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(54) SYSTEM-IN-PACKAGE AND AEROSOL GENERATING APPARATUS COMPRISING THE SAME

SYSTEM-IN-PACKAGE UND AEROSOLERZEUGUNGSVORRICHTUNG DAMIT

SYSTÈME EN BOÎTIER ET APPAREIL DE GÉNÉRATION D'AÉROSOL LE COMPRENANT

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Description

Technical Field

[0001] The present disclosure relates to a system-in-package and an aerosol-generating apparatus including the same.

Background Art

[0002] Recently, the demand for alternative methods to overcome the shortcomings of general cigarettes has increased. For example, there is an increasing demand for a method of generating aerosol by heating an aerosol generating material in cigarettes, rather than by burning cigarettes.

[0003] When a method of generating an aerosol and an apparatus using the same are used, portability may be important to a user. A reduction in size of an aerosol-generating apparatus may increase portability, and in order to manufacture an aerosol-generating apparatus in a compact size while maintaining existing functions, research for the miniaturization of internal components has been conducted.

[0004] EP 3 666 095 A2 discloses an aerosol generating apparatus comprising a microcontroller, a sensor and an (IC) controlling a heater.

Disclosure of Invention

Technical Problem

[0005] Although a cigarette used with an aerosol-generating apparatus is as small as a conventional cigarette, a size of an aerosol-generating apparatus has not been significantly reduced in terms of portability. In this respect, there is a need for a small aerosol-generating apparatuses that users can easily carry.

[0006] Meanwhile, if the size of an aerosol-generating apparatus is reduced, its internal components may be densely arranged, which raises a risk of overheating or damaging the components of an aerosol-generating apparatus.

[0007] On the other hand, foreign materials may be generated in or may intrude into the aerosol-generating apparatuses. For example, foreign materials may intrude into the aerosol-generating apparatuses by droplets generated from the aerosol or by a liquid leakage from a cigarette. In this case, internal components of the aerosol-generating apparatuses may malfunction or may be damaged.

[0008] In order to solve the above-described problems, and the present disclosure provides a system-in-package (SIP) and an aerosol-generating apparatus including the same. 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.

Solution to Problem

[0009] As a technical solution for achieving the above technical goal, a system-in-package (SIP) according to an aspect of the present disclosure may include a microcontroller unit (MCU), a sensor module, and a heating integrated circuit (IC) configured to control a heating operation of a heater assembly included in the aerosol generating apparatus.

[0010] According to another aspect of the present disclosure, an aerosol-generating apparatus includes a heater assembly configured to heat a cigarette inserted into the aerosol-generating apparatus, a battery configured to supply power to the heater assembly, and a system-in-package (SIP) including a microcontroller unit (MCU); a sensor module; and a heating integrated circuit (IC) configured to control a heating operation of the heater assembly.

Advantageous Effects of Invention

[0011] An aerosol-generating apparatus may employ a system-in-package (SIP) to save a mounting space. Devices performing different functions in an on-chip form and/or a module form may be packaged on one wafer. Accordingly, a size of a housing of the aerosol-generating apparatus may be reduced, thus improving the portability of the aerosol-generating apparatus.

[0012] The aerosol-generating apparatus may be configured to protect the components inside the SIP from foreign materials from the outside by using a molding that surrounds (i.e., covers) the SIP. When the aerosol-generating apparatus detects the foreign materials on the molding, a heating operation of a heating unit is suspended to prevent safety problems caused by, for example, a short circuit. The SIP may prevent the components inside the SIP from contacting foreign materials such as droplets, moisture, or dust.

[0013] A molding in the SIP may dissipate the heat of the internal components that may be generated by the foreign material, a heating operation, etc. Also, overheating of the SIP may be detected based on a temperature of each part of the SIP. When it is determined that the SIP is overheated, the heating operation of the heating unit is suspended to prevent problems resulting from the overheating.

Brief Description of Drawings

[0014]

FIG. 1 illustrates components forming an aerosol-generating apparatus including a heater assembly, according to an embodiment.

FIG. 2 is an exploded perspective view schematically illustrating a coupling relationship between a replaceable cartridge containing an aerosol generating material and an aerosol generating apparatus in-

cluding the same, according to an embodiment.

FIGS. 3 to 4B are diagrams of examples in which a cigarette is inserted into an aerosol-generating apparatus.

FIG. 5 is a block diagram of components of an aerosol-generating apparatus, according to some embodiments.

FIGS. 6A and 6B are respectively a plan view and a side view of a system-in-package (SIP), according to some embodiments.

FIG. 7 is a flowchart of an operation method of an aerosol-generating apparatus, according to some embodiments.

FIGS. 8A and 8B are diagrams illustrating arrangements of an aerosol-generating apparatus, according to some embodiments.

Mode for the Invention

[0015] With respect to the terms used to describe the various embodiments, 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 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.

[0016] 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.

[0017] 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.

[0018] The term "cigarette" (i.e., when used alone without a modifier such as "general," "traditional," or "combustive") may refer to any article which has a shape similar to a traditional combustive cigarette. The cigarette may contain an aerosol generating material that generates aerosols by operation (e.g., heating) of an aerosol generating apparatus. Alternatively, the cigarette may not include an aerosol generating material and delivers an aerosol generated from another article (e.g., cartridge) installed in the aerosol generating apparatus.

[0019] 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. The disclosure can, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein.

[0020] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the drawings.

[0021] FIG. 1 illustrates components of an aerosol-generating apparatus including a heater assembly, according to an embodiment.

[0022] Referring to FIG. 1, an aerosol-generating apparatus 100 may include a heater assembly 110, a coil 120, a power supply 130, and a controller 140. However, one or more embodiments are not limited thereto. Other components may be further included in the aerosol-generating apparatus 100 in addition to the components shown in FIG. 1.

[0023] The aerosol-generating apparatus 100 may generate aerosols by heating a cigarette accommodated in the aerosol-generating apparatus 100 by an induction heating method. In the induction heating method, a magnetic substance is heated by applying an alternating magnetic field that changes direction periodically.

[0024] When an alternating magnetic field is applied to the magnetic substance, energy may be lost in the magnetic substance because of eddy currents and hysteresis loss, and the lost energy may be emitted from the magnetic substance as heat energy. The greater an amplitude or a frequency of an alternating magnetic field applied to the magnetic substance is, the more heat energy may be emitted from the magnetic substance. The heat energy may be emitted from the magnetic substance may be transferred to the cigarette.

[0025] The magnetic substance heated by the external magnetic field may be a susceptor. The susceptor may be included in the aerosol-generating apparatus 100 instead of being included in the cigarette in the form of pieces, flakes, or strips. For example, at least some of the heater assembly 110 inside the aerosol-generating apparatus 100 may include a susceptor material.

[0026] At least part of the susceptor material may include a ferromagnetic substance. For example, the susceptor material may include metal or carbon. The susceptor material may include at least one of ferrite, ferromagnetic alloy, stainless steel, and aluminum (Al). Also, the susceptor material may include at least one of ceramic (e.g., graphite, molybdenum, silicon carbide, niobium, nickel (Ni) alloy, a metal film, or zirconia), a transition element (e.g., Ni or cobalt (Co)), and a metalloid (e.g., boron (B) or phosphorus (P)).

[0027] The aerosol-generating apparatus 100 may accommodate the cigarette. In the aerosol-generating ap-

paratus 100, a space for accommodating the cigarette may be formed. In the space for accommodating the cigarette, the heater assembly 110 may be arranged. The heater assembly 110 may have a cylindrical shape in which the space for accommodating the cigarette is formed. Therefore, when the cigarette is inserted into the aerosol-generating apparatus 100, the cigarette may be accommodated in the accommodating space, and the heater assembly 110 may be arranged to surround the cigarette.

[0028] The heater assembly 110 may surround at least a portion of the side surface of the cigarette accommodated in the aerosol-generating apparatus 100. For example, the heater assembly 110 may surround at least a portion of the side surface of the cigarette that corresponds to a tobacco medium included in the cigarette. Accordingly, heat may be effectively transferred from the heater assembly 110 to the tobacco medium included in the cigarette.

[0029] The heater assembly 110 may heat the cigarette accommodated in the aerosol-generating apparatus 100. As described above, for example, the heater assembly 110 may heat the cigarette by the induction heating method. In this case, the heater assembly 110 may include the susceptor material heated by the external magnetic field, and the aerosol-generating apparatus 100 may apply the alternating magnetic field to the heater assembly 110.

[0030] The coil 120 may be included in the aerosol-generating apparatus 100. The coil 120 may apply the alternating magnetic field to the heater assembly 110. When power is supplied from the aerosol-generating apparatus 100 to the coil 120, a magnetic field may be generated in the coil 120. When an alternating current is applied to the coil 120, a direction of the magnetic field formed in the coil 120 may periodically change. When the heater assembly 110 is in the coil 120, it may be exposed to the alternating magnetic field. As a result, the heater assembly 110 may emit heat, and the cigarette accommodated in the heater assembly 110 may be heated.

[0031] The coil 120 may be wound around the heater assembly 110. The coil 120 may be wound around the housing of the aerosol-generating apparatus 100. The heater assembly 110 may be arranged in an internal space around which the coil 120 is wound. Accordingly, when power is supplied to the coil 120, the alternating magnetic field generated by the coil 120 may be applied to the heater assembly 110.

[0032] The coil 120 may extend in a lengthwise direction of the aerosol-generating apparatus 100. The coil 120 may have an appropriate length in the lengthwise direction. For example, the length of the coil 120 in the lengthwise direction may equal to or greater than the length of the heater assembly 110.

[0033] The coil 120 may be arranged at a location appropriate to apply the alternating magnetic field to the heater assembly 110. For example, the coil 120 may be arranged at a location corresponding to the heater assembly 110. Because of a size and an arrangement of the coil 120, the efficiency of applying the alternating magnetic field of the coil 120 to the heater assembly 110 may be improved.

