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(54) **CARTRIDGE AND AEROSOL GENERATING APPARATUS COMPRISING THE SAME**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

4,338,576 A 7/1982 Mitsui
9,560,882 B2 2/2017 Xiang
(Continued)

FOREIGN PATENT DOCUMENTS

CA 3132357 A1 * 7/2015 ..... A24B 15/167
CN 206482028 U 9/2017
(Continued)

OTHER PUBLICATIONS

English machine translation: CN 202445137 U; published Sep. 26, 2012; inventor: Liu; 10 pages. (Year: 2012).*
(Continued)

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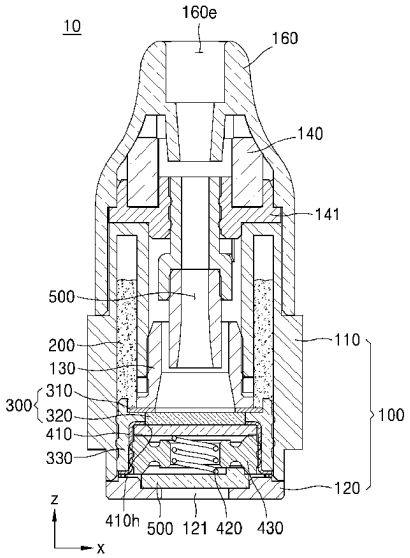
(57) **ABSTRACT**

A cartridge may include: a housing; a reservoir located in the housing and storing an aerosol generating material; an atomizer located in the housing and configured to generate vibration to atomize the aerosol generating material to an aerosol; a liquid delivery element configured to absorb the aerosol generating material stored in the reservoir and deliver the absorbed aerosol generating material to the atomizer; and a resistor located in the housing and configured to eliminate noise of a signal applied to the atomizer.

14 Claims, 8 Drawing Sheets



(51) **Int. Cl.**

A24F 40/42	(2020.01)
A24F 40/50	(2020.01)
B06B 1/00	(2006.01)
B06B 1/06	(2006.01)

(52) **U.S. Cl.**

CPC ***B06B 1/0651*** (2013.01); *B06B 2201/77* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2014/0376895	A1*	12/2014	Han	A24F 40/40 392/395
2015/0053217	A1*	2/2015	Steingraber	A24F 40/50 131/329
2016/0295922	A1	10/2016	John et al.	
2018/0029053	A1	2/2018	Aono et al.	
2018/0092406	A1	4/2018	Monsees et al.	
2019/0045837	A1	2/2019	Spencer	
2019/0099561	A1	4/2019	Nettenstrom	
2019/0110464	A1	4/2019	Wynalda	
2019/0369127	A1	12/2019	Fu et al.	
2020/0060337	A1	2/2020	Liu et al.	
2020/0146353	A1	5/2020	Liu et al.	
2020/0352246	A1	11/2020	Yamada et al.	
2020/0375262	A1	12/2020	Aboabdo	

FOREIGN PATENT DOCUMENTS

CN	206714086	U	12/2017
CN	208079036	U	11/2018
CN	110742323	A	2/2020
CN	111438026	A	7/2020
EP	3510880	A1	7/2019
JP	S63-197836	A	8/1988
JP	2010-091271	A	4/2010
JP	2012-213472	A	11/2012
JP	2016-536997	A	12/2016
JP	2020-037085	A	3/2020
KR	10-2016-0102293	A	8/2016
KR	10-2018-0107161	A	10/2018
KR	10-2018-0117654	A	10/2018
KR	10-2020-0098679	A	8/2020
WO	2020/243335	A1	12/2020

OTHER PUBLICATIONS

English machine translation of CN 202539014 U; Song et al.; Nov. 21, 2012; 13 pages. (Year: 2012).*

Extended European Search Report dated Jun. 13, 2023 in European Application No. 22743437.0.

Korean Office Action dated Jun. 19, 2023 in Korean Application No. 10-2021-0051353.

Canadian Office Action dated Nov. 10, 2023 in Canadian Application No. 3,169,826.

Russian Office Action dated Dec. 22, 2023 in Russian Application No. 2022121619/28.

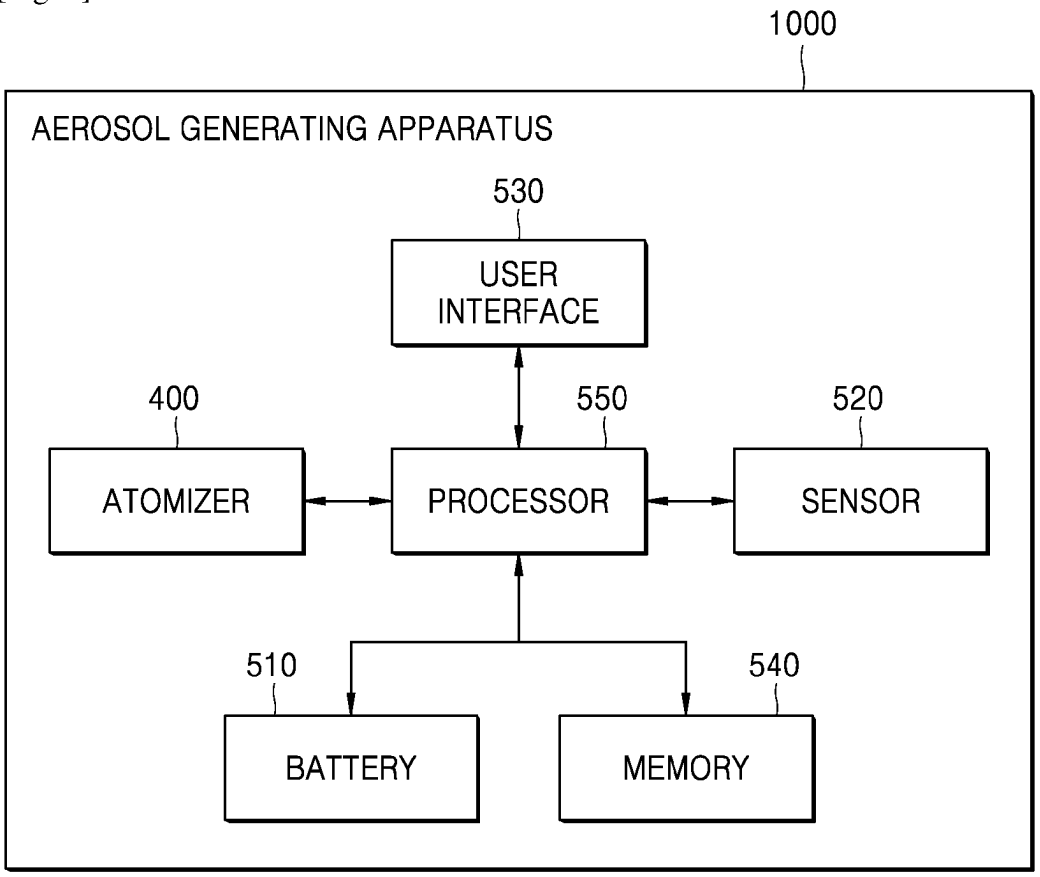
First Office Action issued in Chinese Application No. 202280002584.9 dated Jun. 17, 2024 (18 Pages).

Office Action issued Dec. 15, 2022 in Korean Application No. 10-2021-0051353.

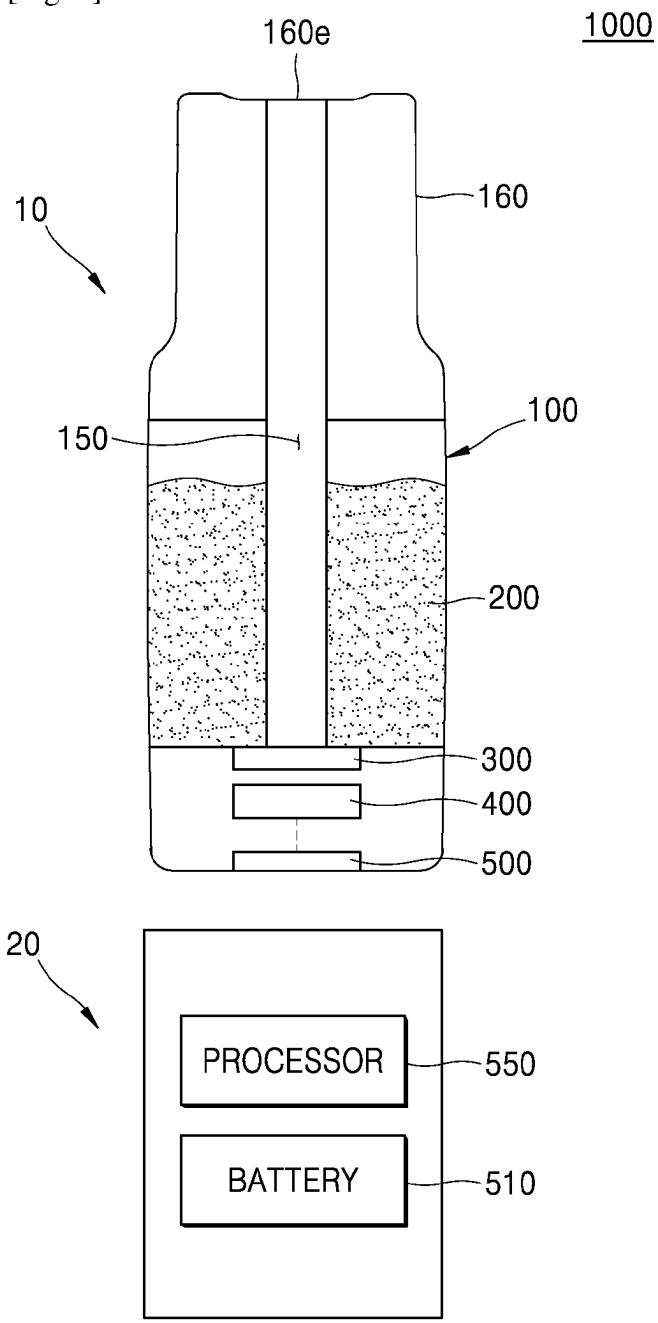
International Search Report for PCT/KR2022/002709 dated Jun. 9, 2022 [PCT/ISA/210].

* cited by examiner

[Fig. 1]


1000
AEROSOL GENERATING APPARATUS
530
USER INTERFACE
400
550
520
ATOMIZER
PROCESSOR
SENSOR
510
540
BATTERY
MEMORY

[Fig. 2]


