater HT has a resistance value R_{HTR} that changes in accordance with the temperature of the heater HT. The resistance value R_{HTR} may have a positive temperature coefficient characteristic (that is, a PTC characteristic) in which the resistance value R_{HTR} increases as the temperature of the heater HT rises, or a negative temperature coefficient characteristic (that is, an NTC characteristic) in which the resistance value R_{HTR} increases as the temperature of the heater HT lowers.

[0036] The power supply unit that supplies electric power to the heater HT can include a power supply circuit 11, a voltage converter 12, and a switch SW, all of which are arranged on a power supply line from the plus terminal of the battery BAT to the heater HT. The power supply circuit 11 includes, for example, a charge IC, and outputs, from an output terminal, a voltage supplied from the plus terminal of the battery BAT. The power supply circuit 11 can be configured to supply, to the battery BAT, a voltage supplied from the external power supply via the V_{BUS} terminal in a case where the external power supply is connected. The voltage converter 12 includes, for example, a DC/DC converter, and converts the power supply voltage supplied from the power supply circuit 11 into a heater driving voltage, and outputs it. The heater driving voltage output from the voltage converter 12 is supplied to the connecting portion R_{c+} (the first electrical contact 111 and the third electrical contact 113). On the other hand, since the connecting portion R_{c-} (the second electrical contact 112 and the fourth electrical contact 114) is electrically connected to the minus terminal of the battery BAT, a current path configured to flow a current to the heater HT can be formed between the output terminal of the voltage converter 12 and the minus terminal of the battery BAT. The switch SW includes, for example, a Field Effect Transistor (FET), and opening/closing (OFF/ON) of the switch SW can be controlled by a processor 10. The switch SW can be arranged on a line (current path) connecting the output terminal of the voltage converter 12 and the heater HT (connecting portion R_{c+}). However, the present invention is not limited to this, and the switch SW may be arranged on a line connecting the heater HT (connecting portion R_{c-}) and the minus terminal of the battery BAT. Note that a diode connected to the switch SW in Fig. 4 represents the body (parasitic) diode of the Field Effect Transistor.

[0037] The detection unit that detects the resistance value R_{HTR} of the heater HT can include a shunt resistor R_{shunt} and an amplifier 13. The shunt resistor R_{shunt} has a characteristic in which the resistance value hardly changes even if the temperature of the shunt resistor R_{shunt} changes. The amplifier 13 can include, for example, an operational amplifier including a noninverting input terminal, an inverting input terminal, and an output terminal. The positive-side power supply terminal of the amplifier 13 can be connected to the output terminal of the voltage converter 12 via the switch SW and the shunt resistor R_{shunt}, and the negative-side power supply terminal of the amplifier 13 can be connected to the ground line. The noninverting input terminal of the amplifier 13 is connected to the connecting portion R_{c+} (first electrical contact 111), and the inverting input terminal of the amplifier 13 is connected to the connecting portion R_{c-} (second electrical contact 112). Therefore, the amplifier 13

can amplify a potential difference between the connecting portions R_{c+} and R_{c-}, that is, a voltage V_{HTR} generated in the heater HT, and outputs the voltage as an output voltage V_{AMP}. This allows the processor 10 to calculate a temperature T_{HTR} of the heater HT based on the output voltage V_{AMP} of the amplifier 13. More specifically, the processor 10 can calculate the resistance value R_{HTR} of the heater HT based on the output voltage V_{AMP} of the amplifier 13 and the amplification factor of the amplifier 13, and convert the resistance value R_{HTR} into the temperature T_{HTR} of the heater HT based on the temperature coefficient [ppm/°C] of the heater HT.

[0038] The energization control unit that controls energization of the heater HT can include the processor 10. The processor 10 can be formed by, for example, a Micro Controller Unit (MCU) but may be formed by an MCU and an analog circuit. An output voltage of a voltage conversion circuit 14 such as Low DropOut (LDO) is supplied to the power supply terminal of the processor 10. The voltage conversion circuit 14 is a circuit that converts the output voltage of the power supply circuit 11 into the power supply voltage of the processor 10 or the like. As described above, the processor 10 can calculate the temperature T_{HTR} of the heater HT based on the output voltage V_{AMP} of the amplifier 13, and control energization of the heater HT by controlling opening/closing of the switch SW based on the calculated temperature T_{HTR} of the heater HT.

[0039] The detection unit that detects a user operation and an atomization request can include the button B and a puff sensor 15. The output voltage of the voltage conversion circuit 14 is supplied to the button B and the puff sensor 15. As described above, the button B is provided, as a part of the user interface 116, on the outer surface of the controller 102, and supplies, when a user operation (the pressing operation of the button B) is detected, a detection signal to the processor 10. The puff sensor 15 includes, for example, a pressure sensor and a microphone capacitor, and supplies, when a puff operation (suction operation) of the user is detected, a detection signal to the processor 10. The detection of the user operation (pressing operation) using the button B and/or the detection of the puff operation using the puff sensor 15 are practical examples of the above-described atomization request.

[0040] In addition, the detection unit may include a first sensor 26 that detects the presence or absence of the cartridge 104, and a second sensor 27 that detects the presence or absence of the capsule 106. The output voltage of the voltage conversion circuit 14 can be supplied to the first sensor 26 and the second sensor 27. Each of the first sensor 26 and the second sensor 27 can be, for example, a photo interrupter, a proximity sensor, an RFID system, or a switch. The switch that detects the presence or absence of the cartridge 104 can be turned on (or off) when the cartridge 104 is inserted into the holding portion 103, and turned off (or on) when the cartridge 104 is detached from the holding portion 103. The switch that detects the presence or absence of the capsule 106 can be turned on (or off) when the capsule 106 is inserted into the holding portion 103 (capsule holder 105), and turned off (or on) when the capsule 106 is detached from the holding portion 103 (capsule holder 105).

[0041] The notification control unit that controls a notification of information to the user can include the first display D1, the second display D2, a vibration motor 16 (vibration motor), and a light emitting element 17. As described above, the first display D1 is, for example, an Organic Light Emitting Diode or Organic EL (OLED), and displays the residual amount information of the battery BAT, the cartridge 104, and/or the capsule 106 stepwise. An output voltage of a voltage converter 18 such as a DC/DC converter is supplied to the first display D1. As described above, the second display D2 is a display that consumes electric power only to rewrite the display contents, such as electronic paper, and displays information for making a notification of an insufficient residual amount of the battery BAT, the cartridge 104, and/or the capsule 106. The vibration motor 16 applies a vibration to the controller 102 by rotating a shaft attached with a vibrator. The light emitting element 17 is, for example, a Light Emitting Diode (LED), and notifies the user of information by turning on or blinking. The light emitting element 17 can be provided, for example, around the button B or in the window portion W. The notification control unit can include a first driving circuit 21 (first driver) that drives the first display D1, a second driving circuit 22 (second driver) that drives the second display D2, a third driving circuit 23 (third driver) that drives the vibration motor 16, and a fourth driving circuit 24 (fourth driver) that drives the light emitting element 17. The first driving circuit 21 to the fourth driving circuit 24 operate by the output voltage of the voltage conversion circuit 14, and can be controlled by the processor 10.

[0042] The second display D2 according to this embodiment is configured to display information (to be sometimes referred to as insufficient residual amount information hereinafter) for making a notification of an insufficient residual amount with respect to one element selected from a plurality of elements used for atomization processing of an aerosol source. More specifically, the second display D2 is configured to display, even in a case where an insufficient residual amount is determined with respect to two or more elements among the plurality of elements, only the insufficient residual amount information with respect to one element selected from the two or more elements. In this arrangement, since it is possible to reduce (suppress) the area of the second display D2, it is possible to reduce the power consumption of the second display D2 when rewriting (changing) the display contents. Furthermore, since only the insufficient residual amount information of the selected one element is largely displayed on the second display D2, it is possible to ensure the visibility of the user even if the area of the second display D2 is reduced. That is, in the arrangement of the second display D2 according to this embodiment,

it is possible to both reduce the power consumption and improve the visibility when displaying the insufficient residual amount information, thereby improving the user usability.

[0043] The plurality of elements used for atomization processing can include, for example, at least two of a first element as the battery BAT (the residual amount thereof) for supplying electric power to the heater HT, a second element as the aerosol source (the residual amount thereof) in the container 125 of the cartridge 104, and a third element as the flavor source (the residual amount thereof) in the capsule 106. The following description assumes that the plurality of elements include the first to third elements. Furthermore, the first element will sometimes be referred to as a residual battery amount hereinafter, the second element will sometimes be referred to as a cartridge residual amount hereinafter, and the third element will sometimes be referred to as a capsule residual amount hereinafter.

[0044] Fig. 5 shows display examples of the insufficient residual amount information on the second display D2. The second driving circuit 22 can rewrite the display on the second display D2 under the control of the processor 10. A display example 5a of Fig. 5 shows a display example in a case where the residual amounts of all the plurality of elements are sufficient (equal to or larger than thresholds). In this case, nothing is displayed on the second display D2. A display example 5b of Fig. 5 shows a display example of the insufficient residual amount information of the capsule 106 (flavor source). A display example 5c of Fig. 5 shows a display example of the insufficient residual amount information of the cartridge 104 (aerosol source). A display example 5d of Fig. 5 shows a display example of the insufficient residual amount information of the battery BAT. The second display D2 may be configured to display information representing that the battery BAT is currently being charged by the external power supply. A display example 5e of Fig. 5 shows a display example of information representing that the battery BAT is currently being charged.

[0045] The operation mode of the processor 10 will be described next. Fig. 6 shows examples of the operation mode of the processor 10. The processor 10 can include, as operation modes, for example, an active mode 31, a sleep mode 32, an aerosol generation mode 33, and a charging mode 34. The active mode 31 is a mode in which atomization processing (to also be referred to as heating processing) of heating the aerosol source by the heater HT and atomizing the aerosol source in response to reception of an atomization request of the user. More specifically, the active mode 31 can be a mode in which the processor 10 stands by for receiving an atomization request so as to start atomization processing at the start of reception of the atomization request of the user. If, in the state of the active mode 31, for example, the user starts a suction operation via the mouthpiece portion 130 to start reception of a detection signal from the puff sensor 15, the processor 10 determines the start of an atomization request, and shifts from the active mode 31 to the aerosol generation mode 33. The aerosol generation mode 33 is a mode of performing the atomization processing to generate aerosol by supplying electric power to the heater HT. If the suction operation of the user ends and the reception of the detection signal from the puff sensor 15 ends, the processor 10 determines the end of the atomization request, and shifts from the aerosol generation mode 33 to the active mode 31.

[0046] If a non-operation period reaches a predetermined time (for example, 6 min) in the active mode 31, the processor 10 shifts from the active mode 31 to the sleep mode 32. The sleep mode 32 is a mode in which the power consumption is made smaller than in the active mode 31. For example, if an operation (pressing) of the button B by the user is detected, the processor 10 shifts from the sleep mode 32 to the active mode 31. If connection of the external power supply (charger) is detected in the active mode 31 and/or the sleep mode 32, the processor 10 shifts to the charging mode 34. The charging mode 34 is a mode of charging the battery BAT. If detachment of the external power supply is detected, the processor 10 shifts from the charging mode 34 to the sleep mode 32. Note that when charging of the battery BAT is complete, the processor 10 may also shift from the charging mode 34 to the sleep mode 32.

[0047] Next, display control of the second display D2 will be described in association with the operation mode of the processor 10. Figs. 7, 8A, and 8B show display control processing concerning display control of the second display D2. The display control processing shown in Figs. 7, 8A, and 8B is started in a state in which the processor 10 is in the sleep mode 32, and can be executed by the processor 10.

[0048] In step S101 of Fig. 7, the processor 10 determines whether charging of the battery BAT by the external power supply (charger) is started. For example, if the external power supply is connected to the connecter (V_{BUS} terminal and GND terminal) of the controller 102, the processor 10 can determine that charging of the battery BAT is started. If the processor 10 determines that charging is started, the process advances to step S102, and the processor 10 shifts from the sleep mode 32 to the charging mode 34 to start charging of the battery BAT, and then executes the rewrite processing #2 (charging) in step S103. Then, after the processor 10 shifts from the charging mode 34 to the sleep mode 32 in step S104, the process returns to step S101. The rewrite processing #2 (charging) is processing of rewriting the display contents of the second display D2, and details thereof will be described later.

[0049] If it is determined in step S101 that charging is not started, the process advances to step S105. In step S105, the processor 10 determines whether to perform activation in accordance with a user operation (manual). For example, if the user operates (presses) the button B, the processor 10 can determine to perform activation. If it is determined to perform activation, the process ad-

vances to step S106, the processor 10 shifts from the sleep mode 32 to the active mode 31, and then process advances to step S201 of Fig. 8A. On the other hand, if it is determined not to manually perform activation, the process advances to step S107.

[0050] In step S107, the processor 10 determines whether to automatically perform activation. For example, the processor 10 may determine to automatically perform activation for every predetermined period such as every several hours or every day, or may determine to automatically perform activation when a predetermined time elapses after the last activation (manual or automatic). If the processor 10 determines to automatically perform activation, the process advances to step S108, and the processor 10 shifts from the sleep mode 32 to the active mode 31. Then, the processor 10 executes the rewrite processing #1 (replacement) in step S109, and executes the rewrite processing #3 (residual amount) in step S110. After that, the processor 10 shifts from the active mode 31 to the sleep mode 32 in step S111, and the process returns to step S101. Each of the rewrite processing #1 (replacement) and the rewrite processing #3 (residual amount) is processing of rewriting the display contents of the second display D2 and details thereof will be describe later. The order of steps S109 and S110 may be changed.