[0034] When the amplitude or frequency of the alternating magnetic field generated by the coil 120 changes, the degree to which the heater assembly 110 heats the cigarette may also change. Because the amplitude or the frequency of the magnetic field generated by the coil 120 may change according to supplied power, the aerosol-generating apparatus 100 may control the heating of the cigarette by adjusting the power supplied to the coil 120. For example, the aerosol-generating apparatus 100 may control the amplitude and frequency of the alternating current applied to the coil 120.

[0035] As an example, the coil 120 may be realized as a solenoid. The coil 120 may be a solenoid wound around the housing of the aerosol-generating apparatus 100, and the heater assembly 110 and the cigarette may be in an internal space of the solenoid. Materials of coils forming the solenoid may include copper (Cu). However, the materials are not limited thereto. The materials may include any one of silver (Ag), gold (Au), aluminum (Al), tungsten (W), zinc (Zn), and nickel (Ni), or an alloy including at least one of the above-listed materials.

[0036] The power supply 130 may supply power to the aerosol-generating apparatus 100. The power supply 130 may supply the power to the coil 120. The power supply 130 may include a battery for supplying a direct current to the aerosol-generating apparatus 100 and a converter for converting the direct current supplied from the battery into an alternating current supplied to the coil 120.

[0037] The battery may supply the direct current to the aerosol-generating apparatus 100. The battery may be a lithium iron phosphate ($LiFePO_4$) battery, but is not limited thereto. For example, the battery may be a lithium cobalt oxide ($LiCoO_2$) battery, a lithium titanate battery, or the like.

[0038] The converter may include a low-pass filter that filters the direct current supplied from the battery and outputs the alternating current supplied to the coil 120. The converter may further include an amplifier for amplifying the direct current supplied from the battery. For example, the converter may be realized using a low-pass filter forming a load network of a class-D amplifier.

[0039] The controller 140 may control the power supplied to the coil 120. The controller 140 may control the power supply 130 to adjust the power supplied to the coil 120. For example, the controller 140 may control the temperature, at which the heater assembly 110 heats the cigarette, to remain constant according to a temperature of the heater assembly 110.

[0040] The controller 140 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 mi-

croprocessor is stored. Also, the controller 140 may include a plurality of processing elements.

[0041] In the aerosol-generating apparatus 100, the temperature of the heater assembly 110 may be measured to uniformly maintain the temperature, at which the heater assembly 110 heats the cigarette, or vary the temperature according to a specific heating profile. However, the aerosol-generating apparatus 100 may not include a separate component for measuring the temperature of the heater assembly 110, and the temperature of the heater assembly 110 may be measured using a sensor pattern integrally included in the heater assembly 110.

[0042] FIG. 2 is an exploded perspective view schematically illustrating a coupling relationship between a replaceable cartridge containing an aerosol generating material and an aerosol generating apparatus including the same, according to an embodiment.

[0043] An aerosol generating apparatus 200 according to the embodiment illustrated in FIG. 2 includes the cartridge 220 containing the aerosol generating material and a main body 210 supporting the cartridge 220.

[0044] The cartridge 220 may be coupled to the main body 210 in a state in which the aerosol generating material is accommodated therein. A portion of the cartridge 220 is inserted into an accommodation space 219 of the main body 210 so that the cartridge 220 may be mounted on the main body 210.

[0045] The cartridge 220 may contain an aerosol generating material in any one of, for example, a liquid state, a solid state, a gaseous state, or a gel state. The aerosol generating material may include a liquid composition. For example, 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.

[0046] For example, the liquid composition may include one component of water, solvents, ethanol, plant extracts, spices, flavorings, and vitamin mixtures, or a mixture of these components. 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.

[0047] For example, the liquid composition may include any weight ratio of 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.

[0048] Acid for the formation of the nicotine salts may be appropriately selected in consideration of the rate of nicotine absorption in the blood, the operating temperature of the aerosol generating apparatus 200, 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.

[0049] The cartridge 220 is operated by an electrical signal or a wireless signal transmitted from the main body 210 to perform a function of generating aerosol by converting the phase of the aerosol generating material inside the cartridge 220 to a gaseous phase. The aerosol may refer to a gas in which vaporized particles generated from an aerosol generating material are mixed with air.

[0050] For example, the cartridge 220 may convert the phase of the aerosol generating material by receiving the electrical signal from the main body 210 and heating the aerosol generating material, or by using an ultrasonic vibration method, or by using an induction heating method. As another example, when the cartridge 220 includes its own power source, the cartridge 220 may generate aerosol by being operated by an electric control signal or a wireless signal transmitted from the main body 210 to the cartridge 220.

[0051] The cartridge 220 may include a liquid storage 221 accommodating the aerosol generating material therein, and an atomizer performing a function of converting the aerosol generating material of the liquid storage 21 to the aerosol.

[0052] When the liquid storage 221 "accommodates the aerosol generating material" therein, it means that the liquid storage 221 may serve as a container directly storing an aerosol generating material or that the liquid storage 221 may include therein an element containing an aerosol generating material, such as a sponge, cotton, fabric, or porous ceramic structure.

[0053] The atomizer may include, for example, a liquid delivery element (e.g., wick) for absorbing the aerosol generating material and maintaining the same in an optimal state for conversion to aerosol, and a heater heating the liquid delivery element to generate aerosol.

[0054] The liquid delivery element may include at least one of, for example, a cotton fiber, a ceramic fiber, a glass fiber, and porous ceramic.

[0055] The heater may include a metallic material such as copper, nickel, tungsten, or the like to heat the aerosol generating material delivered to the liquid delivery element by generating heat using electrical resistance. The heater may be implemented by, for example, a metal wire, a metal plate, a ceramic heating element, or the like, and may be implemented by a conductive filament,

wound on the liquid delivery element, or arranged adjacent to the liquid delivery element, by using a material such as a nichrome wire.

[0056] In addition, the atomizer may be implemented by a heating element in the form of a mesh or plate, which performs both the functions of absorbing the aerosol generating material and maintaining the same in an optimal state for conversion to aerosol without using a separate liquid delivery element and the function of generating aerosol by heating the aerosol generating material.

[0057] At least a portion of the liquid storage 221 of the cartridge 220 may include a transparent material so that the aerosol generating material accommodated in the cartridge 220 may be visually identified from the outside. The liquid storage 221 includes a protruding window 221a protruding from the liquid storage 221, so that the liquid storage 221 may be inserted into a groove 211 of the main body 210 when coupled to the main body 210. A mouthpiece 222 and the liquid storage 221 may be entirely formed of transparent plastic or glass, and only the protruding window 221a corresponding to a portion of the liquid storage 221 may be formed of a transparent material.

[0058] The main body 210 includes a connection terminal 210t arranged inside the accommodation space 219. When the liquid storage 221 of the cartridge 220 is inserted into the accommodation space 19 of the main body 210, the main body 210 may provide power to the cartridge 220 through the connection terminal 210t or supply a signal related to an operation of the cartridge 220 to the cartridge 220.

[0059] The mouthpiece 222 is coupled to one end of the liquid storage 221 of the cartridge 220. The mouthpiece 222 is a portion of the aerosol generating apparatus 200, which is to be inserted into a user's mouth. The mouthpiece 222 includes a discharge hole 222a for discharging aerosol generated from the aerosol generating material inside the liquid storage 221 to the outside.

[0060] The slider 207 is coupled to the main body 210 to move with respect to the main body 210. The slider 207 covers at least a portion of the mouthpiece 222 of the cartridge 220 coupled to the main body 210 or exposes at least a portion of the mouthpiece 222 to the outside by moving with respect to the main body 210. The slider 207 includes an elongated hole 207a exposing at least a portion of the protruding window 221a of the cartridge 220 to the outside.

[0061] The slider 207 has a container shape with a hollow space therein and both ends opened. The structure of the slider 207 is not limited to the container shape as shown in the drawing, and the slider 207 may have a bent plate structure having a clip-shaped cross-section, which is movable with respect to the main body 210 while being coupled to an edge of the main body 210, or a structure having a curved semi-cylindrical shape and a curved arc-shaped cross section.

[0062] The slider 207 includes a magnetic body for maintaining the position of the slider 207 with respect to the main body 210 and the cartridge 220. The magnetic body may include a permanent magnet or a material such as iron, nickel, cobalt, or an alloy thereof.

[0063] The magnetic body includes two first magnetic bodies 208a facing each other with an inner space of the slider 207 therebetween, and two second magnetic bodies 208b facing each other with the inner space of the slider 207 therebetween. The first magnetic bodies 208a and the second magnetic bodies 208b are arranged to be spaced apart from each other along a longitudinal direction of the main body 210, which is a moving direction of the slider 207, that is, the direction in which the main body 210 extends.

[0064] The main body 210 includes a fixed magnetic body 209 arranged on a path along which the first magnetic bodies 208a and the second magnetic bodies 208b of the slider 207 move while the slider 207 moves with respect to the main body 210. Two fixed magnetic bodies 209 of the main body 210 may be mounted to face each other with the accommodation space 219 therebetween.

[0065] Depending on the position of the slider 207, the slider 207 may be stably maintained in a position where an end of the mouthpiece 222 is covered or exposed by a magnetic force acting between the fixed magnetic body 209 and the first magnetic body 208a or between the fixed magnetic body 209 and the second magnetic body 208b.

[0066] The main body 210 includes a position change detecting sensor 203 arranged on the path along which the first magnetic body 208a and the second magnetic body 208b of the slider 207 move while the slider 207 moves with respect to the main body 210. The position change detecting sensor 203 may include, for example, a Hall IC using the Hall effect that detects a change in a magnetic field and generates a signal.