1000
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160
10
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150
200
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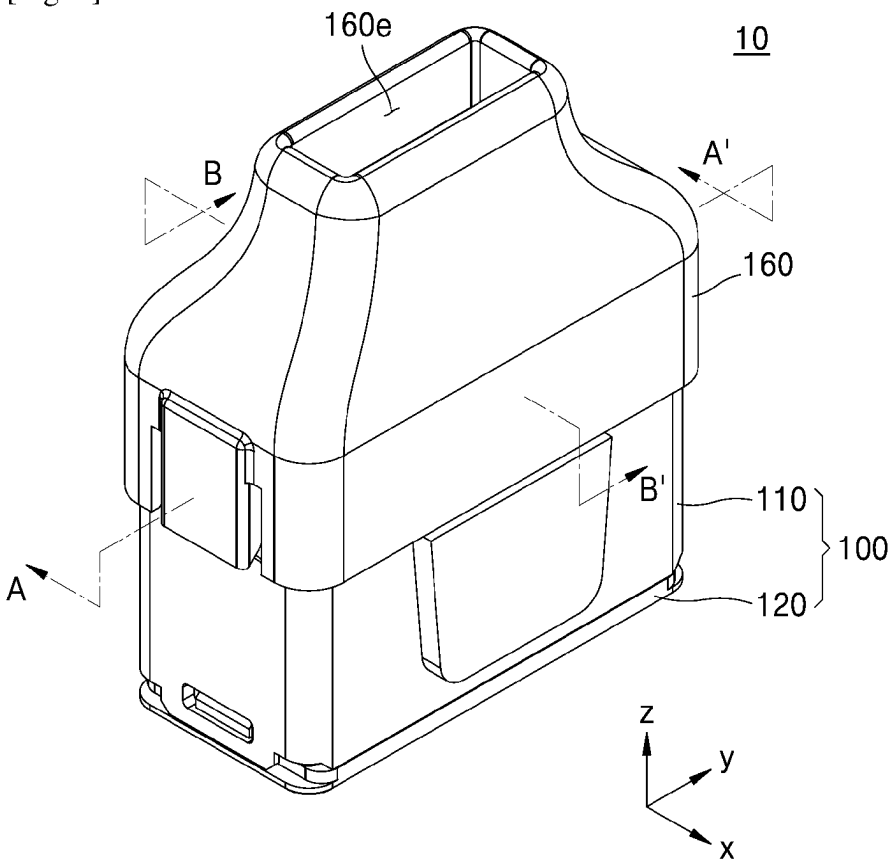
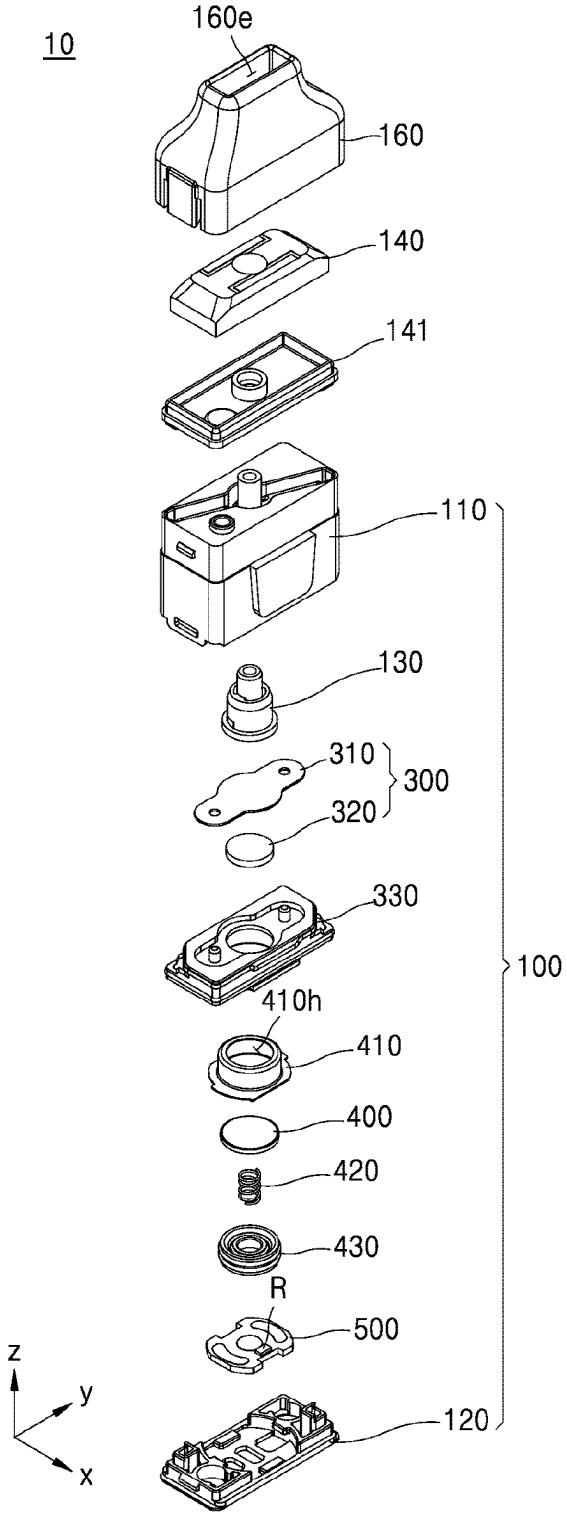
400
500
20
PROCESSOR
550
BATTERY
510

[Fig. 3]



[Fig. 4]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120
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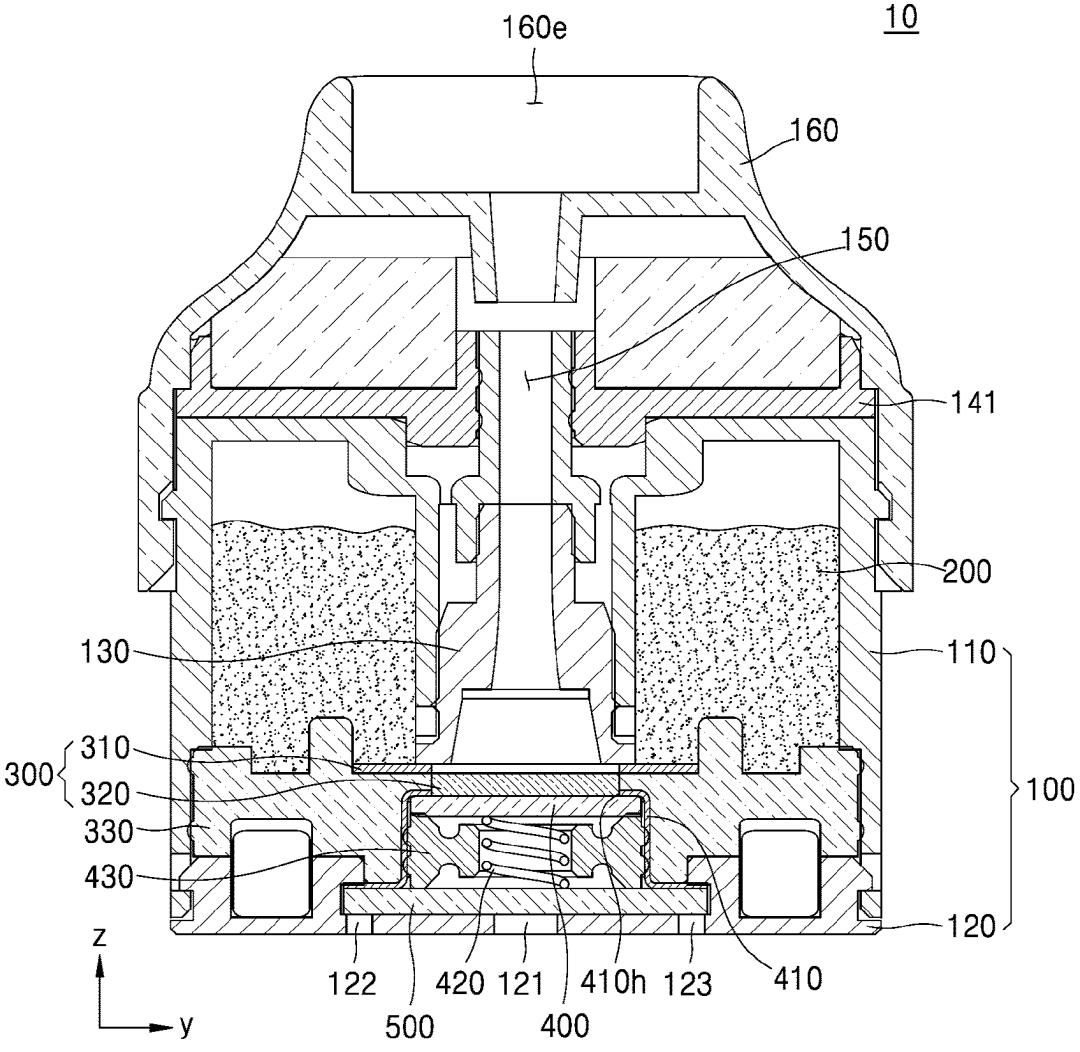
y
x

[Fig. 5]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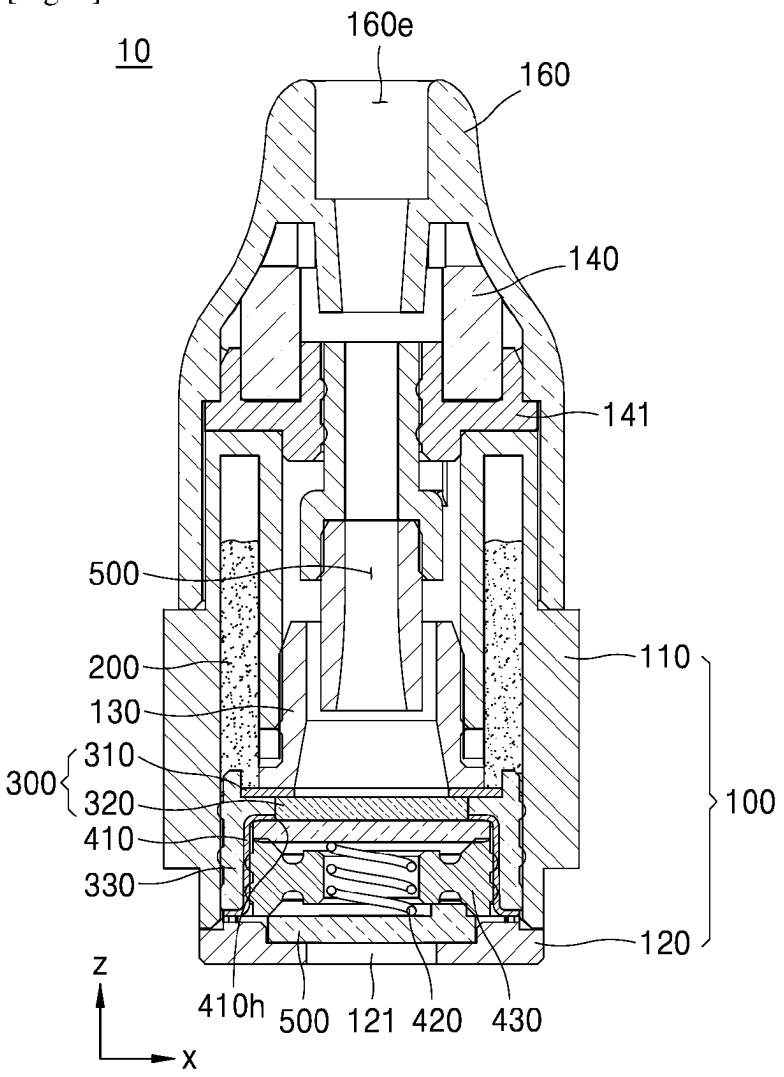
[Fig. 6]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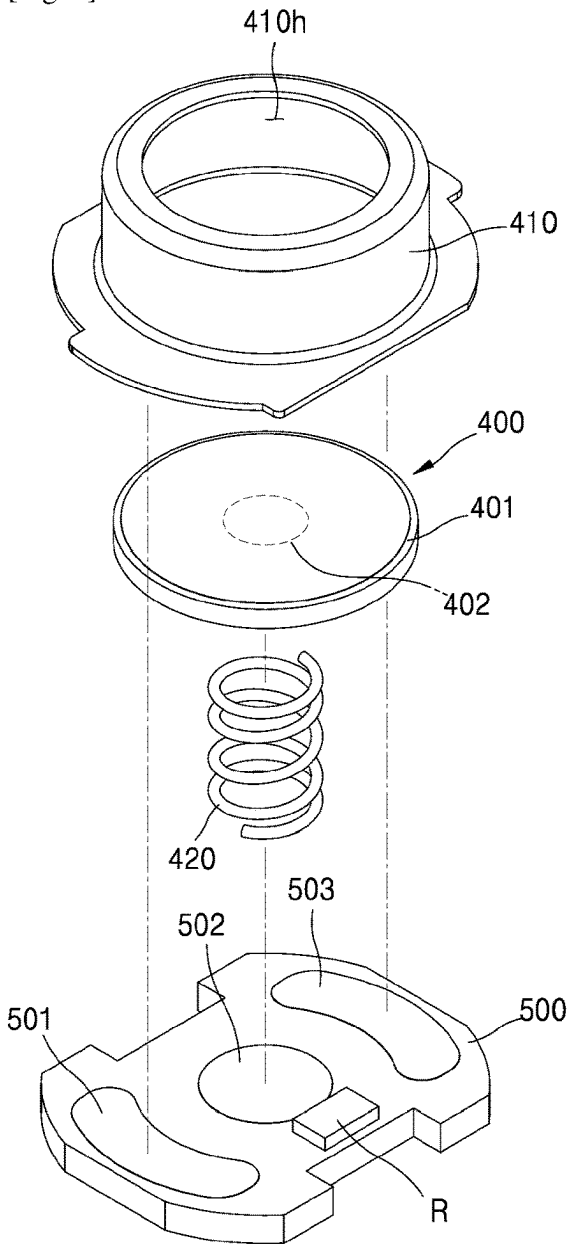
[Fig. 7]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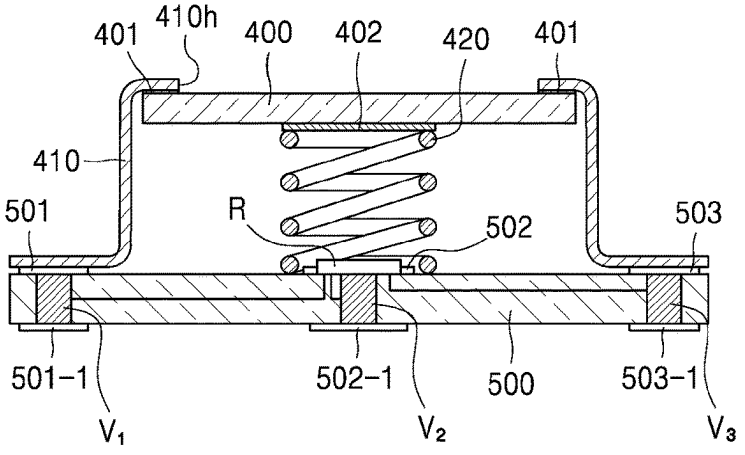
501
500
R