[0051] In step 201 of Fig. 8A, the processor 10 determines whether charging of the battery BAT by the external power supply (charger) is started. For example, if the external power supply is connected to the connecter (V_{BUS} terminal and GND terminal) of the controller 102, the processor 10 can determine that charging of the battery BAT is started. If the processor 10 determines that charging is started, the process advances to step S202, and the processor 10 shifts from the active mode 31 to the charging mode 34 to start charging of the battery BAT, and then executes the rewrite processing #2 (charging). On the other hand, if the processor 10 determines that charging is not started, the process advances to step S203.

[0052] In step S203, the processor 10 determines whether replacement of the cartridge 104 and/or the capsule 106 is detected. For example, the processor 10 can detect replacement of the cartridge 104 and/or the capsule 106 based on the detection result of the first sensor 26 and/or the second sensor 27. Furthermore, the processor 10 can detect replacement of the cartridge 104 and/or the capsule 106 based on the output voltage V_{AMP} of the amplifier 13. When detaching or attaching the cartridge 104, the output voltage V_{AMP} of the amplifier 13 exhibits a predetermined variation. Therefore, when the output voltage V_{AMP} of the amplifier 13 exhibits a predetermined variation, the processor 10 can detect replacement of the cartridge 104. More specifically, when the cartridge 104 is attached, the amplifier 13 outputs, as the output voltage V_{AMP}, a heater driving voltage divided by the shunt resistor R_{shunt} and the heater HT. When the cartridge 104 is detached, the amplifier 13 outputs a heater driving voltage as the output voltage V_{AMP}. With respect to the capsule 106 as well, replacement of the capsule 106 can be detected in the same manner. More specifically, when replacing the capsule 106, a stress is generated between the first electrical contact 111 and the third electrical contact 113 and a stress is generated between the second electrical contact 112 and the fourth electrical contact 114, and thus the electric resistance values of the connecting portions R_{c+} and R_{c-} vary. The variations of the electric resistance values cause a predetermined variation of the output voltage V_{AMP} of the amplifier 13. If replacement of the cartridge 104 and/or the capsule 106 is detected, the rewrite processing #1 (replacement) is executed in step S204 and the rewrite processing #3 (residual amount) is executed in step S205, and then the process returns to step S201. The order of steps S204 and S205 may be changed. On the other hand, if replacement of the cartridge 104 and/or the capsule 106 is not detected, the process advances to step S206.

[0053] In step S206, the processor 10 acquires the residual amounts (the residual battery amount, the cartridge residual amount, and the capsule residual amount) of the respective elements used for the atomization processing. For example, the processor 10 can obtain each of the residual battery amount, the cartridge residual amount, and the capsule residual amount as the number (to be referred to as the possible number of suctions hereinafter) of executions of a puff operation (suction operation) with each residual amount. The possible number of suctions may be understood as the number of responses to the atomization request with the current residual amount. More specifically, as shown in Fig. 9, the processor 10 can set, as a reference number (for example, 250), the possible number of suctions with the residual amount (a residual battery amount of 100%) of the fully charged battery BAT, and can calculate, as the possible number of suctions with the current residual battery amount, a value obtained by subtracting the number of executions of a puff operation from the reference number. Furthermore, the processor 10 can set, as a reference number (for example, 250), the possible number of suctions with the residual amount (a cartridge residual amount of 100%) of the cartridge 104 immediately after replacement, and can calculate, as the possible number of suctions with the current cartridge residual amount, a value obtained by subtracting the number of executions of a puff operation from the reference number. Similarly, the processor 10 can set, as a reference number (for example, 50), the possible number of suctions with the residual amount (a capsule residual amount of 100%) of the capsule 106 immediately after replacement, and can calculate, as the possible number of suctions with the current capsule residual amount, a value obtained by subtracting the number of executions of a puff operation from the reference number. Next, in step S207, the processor 10 executes the rewrite processing #3 (residual amount).

[0054] In step S208, the processor 10 acquires the residual amount of the battery BAT as a voltage value using a power supply management circuit (not shown). Next, in step S209, the processor 10 determines whether the residual amount (voltage value) of the battery BAT acquired in step S208 exceeds a lower limit value. The lower limit value is, for example, the lower limit value of a voltage (dischargeable voltage) that can be discharged by the battery BAT or the lower limit value of a voltage at which the heater HT can be heated, and may be called a discharge termination voltage. If the residual amount (voltage value) of the battery BAT is equal to or smaller than the lower limit value, the process advances to step S210 to shift to the sleep mode 32, and then returns to step S101 of Fig. 7. On the other hand, if the residual amount (voltage value) of the battery BAT exceeds the lower limit value, the process advances to step S211.

[0055] In step S211, based on the detection of the user operation using the button B and/or the detection of the puff operation (suction operation) using the puff sensor 15, the processor 10 determines whether the atomization request of the user has been started. One atomization request may correspond to one pressing operation of the button B. In this case, the atomization request starts at the start of pressing of the button B by the user, and ends at the end of the pressing. Alternatively, one atomization request may end when a predetermined time elapses after the start of pressing of the button B by the user. Alternatively, one atomization request may correspond to one puff operation (suction operation). In this case, the atomization request starts at the start of a puff operation, and ends at the end of the puff operation. If the atomization request has not been started, the process advances to step S212, and the processor 10 determines whether a predetermined time elapses after shifting to the sleep mode 32, that is, whether a non-operation period reaches a predetermined time (for example, 6 min). If the predetermined time elapses, the process advances to step 210; otherwise, the process returns to step S211. On the other hand, if it is determined in step S211 that the atomization request has been started, the process advances to step S213 of Fig. 8B.

[0056] In step S213, the processor 10 starts to supply electric power to the heater HT by controlling opening/closing of the switch SW. In step S214, the processor 10 determines whether the atomization request of the user has ended. If the atomization request has not ended, step S214 is repeatedly performed; otherwise, the process advances to step S215. Note that while step S214 is repeatedly performed, electric power is continuously supplied to the heater HT. In step S215, the processor 10 stops (ends) supplying electric power to the heater HT by controlling opening/closing of the switch SW. Next, the processor 10 acquires, in step S216, the residual amounts (the residual battery amount, the cartridge residual amount, and the capsule residual amount) of the respective elements used for the atomization processing, and executes the rewrite processing #3 (residual amount) in step S217. Step S216 is the same as step S206 and a description thereof will be omitted.

[0057] In step S218, the processor 10 determines whether the residual battery amount (that is, the possible number of suctions with the residual battery amount) obtained in step S216 is smaller than a threshold TH_B (first threshold). If the residual battery amount is smaller than the threshold TH_B, it is determined that the residual amount of the battery BAT is insufficient, and the process advances to step S210 to shift to the sleep mode 32, and then returns to step S101 of Fig. 7. On the other hand, if the residual battery amount is equal to or larger than the threshold TH_B, the process advances to step S219. In step S219, the processor 10 determines whether the cartridge residual amount (that is, the possible number of suctions with the cartridge residual amount) obtained in step S216 is smaller than a threshold TH_{CT} (second threshold). If the cartridge residual amount is smaller than the threshold TH_{CT}, it is determined that the residual amount of the aerosol source in the cartridge 104 is insufficient, and the process advances to step S210 to shift to the sleep mode 32, and then returns to step S101 of Fig. 7. On the other hand, if the cartridge residual amount is equal to or larger than the threshold TH_{CT}, the process advances to step S220. In step S220, the processor 10 determines whether the capsule residual amount (that is, the possible number of suctions with the capsule residual amount) obtained in step S216 is smaller than a threshold TH_{CP} (third threshold). If the capsule residual amount is smaller than the threshold TH_{CP}, it is determined that the residual amount of the flavor source in the capsule 106 is insufficient, and the process advances to step S210 to shift to the sleep mode 32, and then returns to step S101 of Fig. 7. On the other hand, if the capsule residual amount is equal to or larger than the threshold TH_{CP}, the process returns to step S201. Note that the order of steps S218 to S220 can be any order.

[0058] The threshold TH_B of the residual battery amount, the threshold TH_{CT} of the cartridge residual amount, and the threshold TH_{CP} of the capsule residual amount are defined as the thresholds of the possible number of suctions, and can be set to values corresponding to respective characteristics, that is, different values, as shown in Fig. 9. More specifically, with respect to the battery BAT, if the residual battery amount is too small, a decrease in performance of the battery BAT may be accelerated, and thus the threshold TH_B can be set to a relatively large value (for example, the possible number of suctions of 30). With respect to the cartridge 104, since it is desired to use the cartridge 104 as much as possible, the threshold TH_{CT} can be set to a value (for example, the possible number of suctions of 15) smaller than the threshold TH_B of the residual battery amount. With respect to the capsule 106, since it is desired to use the capsule 106, as much as possible, more than the cartridge 104, the threshold TH_{CP} can be set to a value (for example, the possible number of suctions of 10) smaller than the thresholds TH_{CT} of the cartridge residual

amount.

[0059] Next, the rewrite processing #1 (replacement) will be described. Fig. 10 shows the rewrite processing #1 (replacement). As described above, the rewrite processing #1 (replacement) is processing of rewriting the display contents of the second display D2, and can be performed when the processor 10 controls the second driving circuit 22.

[0060] In step S301, the processor 10 determines whether replacement of the capsule 106 by the user has started. As described above, the processor 10 may determine whether replacement of the capsule 106 has started, based on the detection result of the second sensor 27 or based on the output voltage V_{AMP} of the amplifier 13. If replacement of the capsule 106 has started, the process advances to step S302; otherwise, the process advances to step S306.

[0061] In step S302, the processor 10 prohibits supplying electric power to the heater HT. Next, in step S303, the processor 10 determines whether the replacement of the capsule 106 by the user has ended. As described above, the processor 10 may determine whether the replacement of the capsule 106 has ended, based on the detection result of the second sensor 27 or based on the output voltage V_{AMP} of the amplifier 13. If the processor 10 determines that the replacement of the capsule 106 has ended, the process advances to step S304, and the processor 10 rewrites the display contents of the second display D2 to clear the display for making a notification of an insufficient residual amount of the capsule 106, and cancels the prohibition of power supply to the heater HT in step S305. After that, the processor 10 ends the procedure.

[0062] In step S306, the processor 10 determines whether replacement of the cartridge 104 by the user has started. As described above, the processor 10 may determine whether replacement of the cartridge 104 has started, based on the detection result of the first sensor 26 or based on the output voltage V_{AMP} of the amplifier 13. If the replacement of the cartridge 104 has started, the process advances to step S307. If the replacement of the capsule 106 has not started, the procedure ends.

[0063] In step S307, the processor 10 prohibits supplying electric power to the heater HT. Next, in step S308, the processor 10 determines whether the replacement of the cartridge 104 by the user has ended. As described above, the processor 10 may determine whether the replacement of the cartridge 104 has ended, based on the detection result of the first sensor 26 or based on the output voltage V_{AMP} of the amplifier 13. If the processor 10 determines that the replacement of the cartridge 104 has ended, the process advances to step S309, and the processor 10 rewrites the display contents of the second display D2 to clear the display for making a notification of an insufficient residual amount of the cartridge 104, and cancels the prohibition of power supply to the heater HT in step S310. After that, the processor 10 ends the procedure.

[0064] The rewrite processing #2 (charging) will be described next. Fig. 11 shows the rewrite processing #2 (charging). As described above, the rewrite processing #2 (charging) is processing of rewriting the display contents of the second display D2, and can be performed when the processor 10 controls the second driving circuit 22.

[0065] In step S401, the processor 10 rewrites the display contents of the second display D2 so as to make a notification that the battery BAT is currently being charged, as shown in the display example 5e of Fig. 5. Next, in step S402, the processor 10 determines whether the charging of the battery BAT by the external power supply (charger) has ended. For example, when the external power supply is detached from the connector (V_{BUS} terminal and GND terminal) of the controller 102, the processor 10 can determine that the charging of the battery BAT has ended. If the charging of the battery BAT has not ended, step S402 is repeatedly performed; otherwise, the process advances to step S403.

[0066] In step S403, the processor 10 rewrites the display contents of the second display D2 to clear the notification that the battery BAT is currently being charged. Next, in step S404, the processor 10 acquires the residual battery amount. A method of acquiring the residual battery amount is as described with respect to step S206. In step S405, based on the residual battery amount acquired in step S404, the processor 10 determines whether the residual battery amount is smaller than the threshold TH_B. If the residual battery amount is smaller than the threshold TH_B, the process advances to step S406, and the processor 10 rewrites the display contents of the second display D2 so as to make a notification of an insufficient residual amount of the battery BAT, as shown in the display example 5d of Fig. 5, and ends the processing. On the other hand, if the residual battery amount is equal to or larger than the threshold TH_B, the process advances to step S407, and the processor 10 rewrites the display contents of the second display D2 so as to clear the display for making a notification of an insufficient residual amount of the battery BAT, and ends the processing. Note that if the notification of the insufficient residual amount of the battery BAT is not displayed on the second display D2, step S407 need not be performed.

[0067] The rewrite processing #3 (residual amount) will be described next. Figs. 12A and 12B show the rewrite processing #3 (residual amount). As described above, the rewrite processing #3 (residual amount) is processing of rewriting the display contents of the second display D2, and can be performed when the processor 10 controls the second driving circuit 22.

[0068] In step S501, the processor 10 determines whether the residual battery amount is smaller than the threshold TH_B. If the residual battery amount is equal to or larger than the threshold TH_B, the process advances to step S502, and the processor 10 sets, to "FALSE", the value of an element (to be sometime referred to as a battery element in a notification array hereinafter) for

making a notification of an insufficient residual amount of the battery BAT in the notification array. On the other hand, if the residual battery amount is smaller than the threshold TH_B, the process advances to step S503, and the processor 10 sets the value of the battery element in the notification array to "TRUE".