[0067] In the aerosol generating apparatus 200 according to the above-described embodiments, the main body 210, the cartridge 220, and the slider 207 have approximately rectangular cross-sectional shapes in a direction transverse to the longitudinal direction, but in the embodiments, the shape of the aerosol generating apparatus 200 is not limited. The aerosol generating apparatus 200 may have, for example, a cross-sectional shape of a circle, an ellipse, a square, or a polygon of various shapes. In addition, the aerosol generating apparatus 200 is not necessarily limited to a structure that extends linearly when extending in the longitudinal direction, and may extend a long way while being curved in a streamlined shape or bent at a preset angle in a specific area to be easily held by the user.

[0068] FIGS. 3 to 4B are diagrams of examples in which a cigarette is inserted into an aerosol-generating apparatus.

[0069] Referring to FIG. 3, the aerosol generating apparatus 300 (e.g., the aerosol generating apparatus 100, 200 of FIGS.2 and 2) may include a battery 310, a controller 320, and a heater 330. Referring to FIGS. 4A and 4B, the aerosol generating apparatus 400 may further

include a vaporizer 440. Also, the cigarette 340, 450 may be inserted into an inner space of the aerosol generating apparatus 300, 400.

[0070] FIGS. 3 through 4B illustrate components of the aerosol generating apparatus 300, 400, which are related to the present embodiment. Therefore, it will be understood by one of ordinary skill in the art related to the present embodiment that other general-purpose components may be further included in the aerosol generating apparatus 300, in addition to the components illustrated in FIGS. 3 through 4B.

[0071] Also, FIGS. 4A and 4B illustrate that the aerosol generating apparatus 400 (e.g., the aerosol generating apparatus 100, 200, 300 of FIGS. 1 thorugh 3 includes the heater 430. However, according to necessity, the heater 430 may be omitted.

[0072] FIG. 3 illustrates that the battery 310, the controller 320, and the heater 3300 are arranged in series. Also, FIG. 4A illustrates that the battery 410, the controller 420, the vaporizer 440, and the heater 430 are arranged in series. Also, FIG. 4B illustrates that the vaporizer 440 and the heater 430 are arranged in parallel. However, the internal structure of the aerosol generating apparatus 300, 400 is not limited to the structures illustrated in FIGS. 3 through 4B. In other words, according to the design of the aerosol generating apparatus 300, 400, the battery 310, 410, the controller 320, 420, the heater 330, 430 and the vaporizer 440 may be differently arranged.

[0073] When the cigarette 340, 450 is inserted into the aerosol generating apparatus 300, 400, the aerosol generating apparatus 300, 400 may operate the heater 330, 430 and/or the vaporizer 440 to generate an aerosol from the cigarette 340, 450 and/or the vaporizer 440. The aerosol generated by the heater 330, 430 and/or the vaporizer 440 is delivered to a user by passing through the cigarette 340, 450.

[0074] According to necessity, even when the cigarette 340, 450 is not inserted into the aerosol generating apparatus 300, 400, the aerosol generating apparatus 300, 400 may heat the heater 330, 430.

[0075] The battery 310, 410 may supply power to be used for the aerosol generating apparatus 300, 400 to operate. For example, the battery 310, 410 may supply power to heat the heater 330, 430 or the vaporizer 440, and may supply power for operating the controller 320, 420. Also, the battery 310, 410 may supply power for operations of a display, a sensor, a motor, etc. mounted in the aerosol generating apparatus 300, 400.

[0076] The controller 320, 420 may generally control operations of the aerosol generating apparatus 300, 400. In detail, the controller 320, 420 may control not only operations of the battery 310, 410, the heater 330, 430, and the vaporizer 440, but also operations of other components included in the aerosol generating apparatus 300, 400. Also, the controller 320, 420 may check a state of each of the components of the aerosol generating apparatus 300, 400 to determine whether or not the aerosol generating apparatus 300, 400 is able to operate.

[0077] The controller 320, 420 may include at least one processor. A processor 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 can be implemented in other forms of hardware

[0078] The heater 330, 430 may be heated by the power supplied from the battery 310, 410. For example, when the cigarette 340, 450 is inserted into the aerosol generating apparatus 300, 400, the heater 330, 430 may be located outside the cigarette 340, 450. Thus, the heated heater 330, 430 may increase a temperature of an aerosol generating material in the cigarette 340, 450.

[0079] The heater 330, 430 may include an electro-resistive heater. For example, the heater 330, 430 may include an electrically conductive track, and the heater 330, 430 may be heated when currents flow through the electrically conductive track. However, the heater 330, 430 is not limited to the example described above and may include all heaters which may be heated to a desired temperature. Here, the desired temperature may be preset in the aerosol generating apparatus 300, 400 or may be set as a temperature desired by a user.

[0080] As another example, the heater 330, 430 may include an induction heater. In detail, the heater 330, 430 may include an electrically conductive coil for heating a cigarette in an induction heating method, and the cigarette may include a susceptor which may be heated by the induction heater.

[0081] For example, the heater 330, 430 may include a tube-type heating element, a plate-type heating element, a needle-type heating element, or a rod-type heating element, and may heat the inside or the outside of the cigarette 340, 450, according to the shape of the heating element.

[0082] Also, the aerosol generating apparatus 300, 400 may include a plurality of heaters 330, 430. Here, the plurality of heaters 330, 430 may be inserted into the cigarette 340, 450 or may be arranged outside the cigarette 340, 450. Also, some of the plurality of heaters 330, 430 may be inserted into the cigarette 340, 450 and the others may be arranged outside the cigarette 340, 450. In addition, the shape of the heater 330, 430 is not limited to the shapes illustrated in FIGS. 3 through 4B and may include various shapes.

[0083] The vaporizer 440 may generate an aerosol by heating a liquid composition and the generated aerosol may pass through the cigarette 450 to be delivered to a user. In other words, the aerosol generated via the vaporizer 440 may move along an air flow passage of the aerosol generating apparatus 400 and the air flow passage may be configured such that the aerosol generated via the vaporizer 440 passes through the cigarette 450 to be delivered to the user.

[0084] For example, the vaporizer 440 may include a liquid storage, a liquid delivery element, and a heating

element, but it is not limited thereto. For example, the liquid storage, the liquid delivery element, and the heating element may be included in the aerosol generating apparatus 400 as independent modules.

[0085] The liquid storage may store a liquid composition. For example, 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 storage may be formed to be attached/detached to/from the vaporizer 440 or may be formed integrally with the vaporizer 440.

[0086] For example, the liquid composition may include water, a solvent, ethanol, plant extract, spices, flavorings, or a vitamin mixture. 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. Also, the liquid composition may include an aerosol forming substance, such as glycerin and propylene glycol.

[0087] The liquid delivery element may deliver the liquid composition of the liquid storage to the heating element. For example, the liquid delivery element may be a wick such as cotton fiber, ceramic fiber, glass fiber, or porous ceramic, but is not limited thereto.

[0088] The heating element is an element for heating the liquid composition delivered by the liquid delivery element. For example, the heating element may be a metal heating wire, a metal hot plate, a ceramic heater, or the like, but is not limited thereto. In addition, the heating element may include a conductive filament such as nichrome wire and may be positioned as being wound around the liquid delivery element. The heating element may be heated by a current supply and may transfer heat to the liquid composition in contact with the heating element, thereby heating the liquid composition. As a result, aerosol may be generated.

[0089] For example, the vaporizer 440 may be referred to as a cartomizer or an atomizer, but it is not limited thereto.

[0090] The aerosol generating apparatus 300, 400 may further include general-purpose components in addition to the battery 310, 410, the controller 320, 420 the heater 330, 430, and the vaporizer 440. For example, the aerosol generating apparatus 300, 400 may include a display capable of outputting visual information and/or a motor for outputting haptic information. Also, the aerosol generating apparatus 300, 400 may include at least one sensor (a puff detecting sensor, a temperature detecting sensor, a cigarette insertion detecting sensor, etc.). Also, the aerosol generating apparatus 300, 400 may be formed as a structure where, even when the cigarette 340, 450 is inserted into the aerosol generating apparatus 300, 400, external air may be introduced or internal air may be discharged.

[0091] Although not illustrated in FIGS. 3 through 4B, the aerosol generating apparatus 300, 400 and an additional cradle may form together a system. For example, the cradle may be used to charge the battery 310, 410 of the aerosol generating apparatus 300, 400. Alternatively, the heater 330, 430 may be heated when the cradle and the aerosol generating apparatus 300 are coupled to each other.

[0092] The cigarette 340, 450 may be similar as a general combustive cigarette. For example, the cigarette 340, 450 may be divided into a first portion including an aerosol generating material and a second portion including a filter, etc. Alternatively, the second portion of the cigarette 340, 450 may also include an aerosol generating material. For example, an aerosol generating material made in the form of granules or capsules may be inserted into the second portion.

[0093] The entire first portion may be inserted into the aerosol generating apparatus 300, 400, and the second portion may be exposed to the outside. Alternatively, only a portion of the first portion may be inserted into the aerosol generating apparatus 300, 400, or the entire first portion and a portion of the second portion may be inserted into the aerosol generating apparatus 300, 400. The user may puff aerosol while holding the second portion by the mouth of the user. In this case, the aerosol is generated by the external air passing through the first portion, and the generated aerosol passes through the second portion and is delivered to the user's mouth.

[0094] For example, the external air may flow into at least one air passage formed in the aerosol generating apparatus 300, 400. For example, the opening and closing and/or a size of the air passage formed in the aerosol generating apparatus 300, 400 may be adjusted by the user. Accordingly, the amount of smoke and a smoking impression may be adjusted by the user. As another example, the external air may flow into the cigarette 340, 450 through at least one hole formed in a surface of the cigarette 340, 450.