[Fig. 8]


401
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402
420
401
410
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R
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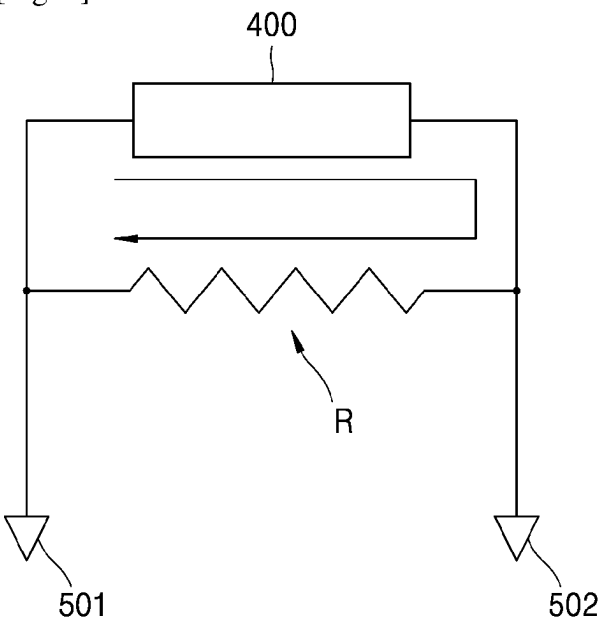
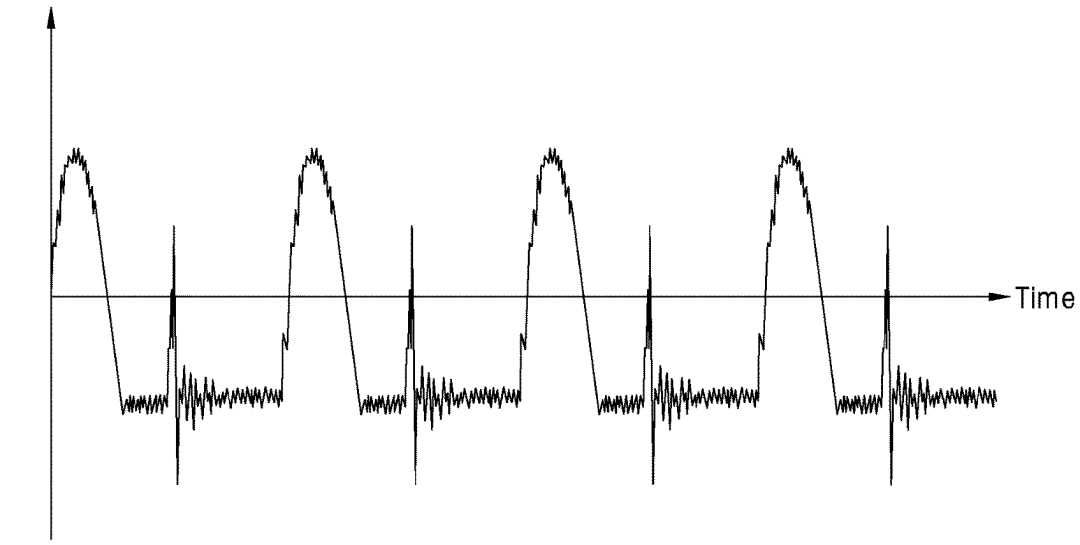
503
501-1
502-1
500
503-1
V1
V2
V3

[Fig. 9]



[Fig. 10]



CARTRIDGE AND AEROSOL GENERATING APPARATUS COMPRISING THE SAME

TECHNICAL FIELD

One or more embodiments relate to a cartridge and an aerosol generating apparatus including the same, more particularly, to a cartridge including a printed circuit board in which a resistor for filtering noise occurring during the application of a voltage to a vibrator is arranged, and an aerosol generating apparatus including the cartridge.

BACKGROUND ART

In recent years, there has been an increasing demand for technology to replace a method of supplying an aerosol by burning a general cigarette, with another method. For example, research has been conducted to supply an aerosol having flavor by generating an aerosol from an aerosol generating material in a liquid or solid state or generating a vapor from an aerosol generating material in a liquid state, and then by passing the generated vapor through a solid fragrance medium.

DISCLOSURE

Technical Problem

Generally, an aerosol generating apparatus uses a heater to heat an aerosol generating material in a liquid or solid state to generate aerosols. To supply aerosols with excellent taste to a user, it is important to heat the aerosol generating material to an appropriate temperature. However, in an aerosol generating apparatus using a heater, the aerosol generating material is sometimes unintentionally heated to a high temperature, thereby causing a situation in which the user feels a burnt taste during the smoking process.

To solve the problem of the aerosol generating apparatus using the heater, an aerosol generating apparatus capable of generating aerosols by using ultrasonic vibration has been proposed. The aerosol generating apparatus using ultrasonic vibration may reduce viscosity of a liquid aerosol generating material through heat generated when an alternating voltage is applied to the vibrator, and may generate aerosols by making the aerosol generating material into fine particles through ultrasonic vibration generated by the vibrator.

The aerosol generating apparatus using ultrasonic vibration is advantageous in that aerosols may be generated while maintaining the aerosol generating material at a lower temperature (e.g., about 100° C. to about 160° C.) compared to the heater, but the vibrator may be damaged due to noise that occurs during the application of an alternating voltage to the vibrator.

For example, if a higher voltage than the intended voltage is applied to the vibrator due to noise included in a voltage signal applied to the vibrator, the temperature of the vibrator may rise above the Curie temperature, and as a result, the vibrator may be damaged and the generation of aerosols may not be performed smoothly.

To resolve the problems described above, the present disclosure provides a cartridge including a printed circuit board on which a resistor is mounted to filter the noise that occurs during the application of a voltage to the vibrator, and an aerosol generating apparatus including the cartridge.

The technical problems of the present disclosure are not limited to the above-described description, and other technical problems may be derived from the embodiments to be described hereinafter.

Technical Solution

According to an embodiment, a cartridge includes a housing, a reservoir located in the housing and storing an aerosol generating material, an atomizer located in the housing and configured to generate vibration to atomize the aerosol generating material to an aerosol, a liquid delivery element configured to absorb the aerosol generating material stored in the reservoir and deliver the absorbed aerosol generating material to the atomizer, and a resistor located in the housing and configured to eliminate noise in a signal applied to the atomizer.

According to an embodiment, an aerosol generating apparatus may include the cartridge, a main body connected to the cartridge, a battery arranged in the main body and configured to supply power to the atomizer of the cartridge, and a processor arranged in the main body and configured to control the power supplied to the cartridge through the battery.

Advantageous Effects

According to one or more embodiments, a cartridge and an aerosol generating apparatus including the same may, by making an aerosol generating material into fine particles by using a vibrator that generates ultrasonic vibration, generate aerosols at a relatively low temperature compared to when a heater is used, and as a result, may improve smoking sensation of a user.

In addition, the cartridge and the aerosol generating apparatus including the same according to one or more embodiments may, by removing noise that occurs during the application of voltage to the vibrator, prevent damage to the vibrator, and as a result, enable a stable operation of the cartridge and the aerosol generating apparatus.

The effects according to one or more embodiments are not limited to the effects described above, and unmentioned effects will be clearly understood by one of ordinary skill in the art from the present specification and the accompanying drawings.

DESCRIPTION OF DRAWINGS

FIG. **1** is a block diagram of an aerosol generating apparatus according to an embodiment;

FIG. **2** is a view schematically illustrating an aerosol generating apparatus illustrated in FIG. **1**;

FIG. **3** is a perspective view of a cartridge according to an embodiment;

FIG. **4** is an exploded perspective view of a cartridge according to an embodiment;

FIG. **5** is a cross-sectional view of the cartridge shown in FIG. **3** along an A-A' direction;

FIG. **6** is a cross-sectional view of the cartridge shown in FIG. **3** along a B-B' direction;

FIG. **7** is an exploded perspective view illustrating an electrical connection between a vibrator and a printed circuit board of the cartridge;

FIG. **8** is a cross-sectional view of an electrical connection between the vibrator and the printed circuit board of the cartridge show in FIG. **7**;

FIG. **9** is a circuit diagram showing an electrical connection between the vibrator of the cartridge and a resistor mounted on the printed circuit board shown in FIG. **7**; and

FIG. **10** is a graph showing a change in voltage applied to the vibrator of the cartridge, according to an embodiment.

MODE FOR INVENTION

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

In addition, unless explicitly described to the contrary, the word "comprise" and variations such as "comprises" or "comprising" will be understood to imply the inclusion of stated elements but not the exclusion of any other elements. In addition, the terms "-er", "-or", and "module" described in the specification mean units for processing at least one function and/or operation and can be implemented by hardware components or software components and combinations thereof.

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

The term "aerosol" described in the specification means a gas in a state in which vaporized particles generated from aerosol generating material and air are mixed.

In addition, the term "aerosol generating device" described in the specification means device that generates the aerosol by using the aerosol generating material such that the aerosol can be inhaled directly into a user's lungs through the user's mouth.

The term "puff" described in the specification means inhalation by the user, and inhalation means a situation in which the aerosol is drawn into the user's mouth, nasal cavity, or lungs through the user's mouth or nose.

Hereinafter, the present disclosure will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the present disclosure are shown such that one of ordinary skill in the art may easily work the present disclosure.

FIG. **1** is a block diagram of an aerosol generating device according to an embodiment.

Referring to FIG. **1**, the aerosol generating device **1000** may include an atomizer **400**, a battery **510**, a sensor **520**, a user interface **530**, a memory **540** and a processor **550**. However, the internal structure of the aerosol generating device **1000** is not limited to the structures illustrated in FIG. **1**. According to the design of the aerosol generating device **1000**, it will be understood by one of ordinary skill in the art that some of the components shown in FIG. **1** may be omitted or new components may be added.

In an embodiment, the aerosol generating device **1000** may consist of only a main body, in which case components included in the aerosol generating device **1000** are located in the main body.

In another embodiment, the aerosol generating device **1000** may consist of a main body and a cartridge, in which case components included in the aerosol generating device **1000** are located separately in the main body and the cartridge. Alternatively, at least some of components included in the aerosol generating device **1000** may be located respectively in the main body and the cartridge.

Hereinafter, an operation of each of the components will be described without being limited to the location in a particular space in the aerosol generating device **1000**.

The atomizer **400** receives power from the battery **510** under the control of the processor **550**. The atomizer **400** receives power from the battery **510** under the control of the processor **550** The atomizer **400** may receive power from the battery **510** and atomize the aerosol generating material stored in the aerosol generating device **1000**.