[0069] In step S504, the processor 10 determines whether the capsule residual amount is smaller than the threshold TH_{CP}. If the capsule residual amount is equal to or larger than the threshold TH_{CP}, the process advances to step S505, and the processor 10 sets, to "FALSE", the value of an element (to be sometime referred to as a capsule element in the notification array hereinafter) for making a notification of an insufficient residual amount of the flavor source in the capsule 106 in the notification array. On the other hand, if the capsule residual amount is smaller than the threshold TH_{CP}, the process advances to step S506, and the processor 10 sets the value of the capsule element in the notification array to "TRUE".

[0070] In step S507, the processor 10 determines whether the cartridge residual amount is smaller than the threshold TH_{CT}. If the cartridge residual amount is equal to or larger than the threshold TH_{CT}, the process advances to step S508, and the processor 10 sets, to "FALSE", the value of an element (to be sometime referred to as a cartridge element in the notification array hereinafter) for making a notification of an insufficient residual amount of the aerosol source in the cartridge 104 in the notification array. On the other hand, if the cartridge residual amount is smaller than the threshold TH_{CT}, the process advances to step S509, and the processor 10 sets the value of the cartridge element in the notification array to "TRUE".

[0071] In step S510, the processor 10 determines whether the number of elements whose values have been set to "TRUE" in the notification array, among the plurality of elements (the battery BAT, the cartridge 104, and the capsule 106) used for the atomization processing, is one or more. If the number of elements set with the value of "TRUE" is smaller than one, the process ends; otherwise, the process advances to step S511.

[0072] In step S511, the processor 10 determines whether the number of elements whose values have been set to "TRUE" in the notification array is one. If the number of elements set with the value of "TRUE" is one, the process advances to step S512, and the processor 10 rewrites the display contents of the second display D2 based on the notification array so as to make a notification of an insufficient residual amount of the element set with the value of "TRUE". On the other hand, if the number of elements set with the value of "TRUE" is two or more, the process advances to step S513.

[0073] In step S513, in accordance with a predetermined condition, the processor 10 selects one of the two or more elements set with the value of "TRUE". Next, in step S514, the processor 10 rewrites the display contents of the second display D2 based on the notification array so as to make a notification of an insufficient residual amount of the one element selected in step S513. Note that the predetermined condition used to select one element in step S513 is a condition concerning a priority order for selecting, from the plurality of elements, one element (to be referred to as a target element hereinafter) for which a notification of an insufficient residual amount is made on the second display D2. The predetermined condition will be described below with reference to Figs. 13 and 14. Fig. 13 shows, for each of the battery BAT, the cartridge 104, and the capsule 106, "possible number of suctions from residual amount of 100%", "time required for recovery from residual amount of 0% to 100%", and "presence/absence of visual confirmation of residual amount". Fig. 14 shows the priority order of the battery BAT, the cartridge 104, and the capsule 106 for each condition example as the predetermined condition. One of the plurality of condition examples shown in Fig. 14 may be used or two or more of the plurality of condition examples may be used in combination.

[0074] As shown in condition example 1 of Fig. 14, the predetermined condition can include a condition that the element for which the time required for recovery of the residual amount is long (longest) is preferentially selected as the target element from the two or more elements set with the value of "TRUE". Note that in the following description, to compare the times required for recovery of the residual amounts of the battery BAT, the cartridge 104, and the capsule 106, the times each required for recovery from a residual amount of 0% to 100% are used as references. As shown in Fig. 13, the residual amount of the battery BAT is recovered by charging using the external power supply, and the time (recovery time) required for recovery from a residual amount of 0% to a residual amount of 100 is about 90 min. On the other hand, the residual amount of the cartridge 104 is recovered when the user replaces the cartridge 104, and the recovery time is about 1 min. Similarly, the residual amount of the capsule 106 is recovered when the user replaces the capsule 106, and the recovery time is about 1 min. Therefore, in the condition concerning the recovery time of the residual amount, the priority order of the battery BAT, the cartridge 104, and the capsule 106 is set in this order. Note that in condition example 1 of Fig. 14, the priority level of the cartridge 104 is set higher than that of the capsule 106 in consideration of easiness of replacement.

[0075] As shown in condition example 2 of Fig. 14, the predetermined condition can include a condition that the element whose residual amount cannot be visually perceived by the user from the outside of the controller 102 is preferentially selected as the target element from the two or more elements set with the value of "TRUE". As shown in Fig. 13, with respect to the cartridge 104, the user can visually perceive (confirm) the residual amount of the aerosol source via the window portion W provided on the outer surface of the controller 102. Therefore, in the condition concerning possibility of visual perception, the priority levels of the elements (battery BAT and cap-

sule 106) other than the cartridge 104 whose residual amount can visually be perceived via the window portion W can be set high. Furthermore, the predetermined condition may be a combination of condition example 1 concerning the recovery time of the residual amount and condition example 2 concerning the possibility of visual perception. In this case, the priority order of the battery BAT, the capsule 106, and the cartridge 104 can be set in this order, as shown in condition example 3 of Fig. 14.

[0076] As shown in condition example 4 of Fig. 14, the predetermined condition can include a condition that the element whose degree of influence on the flavor of a gas generated by the atomization processing is high (highest) is preferentially selected as the target element from the two or more elements set with the value of "TRUE". For example, with respect to the degree of influence on the flavor of the gas generated by the atomization processing, the insufficient residual amount of the aerosol source in the cartridge 104 has the highest degree of influence, and the insufficient residual amount of the flavor source in the capsule 106 has the second highest degree of influence. Therefore, in the condition concerning the degree of influence on the flavor, the priority order of the cartridge 104, the capsule 106, and the battery BAT is set in this order. Furthermore, as shown in condition example 5 of Fig. 14, the predetermined condition may include a condition that the element for which the timing of determining an insufficient residual amount is early (earliest) is preferentially selected as the target element from the two or more elements set with the value of "TRUE". In condition example 5, since the priority order changes in accordance with the timing of determining an insufficient residual amount, the ordinal number of each element is described as "?" in Fig. 14 for the sake of convenience. For example, if it is determined earliest that the residual amount of the aerosol source in the cartridge 104 is insufficient, it is determined next that the residual amount of the flavor source in the capsule 106 is insufficient, it is determined last that the residual amount of the battery BAT is insufficient, and it is continuously determined that the residual amount of the aerosol source in the cartridge 104 and the residual amount of the flavor source in the capsule 106 are insufficient at the timing of determining that the residual amount of the battery BAT is insufficient, the priority order of the cartridge 104, the capsule 106, and the battery BAT is set in this order.

[0077] Fig. 15 shows Example 1 concerning rewrite of the display contents of the second display D2. In Example 1 shown in Fig. 15, as an initial state, a state in which the residual amounts of all the elements (the battery BAT, the cartridge 104, and the capsule 106) are sufficient, that is, a state in which the residual amounts of the elements are equal to or larger than the thresholds, respectively, is shown. In this initial state, the values in the notification array for all the elements are set to "FALSE", and nothing is displayed on the second display D2. After that, if only the residual amount of the capsule 106 becomes insufficient, that is, the capsule residual amount becomes smaller than the threshold TH_{CP}, the value of the capsule element in the notification array is set to "TRUE", and thus the display contents of the second display D2 are rewritten so as to make a notification of the insufficient residual amount of the capsule 106.

[0078] If the residual amount of the capsule 106 becomes sufficient (equal to or larger than the threshold TH_{CP}) by replacing the capsule 106, the flag of the capsule element in the notification array is set to "FALSE", and thus the display contents of the second display D2 are rewritten so as to clear the notification of the insufficient residual amount of the capsule 106. After that, if only the residual amount of the battery BAT becomes insufficient, that is, the residual battery amount becomes smaller than the threshold TH_B, the value of the battery element in the notification array is set to "TRUE", and thus the display contents of the second display D2 are rewritten so as to make a notification of the insufficient residual amount of the battery BAT.

[0079] Fig. 16 shows Example 2 concerning rewrite of the display contents of the second display D2. In Example 2 shown in Fig. 16, as an initial state, a state in which the residual amounts of all the elements (the battery BAT, the cartridge 104, and the capsule 106) are sufficient, that is, a state in which the residual amounts of the elements are equal to or larger than the thresholds, respectively, is shown. In this initial state, the values in the notification array for all the elements are set to "FALSE", and nothing is displayed on the second display D2. After that, if the residual amount of the battery BAT and the residual amount of the capsule 106 become insufficient, that is, the residual battery amount becomes smaller than the threshold TH_B and the capsule residual amount becomes smaller than the threshold TH_{CP}, both the values of the battery element and the capsule element in the notification array are set to "TRUE". In this case, in accordance with the above-described predetermined condition, one of the battery BAT and the capsule 106 is selected as the target element. As an example, in a case where the condition (condition example 1 of Fig. 14) concerning the recovery time of the residual amount is adopted, the battery BAT is selected as the target element, and the display contents of the second display D2 are rewritten so as to make a notification of the insufficient residual amount of the battery BAT.

[0080] If the residual battery amount becomes sufficient (equal to or larger than the threshold TH_B) by charging the battery BAT, the value of the battery element in the notification array is set to "FALSE", and thus the display contents of the second display D2 are rewritten so as to clear the notification of the insufficient residual amount of the battery BAT and make a notification of the insufficient residual amount of the capsule 106. After that, if the residual amount of the capsule 106 becomes sufficient (equal to or larger than the threshold TH_{CP}) by replacing the capsule 106, the value of the capsule element in the notification array is set to "FALSE", and thus the display contents of the second display D2 are rewrit-

ten so as to clear the notification of the insufficient residual amount of the capsule 106.

[0081] The invention is not limited to the foregoing embodiments, and various variations/changes are possible within the spirit of the invention.

Claims

1. A controller for a suction apparatus, that performs atomization processing of heating and atomizing an aerosol source in response to reception of an atomization request of the aerosol source, **characterized by** comprising:

   a processor configured to determine, for each of a plurality of elements used for the atomization processing, whether a residual amount is insufficient; and
   a display configured to display information for making a notification of an insufficient residual amount for each of the plurality of elements,
   wherein the display is configured to display, even in a case where the processor determines insufficient residual amounts for at least two elements among the plurality of elements, the information concerning one element selected from the at least two elements.

2. The controller for the suction apparatus according to claim 1, **characterized in that** in a case where the processor determines insufficient residual amounts for at least two elements among the plurality of elements, the processor selects the one element from the at least two elements in accordance with a predetermined condition concerning a priority order of displaying the information on the display.

3. The controller for the suction apparatus according to claim 2, **characterized in that** the predetermined condition includes a condition that an element for which a time required for recovery of the residual amount is longer is preferentially selected as the one element from the at least two elements.

4. The controller for the suction apparatus according to claim 2 or 3, **characterized in that** the predetermined condition includes a condition that an element that cannot be visually perceived by a user is preferentially selected as the one element from the at least two elements.

5. The controller for the suction apparatus according to any one of claims 2 to 4, **characterized in that** the predetermined condition includes a condition that an element whose degree of influence on a flavor of a gas generated by the atomization processing is higher is preferentially selected as the one element from the at least two elements.

6. The controller for the suction apparatus according to any one of claims 2 to 5, **characterized in that** the predetermined condition includes a condition that an element for which a timing of determining the insufficient residual amount is earlier is preferentially selected as the one element from the at least two elements.

7. The controller for the suction apparatus according to any one of claims 2 to 6, **characterized in that** in a case where the residual amount of the one element is recovered, the processor displays, on the display, the information concerning another element of the at least two elements instead of the information concerning the one element.

8. The controller for the suction apparatus according to any one of claims 1 to 7, **characterized in that** the processor determines, for each of the plurality of elements, whether the residual amount is insufficient, based on whether the number of responses to the atomization request with a current residual amount is equal to or greater than a threshold.

9. The controller for the suction apparatus according to claim 8, **characterized in that** the thresholds for at least two elements among the plurality of elements are set to different values.

10. The controller for the suction apparatus according to claim 9, **characterized in that**

    the controller for the suction apparatus is detachably attached with an atomizer including a container configured to hold the aerosol source and a heater configured to heat the aerosol source in the container,
    the plurality of elements include a first element as a power supply configured to supply electric power to the heater and a second element as the aerosol source in the container, and
    a second threshold as the threshold for determining whether the residual amount of the second element is insufficient is set to a value smaller than a first threshold as the threshold for determining whether the residual amount of the first element is insufficient.

11. The controller for the suction apparatus according to claim 10, **characterized in that**

    the controller for the suction apparatus is detachably attached with a capsule including a flavor source,
    the plurality of elements further include a third element as the flavor source in the capsule, and

a third threshold as the threshold for determining whether the residual amount of the third element is insufficient is set to a value smaller than the second threshold.

12. The controller for the suction apparatus according to any one of claims 1 to 11, **characterized in that**

the controller for the suction apparatus is detachably attached with an atomizer including a container configured to hold the aerosol source and a heater configured to heat the aerosol source in the container and with a capsule including a flavor source, and
the plurality of elements include at least two of a first element as a power supply configured to supply electric power to the heater, a second element as the aerosol source in the container, and a third element as the flavor source in the capsule.

13. The controller for the suction apparatus according to any one of claims 1 to 12, **characterized in that** the display is electronic paper.