[0095] According to various embodiments, the aerosol-generating apparatus may include at least one of the aerosol-generating apparatuses 100, 200, 300, and 400 of FIGS. 1 to 4B. For example, components of an aerosol-generating apparatus may be differently arranged and different types of cigarettes may be used according to the embodiments of FIGS. 1 to 4B. According to an embodiment, the aerosol-generating apparatus may include at least some of configurations and/or functions of the aerosol-generating apparatuses 100 to 400. According to an embodiment, a method of generating aerosols in the aerosol-generating apparatus may be the same as or similar to the methods of generating aerosols in the aerosol-generating apparatuses 100 to 400.

[0096] FIG. 5 is a block diagram of components of an aerosol-generating apparatus, according to some embodiments.

[0097] Referring to FIG. 5, a device 50 (e.g., the aerosol-generating apparatuses 100, 200, 300, and 400 of FIGS. 1 to 4B) may include a battery 510, a system-in-

package (SIP) 520, and a heater assembly 530. The device 50 of FIG. 5 includes components related to the present embodiment. Therefore, it will be understood by one of ordinary skill in the art that the device 50 may further include other components in addition to the components shown in FIG. 5. The device 50 according to various embodiments may include at least some of the configurations and/or the functions of the aerosol-generating apparatuses 100, 200, 300, and 400 of FIGS. 1 to 4B.

[0098] The SIP 520 may include a microcontroller unit (MCU) 521 (e.g., the controller 140 of FIG. 1 and the controllers 320 and 420 of FIGS. 3 to 4B), an impurity detector 522, a temperature detector 523, and a molding 524. It will be understood by one of ordinary skill in the art that the SIP 520 of FIG. 5 may further include other components in addition to the components shown in FIG. 5. The controllers 320 and 420 of FIGS. 3 to 4B may correspond to the MCU 521 or the SIP 520.

[0099] Referring to FIG. 5, in the SIP 520, various semiconductor devices and/or passive elements for controlling the device 50 may be mounted. Also, components that may be included in a Printed Circuit Board (PCB) may be mounted on the SIP 520. The SIP 520 may be formed as a single wafer.

[0100] The impurity detector 522 may detect impurities which have been generated in or have intruded into the device 50 and/or the molding 524 of the SIP 520. For example, the impurities may include droplets, liquids, vapor, and the like.

[0101] The impurity detector 522 may include at least one sensor (e.g., a liquid leakage sensor, a water leakage sensor, etc.). For example, the impurity detector 522 may detect changes in resistance, magnetic fields, colors, and the like, and thus may detect impurities on at least some portions of the molding 524 of the SIP 520.

[0102] The impurity detector 522 may detect the amount of impurities according to a preset cycle (e.g., 1 ms). The amount of impurities detected by the impurity detector 522 may be compared with a threshold value (e.g., a threshold value for normal operation of a SIP) set in advance by the MCU 521. When the amount of impurities is greater than the preset threshold value, the MCU 521 may stop a heating operation of the heater assembly 530. When the amount of impurities is less than or equal to the preset threshold value (e.g., when there is no impurities detected), the MCU 521 may allow the heating operation of the heater assembly 530 to be performed.

[0103] The temperature detector 523 may detect a temperature of each part of the SIP 520. For example, the temperature detector 523 may be connected to the components of the SIP 520 and may detect temperatures of individual components (e.g., the temperature of each part).

[0104] The temperature detector 523 may include at least one sensor (e.g., a thermistor). For example, the temperature detector 523 may be connected directly to or connected close to each part of the SIP 520 to detect the its temperature.

[0105] The temperature detector 523 may detect the temperature according to a preset cycle (e.g., 1 ms). The MCU 521 may compare the detected temperature with a preset threshold value (e.g., a threshold value for determining an overheating state of an SIP). The temperature of at least one component and/or a sum of the temperatures of the individual components are greater than a preset threshold value, the MCU 521 may stop the heating operation of the heater assembly 530. When the sum of the detected temperatures are less than or equal to the preset threshold value, the MCU 521 may allow the heating operation of the heater assembly 530 to be performed. According to another embodiment, the temperature of at least one component and/or the sum of the temperatures of the components may be detected by using a heat dissipation function of the molding 524. For example, the temperature detector 523 may be connected to the molding 524 to detect a temperature of at least part of the molding 524, and determine the temperature of at least one component and/or the sum of the temperatures of the components based on the temperature of the molding 524.

[0106] The molding 524 may cover all components arranged on the wafer. For example, the molding 524 may entirely surround the SIP 524 or surround only an upper side on which the components are arranged.

[0107] The molding 524 may include a material that radiates (i.e., dissipate) heat and is waterproof. For example, the molding 524 may include an epoxy molding compound (EMC) and thus protect an exterior of the SIP 520. Here, the EMC is merely an example of a material used for the molding 524 and may be replaced with a material having the same and/or similar functions. As a heat dissipation function, the molding 524 may dissipate an internal heat of the SIP 520 according to increasing temperatures of the components, thus decreasing the temperature of the SIP 520. For example, the molding 524 may dissipate an external heat of the SIP 520 adjacent to the battery 510 and the heater assembly 530, thus decreasing the temperature of the SIP 520.

[0108] The heater assembly 530 may include a heating unit 531 that heats the cigarette and may include at least one of the configurations and/or the functions of the heater assembly 110 of FIG. 1 and/or the heaters 330 and 430 of FIGS. 3 to 4B.

[0109] Although not shown in FIG. 5, the device 50 may include a memory, and the memory may be included as a component of the SIP 520. The memory (not shown) may store data processed in the device 50. For example, the memory may store data processed and to be processed in the MCU 521. The memory may store the settings regarding detection cycles of the impurity detector 522 and the temperature detector 523. Also, the memory may store the settings regarding a threshold value regarding the amount of impurities and a threshold value regarding the temperature of the molding 524 or the SIP 520.

[0110] FIGS. 6A and 6B are respectively a plan view and a side view of an SIP, according to some embodiments.

[0111] FIG. 6A is a plan view of the SIP according to some embodiments. Referring to FIG. 6A, an SIP 60 (e.g., the SIP 520 of FIG. 5) may include an MCU 610, a heating integrated circuit (IC) 620, a memory 630, a sensor module 640, a charging IC 650, and a communication module 660. The SIP 60 of FIG. 6A is merely an example. Therefore, it will be understood by one of ordinary skill in the art that one or more components may be omitted or the SIP 60 may further include other components in addition to the components shown in FIG. 6A. According to various embodiments, the MCU 610 of FIG. 6A may include at least some of the configurations and/or the functions of the controller 140 of FIG. 1, the controllers 320 and 420 of FIGS. 3 to 4B and/or the MCU 521 of FIG. 5. Also, the sensor module 640 of FIG. 6A may include at least some of the configurations and/or the functions of the impurity detector 522 and/ or the temperature detector 523 of FIG. 5.

[0112] Referring to FIG. 6A, the heating IC 620 may include a circuit that controls a heating operation of the heater according to an induction heating method. For example, the heating IC 620 may provide electrical signals to perform a heating operation of a heater assembly, under the control of the MCU 610.

[0113] Referring to FIG. 6A, the memory 630 may store data processed in the MCU 610 and data processed and to be processed in the MCU 610. The memory 630 may store the settings regarding a detection cycle of the sensor module 640 and the settings regarding a threshold value regarding the amount of impurities and a threshold value regarding a temperature of a molding or the SIP 60.

[0114] Referring to FIG. 6A, the charging IC 650 may control the charging of a battery (e.g., the power supply 130 of FIG. 1 and the batteries 310, 410, and 510 of FIGS. 3 to 5). For example, when power for charging the battery is supplied from the outside, the charging IC 650 may charge the battery. According to some embodiments, when the aerosol-generating apparatus (e.g., the aerosol-generating apparatuses 100 to 400 of FIGS. 1 to 4B and the device 50 of FIG. 5) supports wireless charging, the charging IC 650 of the SIP 60 may be arranged to overlap the battery.

[0115] Referring to FIG. 6A, the communication module 660 may include a configuration for supporting communication with an external device.

[0116] FIG. 6B is a side view of a SIP according to some embodiments. For example, semiconductor devices, a system-on-chip (SoC), and/or passive elements that may be packed in the SIP 60. FIG. 6B illustrates that two separate chips are stacked on a substrate, but embodiments are not limited thereto. For example, components 610 and 620 formed on a single wafer may be packaged by wafer level packaging (WLP). In this case, components 610 and 620 of the SIP 60 may be packaged through a single molding process using the molding 670. The components 610 and 620 of the SIP 60 are merely an example and may be replaced with other components, or additional components may be added.

[0117] Referring to FIG. 6B, the components 610 and 620 of the SIP 60 may include micro-connection bumps 684. The micro-connection bumps 684 may be terminals for inputting/outputting signals to a circuit device and may be provided to connect the components 610 and 620 to lower wire patterns. However, when components are packaged by WLP from a single wafer, the micro-connection bumps 684 may be omitted.

[0118] Referring to FIG. 6B, wire portions 681 may include various wire patterns. For example, the wire portion 681 may include an upper wire, a via electrode, a lower wire, and the like. Here, the upper wire may include pads to which the micro-connection bumps 684 of the components 610 and 620 are connected. The via electrode may connect the upper wire to the lower wire. The lower wire may be electrically connected to the circuit of the components 610 and 620, the electrodes 682, the solder balls 683, etc. According to an embodiment, the wire patterns may denote the wire portions 681. When the SIP 60 is packaged by WLP, the wire patterns may electrically connect individual components (e.g., the components 610 and 660 of FIG. 6A) to each other. Examples of FIGS. 6A and 6B according to some embodiments show stack structures, but one or more embodiments are not limited thereto. When components are packaged by WLP, components having stack structures may be omitted, or other components may replace the existing components.