The atomizer **400** may be located in the main body of the aerosol generating device **1000**. Alternatively, when the aerosol generating device **1000** consists of the main body and the cartridge, the atomizer **400** may be located in the cartridge. When the atomizer **400** is located in the cartridge, the atomizer **400** may receive power from the battery **510** located in at least one of the main body and the cartridge. In addition, when the atomizer **400** is located separately in the main body and the cartridge, components requiring power supply in the atomizer **400** may receive power from battery **510** located in at least one of the main body and the cartridge.

The atomizer **400** generate aerosol from the aerosol generating material inside the cartridge. The aerosol may refer to a gas in which vaporized particles generated from the aerosol generating material are mixed with air. Therefore, the aerosol generated from the atomizer **400** means a gas in which vaporized particles generated from the aerosol generating material are mixed with air. For example, the atomizer **400** performs a function of generating aerosol by converting the phase of the aerosol generating material inside the cartridge **20** to a gaseous phase. In addition, the atomizer **400** generates an aerosol by discharging the aerosol generating material in a liquid and/or solid phase into fine particles.

For example, the atomizer **400** generates the aerosol from the aerosol generating material by using an ultrasonic vibration method. The ultrasonic vibration method means a method of generating the aerosol by atomizing the aerosol generating material with ultrasonic vibration generated by a vibrator.

Although not shown in FIG. **1**, the atomizer **400** may optionally include a heater capable of heating the aerosol generating material by generating heating. The aerosol generating material may be heated by the heater, such that the aerosol may be generated.

The heater may be formed of any suitable electrically resistive material. For example, the suitable electrically resistive material may be a metal or a metal alloy including titanium, zirconium, tantalum, platinum, nickel, cobalt, chromium, hafnium, niobium, molybdenum, tungsten, tin, gallium, manganese, iron, copper, stainless steel, or nichrome, but is not limited thereto. In addition, the heater may be implemented by a metal wire, a metal plate on which an electrically conductive track is arranged, or a ceramic heating element, but is not limited thereto.

In an embodiment, the heater may be a component included in the cartridge. The cartridge may include the heater **130**, the liquid delivery element, and the liquid storage. The aerosol generating material accommodated in the liquid storage may be moved to the liquid delivery element, and the heater may heat the aerosol generating material absorbed by the liquid delivery element, thereby generating aerosol. For example, the heater may include a material such as nickel chromium and may be wound around or arranged adjacent to the liquid delivery element.

In another embodiment, the aerosol generating device **1000** may include an accommodation space accommodating the aerosol generating article. The heater **130** may heat the aerosol generating article inserted into the accommodation space of the aerosol generating device **1000**. As the aerosol generating article is accommodated in the accommodation space of the aerosol generating device **1000**, the heater may be located inside and/or outside the aerosol generating article. Accordingly, the heater may generate aerosol by heating the aerosol generating material in the aerosol generating article.

Meanwhile, the heater may include an induction heater. The heater may include an electrically conductive coil for heating an aerosol generating article in an induction heating method, and the aerosol generating article or the cartridge may include a susceptor which may be heated by the induction heater.

The battery **510** supplies power to be used for the aerosol generating device **1000** to operate. In other words, the battery **510** may supply power such that the heater may be heated. In addition, the battery **510** may supply power required for operation of other components included in the aerosol generating device **1000**, that is, the sensor **520**, the user interface **530**, the memory **540**, and the processor **550**. The battery **510** may be a rechargeable battery or a disposable battery.

For example, the battery **510** is a lithium-ion battery, a nickel-based battery (for example, a nickel-metal hydride battery, a nickel-cadmium battery), or a lithium-based battery (for example, a lithium-cobalt battery, a lithium-Phosphate battery, lithium titanate battery or lithium-polymer battery). However, the type of the battery **510** can be used in the aerosol generating device **100** is not limited by the above description. If necessary, the battery **510** may include an alkaline battery or a manganese battery.

The aerosol generating device **1000** may include at least one sensor **520**. A result sensed by the at least one sensor **520** is transmitted to the processor **550**, and the processor **550** may control the aerosol generating device **1000** to perform various functions such as controlling the operation of the heater, restricting smoking, determining whether an aerosol generating article (or a cartridge) is inserted, and displaying a notification.

For example, at least one sensor **520** may include a puff sensor. The puff sensor may detect a user's puff based on any one of a temperature change, a flow change, a voltage change, and a pressure change. The puff sensor may detect a start timing and an end timing of the user's puff, and the processor **550** may determine a puff period and a non-puff period according to the detected start timing and end timing of the puff.

In addition, at least one sensor **520** may include a user input sensor. The user input sensor may be a sensor capable of receiving a user's input, such as a switch, a physical button, or a touch sensor. For example, the touch sensor may be a capacitive sensor capable of detecting a user's input by detecting a change in capacitance when the user touches a predetermined area formed of a metal material. The process **550** may determine whether a user's input has occurred by comparing values before and after a change in capacitance received from the capacitive sensor. When the value before and after the change of capacitance exceeds the preset threshold, the processor **550** may determine that the user's input has occurred.

In addition, at least one sensor **520** may include a motion sensor. Through the motion sensor, information on the movement of the aerosol generating apparatus **1000**, such as the tilt, movement speed, and acceleration of the aerosol generating apparatus **1000** may be obtained. For example, the motion sensor may determine whether the aerosol generating apparatus **1000** is moving, whether the aerosol generating apparatus **1000** is inclined at an angle within a certain range for puffing, and whether the aerosol generating apparatus **1000** is inclined, between puffing actions, at an angle different from the angle during the puffing action. The motion sensor may measure movement information of the aerosol generating apparatus **1000** using various methods known in the art. For example, the motion sensor may include an acceleration sensor for measuring accelerations in three directions, which are X-axis, Y-axis, and Z-axis directions, and a gyro sensor for measuring angular velocity in three directions.

In addition, at least one sensor **520** may include a proximity sensor. The proximity sensor may detect an approaching object or presence of an object in the vicinity, or a distance to the object by using an electromagnetic force, infrared rays, or the like without mechanical contact, thereby detecting whether the user accesses the aerosol generating apparatus **1000**.

In addition, at least one sensor **520** may include an image sensor. The image sensor may include, for example, a camera for acquiring an image of the object. The image sensor may recognize an object on the basis of the image acquired by the camera. The processor **550** may analyze the image obtained through the image sensor to determine whether the user is about to use the aerosol generating apparatus **1000**. For example, when the user brings the aerosol generating apparatus **1000** near the lips to use the aerosol generating apparatus **1000**, the image sensor may obtain an image of the lips. In this case, the processor **550** may analyze the image and determine that the user is about to use the aerosol generating apparatus **1000**. Accordingly, the aerosol generating apparatus **1000** may operate the atomizer in advance, or preheat the heater.

In addition, at least one sensor **520** may include a consumable detachment sensor capable of detecting mounting or removal of consumables (e.g., cartridges, cigarettes, etc.) for the aerosol generating apparatus **1000**. For example, the consumable detachment sensor may detect whether the consumables are in contact with the aerosol generating apparatus **1000**, or may determine whether the consumables are detached based on an image obtained by the image sensor. In addition, the consumable detachment sensor may also be an inductance sensor that detects a change in an inductance value of the coil that may interact with a marker of the consumable, or a capacitance sensor that detects a change in a capacitance value of a capacitor that may interact with the marker of the consumable.

In addition, at least one sensor **520** may include a temperature sensor. The temperature sensor may detect a temperature at which the heater (or the aerosol generating material) of the atomizer **400** is heated. The aerosol generating apparatus **1000** may include a separate temperature sensor for sensing a temperature of the heater, or the heater

itself may serve as a temperature sensor instead of separately including the temperature sensor. Alternatively, the heater may serve as a temperature sensor and, at the same time, the aerosol generating apparatus **1000** may further include a separate temperature sensor. In addition, the temperature sensor may detect the temperatures of internal components such as a printed circuit board, the battery, etc. of the aerosol generating apparatus **1000**, in addition to the heater.

In addition, at least one sensor **520** may include various sensors for measuring information of the surrounding environment of the aerosol generating apparatus **1000**. For example, at least one sensor **520** may include a temperature sensor capable of measuring the temperature of the surrounding environment, a humidity sensor for measuring the humidity of the surrounding environment, and an atmospheric pressure sensor for measuring the pressure of the surrounding environment.

The sensor **520** that may be provided in the aerosol generating apparatus **1000** is not limited to the types described above, and may further include various sensors. For example, the aerosol generating apparatus **1000** may include a fingerprint sensor for obtaining fingerprint information from the finger of the user for user authentication and security, an iris recognition sensor for analyzing an iris pattern of a pupil, a vein recognition sensor for detecting the amount of infrared absorption of reduced hemoglobin in veins from images of a palm, a facial recognition sensor that recognizes feature points such as eyes, nose, mouth and facial contours in a 2D or 3D method, and a radio-frequency identification sensor (RFID).

The aerosol generating apparatus **1000** may selectively include only some of the various sensors **520** exemplified above. In other words, the aerosol generating apparatus **1000** may combine and utilize information sensed by at least one sensor of the sensors described above.

The user interface **530** may provide the user with information about the state of the aerosol generating device **1000**. The user interface **530** may include various interfacing devices, such as a display or a light emitter for outputting visual information, a motor for outputting haptic information, a speaker for outputting sound information, input/output (I/O) interfacing devices (e.g., a button or a touch screen) for receiving information input from the user or outputting information to the user, terminals for performing data communication or receiving charging power, and communication interfacing modules for performing wireless communication (e.g., Wi-Fi, Wi-Fi direct, Bluetooth, near-field communication (NFC), etc.) with external devices.

However, the aerosol generating device **1000** may be implemented by selecting only some of the above-described examples of various user interface **530**.

The memory **540**, as a hardware component configured to store various pieces of data processed in the aerosol generating device **1000**, may store data processed or to be processed by the processor **550**. The memory **540** may include various types of memories; random access memory (RAM), such as dynamic random access memory (DRAM) and static random access memory (SRAM), etc.; read-only memory (ROM); electrically erasable programmable read-only memory (EEPROM), etc.

The memory **540** may store an operation time of the aerosol generating device **1000**, the maximum number of puffs, the current number of puffs, at least one temperature profile, data on a user's smoking pattern, etc.

The processor **550** may generally control operations of the aerosol generating device **1000**. The processor **550** can be implemented as an array of a plurality of logic gates or can be implemented as a combination of a general-purpose microprocessor and a memory in which a program executable in the microprocessor is stored. It will be understood by one of ordinary skill in the art that the processor **550** can be implemented in other forms of hardware.

The processor **550** analyzes a result of the sensing by at least one sensor **520**, and controls the processes that are to be performed subsequently.

The processor **550** may control power supplied to the atomizer **400** so that the operation of the atomizer **400** is started or terminated, based on the result of the sensing by the at least one sensor **520**. In addition, based on the result of the sensing by the at least one sensor **520**, the processor **550** may control the amount of power supplied to the atomizer **400** and the time at which the power is supplied, so that the atomizer **400** is heated to a predetermined temperature or maintained at an appropriate temperature. For example, the processor **550** may control the current or voltage supplied to the vibrator so that the vibrator of the atomizer **400** may vibrate at a certain frequency.

In an embodiment, the processor **550** may start the operation of the atomizer **400** after receiving a user input to the aerosol generating device **1000**. In addition, the processor **550** may start the operation of the atomizer after detecting a user's puff by using the puff sensor. In addition, the processor **550** may stop supplying power to the atomizer **400** when the number of puffs reaches a preset number after counting the number of puffs by using the puff sensor.

The processor **550** may control the user interface **530** based on the result of the sensing by the at least one sensor **520**. For example, when the number of puffs reaches the preset number after counting the number of puffs by using the puff sensor, the processor **550** may notify the user by using at least one of a light emitter, a motor, or a speaker that the aerosol generating device **1000** will soon be terminated.

Although not illustrated in FIG. **1**, the aerosol generating device **1000** may form an aerosol generating system together with an additional cradle. For example, the cradle may be used to charge the battery **510** of the aerosol generating device **1000**. For example, while the aerosol generating device **1000** is accommodated in an accommodation space of the cradle, the aerosol generating device **1000** may receive power from a battery of the cradle such that the battery **510** of the aerosol generating device **1000** may be charged.