FIG. 1

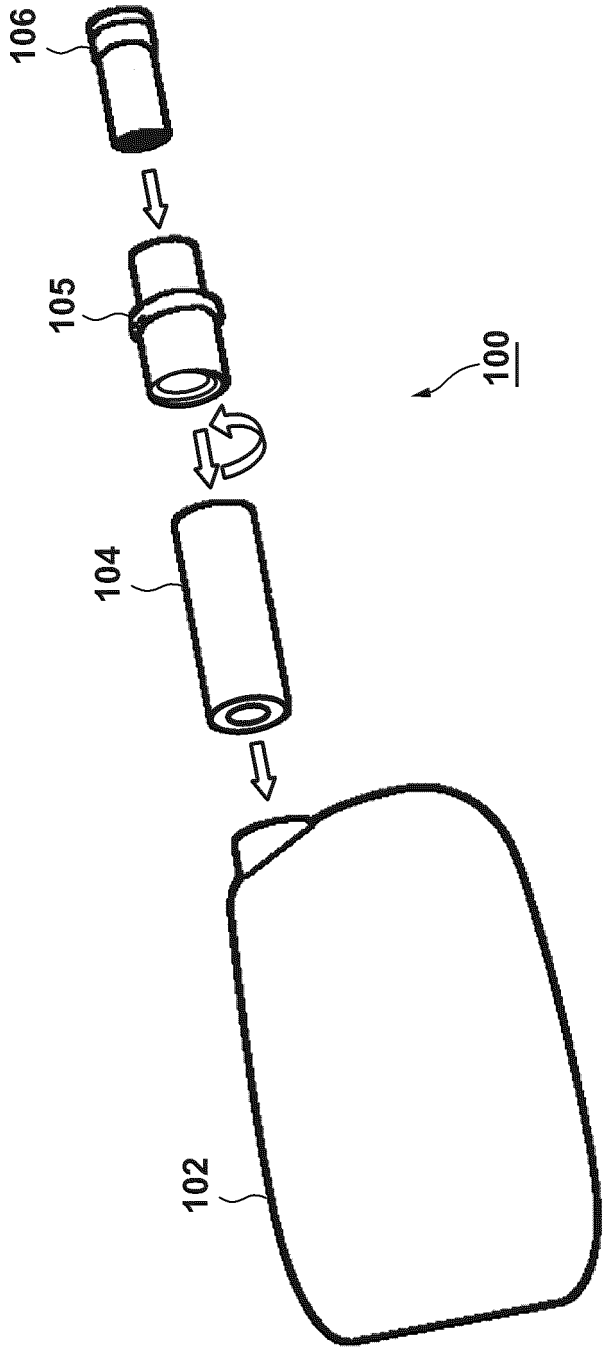


FIG. 2

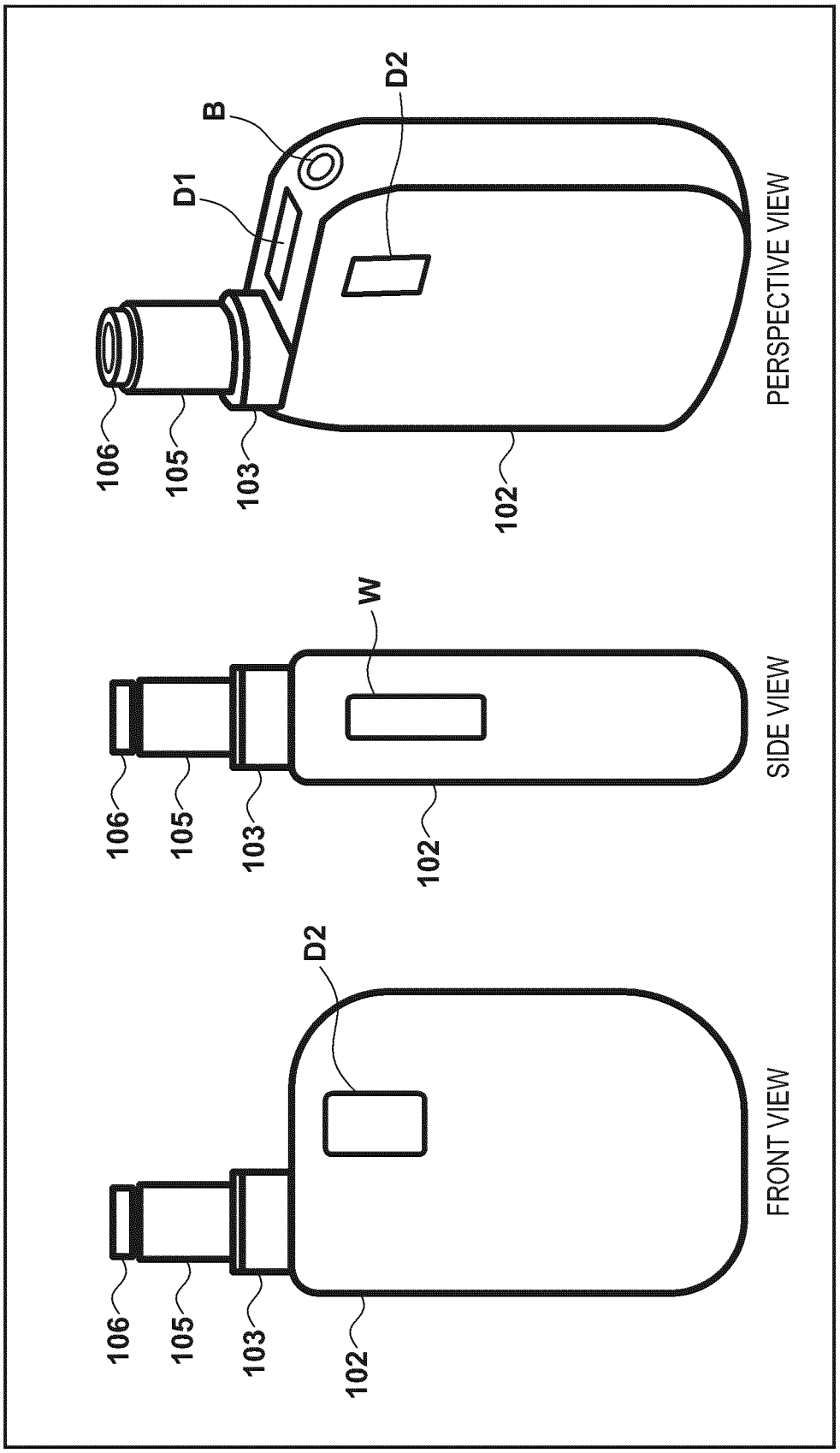

B
D2
D1
106
105
103
102
PERSPECTIVE VIEW
W
106
105
103
102
SIDE VIEW
D2
106
105
103
102
FRONT VIEW

FIG. 3

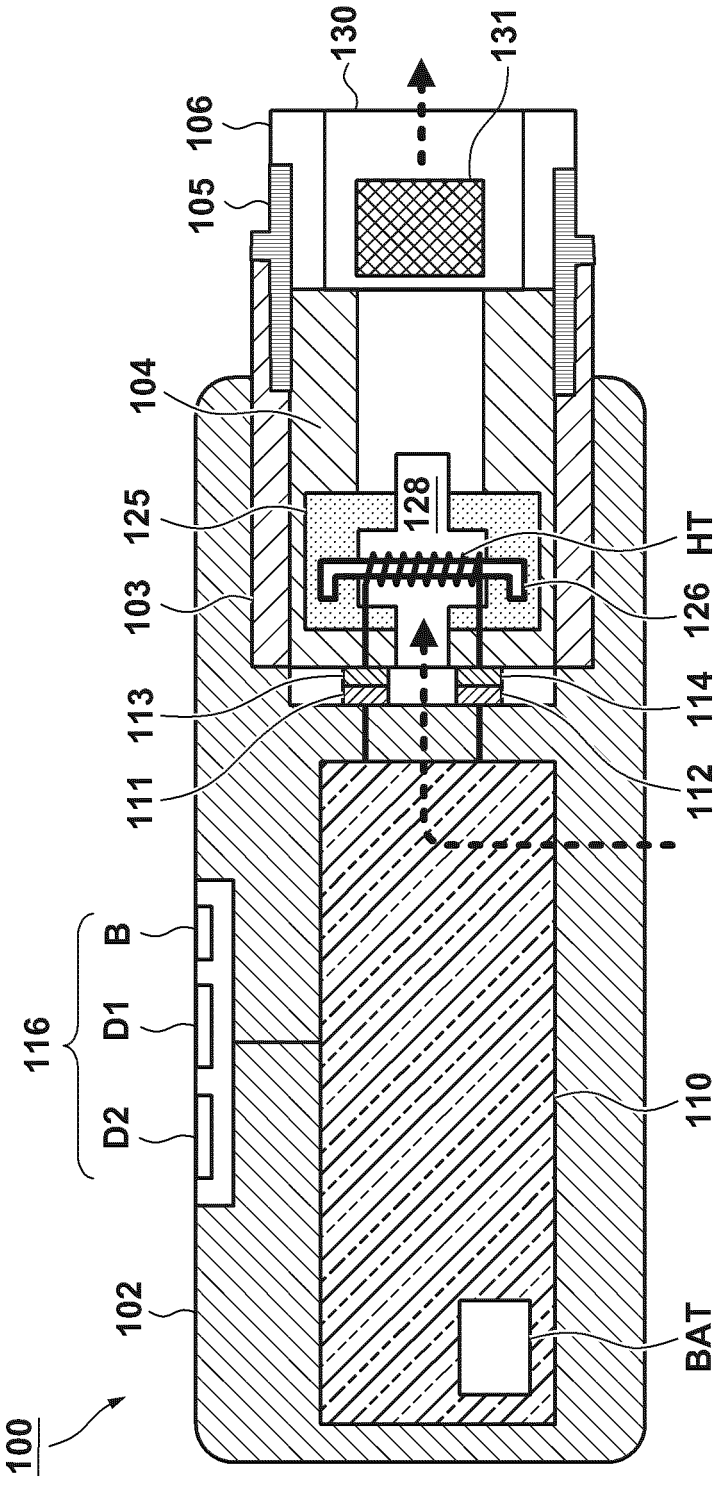

130
131
106
105
104
125
128
HT
103
126
113
114
111
112
116
B
D1
D2
110
102
BAT
100

FIG. 4

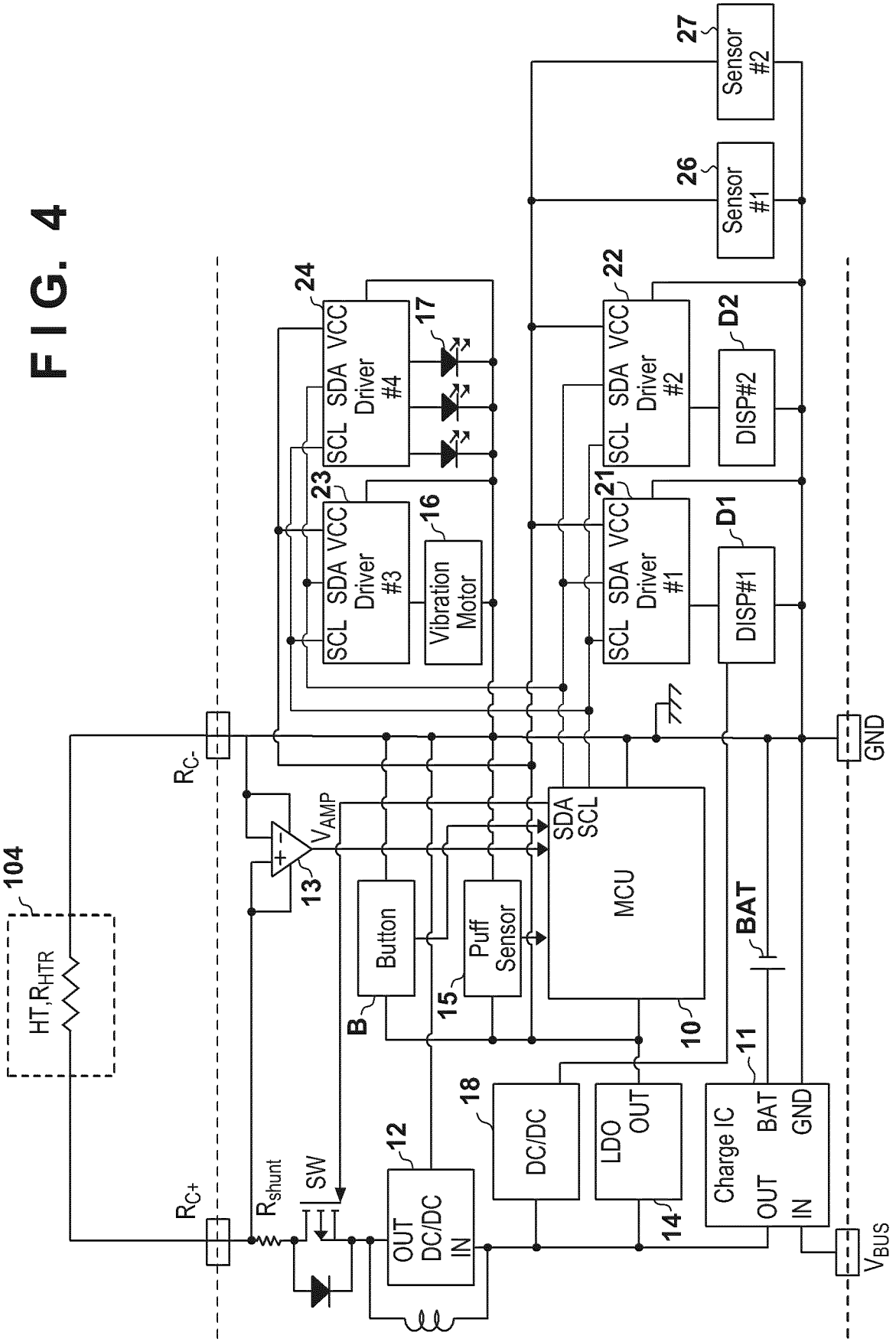

104
HT, R_{HTR}
R_{C+}
R_{C-}
R_{shunt}
SW
V_{AMP}
13
12
OUT DC/DC IN
18
DC/DC
LDO OUT
14
Charge IC
OUT BAT GND
IN
11
BAT
10
MCU
SDA
SCL
B
Button
15
Puff Sensor
24
Driver #4
17
23
Driver #3
16
Vibration Motor
22
Driver #2
D2
DISP#2
21
Driver #1
D1
DISP#1
27
Sensor #2
26
Sensor #1
GND
V_{BUS}