[0119] Referring to FIG. 6B, the individual components 610 and 620 may correspond to components shown on one side of the SIP 60. That is, other components 630 to 660 of FIG. 6A may be seen from a different viewpoint.

[0120] FIG. 7 is a flowchart of an operation method of an aerosol-generating apparatus, according to some embodiments.

[0121] Referring to FIG. 7, the operation method of an aerosol-generating apparatus may include operations that are performed in the aerosol-generating apparatuses of FIGS. 1 to 4B and the device 50 of FIG. 5. Therefore, although omitted, the descriptions provided regarding the aerosol-generating apparatuses 100 to 400 of FIGS. 1 to 4B or the device 50 of FIG. 5 may be applied to the operation method of FIG. 7.

[0122] In operation 710, the aerosol-generating apparatus may determine whether impurities are detected from a molding (e.g., the moldings 524 and 670 of FIGS. 5 to 6B) of an SIP (e.g., the SIPs 520 and 60 of FIGS. 5 to 6B). A threshold value regarding the amount of impurities detected by an impurity detector (e.g., the impurity detector 522 of FIG. 5) may be an experimental value. The threshold value may be set such that an amount of impurities that does not affect the operation of the aerosol-generating apparatus and does not damage components may be ignored. When the aerosol-generating apparatus determines that no impurities are detected from the molding, the aerosol-generating apparatus may per-

form a heating operation of a heater assembly (e.g., the heater assembly 110 of FIG. 1, the heaters 330 and 340 of FIGS. 3 to 4B, and the heater assembly 530 of FIG. 5). The operations 710 and 720 may not necessarily be performed in sequence in FIG. 7. For example, the aerosol-generating apparatus may repeatedly perform operation 710 according to a preset cycle, and depending on whether impurities exist, the aerosol-generating apparatus may determine whether to perform the heating operation of the heater assembly (i.e., the method may skip operation 720 and proceed to operation 730 or operation 740). In this case, when no impurities are detected from the molding, the aerosol-generating apparatus may proceed with operation 730 and perform the heating operation of the heater assembly. On the other hand, when impurities are detected from the molding, the aerosol-generating apparatus may proceed to operation 740 and stop the heating operation of the heater assembly.

[0123] In operation 720, the aerosol-generating apparatus may determine whether the molding is overheated. The aerosol-generating apparatus may determine an overheating state of the SIP based on the temperature of the molding. A threshold value regarding the temperature detected by the temperature detector (e.g., the temperature detector 523 of FIG. 5) may be an experimental value (i.e., the threshold value may be set according to experiments). The threshold value may be set such that a temperature that does not affect the operation of the internal components of the aerosol-generating apparatus and does not damage the internal components is ignored. For example, the aerosol-generating apparatus may repeatedly perform operation 720 according to a preset cycle and may determine whether to perform the heating operation of the heater assembly based on whether the molding is overheated. According to an embodiment, when the aerosol-generating apparatus determines that the molding is in a normal state (i.e., not overheated), the aerosol-generating apparatus may proceed to operation 730 and perform the heating operation of the heater assembly. On the other hand, when the aerosol-generating apparatus determines that the molding is overheated, the aerosol-generating apparatus may proceed with operation 740 and stop the heating operation of the heater assembly.

[0124] FIGS. 8A and 8B are diagrams illustrating arrangements of an aerosol-generating apparatus, according to some embodiments.

[0125] Referring to FIGS. 8A and 8B, an aerosol-generating apparatus 80 (e.g., the aerosol-generating apparatuses 100 to 400 of FIGS. 1 to 4B and the device 50 of FIG. 5) may include a battery 810 (e.g., the power supply 130 of FIG. 1 and the batteries 310, 410, and 510 of FIGS. 3 to 5), an SIP 820 (e.g., the SIP 520 of FIG. 5 and the SIP 60 of FIGS. 6A and 6B), and a heater assembly 830 (e.g., the heater assembly 110 of FIG. 1, the heaters 330 and 430 of FIGS. 3 to 4B, and the heater assembly 530 of FIG. 5). A molding 821 of the SIP 820 may cover at least part of the SIP 820.

[0126] Referring to FIG. 8A, in the aerosol-generating apparatus 80, the battery 810 and the SIP 820 may be arranged under the heater assembly 830 in which a cigarette is inserted and heated. The illustration that the battery 810 and the SIP 820 are arranged side by side is merely an example. According to another embodiment, at least part of the SIP 820 may be stacked on at least part of the battery 810. For example, when a size of the SIP 820 including the molding 821 is the same as or similar to that of the battery 810, the battery 810 and the SIP 820 may overlap each other and may be mounted on the aerosol-generating apparatus 80.

[0127] Referring to FIG. 8B, in the aerosol-generating apparatus 80, the SIP 820 may be arranged under the heater assembly 830, in which the cigarette is inserted and heated, and the battery 810 may be arranged under the SIP 820. The illustration that the battery 810 and the SIP 820 are vertically arranged is merely an example. At least part of the SIP 820 may be stacked on at least part of the battery 810. For example, when the size of the SIP 820 including the molding 821 is the same as or similar to that of the battery 810, the battery 810 and the SIP 820 may overlap each other and may be mounted on the aerosol-generating apparatus 80.

[0128] 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 present disclosure is defined by the appended claims rather than by the foregoing description, and all differences within the scope of equivalents thereof should be construed as being included in the present disclosure.

Claims

1. A system-in-package (SIP) for an aerosol generating apparatus, comprising:

   a microcontroller unit (MCU);
   a sensor module; and
   a heating integrated circuit (IC) configured to control a heating operation of a heater assembly included in the aerosol generating apparatus.

2. The SIP of claim 1, wherein the MCU is configured to control the heating IC to stop the heating operation based on impurities being detected from a molding of the SIP by the sensor, and control the heating IC to resume the heating operation of the heater assembly when no impurities are detected from the molding.

3. The SIP of claim 2, wherein the MCU is configured to control the heating IC to stop the heating operation

based on an amount of the impurities detected by the sensor module being greater than a preset threshold value.

4. The SIP of claim 1, wherein the MCU is configured to control the heating IC to stop the heating operation based on a temperature of at least one component of the SIP detected by the sensor module being greater than a preset threshold value.

5. The SIP of claim 1, wherein the MCU is configured to control the heating IC to stop the heating operation based on a sum of temperatures of respective components of the SIP being greater than a preset threshold value.

6. The SIP of claim 1, wherein a molding of the SIP is arranged to cover at least part of an exterior of the SIP to dissipate internal heat of the SIP.

7. The SIP of claim 1, wherein the SIP is stacked on at least part of a battery or arranged alongside the battery.

8. The SIP of claim 1, wherein the MCU, the heating IC, and the sensor module are packaged by wafer-level packaging (WLP).

9. An aerosol-generating apparatus comprising:

a heater assembly configured to heat a cigarette inserted into the aerosol-generating apparatus;
a battery configured to supply power to the heater assembly; and
a system-in-package (SIP) according to claim 1.

10. The aerosol-generating apparatus of claim 9, wherein the MCU is configured to control the heating IC to stop the heating operation based on impurities being detected from a molding of the SIP by the sensor module, and control the heating IC to resume the heating operation of the heater assembly when no impurities are detected from the molding.

11. The aerosol-generating apparatus of claim 10, wherein the MCU is configured to control the heating IC to stop the heating operation based on a temperature of at least one component of the SIP detected by the sensor module being greater than a preset threshold value.

12. The aerosol-generating apparatus of claim 9, wherein the MCU is configured to control the heating IC to stop the heating operation based on a temperature of at least one component of the SIP detected by the sensor module being greater than a preset threshold value.

13. The aerosol-generating apparatus of claim 9, wherein the MCU is configured to control the heating IC to stop the heating operation based on a sum of temperatures of respective components of the SIP being greater than a preset threshold value.

14. The aerosol-generating apparatus of claim 9, wherein a molding of the SIP is arranged to cover at least part of an exterior of the SIP to dissipate internal heat of the SIP.

15. The aerosol-generating apparatus of claim 9, wherein the SIP is stacked on at least part of the battery or arranged alongside the battery.

Patentansprüche

1. System-im-Gehäuse (SIP) für eine aerosolerzeugende Vorrichtung, das Folgendes umfasst:

eine Mikrocontroller-Einheit (MCU);
ein Sensormodul; und
eine integrierte Heizschaltung (Heiz-IC), die konfiguriert ist, einen Heizbetrieb einer Heizanordnung, die in der aerosolerzeugenden Vorrichtung enthalten ist, zu steuern.

2. SIP nach Anspruch 1, wobei die MCU konfiguriert ist, die Heiz-IC basierend auf Verunreinigungen, die aus einer Formmasse des SIP durch den Sensor detektiert werden, zu steuern, um den Heizbetrieb anzuhalten, und die Heiz-IC zu steuern, den Heizbetrieb der Heizanordnung wieder aufzunehmen, wenn aus der Formmasse keine Verunreinigungen detektiert werden.

3. SIP nach Anspruch 2, wobei die MCU konfiguriert ist, die Heiz-IC basierend auf einer Menge der durch das Sensormodul detektieren Verunreinigungen, die größer als ein im Voraus festgelegter Schwellenwert ist, zu steuern, um den Heizbetrieb anzuhalten.

4. SIP nach Anspruch 1, wobei die MCU konfiguriert ist, die Heiz-IC basierend auf einer Temperatur wenigstens einer Komponente des SIP, die durch das Sensormodul detektiert wird und größer als ein im Voraus festgelegter Schwellenwert ist, zu steuern, um den Heizbetrieb anzuhalten.

5. SIP nach Anspruch 1, wobei die MCU konfiguriert ist, die Heiz-IC basierend auf einer Summe von Temperaturen jeweiliger Komponenten des SIP, die größer als ein im Voraus festgelegter Schwellenwert ist, zu steuern, um den Heizbetrieb anzuhalten.