FIG. **2** is a view schematically illustrating an aerosol generating apparatus according to an embodiment.

At least one of the components of the aerosol generating apparatus **1000** shown in FIG. **2** may be the same as or similar to at least one of the components of the aerosol generating apparatus **1000** shown in FIG. **1**, and thus redundant descriptions will be omitted.

Referring to FIG. **2**, the aerosol generating apparatus **1000** includes a cartridge **10** for storing the aerosol generating material and a main body **20** that supports the cartridge **10**.

*77 The cartridge **10** may be coupled to the main body **20** in a state of accommodating an aerosol generating material therein. For example, the cartridge **10** may be coupled to the main body **20** by at least a portion of the cartridge **10** being inserted into the main body **20**. As another example, the cartridge **10** may be coupled to the main body **20** by at least a portion of the main body **20** being into the cartridge **10**.

The cartridge **10** and the main body **20** may be coupled to each other by at least one of a snap-fit method, a screw connection method, a magnetic force coupling method, or an

interference fit method, but a method of coupling the cartridge **10** and the main body **20** is not limited to the examples described above.

According to an embodiment, the cartridge **10** may include a housing **100**, a mouthpiece **160**, a reservoir **200**, a liquid delivery element **300**, the atomizer **400**, and a printed circuit board **500**.

The housing **100** may form an overall outer shape of the cartridge **10** together with the mouthpiece **160**, and the components for the operation of the cartridge **10** may be arranged in the housing **100**. In an embodiment, the housing **100** may be formed in a rectangular shape, but the shape of the housing **100** is not limited to the embodiment described above. According to an embodiment, the housing **100** may be formed in a polygonal column (e.g., a triangular column, a pentagon column) shape or a cylindrical shape.

The mouthpiece **160** is arranged at the housing **100**, and may include an outlet **160***e* for discharging the aerosol generated from the aerosol generating material to the outside. In one embodiment, the mouthpiece **160** may be disposed at a portion of the cartridge **10**, and the opposite portion of the cartridge **10** may be coupled to the main body **20**. The user may be provided with aerosol from the cartridge **10** by contacting the mouth with the mouthpiece **160** and inhaling.

Through the inhalation or puffing actions of the user, a difference in pressure may occur between the outside of the cartridge **10** and the inside of the cartridge **10**. Accordingly, an aerosol generated from the inside of the cartridge **10** may be discharged to the outside of the cartridge **10** through the outlet **160***e*. In this way, the user may be provided with aerosol discharged to the outside of the cartridge **10** through the outlet **160***e* by contacting the mouth with the mouthpiece **160** and inhaling.

The reservoir **200** may be located in an inner space of the housing **100** and may accommodate the aerosol generating material. In the present disclosure, the expression "the reservoir accommodates the aerosol generating material" means that the reservoir **200** may simply serve as a container for directly storing the aerosol generating material, or include an element impregnated with (containing) an aerosol generating material, such as a sponge, cotton, fabric, or porous ceramic structure.

The reservoir **200** may accommodate an aerosol generating material having any one state of, for example, a liquid, solid, gas, gel, or the like.

In an embodiment, the aerosol generating material may include a liquid composition. The liquid composition may be a liquid including a tobacco-containing material having a volatile tobacco flavor component, or a liquid including a non-tobacco material.

The liquid composition may include, for example, any one component of water, solvents, ethanol, plant extracts, spices, flavorings, and vitamin mixtures, or a mixture thereof. The spices may include menthol, peppermint, spearmint oil, and various fruit-flavored ingredients, but are not limited thereto.

The flavorings may include ingredients capable of providing various flavors or tastes to a user. Vitamin mixtures may be a mixture of at least one of vitamin A, vitamin B, vitamin C, and vitamin E, but are not limited thereto. In addition, the liquid composition may include an aerosol forming agent such as glycerin and propylene glycol.

For example, the liquid composition may have any weight ratio between glycerin and propylene glycol solution to which nicotine salts are added. The liquid composition may include two or more types of nicotine salts. Nicotine salts may be formed by adding suitable acids, including organic or inorganic acids, to nicotine. Nicotine may be a naturally generated nicotine or synthetic nicotine and may have any suitable weight concentration relative to the total solution weight of the liquid composition.

Acid for forming nicotine salts may be appropriately selected in consideration of the rate of nicotine absorption in the blood, operating temperature of the aerosol generating apparatus **1000**, the flavor or savor, the solubility, or the like. For example, the acid for the formation of nicotine salts may be a single acid selected from the group consisting of benzoic acid, lactic acid, salicylic acid, lauric acid, sorbic acid, levulinic acid, pyruvic acid, formic acid, acetic acid, propionic acid, butyric acid, valeric acid, caproic acid, caprylic acid, capric acid, citric acid, myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, linolenic acid, phenylacetic acid, tartaric acid, succinic acid, fumaric acid, gluconic acid, saccharic acid, malonic acid or malic acid, or a mixture of two or more acids selected from the group, but is not limited thereto.

The atomizer **400** may be located inside the housing **100** and may convert a phase of the aerosol generating material stored in the cartridge **10** to generate aerosol.

For example, the aerosol generating material stored or accommodated in the reservoir **200** may be supplied from the reservoir **200** to the atomizer **400** through the liquid delivery element **300**, and the atomizer **400** may generate aerosols by atomizing the aerosol generating material received from the liquid delivery element **300**. At this time, the liquid delivery element **300** may be a wick including at least one of cotton fiber, ceramic fiber, glass fiber, and porous ceramic, but the liquid delivery element **300** is limited to the embodiments described above.

According to one embodiment, the atomizer **400** of the aerosol generating apparatus **1000** may convert the phase of the aerosol generating material by using an ultrasonic vibration method that atomizes the aerosol generating material with ultrasonic vibration.

For example, the atomizer **400** may include a vibrator that generates vibrations having a short period. For example, the vibrations generated from the vibrator may be ultrasonic vibrations. The frequency of the ultrasonic vibrations may be about 100 kHz to about 3.5 MHz, but is not limited thereto.

The aerosol generating material supplied to the atomizer **400** from the reservoir **200** by short periods of vibrations generated from the vibrator may be vaporized and/or changed to particles and atomized to an aerosol.

The vibrator may include, for example, a piezoelectric ceramic, and the piezoelectric ceramic may, by generating electricity (voltage) by a physical force (pressure), and generating vibration (mechanical force) when electricity is applied thereto, act as a functional material capable of converting electrical force into mechanical force and vice versa. That is, as electricity is applied to the vibrator, vibrations (physical force) of short periods may be generated, and the generated vibrations break down the aerosol generating material to small particles to thereby atomize to an aerosol.

The vibrator may be electrically connected to other components of the aerosol generating apparatus **1000** through an electrical connection member.

According to an embodiment, the vibrator may be electrically connected with at least one of a battery **510** (e.g., the battery **510** of FIG. **1**), a processor **550** (e.g., the processor **550** of FIG. **1**), and a driving circuit of the aerosol generating apparatus **1000** through a printed circuit board **500** located

inside the housing **100** of the cartridge **10**. For example, the vibrator may be electrically connected to the printed circuit board **500** located inside the cartridge **10** through the first electrical connection member, and the printed circuit board **500** may be electrically connected to the battery **510**, processor **550**, and/or other driving circuits of the main body **20** through the second electrical connection member. That is, the vibrator may be electrically connected to the components of the main body **20** via the printed circuit board **500**.

According to another embodiment (not shown), the vibrator may be directly connected to at least one of the battery **510** and the processor **550** of the main body **20** and the driving circuit of the aerosol generating apparatus **1000**, without the printed circuit board **500** as a medium for connection.

The vibrator may generate ultrasonic vibration by receiving currents or voltages from the battery **510** of the main body **20** through the electrical connection member. In addition, the vibrator may be electrically connected to the processor **550** of the main body **20** through the electrical connection member, and the processor **550** may control the operation of the vibrator.

The electrical connection member may include, for example, a pogo pin, a wire, a cable, a flexible printed circuit board (FPCB), or a C-clip, but the electrical connection member is not limited to the examples described above.

In another embodiment (not shown), the atomizer **400** may be implemented with receiving portion in a mesh shape or plate shape, which absorbs the aerosol generating material without a separate liquid delivery element **300**, maintains the aerosol generating material in an optimal state for conversion to an aerosol, and transmits vibration to the aerosol generating material such that an aerosol is generated.

The aerosol generated by the atomizer **400** may be discharged to the outside of the cartridge **10** through a discharge passage **150** and supplied to the user.

According to an embodiment, the discharge passage **150** may be located inside the cartridge **10** and may be connected to or communicate with the atomizer **400** and the outlet **160***e* of the mouthpiece **160**. Accordingly, the aerosol generated in the atomizer **400** may flow along the discharge passage **150** and may be discharged to the outside of the cartridge **10** or the aerosol generating apparatus **1000** through the outlet **160***e*. The user may be supplied with the aerosol by contacting the mouth with the mouthpiece **160** and inhaling the aerosol being discharged from the discharge outlet **160***e*.

For example, the discharge passage **150** may be arranged such that the discharge passage **150** is surrounded by the reservoir **200** inside the housing **100**. However, the arrangement of the discharge passage **150** is not limited to the example described above.

Although not shown in the drawing, the cartridge **10** may include at least one air entry passage for air (hereinafter referred to as external air) outside of the cartridge **10** or the aerosol generating apparatus **1000** to flow into the housing **100**.

The external air may flow through at least one air entry passage into a space in which aerosols are generated by the discharge passage **150** or atomizer **400** inside the cartridge **10**. The introduced external air may be mixed with vaporized particles generated from the aerosol generating material, and as a result, aerosols may be generated.

According to an embodiment, the cross-sectional shape in a direction transverse to the longitudinal direction of the cartridge **10** and/or the main body **20** of the aerosol generating apparatus **1000** may be circular, elliptical, square, rectangular, or other various types of polygons. However, the cross-sectional shape of the cartridge **10** and/or the main body **20** is not limited to the shape described above, and the aerosol generating apparatus **1000** may not extend in a straight line in the longitudinal direction.

In another embodiment, the aerosol generating apparatus **1000** may be curved in a streamline shape for the user to comfortably hold the aerosol generating apparatus **1000** or may have a portion bent at a predetermined angle. The cross-sectional shape of the aerosol generating apparatus **1000** may change along the longitudinal direction.

FIG. **3** is a perspective view of a cartridge according to an embodiment, and FIG. **4** is an exploded perspective view of a cartridge according to an embodiment. FIG. **5** is a cross-sectional view of the cartridge shown in FIG. **3** along an A-A' direction, and FIG. **6** is a cross-sectional view of the cartridge shown in FIG. **3** along a B-B' direction.

The cartridge **10** according to the embodiment shown in FIGS. **3** to **6** may be the cartridge **10** of the aerosol generating apparatus **1000** shown in FIG. **2**, and thus redundant descriptions will be omitted.

Referring to FIGS. **3**, **4**, **5**, and **6**, the cartridge **10** according to an embodiment may include the housing **100**, the discharge passage **150**, the mouthpiece **160**, the reservoir **200**, the liquid delivery element **300**, the atomizer **400**, and the printed circuit board **500**. The components of the cartridge **10** according to an embodiment are not limited to the examples described above, and any one configuration may be added, or any one configuration (for example, the mouthpiece **160**) may be omitted according to the embodiment.

The housing **100** may form the overall outer shape of the cartridge **10**, and form an internal space in which the components of the cartridge **10** may be arranged. Although the overall shape of the housing **100** of the cartridge **10** is a square column in the drawings, the shape of the housing **100** is not limited thereto. In another embodiment (not shown), the housing **100** may be formed in a cylindrical shape, or a polygonal column (e.g., a triangular column, a pentagonal column) shape other than a square column, overall.

According to one embodiment, the housing **100** may include a first housing **110** and a second housing **120** connected to a portion of the first housing **110**. The first housing **110** and the second housing **120** may protect the components of the cartridge **10** which are arranged in the inner space formed by the coupling of the first housing **110** and the second housing **120**.