FIG. 5

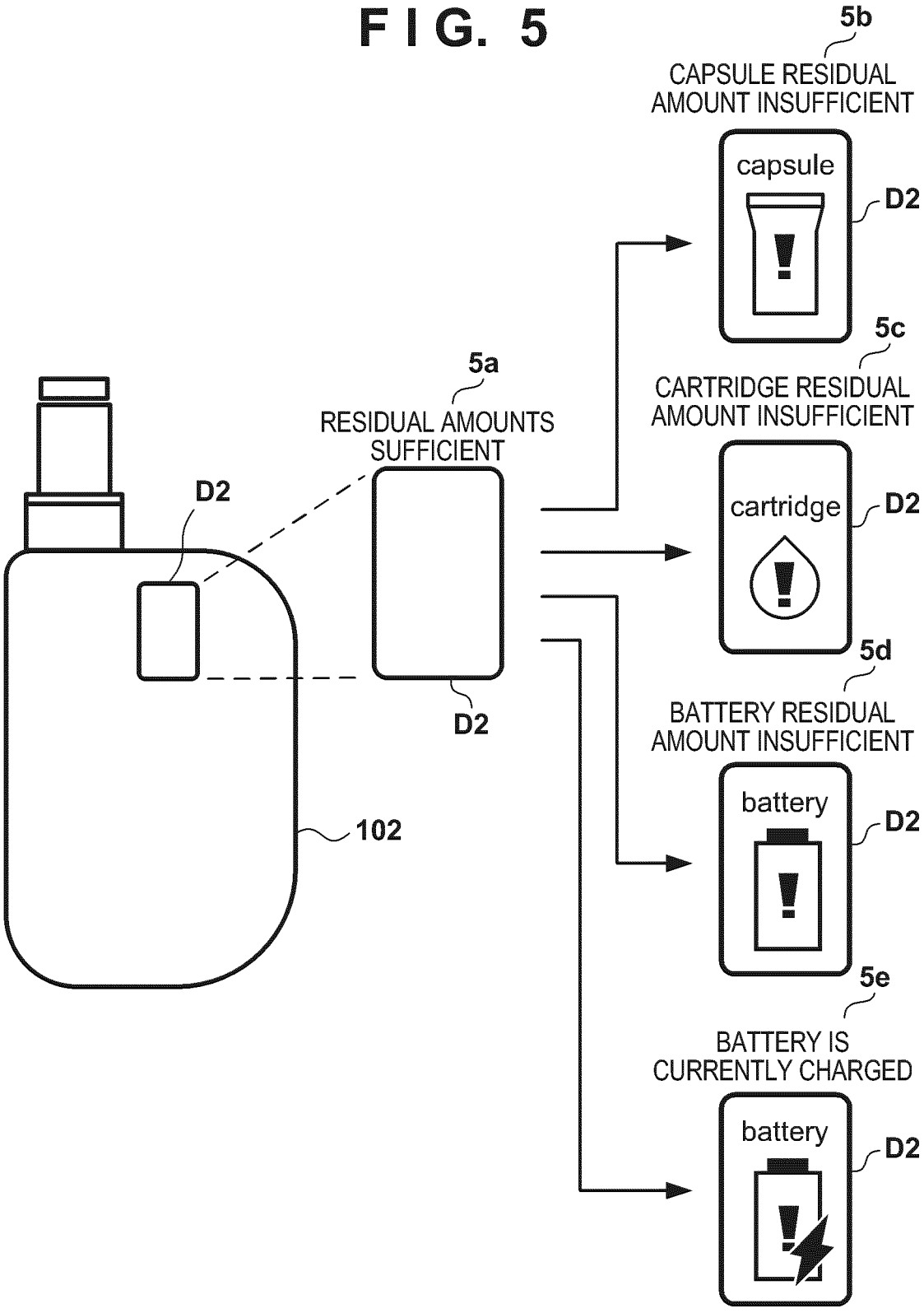

5b
CAPSULE RESIDUAL AMOUNT INSUFFICIENT
capsule
D2
5c
CARTRIDGE RESIDUAL AMOUNT INSUFFICIENT
cartridge
D2
5d
BATTERY RESIDUAL AMOUNT INSUFFICIENT
battery
D2
5e
BATTERY IS CURRENTLY CHARGED
battery
D2
5a
RESIDUAL AMOUNTS SUFFICIENT
D2
D2
102

FIG. 6

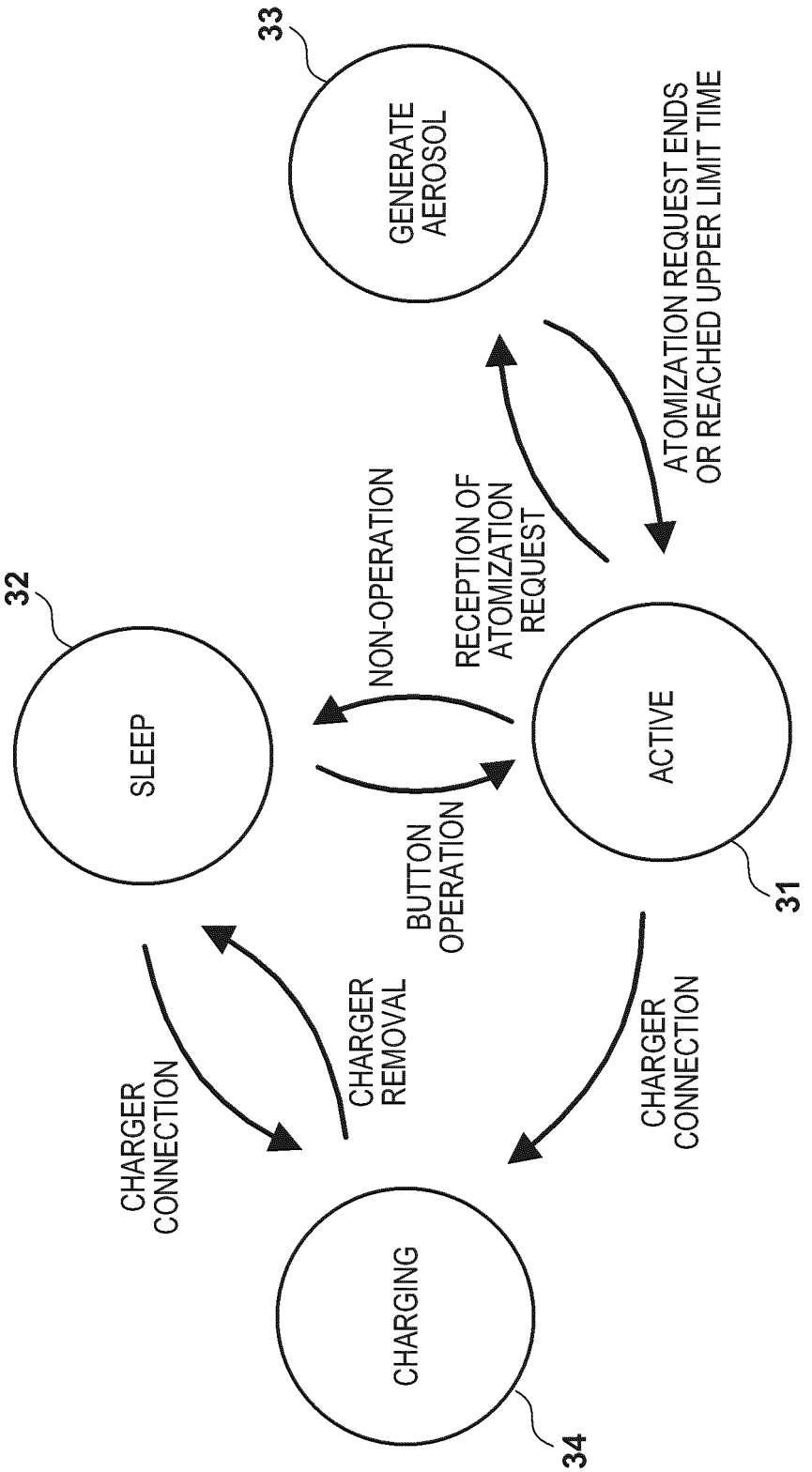

33
GENERATE AEROSOL
ATOMIZATION REQUEST ENDS OR REACHED UPPER LIMIT TIME
RECEPTION OF ATOMIZATION REQUEST
NON-OPERATION
32
SLEEP
ACTIVE
31
BUTTON OPERATION
CHARGER REMOVAL
CHARGER CONNECTION
CHARGER CONNECTION
CHARGING
34

FIG. 7

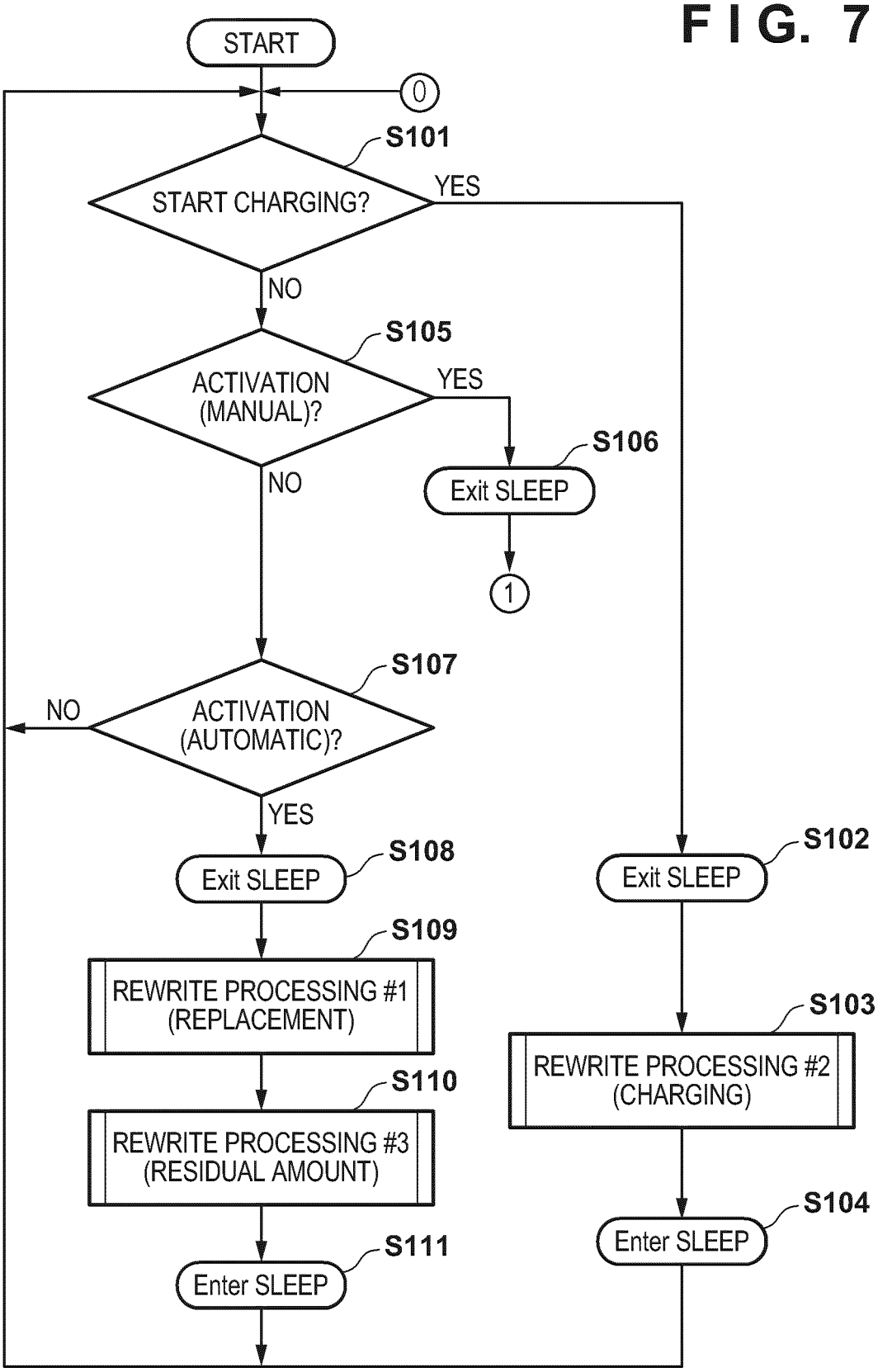

START
0
S101
START CHARGING?
YES
NO
S105
ACTIVATION (MANUAL)?
YES
S106
Exit SLEEP
NO
1
S107
NO
ACTIVATION (AUTOMATIC)?
YES
S108
Exit SLEEP
S109
REWRITE PROCESSING #1 (REPLACEMENT)
S110
REWRITE PROCESSING #3 (RESIDUAL AMOUNT)
S111
Enter SLEEP
S102
Exit SLEEP
S103
REWRITE PROCESSING #2 (CHARGING)
S104
Enter SLEEP