6. SIP nach Anspruch 1, wobei eine Formmasse des SIP so angeordnet ist, dass sie wenigstens einen

Teil der Außenseite des SIP abdeckt, um innere Wärme des SIP abzuführen.

7. SIP nach Anspruch 1, wobei das SIP wenigstens auf einem Teil einer Batterie gestapelt oder längs der Batterie angeordnet ist.

8. SIP nach Anspruch 1, wobei die MCU, die Heiz-IC und das Sensormodul durch eine Anordnung im Gehäuse auf Wafer-Ebene ("wafer-level packaging", WLP) verbaut sind.

9. Aerosolerzeugende Vorrichtung, die Folgendes umfasst:

eine Heizanordnung, die konfiguriert ist, eine in die aerosolerzeugende Vorrichtung eingesetzte Zigarette zu erhitzen;
eine Batterie, die konfiguriert ist, der Heizanordnung Leistung zuzuführen; und
ein System-im-Gehäuse (SIP) nach Anspruch 1.

10. Aerosolerzeugende Vorrichtung nach Anspruch 9, wobei die MCU konfiguriert ist, die Heiz-IC basierend auf Verunreinigungen, die aus einer Formmasse des SIP durch das Sensormodul detektiert werden, zu steuern, um den Heizbetrieb anzuhalten, und die Heiz-IC zu steuern, den Heizbetrieb wieder aufzunehmen, wenn aus der Formmasse keine Verunreinigungen detektiert werden.

11. Aerosolerzeugende Vorrichtung nach Anspruch 10, wobei die MCU konfiguriert ist, die Heiz-IC basierend auf einer Temperatur wenigstens einer Komponente des SIP, die durch das Sensormodul detektiert wird und größer als ein im Voraus festgelegter Schwellenwert ist, zu steuern, um den Heizbetrieb anzuhalten.

12. Aerosolerzeugende Vorrichtung nach Anspruch 9, wobei die MCU konfiguriert ist, die Heiz-IC basierend auf einer Temperatur wenigstens einer Komponente des SIP, die durch das Sensormodul detektiert wird und größer als ein Voraus festgelegter Schwellenwert ist, zu steuern, um den Heizbetrieb anzuhalten.

13. Aerosolerzeugende Vorrichtung nach Anspruch 9, wobei die MCU konfiguriert ist, die Heiz-IC basierend auf einer Summe von Temperaturen jeweiliger Komponenten des SIP, die größer als ein im Voraus festgelegte Schwellenwert ist, zu steuern, um den Heizbetrieb anzuhalten.

14. Aerosolerzeugende Vorrichtung nach Anspruch 9, wobei eine Formmasse des SIP so angeordnet ist, dass sie wenigstens einen Teil einer Außenseite des SIP abdeckt, um innere Wärme des SIP abzuführen.

15. Aerosolerzeugende Vorrichtung nach Anspruch 9, wobei das SIP wenigstens auf einem Teil der Batterie gestapelt ist oder längs der Batterie angeordnet ist.

Revendications

1. Système en boîtier (SIP) pour un appareil de production d'aérosol, comportant :

une unité de microcontrôleur (MCU) ;
un module capteur ; et
un circuit intégré (IC) de chauffage configuré pour commander une opération de chauffage d'un ensemble chauffant inclus dans l'appareil de production d'aérosol.

2. SIP selon la revendication 1, dans lequel la MCU est configurée pour commander à l'IC de chauffage d'arrêter l'opération de chauffage sur la base d'impuretés étant détectées à partir d'un moulage du SIP par le capteur, et commander à l'IC de chauffage de reprendre l'opération de chauffage de l'ensemble chauffant lorsqu'aucune impureté n'est détectée à partir du moulage.

3. SIP selon la revendication 2, dans lequel la MCU est configurée pour commander à l'IC de chauffage d'arrêter l'opération de chauffage sur la base d'une quantité des impuretés détectées par le module capteur étant supérieure à une valeur de seuil prédéfinie.

4. SIP selon la revendication 1, dans lequel la MCU est configurée pour commander à l'IC de chauffage d'arrêter l'opération de chauffage sur la base d'une température d'au moins un composant du SIP détectée par le module capteur étant supérieure à une valeur de seuil prédéfinie.

5. SIP selon la revendication 1, dans lequel la MCU est configurée pour commander à l'IC de chauffage d'arrêter l'opération de chauffage sur la base d'une somme de températures de composants respectifs du SIP étant supérieure à une valeur de seuil prédéfinie.

6. SIP selon la revendication 1, dans lequel un moulage du SIP est agencé de manière à recouvrir au moins une partie d'un extérieur du SIP afin de dissiper la chaleur interne du SIP.

7. SIP selon la revendication 1, dans lequel le SIP est empilé sur au moins une partie d'une batterie ou agencé à côté de la batterie.

8. SIP selon la revendication 1, dans lequel la MCU, l'IC de chauffage et le module capteur sont encap-

sulés par une encapsulation sur tranche (WLP).

9. Appareil de production d'aérosol comportant :

un ensemble chauffant configuré pour chauffer une cigarette insérée dans l'appareil de production d'aérosol ;
une batterie configurée pour fournir de l'énergie à l'ensemble chauffant ; et
un système en boîtier (SIP) selon la revendication 1.

10. Appareil de production d'aérosol selon la revendication 9, dans lequel la MCU est configurée pour commander à l'IC de chauffage d'arrêter l'opération de chauffage sur la base d'impuretés étant détectées à partir d'un moulage du SIP par le module capteur, et commander à l'IC de chauffage de reprendre l'opération de chauffage de l'ensemble chauffant lorsqu'aucune impureté n'est détectée à partir du moulage.

11. Appareil de production d'aérosol selon la revendication 10, dans lequel la MCU est configurée pour commander à l'IC de chauffage d'arrêter l'opération de chauffage sur la base d'une température d'au moins un composant du SIP détectée par le module capteur étant supérieure à une valeur de seuil prédéfinie.

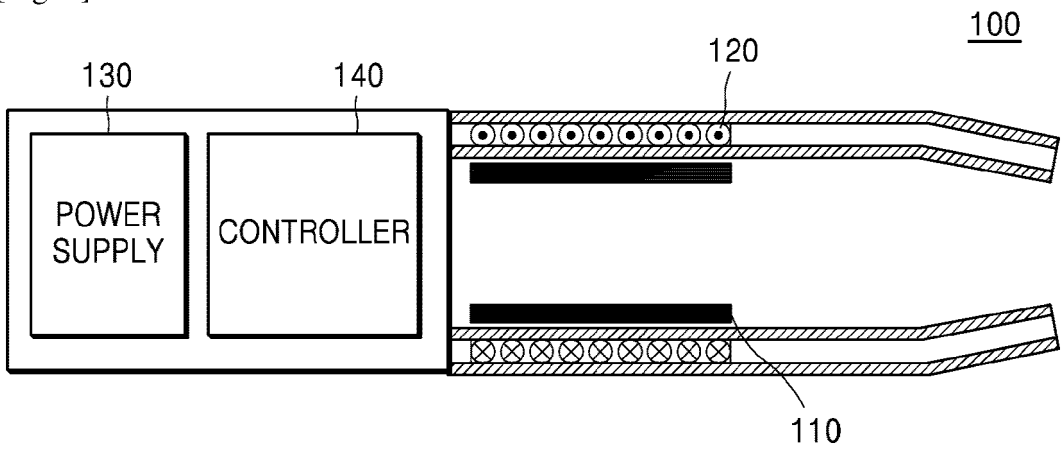
12. Appareil de production d'aérosol selon la revendication 9, dans lequel la MCU est configurée pour commander à l'IC de chauffage d'arrêter l'opération de chauffage sur la base d'une température d'au moins un composant du SIP détectée par le module capteur étant supérieure à une valeur de seuil prédéfinie.

13. Appareil de production d'aérosol selon la revendication 9, dans lequel la MCU est configurée pour commander à l'IC de chauffage d'arrêter l'opération de chauffage sur la base d'une somme de températures de composants respectifs du SIP étant supérieure à une valeur de seuil prédéfinie.