For example, the first housing **110** (or an "upper housing") is coupled to an upper end (e.g., z direction) of the second housing **120** (or "lower housing"), thereby forming, between the first housing **110** and the second housing **120**, an inner space in which the components of the cartridge **10** may be arranged, but embodiments are not limited thereto.

In this disclosure, "upper end" may refer to the end portion in the "+z" direction of FIGS. **3** to **6**, and "lower end" may refer to the end portion in the "−z" direction of FIGS. **3** to **6**, and the expressions will be used for the same meaning below.

The mouthpiece **160**, which may be inserted into the mouth of the user, may be connected to the housing **100**. For example, the mouthpiece **160** may be connected to a portion (for example, an upper end portion) of the first housing **110**, and the opposite portion of the first housing **110** may be connected to the second housing **120**.

In an embodiment, the mouthpiece **160** may be detachably coupled to the housing **100**, but the mouthpiece **160** may be formed integrally with the housing **100**, according to embodiments.

The mouthpiece **160** may include at least one outlet **160***e* for discharging the aerosol generated from the inside of the cartridge **10** to the outside of the cartridge **10**. The user may contact the mouthpiece **160** with the mouth and be provided with the aerosol that is discharged to the outside through the outlet **160***e* of the mouthpiece **160**.

The reservoir **200** may be arranged in the inner space of the first housing **110**, and the aerosol generating material may be stored in the reservoir **200**. For example, a liquid aerosol generating material may be stored in the reservoir **200**, but embodiments are not limited thereto.

The liquid delivery element **300** may be located between the reservoir **200** and the atomizer **400**, and the aerosol generating material stored in the reservoir **200** may be supplied to the atomizer **400** through the liquid delivery element **300**.

According to an embodiment, the liquid delivery element **300** may receive the aerosol generating material from the reservoir **200**, and may deliver the received aerosol generating material to the atomizer **400**. For example, the liquid delivery element **300** may absorb the aerosol generating material moving in a direction from the reservoir **200** to the liquid delivery element **300**, and the absorbed aerosol generating material may be move along the liquid delivery element **300** and supplied to the atomizer **400**.

According to an embodiment, the liquid delivery element **300** may include a plurality of liquid delivery elements. For example, the liquid delivery element **300** may include a first liquid delivery element **310** and a second liquid delivery element **320**.

The first liquid delivery element **310** may be arranged adjacent to the reservoir **200** to receive the liquid aerosol generating material from the reservoir **200**. For example, the first liquid delivery element **310** may receive the aerosol generating material from the reservoir **200** by absorbing at least some of the aerosol generating material discharged from the reservoir **200**.

For example, the aerosol generating material stored in the reservoir **200** may be discharged to the outside of the reservoir **200** through a liquid supply hole (not shown) formed in an area of the reservoir **200** facing the first liquid delivery element **310**, but embodiments are not limited thereto.

The second liquid delivery element **320** may be located between the first liquid delivery element **310** and the atomizer **400**, and deliver the aerosol supplied from the first liquid delivery element **310** to the atomizer **400**. For example, the second liquid delivery element **320** may be located in a lower end (i.e., end portion in the −z direction) of the first liquid delivery element **310**, and the aerosol generating material absorbed by the first liquid delivery element **310** may be supplied to the atomizer **400**.

In an embodiment, a portion of the second liquid delivery element **320** may contact a lower end of the first liquid delivery element **310**, and the opposite portion of the second liquid delivery element **320** may contact an upper end of the atomizer **400**.

That is, the atomizer **400**, the second liquid delivery element **320**, and the first liquid delivery element **310** may be sequentially arranged in the longitudinal direction (i.e., +z direction) of the cartridge **10** or the housing **100**. In other words, the second liquid delivery element **320** and the first liquid delivery element **310** may be sequentially stacked on the atomizer **400**.

At least some of the aerosol generating material supplied from the reservoir **200** to the first liquid delivery element **310** may move to the second liquid delivery element **320** in contact with the first liquid delivery element **310**. Further, the aerosol generating material moved to the second liquid delivery element **320** may move along the second liquid delivery element **320** and reach the atomizer **400** in contact with the second liquid delivery element **320**.

Although the liquid delivery element **300** includes two liquid delivery elements in the drawings, the liquid delivery element **300** may include one liquid delivery element or three or more liquid delivery elements, according to embodiments.

The atomizer **400** may atomize the liquid aerosol generating material supplied from the liquid delivery element **300** to generate an aerosol.

For example, the atomizer **400** may include the vibrator that generates ultrasonic vibration. The frequency of ultrasonic vibration generated in the vibrator may be about 100 kHz to about 10 MHz, for example, about 100 kHz to about 3.5 MHz. As the vibrator generates ultrasonic vibration in the frequency band described above, the vibrator may vibrate along the longitudinal direction (e.g., +z direction and −z direction) of the cartridge **10** or the housing **100**. However, the embodiments are not limited thereto, and the direction in which the vibrator vibrates may be changed to various directions (e.g., +z and −z directions, +x and −x directions, +y and −y directions).

By using an ultrasonic vibration method, the atomizer **400** may generate an aerosol at a relatively low temperature compared to a heating method where the aerosol generating material is atomized by heating. For example, in the case of heating the aerosol generating material by using the heater, the aerosol generating material may be heated to a temperature of 200° C. or more, causing the user to feel a burnt taste in the aerosol.

The cartridge **10** according to an embodiment may generate an aerosol at a temperature of about 100° C. to about 160° C., which is lower than when the aerosol generating material is heated with the heater, by atomizing the aerosol generating material through the ultrasonic vibration method. Accordingly, the cartridge **10** may minimize the burnt taste in the aerosol, thereby improving the smoking sensation of the user.

In this disclosure, "smoking sensation" may mean a sense felt by the user during smoking.

The atomizer **400** may be electrically connected to an external power source (e.g., a battery **510** located inside the main body **20** of FIG. **2**) through the printed circuit board **500**, and may generate ultrasonic vibration by power supplied from the external power source. For example, the atomizer **400** may be electrically connected to the printed circuit board **500** located inside the cartridge **10**, and the printed circuit board **500** may be electrically connected to the power source outside of the cartridge **10**, thereby enabling the atomizer **400** to receive power from the external power source.

According to an embodiment, the atomizer **400** may be electrically connected to the printed circuit board **500** through a first conductor **410** and a second conductor **420**.

In an embodiment, the first conductor **410** may include a material (e.g., metal) having electrical conductivity, and may be located at the upper end of the atomizer **400**, thereby electrically connecting the atomizer **400** to the printed circuit board **500**.

For example, a portion of the first conductor **410** (e.g., the upper portion) may be arranged to surround at least an area of the outer circumferential surface of the atomizer **400** and contact the atomizer **400**, and the other portion (e.g., the lower portion) of the first conductor **410** may contact the

printed circuit board **500**. Accordingly, the atomizer **400** and the printed circuit board **500** may be electrically connected with each other.

For example, an opening **410***h* may be formed in the first conductor **410** such that at least a portion of the atomizer **400** is exposed to the outside of the first conductor **410**. A portion of the atomizer **400** exposed to the outside of the first conductor **410** through the opening **410***h* of the first conductor **410** may contact the second liquid delivery element **320**, thereby receiving the aerosol generating material from the second liquid delivery element **320**.

In an embodiment, the second conductor **420** may include a material having electrical conductivity, and may be located at the lower end of the atomizer **400** or between the atomizer **400** and the printed circuit board **500**, thereby electrically connecting the atomizer **400** to the printed circuit board **500**. For example, one end of the second conductor **420** may contact the lower end of the atomizer **400**, and the other end of the second conductor **420** may contact an area of the printed circuit board **500** facing the atomizer **400**, thereby electrically connecting the atomizer **400** to the printed circuit board **500**.

According to an embodiment, the second conductor **420** may include a conductive material having an elasticity, thereby elastically supporting the atomizer **400** in addition to electrically connecting the atomizer **400** to the printed circuit board **500**. For example, the second conductor **420** may include a conductive spring, but the second conductor **420** is not limited to the embodiment described above.

The cartridge **10** according to an embodiment may further include an elastic support **430** that is located between the atomizer **400** and the printed circuit board **500**, thereby supporting the second conductor **420**. The elastic support **430** may include, for example, a material having a flexible characteristic, and may be arranged to wrap the outer circumferential surface of the second conductor **420** to elastically support the second conductor **420**. However, the embodiment of the cartridge **10** is not limited thereto, and the elastic support **430** may be omitted according to embodiments.

According to an embodiment, the printed circuit board **500** may be located inside the second housing **120**, and may be electrically connected to the atomizer **400** through the first conductor **410** and the second conductor **420**, while also being electrically connected to an external power source (e.g., the battery **510** of FIG. **2**) through an electrical connection member (not shown).

The electrical connection member may include, for example, a pogo pin, a wire, a cable, an FPCB, or a C-clip, but the electrical connection member is not limited to the examples described above.

In an embodiment, the second housing **120** may include a plurality of through holes **121**, **122**, and **123** (hereinafter, also referred to as a first through hole **121**, a second through hole **122**, and a third through hole **123**) that provides fluid communication between the inside of the second housing **120** and the outside of the cartridge **10**. An electrical connection member may be arranged in the plurality of through holes **121**, **122**, and **123**, thereby electrically connecting the printed circuit board **500** located inside the cartridge **10** to the power source outside the cartridge **10**.

That is, the printed circuit board **500** may be electrically connected to the atomizer **400** through the first conductor **410**, while being also electrically connected to the power source outside the cartridge **10** through the electrical connection member. As a result, the atomizer **400** may receive power from the external power source via the printed circuit board **500**.

The printed circuit board **500** may include a resistor R for removing the noise (or "noise signal") occurred during the operation of the cartridge **10**. Accordingly, the resistor R may prevent the atomizer **400** from being damaged by removing the noise. The operation of removing the noise by the resistor R will be described in detail below.

The aerosol atomized by the ultrasonic vibration generated in the atomizer **400** may be discharged to the outside of the cartridge **10** through the discharge passage **150** and provided to the user. For example, the discharge passage **150** may enable the inner space of the housing **100** to communicate with the outlet **160***e* of the mouthpiece **160**. Thus, the aerosol generated by the atomizer **400** may flow along the discharge passage **150** and be discharged to the outside of the cartridge **10** through the outlet **160***e*.

According to an embodiment, the discharge passage **150** may be located in the inner space of the housing **100**, and at least a portion of the discharge passage **150** may be surrounded by the reservoir **200**, but embodiments are not limited thereto.

The cartridge **10** according to an embodiment may further include a sealing element **130** for preventing leakage from the reservoir **200** from flowing into the discharge passage **150**.

When the reservoir **200** is arranged to surround the discharge passage **150**, the leakage from the reservoir **200** may flow into the discharge passage **150**, deteriorate the smoking sensation of the user.

In this regard, the cartridge **10** according to an embodiment may prevent the leakage from the reservoir **200** from flowing into the discharge passage **150** by the sealing element **130**, thereby preventing the deterioration of the smoking sensation of the user.

In an embodiment, the sealing element **130** may be located inside the discharge passage **150** to prevent the leakage from flowing into the discharge passage **150**. For example, the sealing element **130** may be in close contact with an inner wall of the discharge passage **150** by being fit to the discharge passage **150**, but embodiments are not limited thereto.

In addition, the sealing element **130** may be formed in a hollow shape, thereby preventing the leakage from the reservoir **200** from flowing into the discharge passage **150**, while not interfering with the movement of the aerosol generated from the atomizer **400**.

In another embodiment, the sealing element **130** may absorb the ultrasonic vibration generated from the atomizer **400** by including a material (e.g., rubber) having elasticity, and as a result, may minimize the ultrasonic vibration generated in the atomizer **400** being delivered to the user through the housing **100** of the cartridge **10**.