FIG. 8A

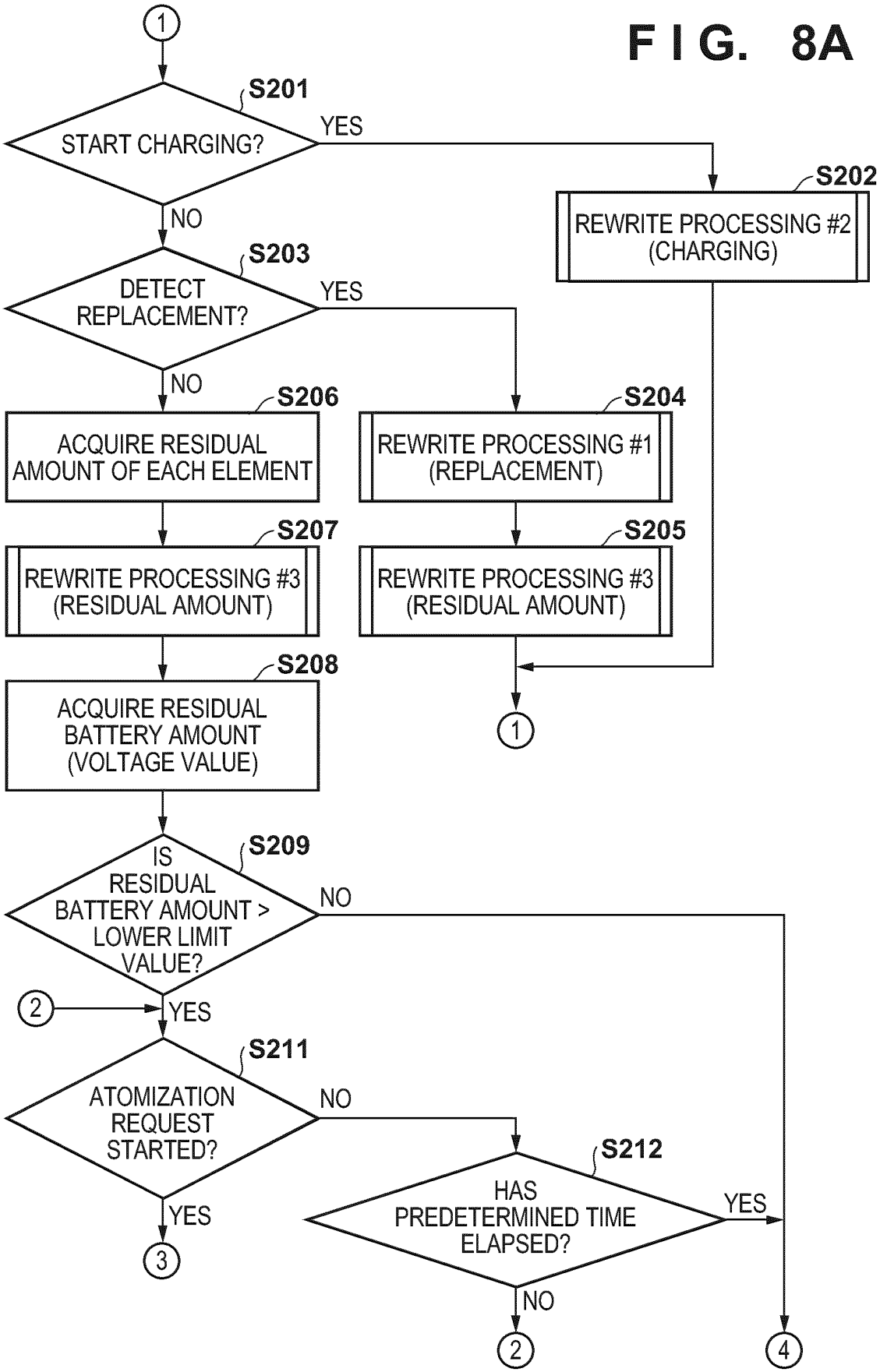

1
S201
START CHARGING?
YES
S202
REWRITE PROCESSING #2 (CHARGING)
NO
S203
DETECT REPLACEMENT?
YES
NO
S206
ACQUIRE RESIDUAL AMOUNT OF EACH ELEMENT
S204
REWRITE PROCESSING #1 (REPLACEMENT)
S207
REWRITE PROCESSING #3 (RESIDUAL AMOUNT)
S205
REWRITE PROCESSING #3 (RESIDUAL AMOUNT)
S208
ACQUIRE RESIDUAL BATTERY AMOUNT (VOLTAGE VALUE)
1
S209
IS RESIDUAL BATTERY AMOUNT > LOWER LIMIT VALUE?
NO
2
YES
S211
ATOMIZATION REQUEST STARTED?
NO
YES
S212
HAS PREDETERMINED TIME ELAPSED?
YES
NO
3
2
4

FIG. 8B

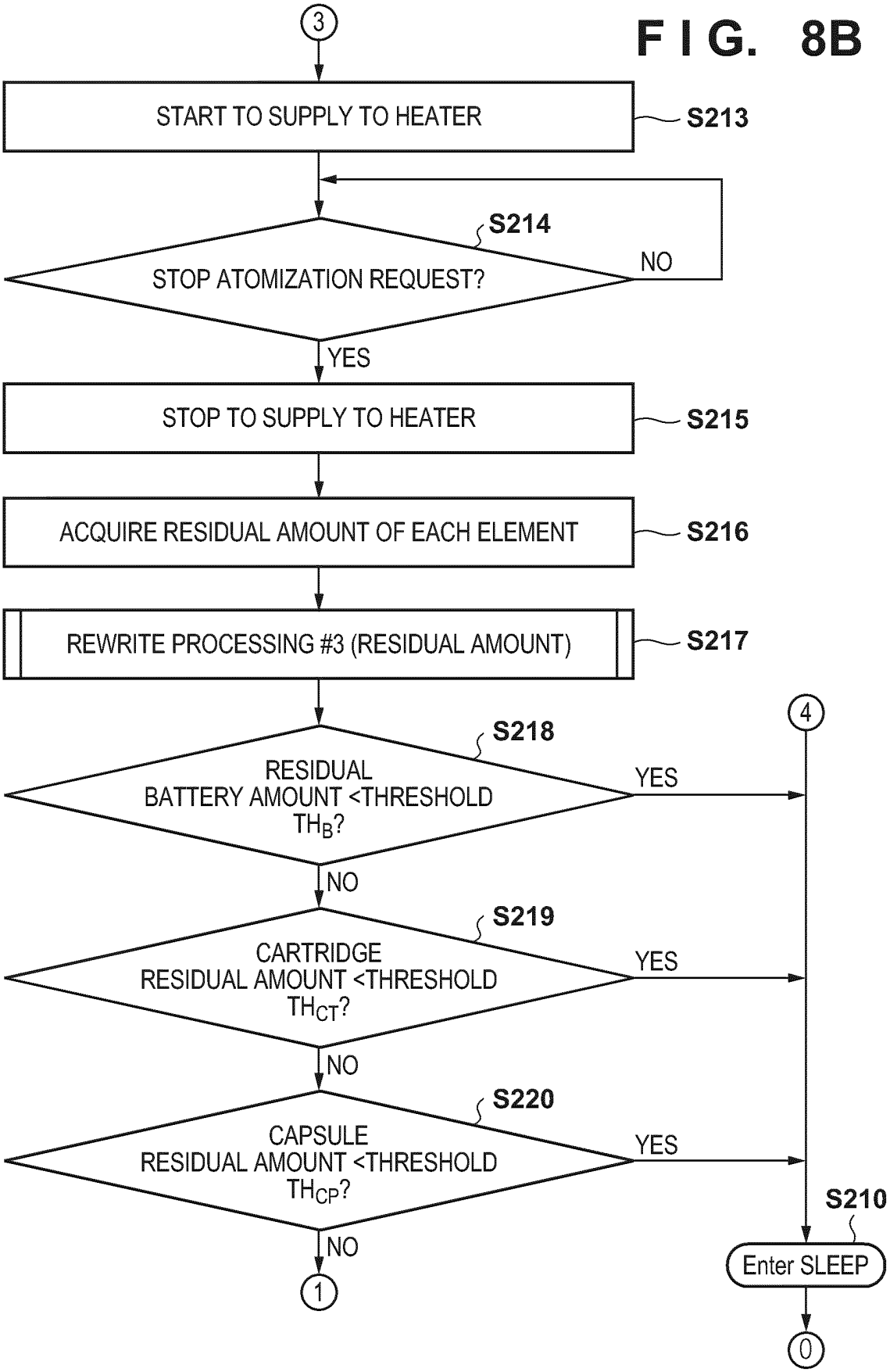

3
START TO SUPPLY TO HEATER
S213
S214
STOP ATOMIZATION REQUEST?
NO
YES
STOP TO SUPPLY TO HEATER
S215
ACQUIRE RESIDUAL AMOUNT OF EACH ELEMENT
S216
REWRITE PROCESSING #3 (RESIDUAL AMOUNT)
S217
S218
RESIDUAL BATTERY AMOUNT <THRESHOLD TH_B?
YES
NO
S219
CARTRIDGE RESIDUAL AMOUNT <THRESHOLD TH_{CT}?
YES
NO
S220
CAPSULE RESIDUAL AMOUNT <THRESHOLD TH_{CP}?
YES
NO
1
4
S210
Enter SLEEP
0

FIG. 9

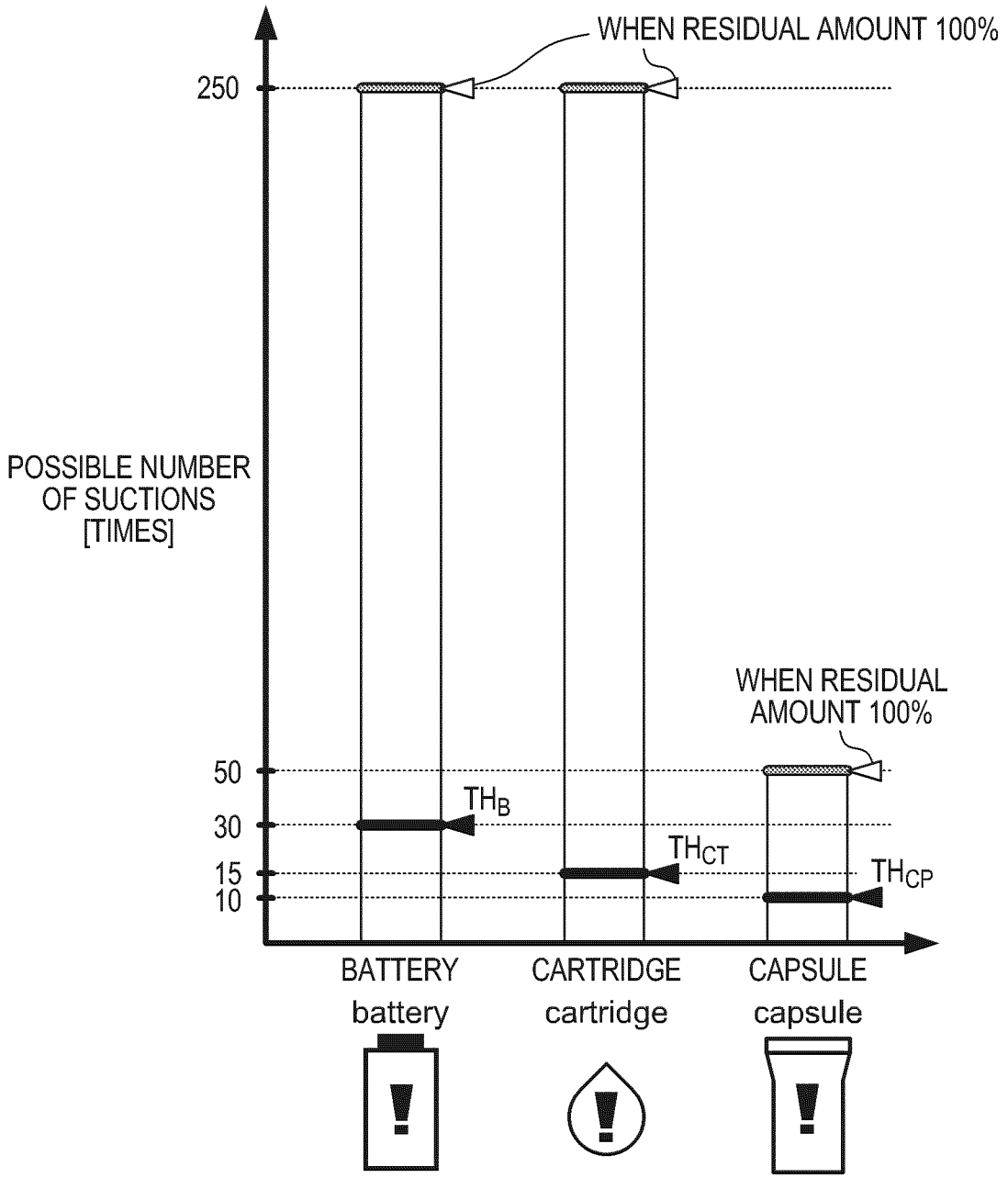

WHEN RESIDUAL AMOUNT 100%
250
POSSIBLE NUMBER OF SUCTIONS [TIMES]
WHEN RESIDUAL AMOUNT 100%
50
30
15
10
THB
THCT
THCP
BATTERY
battery
CARTRIDGE
cartridge
CAPSULE
capsule