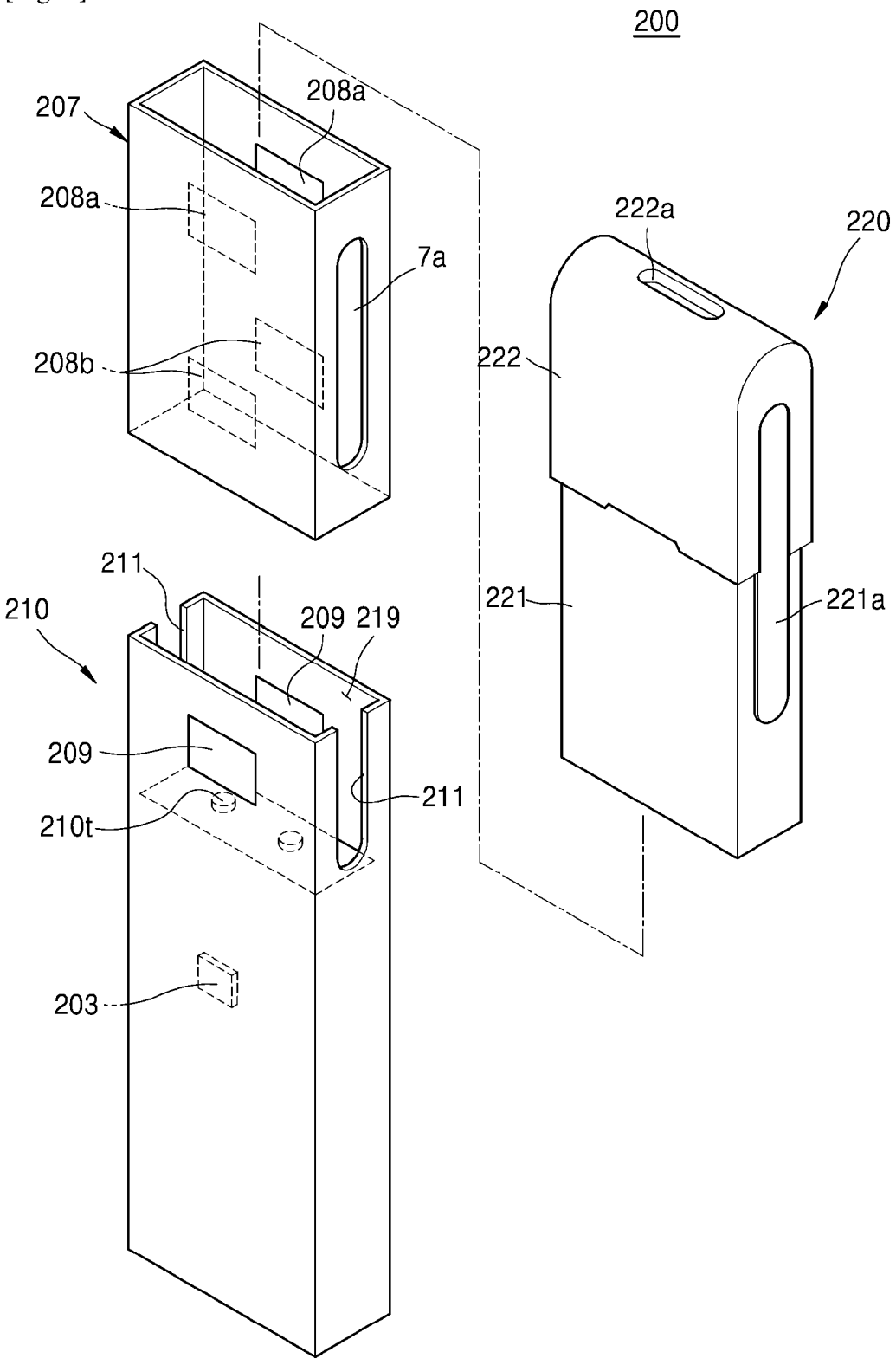
14. Appareil de production d'aérosol selon la revendication 9, dans lequel un moulage du SIP est agencé de manière à recouvrir au moins une partie d'un extérieur du SIP afin de dissiper la chaleur interne du SIP.

15. Appareil de production d'aérosol selon la revendication 9, dans lequel le SIP est empilé sur au moins une partie d'une batterie ou agencé à côté de la batterie.

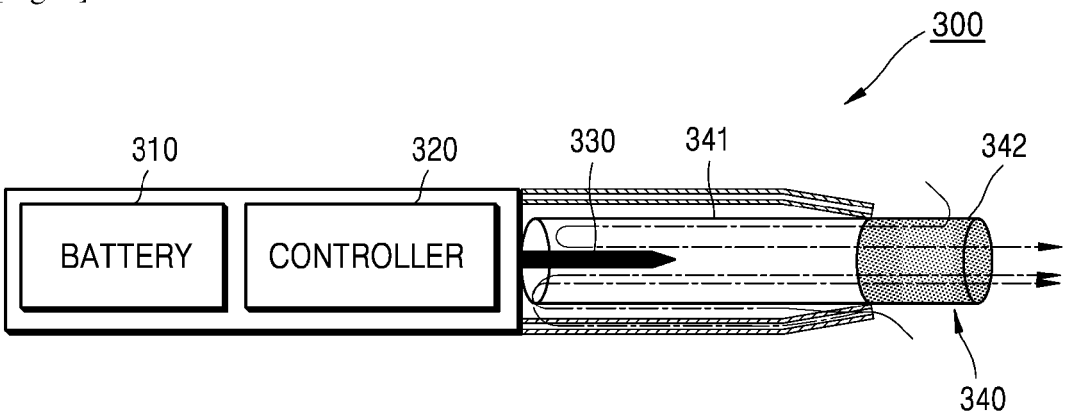
[Fig. 1]



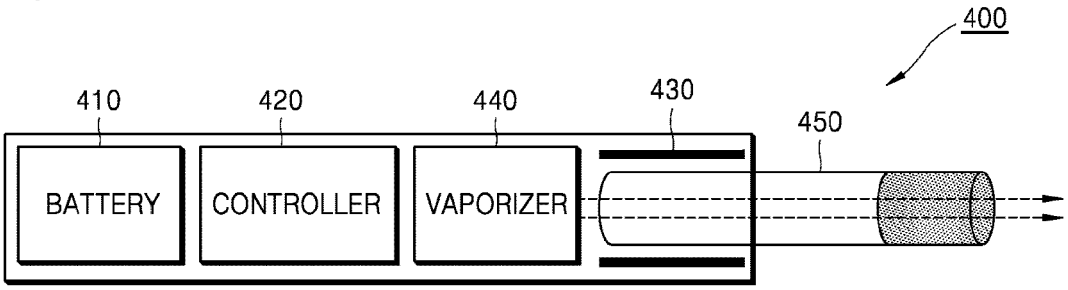
[Fig. 2]


200
207
208a
208a
7a
208b
222a
220
222
221
221a
211
210
209 219
209
211
210t
203

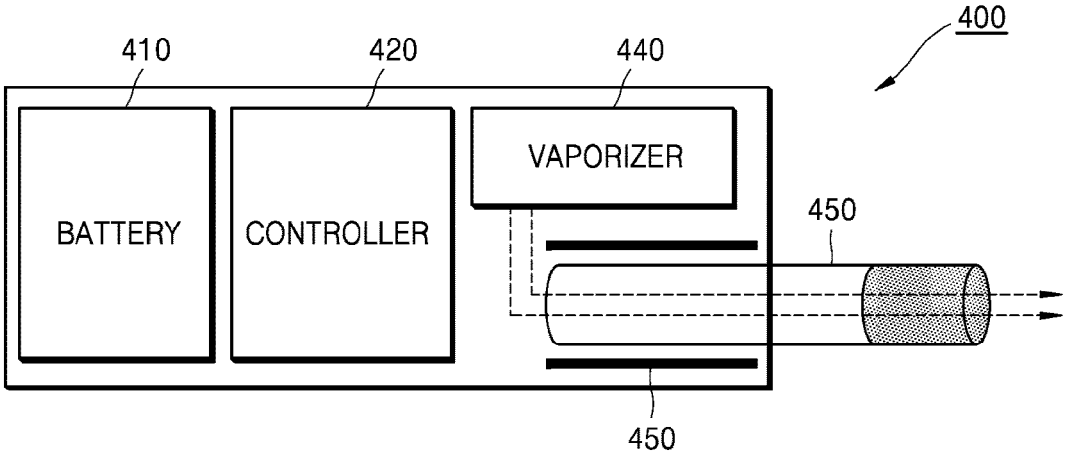
[Fig. 3]



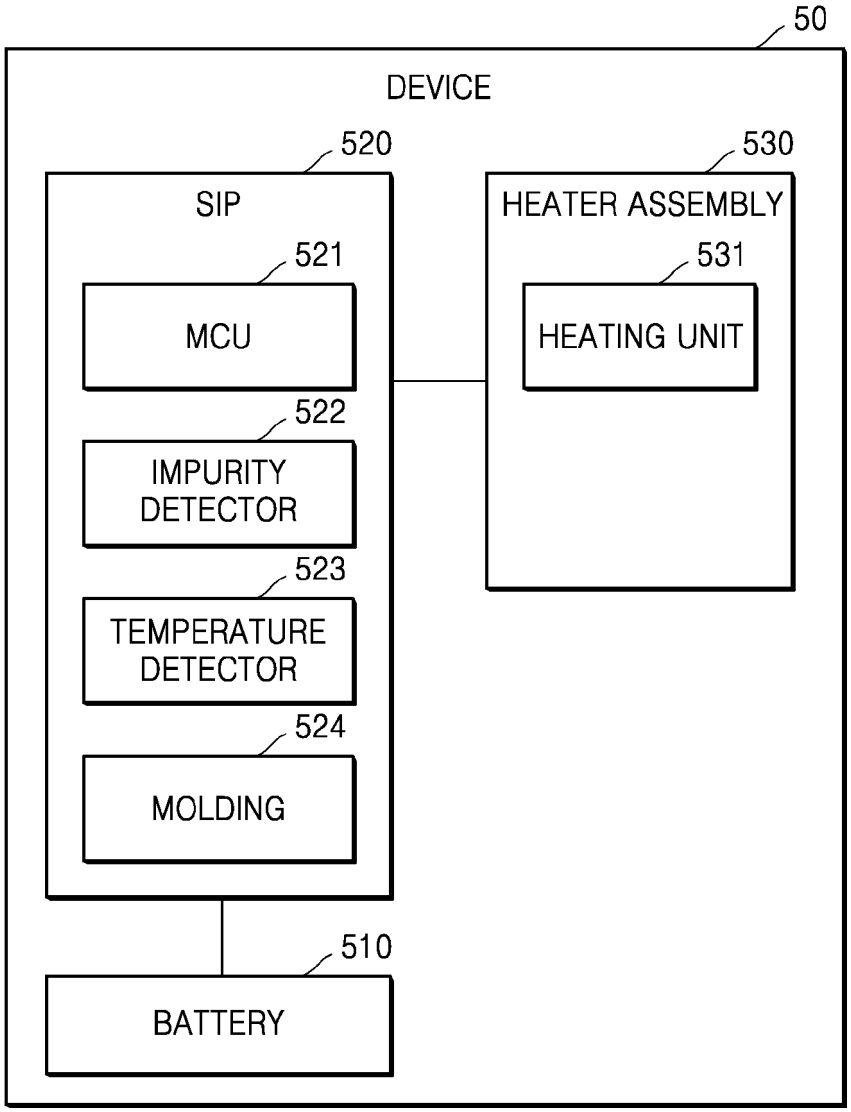
[Fig. 4A]