In another embodiment, the sealing element **130** may be located at the upper end of the liquid delivery element **300**, and by applying pressure to the liquid delivery element **300** in a direction toward the atomizer **400**, a contact between the liquid delivery element **300** and the atomizer **400** may be maintained. For example, the sealing element **130** may apply pressure to the first liquid delivery element **310** and/or the second liquid delivery element **320** in the −z direction, and thus a contact between the second liquid delivery element **320** and the atomizer **400** may be maintained.

The cartridge **10** according to an embodiment may further include a structure **140** for preventing droplets bouncing

from the atomizer **400** from being provided to the user, and a first support element **141** for fixing or supporting the structure **140**.

In the process in which the aerosol generating material is atomized by the ultrasonic vibration generated in the atomizer **400**, some of the aerosol generating material may not be atomized, resulting in the generation of droplets. The generated droplets may bounce due to the ultrasonic vibration generated in the atomizer **400** and be discharged to the outside of the cartridge **10** through the outlet **160***e*.

The structure **140** may be arranged at a position adjacent to the discharge passage **150** and restrict the movement or flow of the bounced droplets in a direction toward the outlet **160***e* of the mouthpiece **160**.

For example, the structure **140** may include a material (e.g., a felt material) capable of absorbing the droplets bouncing from the atomizer **400** such that the movement or flow of the droplets toward the outlet **160***e* is restricted, but embodiments are not limited thereto.

When the droplets that bounce from the atomizer **400** are discharged to the outside of the cartridge **10** through the outlet **160***e* and delivered to the user, the user may feel uncomfortable and the overall smoking sensation may be deteriorated.

In this regard, the cartridge **10** according to an embodiment may include the structure **140** that prevents the droplets that have not been atomized from bouncing from the atomizer **400** toward the outlet **160***e*, thereby minimizing the deterioration of smoking sensation of the user due to the splash of droplets. In the present disclosure, "splash of droplets" may mean that the droplets that have not been atomized in the atomizer **400** are bounced off.

The first support element **141** may accommodate at least a portion of the structure **140**, and maintain or fix the position of the accommodated portion of the structure **140** with respect to the first housing **110**. For example, the first support element **141** may maintain or fix the structure **140** in a portion (e.g., an upper region) of the first housing **110** adjacent to the mouthpiece **160**, but embodiments are not limited thereto.

In an embodiment, the first support element **141** may be arranged to surround at least a portion of the structure **140** to accommodate the structure **140**. Because the first support element **141** accommodating the structure **140** is coupled to the first housing **110**, the structure **140** may also be fixed to the first housing **110**.

The first support element **141** accommodating the structure **140** may be coupled to the first housing **110** by an interference fit, but the method of coupling the first housing **110** to the first support element **141** is not limited thereto. In another example, the first housing **110** and the first support element **141** may be coupled by at least one of a snap-fit method, a screw connection method, or a magnetic force coupling method.

The first support element **141** may include a material (e.g., rubber) having a certain rigidity and waterproofness. As such, the first support element **141** may not only fix the structure **140** to the first housing **110**, but also prevent the aerosol generating material leaking from the reservoir **200**. For example, the first support element **141** may prevent the leakage of the aerosol generating material by blocking a portion of the reservoir **200** which faces the mouthpiece **160**.

The cartridge **10** according to an embodiment may further include a second support element **330** for maintaining the liquid delivery element **300** and/or the atomizer **400** inside the first housing **110**.

The second support element **330** may be arranged to surround at least a portion of the first liquid delivering unit **310**, the second liquid delivering unit **320**, and/or the atomizer **400**, thereby accommodating the first liquid delivering unit **310**, the second liquid delivering unit **320**, and/or the atomizer **400**.

In an embodiment, the second support element **330** may be coupled to the lower portion (e.g., an end portion in the −z direction) of the first housing **110**. As a result, the first liquid delivering unit **310**, the second liquid delivering unit **320**, and/or the atomizer **400** may be maintained or fixed to the lower portion of the first housing **110**.

The second support element **330** may be coupled to the first housing **110** by an interference fit, but the method of coupling the first housing **110** to the second support element **330** is not limited thereto. In another example, the first housing **110** and the second support element **330** may be coupled by at least one of a snap-fit method, a screw connection method, or a magnetic force coupling method.

According to an embodiment, the second support element **330** may include a material (e.g., rubber) having a certain rigidity and waterproofness. As such, the second support element **330** may not only fix the liquid delivery element **300** and the atomizer **400** to the first housing **110**, but also prevent the aerosol generating material from leaking from the reservoir **200**. For example, the second support element **330** may prevent the leakage of the aerosol generating material by blocking a portion of the reservoir **200** adjacent to the liquid delivery element **300** or the atomizer **400**.

Hereinafter, with reference to FIGS. **7** to **9**, an electrical connection structure between the atomizer **400** and the printed circuit board **500** and an electrical connection between the resistor R mounted on the printed circuit board **500** and the atomizer **400** will be described in detail.

FIG. **7** is an exploded perspective view illustrating an electrical connection between the vibrator of the cartridge and the printed circuit board, FIG. **8** is a cross-sectional view illustrating an electrical connection between the vibrator of the cartridge and the printed circuit board shown in FIG. **7**, and FIG. **9** is a circuit diagram showing an electrical connection between the vibrator of the cartridge and the resistor mounted on the printed circuit board shown in FIG. **7**.

FIGS. **7** and **8** show some components (e.g., the atomizer **400**, the first conductor **410**, the second conductor **420**, and the printed circuit board **500**) of the cartridge **10** shown in FIGS. **3** to **6** for convenience of description, but the components of the cartridge **10** are not limited to the illustrated embodiment.

Referring to FIGS. **7**, **8** and **9**, a cartridge according to an embodiment (e.g., the cartridge **10** of FIGS. **3** to **6**) may include the atomizer **400**, the printed circuit board **500**, the first conductor **410**, and the second conductor **420**. The first conductor **410** and the second conductor **420** electrically connect the atomizer **400** to the printed circuit board **500**.

The printed circuit board **500** may include a first surface facing the atomizer **400**, and a second surface opposite to the first surface. A plurality of electrical contacts may be arranged on the first surface and the second surface of the printed circuit board **500** to electrically connect the printed circuit board **500** to the atomizer **400** and/or an external power source (e.g., the battery **510** of FIG. **2**).

According to an embodiment, a first electrical contact **501** and a second electrical contact **502** arranged apart from the first electrical contact **501** may be arranged on the first surface of the printed circuit board **500**.

A portion (e.g., upper portion) of the first conductor **410** may be arranged to surround at least a portion of the outer circumferential surface of the atomizer **400** and contact the atomizer **400**, and another portion (e.g., "lower portion") of the first conductor **410** may contact the first electrical contact **501** of the printed circuit board **500**. The atomizer **400** and the first electrical contact **501** may be electrically connected by the arrangement and structure of the first conductor **410** described above.

The second conductor **420** may be located between the atomizer **400** and the printed circuit board **500**. For example, one end (e.g., end portion in the +z direction) of the second conductor **420** may contact an area of the atomizer **400** facing the printed circuit board **500**, and the opposite end (e.g., end portion in the −z direction) of the second conductor **420** may contact the second electrical contact **502** of the printed circuit board **500**. The atomizer **400** and the second electrical contact **502** may be electrically connected by the arrangement and structure of the second conductor **420** described above.

According to an embodiment, the atomizer **400** may include a first electrode **401** (or "upper electrode") arranged at a portion of the atomizer **400** in a direction opposite to the printed circuit board **500**, and a second electrode **402** (or "lower electrode") arranged at a portion of the atomizer **400** facing the printed circuit board **500**.

The first electrode **401** and/or the second electrode **402** may include a material having a high electrical conductivity, and may electrically connect the atomizer **400** to the first conductor **410** and/or the second conductor **420**. The first electrode **401** and/or the second electrode **402** may include any one of, for example, silver (Ag), copper (Cu), gold (Au), aluminum (Al), tungsten (W), iron (Fe), platinum (Pt), or lead (Pb), but is not limited thereto.

In the figures, the first electrode **401** is arranged along the edge of the atomizer **400**, and the second electrode **402** is arranged in the center of atomizer **400** facing the printed circuit board **500**. However, the arrangement and structure of the first electrode **401** and/or the second electrode **402** are not limited to the illustrated embodiment. In another embodiment, the first electrode **401** may be arranged only at a portion of the edge of the atomizer **400**, or the second electrode **402** may be arranged at a side rather than the center of the atomizer **400**.

In an embodiment, a portion of the first conductor **410** may be arranged to surround and contact the outer circumferential surface of the atomizer **400** where the first electrode **401** is arranged. In another example, the first electrode **401** may be arranged on the top surface of the atomizer **400**, and the inner wall of the upper end of the first conductor **410** protruding inwardly may contact the first electrode **401**. On the other hand, another portion of the first conductor **410** may contact the first electrical contact **501** of the printed circuit board **500**. As a result, the atomizer **400** may be electrically connected to the first electrical contact **501**.

Also, one end of the second conductor **420** may contact the second electrode **402** of the atomizer **400**, and the other end of the second conductor **420** may contact the second electrical contact **502** of the printed circuit board **500**, thereby electrically connecting the atomizer **400** to the second electrical contact **502**.

That is, the cartridge **10** according to an embodiment may electrically connect the atomizer **400** to the printed circuit board **500** by the first conductor **410** in contact with the first electrode **401** of the atomizer **400** and the first electrical contact **501** of the printed circuit board **500**, and a second conductor **420** in contact with the second electrode **402** of the atomizer **400** and the second electrical contact **502** of the printed circuit board **500**.

According to an embodiment, a third electrical contact **501-1** and a fourth electrical contact **502-1** may be arranged on the second surface opposite to the first surface of the printed circuit board **500**.

In an embodiment, the third electrical contact **501-1** may be placed in a position corresponding to the first electrical contact **501** arranged on the first surface of the printed circuit board **500**, and may be electrically connected to the first electrical contact **501** through a first conductive via V**1**.

For example, the third electrical contact **501-1** may be placed at a position that overlaps with the first electrical contact **501** when viewed from the first surface of the printed circuit board **500**, and the first conductive via V**1** may be located between the first electrical contact **501** and the third electrical contact **501-1**, thereby connecting the first electrical contact **501** to the third electrical contact **501-1**.

The first conductive via V**1** may be arranged to pass through the first surface and the second surface of the printed circuit board **500**, thereby electrically connecting the first electrical contact **501** to the third electrical contact **501-1**.

In an embodiment, the fourth electrical contact **502-1** may be placed in a position corresponding to the second electrical contact **502** arranged on the first surface of the printed circuit board **500**, and may be electrically connected to the second electrical contact **501** through a second conductive via V**2**.

For example, the fourth electrical contact **502-1** may be placed at a position that overlaps with the second electrical contact **502** when viewed from the first surface of the printed circuit board **500**, and the second conductive via V**2** may be located between the second electrical contact **502** and the fourth electrical contact **502-1**, thereby connecting the second electrical contact **502** to the fourth electrical contact **502-1**.

The second conductive via V**2** may be arranged to pass through the first surface and the second surface of the printed circuit board **500**, thereby electrically connecting the second electrical contact **502** to the fourth electrical contact **502-1**.

The third electrical contact **501-1** may be arranged at a position corresponding to the first through hole (e.g., the first through hole **121** of FIG. **5**) of the second housing (e.g. the second housing **120** of FIG. **5**), and may be electrically connected to the external power source through the electrical connection member arranged inside the first through hole. For example, the third electrical contact **501-1** may be electrically connected to the battery (e.g., the battery **510** of FIG. **2**) of the main body (e.g., the main body **20** of FIG. **2**) through the electrical connection member arranged in the first through hole.

Further, the fourth electrical contact **502-1** may be arranged at a position corresponding to a second through hole (e.g., the second through hole **122** of FIG. **5**) of the second housing **120**, and may be electrically connected to the external power source through the electrical connection member arranged inside the second through hole. For example, the fourth electrical contact **502-1** may be electrically connected to the battery of the main body through the electrical connection member arranged inside the second through hole.

The printed circuit board **500** of the cartridge **10** according to an embodiment may operate as a medium for electrically connecting the atomizer **400** to the external power source (e.g., the battery of the main body) by having a structure in which the first electrical contact **501** and the second electrical contact **502** are arranged on the first

surface, and the third electrical contact **501-1** and the fourth electrical contact **502-1** electrically connected to the first electrical contact **501** and the second electrical contact **502**, respectively, are arranged on the second surface.