FIG. 10

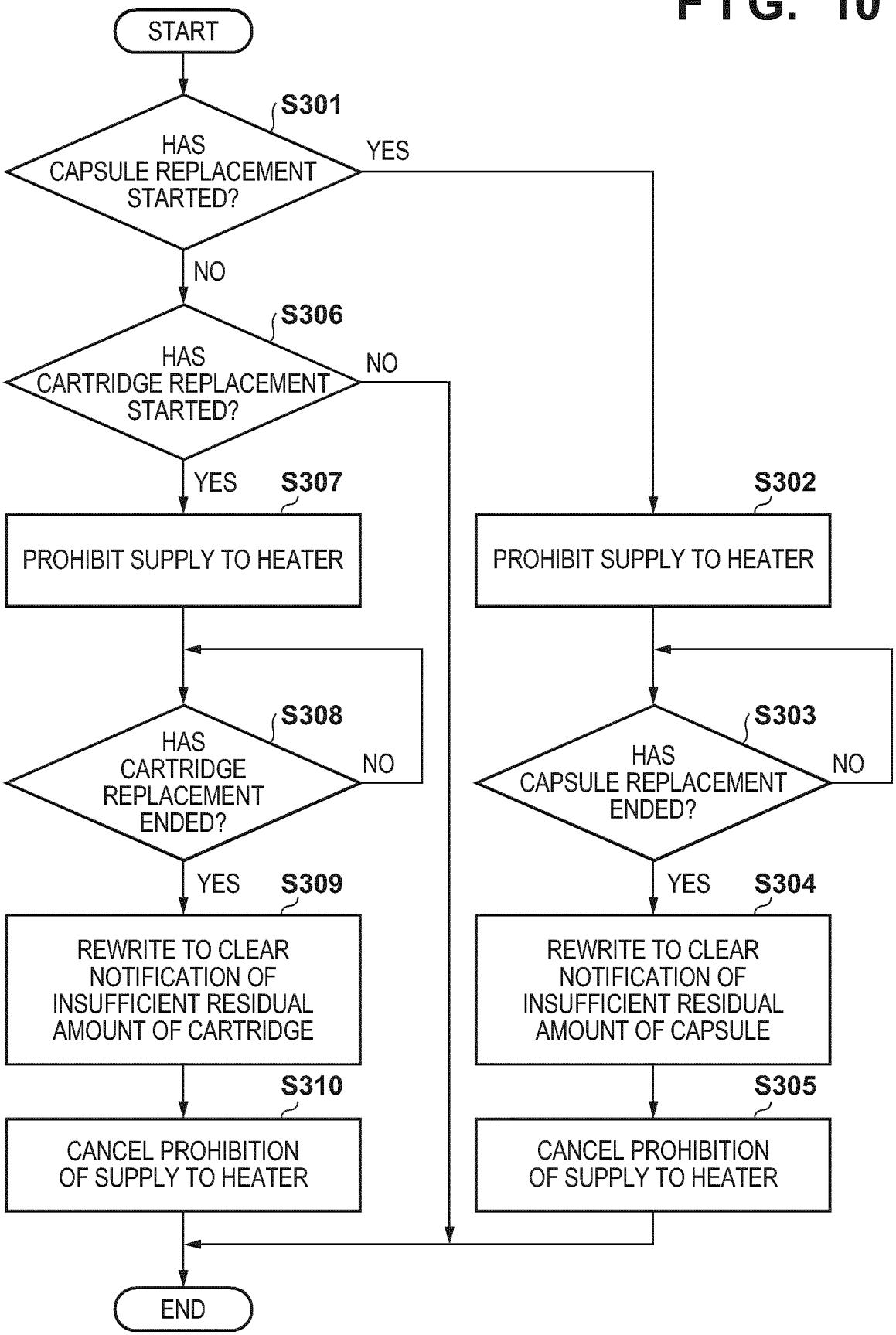

START
S301
HAS CAPSULE REPLACEMENT STARTED?
YES
NO
S306
HAS CARTRIDGE REPLACEMENT STARTED?
NO
YES
S307
PROHIBIT SUPPLY TO HEATER
S308
HAS CARTRIDGE REPLACEMENT ENDED?
NO
YES
S309
REWRITE TO CLEAR NOTIFICATION OF INSUFFICIENT RESIDUAL AMOUNT OF CARTRIDGE
S310
CANCEL PROHIBITION OF SUPPLY TO HEATER
S302
PROHIBIT SUPPLY TO HEATER
S303
HAS CAPSULE REPLACEMENT ENDED?
NO
YES
S304
REWRITE TO CLEAR NOTIFICATION OF INSUFFICIENT RESIDUAL AMOUNT OF CAPSULE
S305
CANCEL PROHIBITION OF SUPPLY TO HEATER
END

FIG. 11

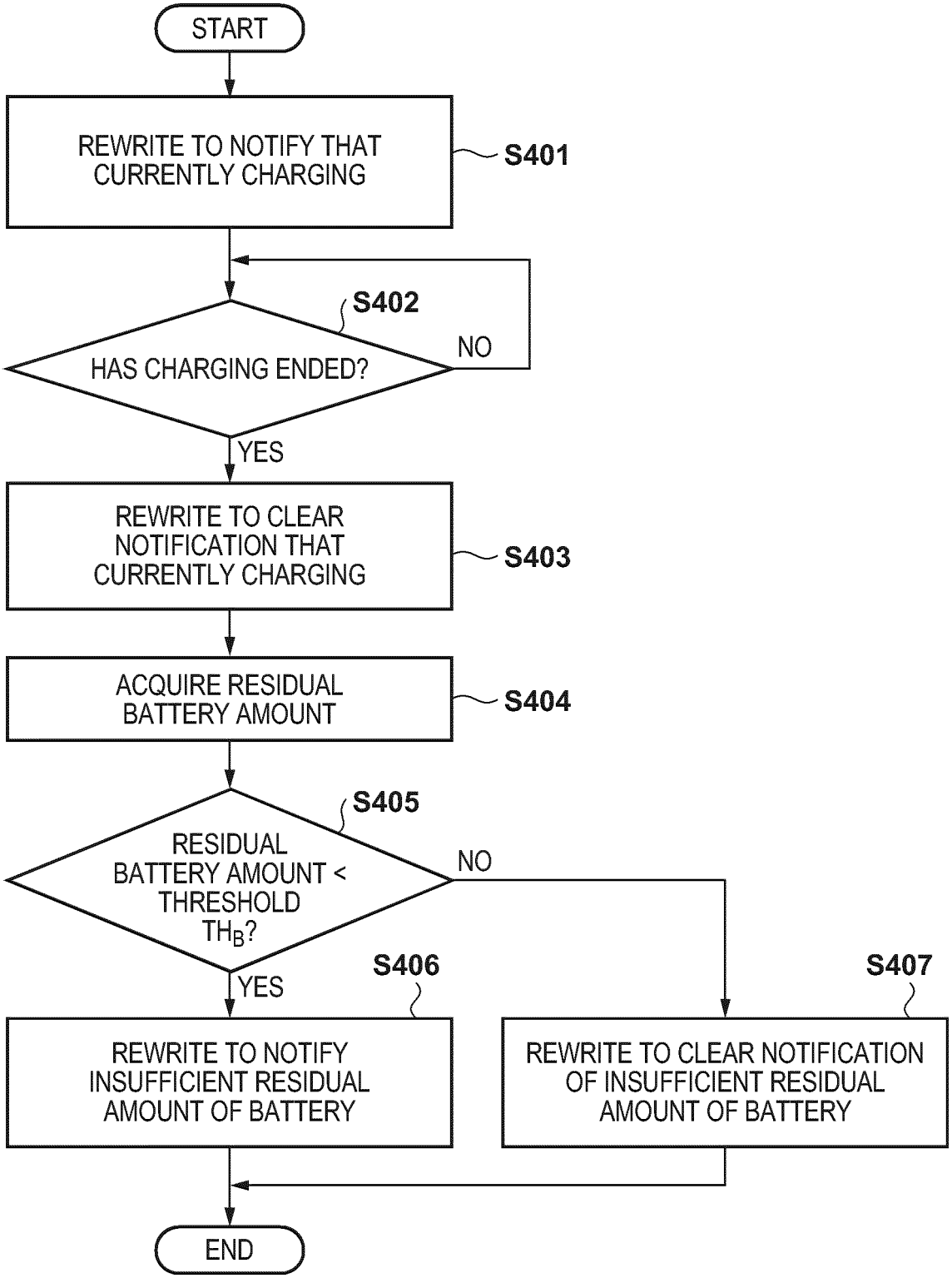

START
REWRITE TO NOTIFY THAT CURRENTLY CHARGING
S401
S402
HAS CHARGING ENDED?
NO
YES
REWRITE TO CLEAR NOTIFICATION THAT CURRENTLY CHARGING
S403
ACQUIRE RESIDUAL BATTERY AMOUNT
S404
S405
RESIDUAL BATTERY AMOUNT < THRESHOLD TH_B?
NO
YES
S406
S407
REWRITE TO NOTIFY INSUFFICIENT RESIDUAL AMOUNT OF BATTERY
REWRITE TO CLEAR NOTIFICATION OF INSUFFICIENT RESIDUAL AMOUNT OF BATTERY
END

FIG. 12A

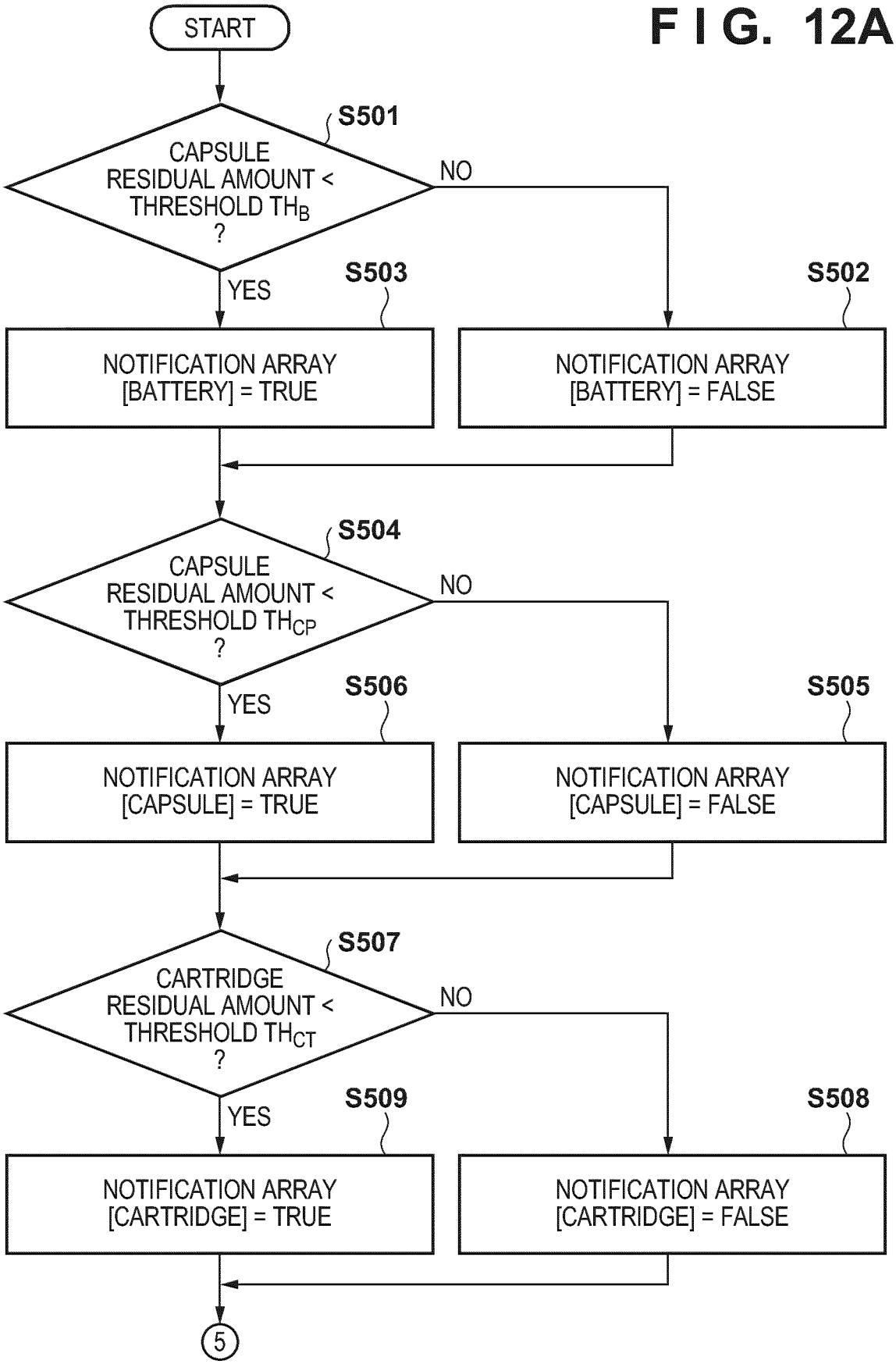

START
S501
CAPSULE RESIDUAL AMOUNT < THRESHOLD TH_B ?
NO
YES
S503
S502
NOTIFICATION ARRAY [BATTERY] = TRUE
NOTIFICATION ARRAY [BATTERY] = FALSE
S504
CAPSULE RESIDUAL AMOUNT < THRESHOLD TH_{CP} ?
NO
YES
S506
S505
NOTIFICATION ARRAY [CAPSULE] = TRUE
NOTIFICATION ARRAY [CAPSULE] = FALSE
S507
CARTRIDGE RESIDUAL AMOUNT < THRESHOLD TH_{CT} ?
NO
YES
S509
S508
NOTIFICATION ARRAY [CARTRIDGE] = TRUE
NOTIFICATION ARRAY [CARTRIDGE] = FALSE
5