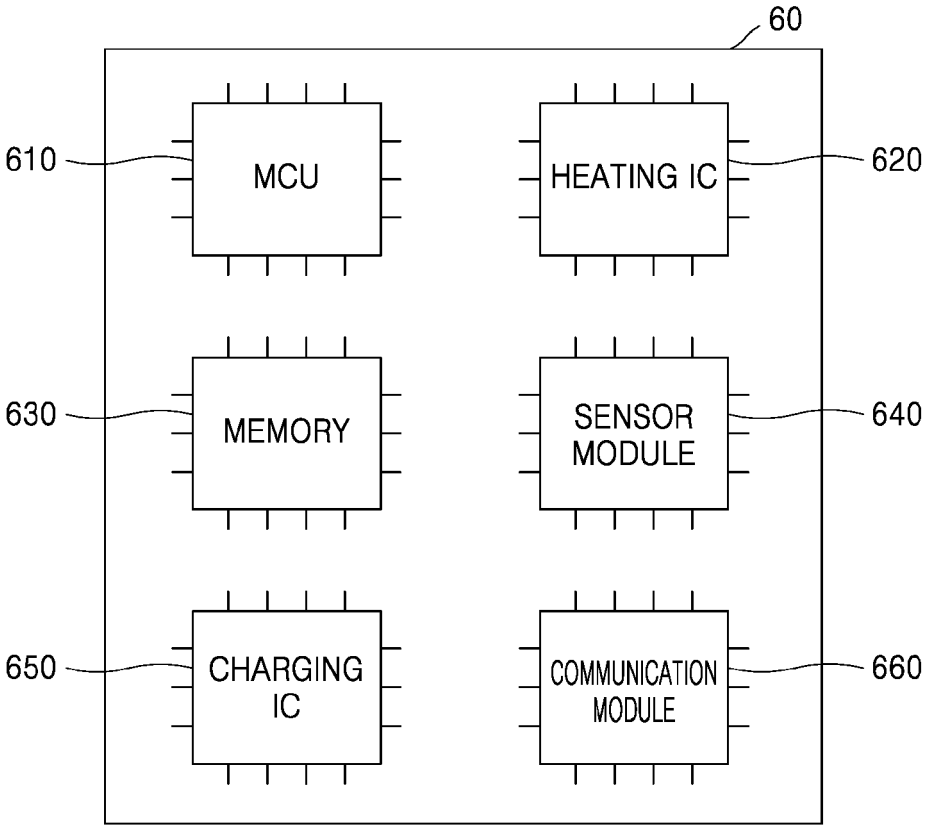
[Fig. 4B]



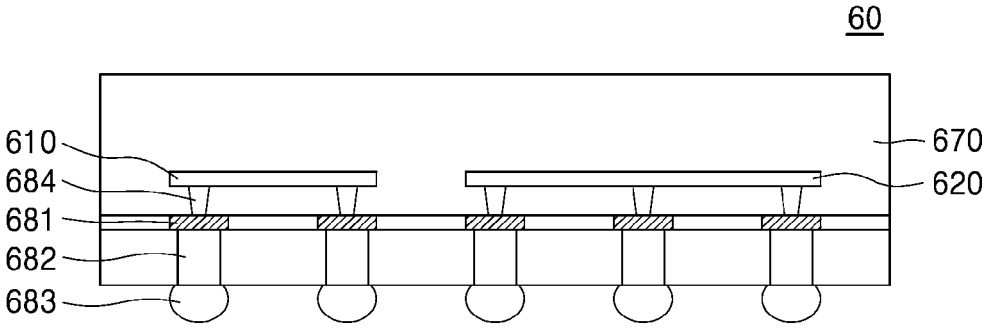
[Fig. 5]


50
DEVICE
520
SIP
521
MCU
522
IMPURITY DETECTOR
523
TEMPERATURE DETECTOR
524
MOLDING
530
HEATER ASSEMBLY
531
HEATING UNIT
510
BATTERY

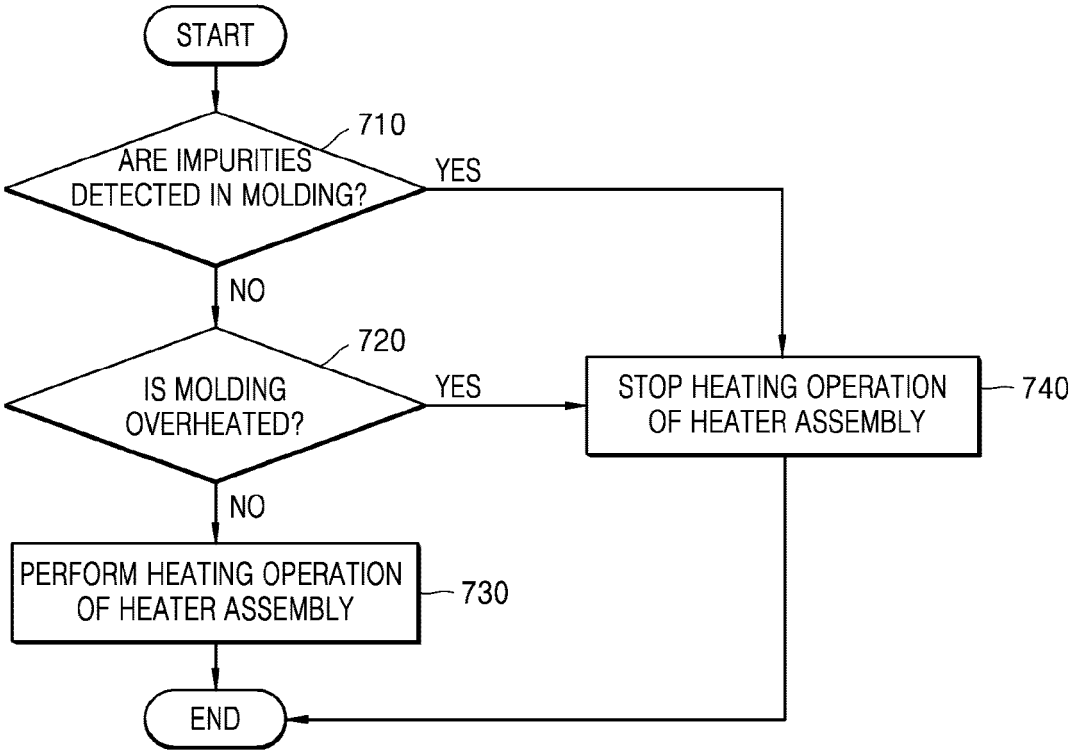
[Fig. 6A]


60
610
MCU
HEATING IC
620
630
MEMORY
SENSOR MODULE
640
650
CHARGING IC
COMMUNICATION MODULE
660

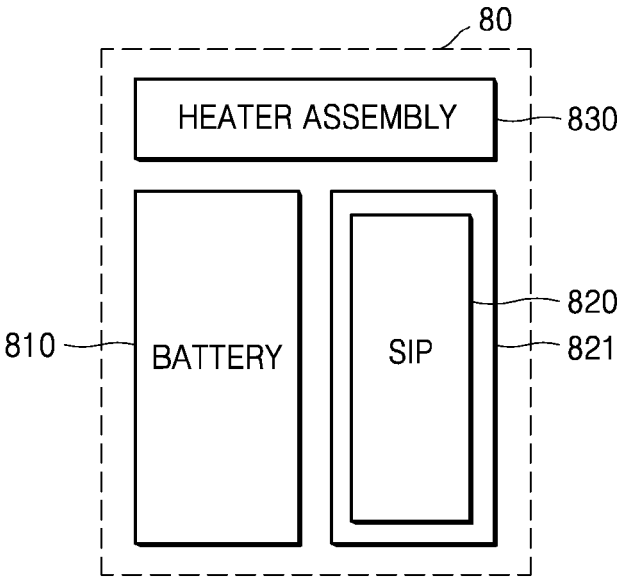
[Fig. 6B]


60
610
684
681
682
683
670
620

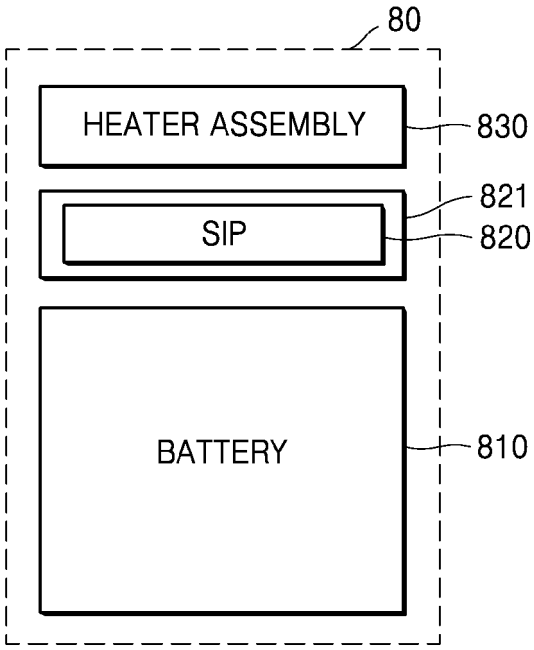
[Fig. 7]


START
710
ARE IMPURITIES DETECTED IN MOLDING?
YES
NO
720
IS MOLDING OVERHEATED?
YES
STOP HEATING OPERATION OF HEATER ASSEMBLY
740
NO
PERFORM HEATING OPERATION OF HEATER ASSEMBLY
730
END

[Fig. 8A]


80
HEATER ASSEMBLY
830
820
810
BATTERY
SIP
821

[Fig. 8B]



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 3666095 A2 **[0004]**