Because the first electrical contact **501** and the second electrical contact **502** of the printed circuit board **500** are electrically connected to the atomizer **400**, and the third electrical contact **501-1** and the fourth electrical contact **502-1** of the printed circuit board **500** are electrically connected to the battery of the main body, an electrical circuit may be formed between the atomizer **400** and the external power source.

Through the electrical circuit formed between the atomizer **400** and the external power source, the atomizer **400** may receive power from the external power source to atomize the aerosol generating material into an aerosol. For example, the power supplied from the external power source may be transmitted to the atomizer **400** through the printed circuit board **500** arranged inside the cartridge, and the atomizer **400** may generate the aerosol by generating ultrasonic vibration through the received power.

According to an embodiment, the printed circuit board **500** may further include a fifth electrical contact **503** arranged on the first surface and a sixth electrical contact **503-1** arranged on an area of the second surface corresponding to the fifth electrical contact **503**.

The fifth electrical contact **503** may be placed at a position that corresponds to or overlaps with the sixth electrical contact **503-1** when viewed from the first surface of the printed circuit board **500**, and a third conductive via V**3** may be located between the fifth electrical contact **503** and the sixth electrical contact **503-1**, thereby electrically connecting the fifth electrical contact **503** to the sixth electrical contact **503-1**.

In an example, because the fifth electrical contact **503** may be electrically connected to the first conductor **410**, the atomizer **400** may be electrically connected to the first electrical contact **501**.

The sixth electrical contact **503-1** may be arranged at a position corresponding to a third through hole (e.g., the third through hole **123** of FIG. **5**) of the second housing **120**, and may be electrically connected to the external power source (e.g., the battery of the main body) through the electrical connection member arranged inside the third through hole.

In the cartridge according to an embodiment, because two electrical contacts (the first electrical contact **501** and the fifth electrical contact **503**) arranged on the first surface of the printed circuit board **500** are electrically connected to the first conductor **410**, the atomizer **400** may be electrically connected to the printed circuit board **500** if the first conductor **410** is in contact with any one of the two electrical contacts.

Because the atomizer **400** may be electrically connected to the printed circuit board **500** as long as the first conductor **410** is in contact with any one of the first electrical contact **501** and the fifth electrical contact **503**, the electrical connection between the atomizer **400** and the printed circuit board **500** may be maintained regardless of the direction of arrangement of the printed circuit board **500**.

The first electrical contact **501** through the sixth electrical contact **503-1** may be, for example, a conductive pad or a soldering pad mounted on the printed circuit board **500**, but are not limited thereto.

The resistor R may be arranged in the printed circuit board **500**. The resistor R may remove or filter noise occurring when power is supplied from the external power source to the atomizer **400** or noise occurring in a circuit of the printed circuit board **500**.

According to an embodiment, the resistor R may be mounted on an area of the printed circuit board **500** to eliminate the noise that occurs when the aerosol generating apparatus operates (or when power is turned on), thereby stabilizing the voltage supplied to the atomizer **400**.

When power starts to be supplied to the atomizer **400**, or during the process of supplying power to the atomizer **400**, noise may occur in the electrical circuit between the atomizer **400** and the external power source. For example, a higher voltage than a designated value may be applied to the atomizer **400** due to the noise in the voltage signal provided to the atomizer **400**. As a result, the temperature of the atomizer **400** may rise sharply (e.g., rise above the Curie temperature), thereby damaging the atomizer **400**.

In this regard, the cartridge according to an embodiment may eliminate or filter the noise occurring in the electrical circuit formed between the atomizer **400** and the external power source by using the resistor R mounted on the printed circuit board **500**. As a result, the cartridge or the aerosol generating apparatus may operate stably.

According to an embodiment, as shown in FIG. **9**, the resistor R may eliminate or filter the noise included in the voltage signal applied to the atomizer **400** by forming a feedback circuit electrically connected in parallel with the atomizer **400**.

In an embodiment, the resistor R may be electrically connected to the first electrical contact **501** (or the fifth electrical contact **503**) and the second electrical contact **502** to be connected in parallel with the atomizer **400**. For example, the resistor R may be electrically connected to the first conductive via V**1** (or the third conductive via V**3**) and the second conductive via V**2** in the printed circuit board **500**, but embodiments are not limited thereto.

The resistor R may allow a stable voltage to be applied to the atomizer **400** by removing the noise included in the voltage signal applied to the atomizer **400** by forming the feedback circuit. As a result, damage to the atomizer **400** by the noise may be prevented, thereby enabling a stable operation of the cartridge or the aerosol generating apparatus.

According to an embodiment, the printed circuit board **500** may be arranged inside the cartridge to be adjacent to the atomizer **400**, and the resistor R may be arranged or mounted on the first surface of the printed circuit board **500** facing the atomizer **400**. Otherwise, if the resistor R is arranged on the second surface of the printed circuit board **500**, or on the main body (e.g., the main body **20** of FIG. **2**) instead of the cartridge **10**, the electrical length of the feedback circuit may increase. When the electrical length of the feedback circuit increases, noise may additionally occur during a feedback process of the voltage signal applied to the atomizer **400**, and thus a voltage signal applied to the atomizer **400** may be affected by the noise despite the feedback circuit.

In this regard, in the cartridge according to an embodiment, the printed circuit board **500** is arranged in a within a designated distance from the atomizer **400**, and the resistor R forming the feedback circuit is arranged on the first surface of the printed circuit board **500** adjacent to the atomizer **400**, such that the electrical length of the feedback circuit is not too long. As a result, additional noise may be prevented from occurring during a feedback process of the voltage signal applied to the atomizer **400**, and thus a stable voltage signal may be provided to the atomizer **400**.

In this disclosure, "a designated distance" between the printed circuit board **500** and the atomizer **400** may refer to a distance to prevent noise from occurring during the feedback process of the voltage signal.

In the cartridge according to an embodiment, the printed circuit board **500** on which the resistor R is mounted may be arranged inside the cartridge instead of the main body such that stable voltage may be provided to the atomizer **400**. As a result, damage to the atomizer **400** may be prevented and the cartridge and aerosol generating apparatus may operate stably.

The resistor R may be mounted on the first surface of the printed circuit board **500** in various ways. For example, the resistor R may be electrically connected to the printed circuit board **500** by a surface mount method in which the resistor R protrudes from the first surface of the printed circuit board **500**, or by a method in which at least a portion of the resistor R is embedded in the first surface of the printed circuit board **500**.

According to an embodiment, the resistor R may have a resistance value of about 0.8 MΩ to about 1.2 MΩ to eliminate noise included in the voltage signal applied to the atomizer **400**. However, the resistance value of the resistor R may be altered according to the embodiment.

FIG. **10** is a graph showing a change in the voltage applied to the vibrator of the cartridge, according to an embodiment.

FIG. **10** shows a change in the voltage signal applied to the atomizer **400** over time when the resistor R is mounted on the printed circuit board **500** in the cartridge, according to the embodiment illustrated in FIGS. **7** and **8**.

Referring to FIG. **10**, in a cartridge according to an embodiment, the noise included in the voltage signal applied to the atomizer may be eliminated or filtered, because the printed circuit board is arranged inside the cartridge, and the resistor (e.g., the resistor R of FIGS. **7** and **8**) connected in parallel with the atomizer (e.g., the atomizer **400** of FIGS. **7** and **8**) is mounted on the printed circuit board.

Because the resistor eliminates the noise occurred during a process of applying voltage to the atomizer, only components corresponding to the resonance frequency may remain in the voltage signal applied to the atomizer, and thus stable voltage may be provided to the atomizer.

That is, the cartridge and the aerosol generating apparatus including the same may prevent an excessively high voltage from being applied to the vibrator by the resistor which is mounted on the printed circuit board placed adjacent to the atomizer and removes the noise occurred during the operation of the cartridge or the aerosol generating apparatus. As a result, the cartridge and the aerosol generating apparatus including the same according to the embodiments described above may prevent damage to the atomizer, and thus operate stably.

Those of ordinary skill in the art related to the present embodiments may understand that various changes in form and details can be made therein without departing from the scope of the characteristics described above. The disclosed methods should be considered in a descriptive sense only and not for purposes of limitation. The scope of the disclosure should be defined by the appended claims, and all differences within the scope equivalent to those described in the claims will be construed as being included in the scope of protection defined by the claims.

The invention claimed is:

1. A cartridge comprising:

a housing;

a reservoir located in the housing and configured to store an aerosol generating material;

an atomizer located in the housing and configured to generate vibration to atomize the aerosol generating material to an aerosol;

a liquid delivery element configured to absorb the aerosol generating material stored in the reservoir and deliver the absorbed aerosol generating material to the atomizer, wherein the liquid delivery element comprises at least one of cotton fiber, ceramic fiber, glass fiber, or porous ceramic; and

a resistor located in the housing wherein the resistor and the atomizer are connected in parallel to form a feedback circuit such that the resistor eliminates a noise in a voltage signal applied to the atomizer.

2. The cartridge of claim **1**, further comprising a printed circuit board located in the housing and electrically connected to the atomizer,

wherein the resistor is arranged in the printed circuit board.

3. The cartridge of claim **2**, wherein the printed circuit board is arranged within a designated distance from the atomizer.

4. The cartridge of claim **2**, wherein the resistor is arranged at an area of the printed circuit board facing the atomizer.

5. The cartridge of claim **2**, further comprising:

a first electrical contact arranged on a first surface of the printed circuit board facing the atomizer; and

a second electrical contact arranged apart from the first electrical contact on the first surface of the printed circuit board.

6. The cartridge of claim **5**, wherein the resistor forms a feedback circuit by being electrically connected to the first electrical contact and the second electrical contact.

7. The cartridge of claim **5**, further comprising:

a first conductor electrically connecting the atomizer and the first electrical contact; and

a second conductor electrically connecting the atomizer and the second electrical contact.

8. The cartridge of claim **7**, wherein

a first portion of the first conductor is arranged to surround at least a portion of the atomizer, and

a second portion of the first conductor extends from the first portion toward the first surface of the printed circuit board, thereby contacting the first electrical contact.

9. The cartridge of claim **7**, wherein the second conductor is located between the atomizer and the printed circuit board, and one end of the second conductor contacts an area of the atomizer facing the printed circuit board and another end of the second conductor contacts the second electrical contact.

10. The cartridge of claim **9**, wherein the second conductor is a conductive spring.

11. The cartridge of claim **5**, further comprising:

a third electrical contact arranged on a second surface opposite to the first surface of the printed circuit board and configured receive power from an external power source; and

a fourth electrical contact arranged apart from the third electrical contact on the second surface of the printed circuit board and configured to receive power from the external power source.

12. The cartridge of claim **11**, wherein

the first electrical contact is electrically connected to the third electrical contact through a first conductive via, and

the second electrical contact is electrically connected to the fourth electrical contact through a second conductive via.

13. The cartridge of claim **1**, further comprising:

a mouthpiece including an outlet for discharging the aerosol; and

a discharge passage connecting the atomizer and the outlet such that the aerosol atomized by the atomizer moves along the discharge passage toward the outlet.

14. An aerosol generating apparatus comprising:

a cartridge comprising:

a housing,

a reservoir located in the housing and configured to store an aerosol generating material,

an atomizer located in the housing and configured to generate vibration to atomize the aerosol generating material to an aerosol,

a liquid delivery element configured to absorb the aerosol generating material stored in the reservoir and deliver the absorbed aerosol generating material to the atomizer, wherein the liquid delivery element comprises at least one of cotton fiber, ceramic fiber, glass fiber, or porous ceramic, and

a resistor located in the housing wherein the resistor and the atomizer are connected in parallel to form a feedback circuit such that the resistor eliminates a noise in a voltage signal applied to the atomizer;

a main body connected to the cartridge;

a battery arranged in the main body and configured to supply power to the atomizer of the cartridge; and

a processor arranged in the main body and configured to control the power supplied to the cartridge from the battery.

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