FIG. 12B

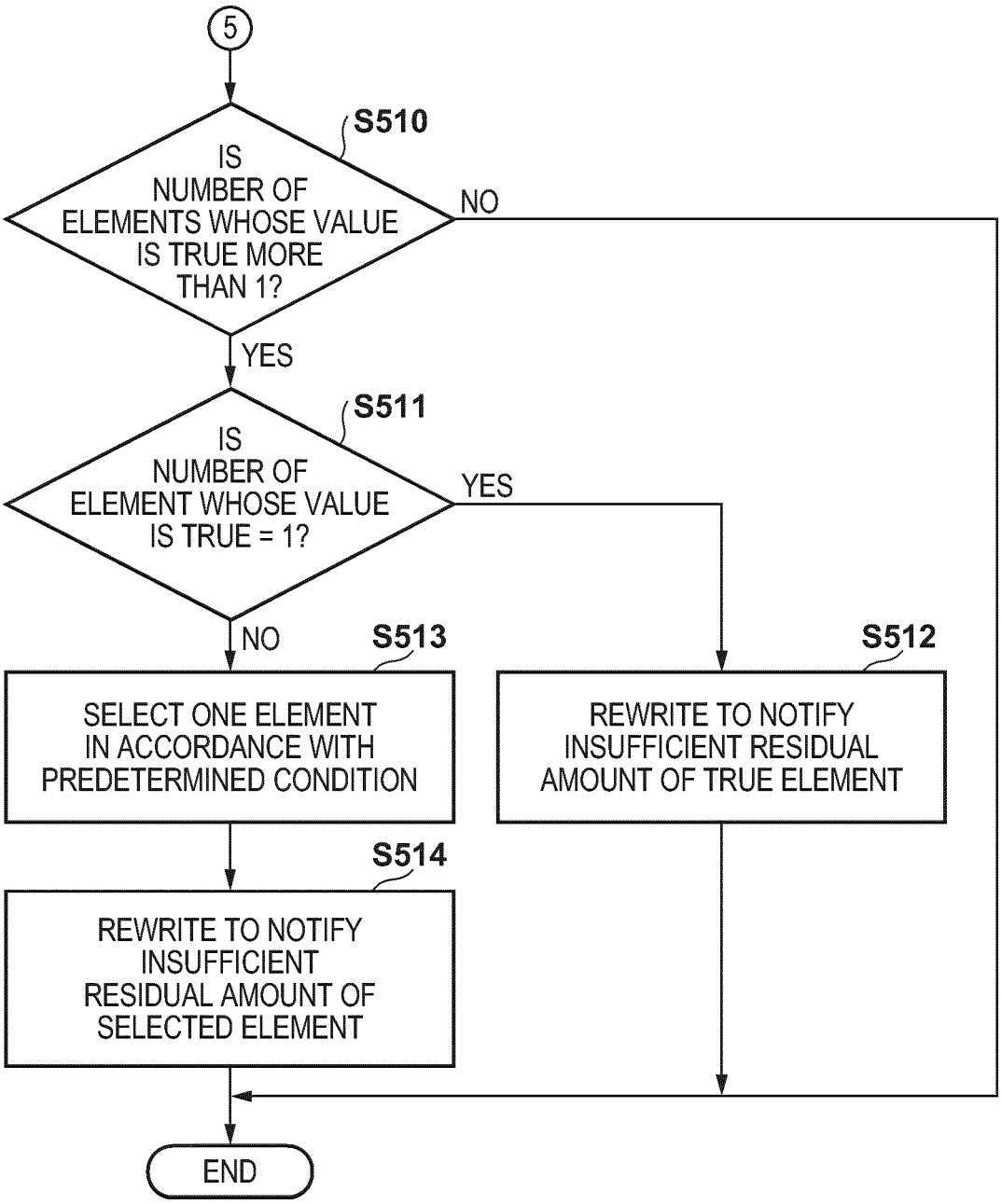

5
S510
IS NUMBER OF ELEMENTS WHOSE VALUE IS TRUE MORE THAN 1?
NO
YES
S511
IS NUMBER OF ELEMENT WHOSE VALUE IS TRUE = 1?
YES
NO
S513
SELECT ONE ELEMENT IN ACCORDANCE WITH PREDETERMINED CONDITION
S512
REWRITE TO NOTIFY INSUFFICIENT RESIDUAL AMOUNT OF TRUE ELEMENT
S514
REWRITE TO NOTIFY INSUFFICIENT RESIDUAL AMOUNT OF SELECTED ELEMENT
END

FIG. 13

CHARACTERISTIC ITEM (PARAMETER)	BATTERY battery 	CARTRIDGE cartridge 	CAPSULE capsule 
POSSIBLE NUMBER OF SUCTIONS FROM RESIDUAL AMOUNT 100%	250	250	50
TIME REQUIRING RECOVERY FROM RESIDUAL AMOUNT 0% TO 100%	90 min	1 min	1 min
VISUAL CONFIRMATION OF RESIDUAL AMOUNT	×	○	×

FIG. 14

CONDITION EXAMPLE	BATTERY battery 	CARTRIDGE cartridge 	CAPSULE capsule 
1. PRIORITY ORDER CONCERNING RECOVERY TIME OF RESIDUAL AMOUNT	1	2	3
2. PRIORITY ORDER CONCERNING POSSIBILITY OF VISUAL PERCEPTION	1 or 2	3	1 or 2
3. CONDITION 1 + CONDITION 2	1	3	2
4. PRIORITY ORDER CONCERNING INFLUENCE ON FLAVOR	3	1	2
5. PRIORITY ORDER CONCERNING TIMING OF INSUFFICIENT RESIDUAL AMOUNT	?	?	?

FIG. 15

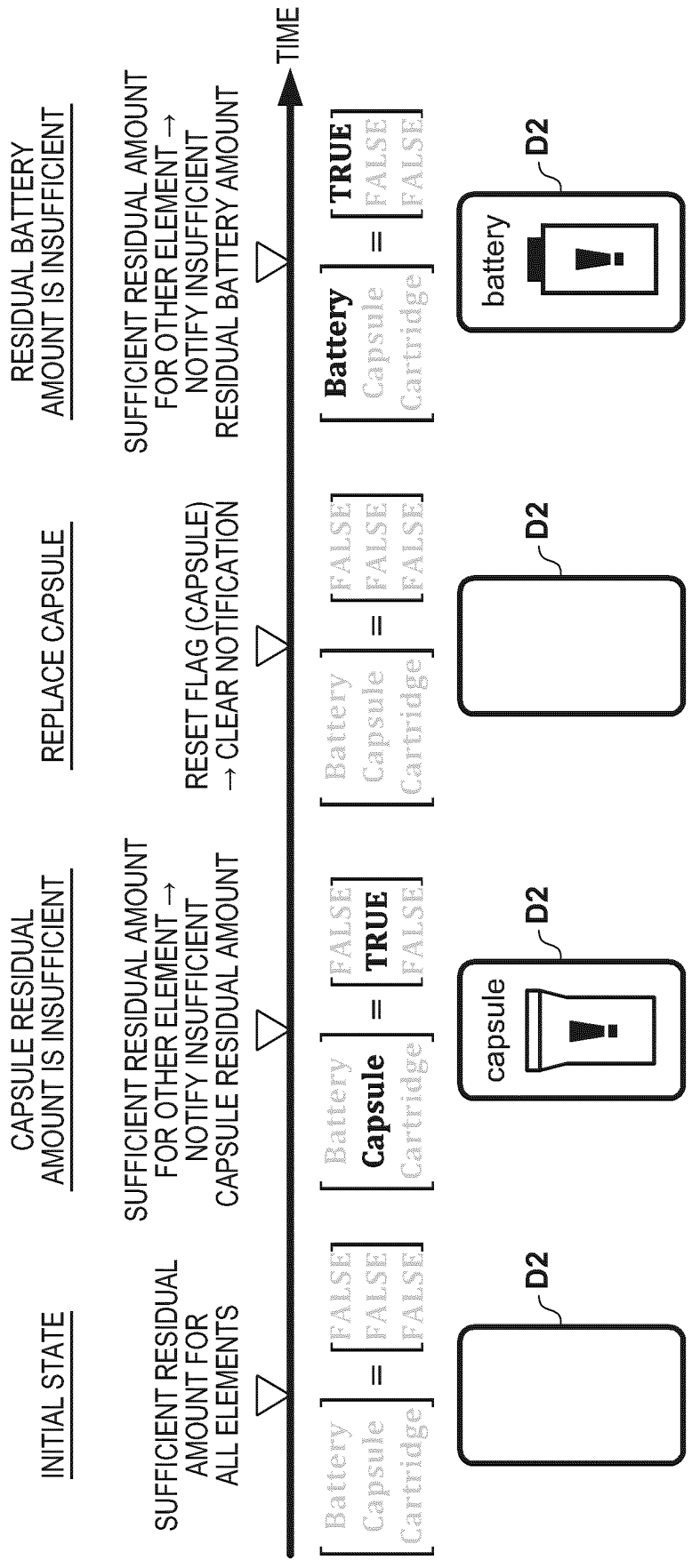
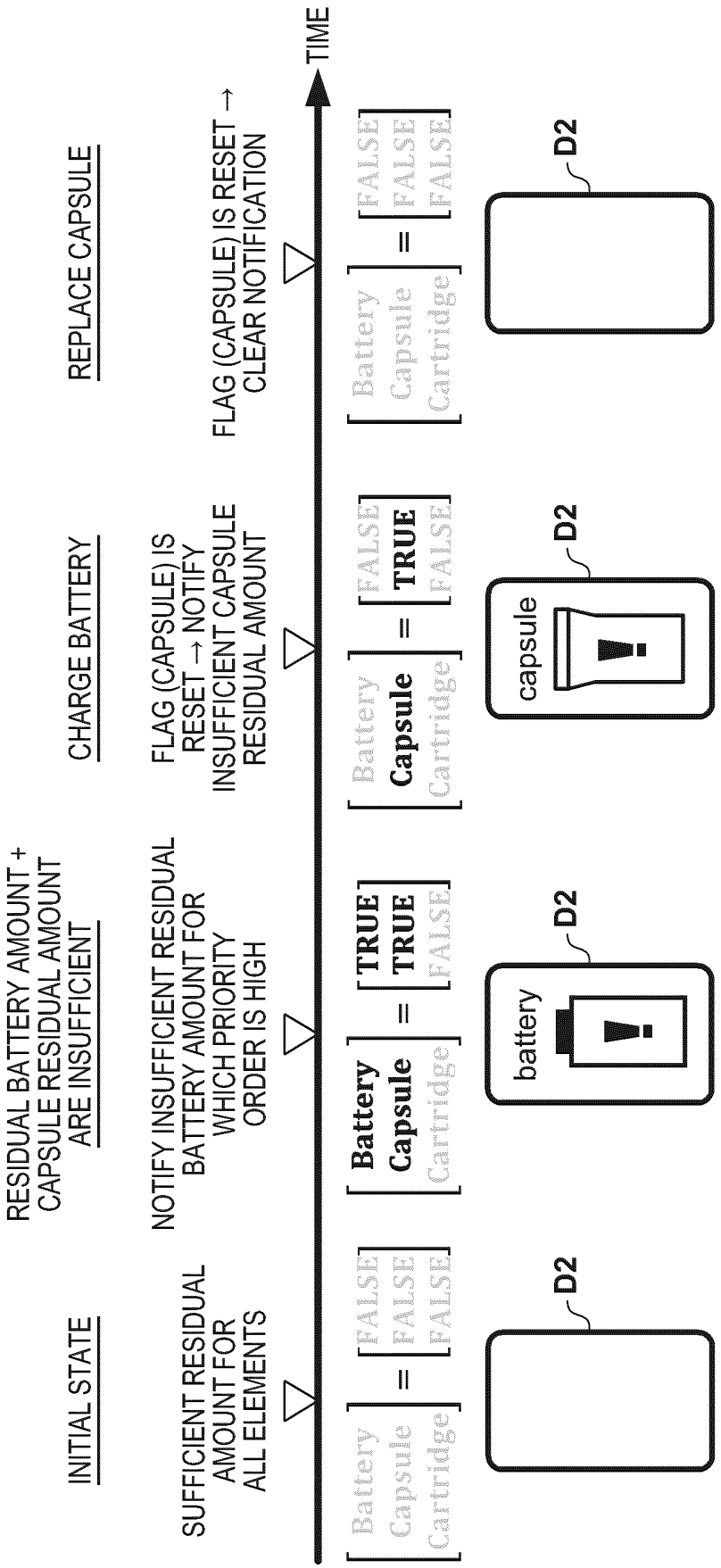

INITIAL STATE
SUFFICIENT RESIDUAL AMOUNT FOR ALL ELEMENTS
Battery FALSE
Capsule FALSE
Cartridge FALSE
D2
CAPSULE RESIDUAL AMOUNT IS INSUFFICIENT
SUFFICIENT RESIDUAL AMOUNT FOR OTHER ELEMENT → NOTIFY INSUFFICIENT CAPSULE RESIDUAL AMOUNT
Battery FALSE
Capsule TRUE
Cartridge FALSE
capsule
D2
REPLACE CAPSULE
RESET FLAG (CAPSULE) → CLEAR NOTIFICATION
Battery FALSE
Capsule FALSE
Cartridge FALSE
D2
RESIDUAL BATTERY AMOUNT IS INSUFFICIENT
SUFFICIENT RESIDUAL AMOUNT FOR OTHER ELEMENT → NOTIFY INSUFFICIENT RESIDUAL BATTERY AMOUNT
Battery TRUE
Capsule FALSE
Cartridge FALSE
battery
D2
TIME

FIG. 16


INITIAL STATE
SUFFICIENT RESIDUAL AMOUNT FOR ALL ELEMENTS
RESIDUAL BATTERY AMOUNT + CAPSULE RESIDUAL AMOUNT ARE INSUFFICIENT
NOTIFY INSUFFICIENT RESIDUAL BATTERY AMOUNT FOR WHICH PRIORITY ORDER IS HIGH
CHARGE BATTERY
FLAG (CAPSULE) IS RESET → NOTIFY INSUFFICIENT CAPSULE RESIDUAL AMOUNT
REPLACE CAPSULE
FLAG (CAPSULE) IS RESET → CLEAR NOTIFICATION
TIME
Battery Capsule Cartridge = FALSE FALSE FALSE
Battery Capsule Cartridge = TRUE TRUE FALSE
Battery Capsule Cartridge = FALSE TRUE FALSE
Battery Capsule Cartridge = FALSE FALSE FALSE
D2
battery
D2
capsule
D2
D2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/023449

A. CLASSIFICATION OF SUBJECT MATTER
A24F 40/50(2020.01)i
FI: A24F40/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A24F40/50

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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.
A	WO 2018/138750 A1 (JAPAN TOBACCO INC) 02 August 2018 (2018-08-02) fig. 4-5	1-13
A	JP 6834052 B1 (JAPAN TOBACCO INC) 24 February 2021 (2021-02-24) paragraph [0085]	1-13

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

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"&" document member of the same patent family

Date of the actual completion of the international search 04 August 2021 (04.08.2021)	Date of mailing of the international search report 17 August 2021 (17.08.2021)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/023449

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2018/138750 A1	02 Aug. 2018	US 2019/0336710 A1 fig. 4-5	
JP 6834052 B1	24 Feb. 2021	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

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Patent documents cited in the description

- US 20170304567 A **[0003]**