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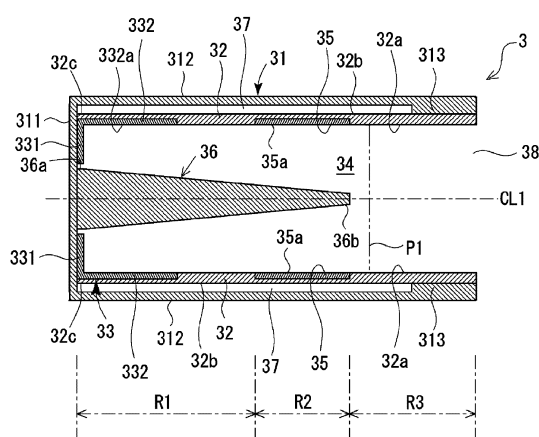
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(54) **NON-COMBUSTIBLE HEATING-TYPE SMOKING DEVICE**

(57) Provided is a non-combustible heating-type smoking device which can prevent condensation of aerosol generated by heating and deliver a sufficient amount of aerosol to a smoking person. This non-combustible heating-type smoking device is provided with: a receiving cavity for receiving a tobacco rod containing cut tobacco and an aerosol generating substrate; an internal heater which is placed within the receiving cavity, penetrates or is inserted into the tobacco rod inserted into the receiving cavity, and heats the tobacco rod from the inside to volatilize the aerosol generating substrate; and an external heater which is placed on a side peripheral part of the receiving cavity, and preheats the outer peripheral part of the tobacco rod during at least a tobacco rod preheating period to prevent condensation of aerosol generated during the operation of the internal heater.

FIG. 3



Description

Solution to Problem

Technical Field

[0001] The present invention relates to a non-combustible heating-type smoking device.

Background Art

[0002] There is a known non-combustible heating-type smoking device of a type that delivers, to a smoking person, aerosol generated by heating a tobacco rod that contains cut tobacco and an aerosol-source material (glycerin, propylene glycol, and the like) by a heating device, such as an electric heater (refer to, for example, Patent document 1).

[0003] It has been desired in non-combustible heating-type smoking devices to increase a smoke voluminous feel by increasing the generation amount (delivery amount) of aerosol. To achieve this, it is important to deliver aerosol generated by heating an aerosol-source material to a mouthpiece without a loss.

Citation List

Patent document

[0004]

Patent document 1: Japanese Patent No. 6026556

Patent document 2: Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2014-525251

Patent document 3: Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2013-511962

Summary of Invention

Technical Problem

[0005] However, in an existing non-combustible heating-type smoking device, a part whose article temperature is partially low is easily present during heating of a tobacco rod. In some cases, an aerosol-source material that has been once volatilized condenses by being cooled by the part whose article temperature is low. As a result, it may not be possible to deliver a sufficient amount of aerosol to a smoking person, which may decrease smoke voluminous feel. The present invention has been made in condensation of the aforementioned circumstance, and an object of the present invention is to provide a non-combustible heating-type smoking device that is able to suppress aerosol generated by heating from condensing and deliver a sufficient amount of the aerosol to a smoking person.

[0006] A non-combustible heating-type smoking device according to the present invention for solving the aforementioned problems includes: a receiving cavity for receiving a tobacco rod containing cut tobacco and an aerosol-source material; an internal heater that is disposed in the receiving cavity to penetrate a tobacco rod inserted into the receiving cavity or to be inserted into a recessed portion formed on an end surface of the tobacco rod, the internal heater being configured to heat the tobacco rod from inside to volatilize the aerosol-source material; and an external heater that is disposed at a side peripheral portion of the receiving cavity and suppresses condensation of aerosol generated during operation of the internal heater by preheating an outer peripheral portion of the tobacco rod during at least a period of preheating the tobacco rod.

[0007] There may be included a control unit that controls the internal heater and the external heater, and the control unit may perform control to cause a temperature of the external heater to be higher than a temperature of the internal heater in a simultaneous heating period in which both the internal heater and the external heater are operated.

[0008] At a point of time when an elapsed time since a start of preheating of the tobacco rod by the external heater reaches a predetermined set time or when a temperature of the external heater reaches a predetermined set temperature, the control unit may stop operation of the external heater but continue the operation of the internal heater.

[0009] After an operation stop of the external heater, the control unit may increase a temperature of the internal heater compared with that before the operation stop of the external heater.

[0010] To start preheating of the tobacco rod, the control unit may cause only the external heater to operate to thereby start the preheating and cause the internal heater to operate by following operation of the external heater.

[0011] The receiving cavity may have an insertion port positioned on a leading end side of the side peripheral portion and opening to enable insertion of the tobacco rod, and a cavity bottom portion positioned on a base end side of the side peripheral portion. The side peripheral portion may have a first region including a base end at which the cavity bottom portion is provided and a second region positioned on a side of the insertion port to be adjacent to the first region. The external heater may be not disposed in the first region while being disposed in the second region.

[0012] The external heater may be disposed over a whole circumference in a circumferential direction of the side peripheral portion in a partial section or a whole section of the second region.

[0013] The internal heater may have n-fold symmetry with respect to a center axis of the receiving cavity, and

n may be a whole number more than or equal to 3.

[0014] The internal heater may have a columnar shape and may include a conical portion formed on a leading end side thereof.

[0015] The internal heater may have a conic solid shape or a frustum shape and may have a shape tapered from a side of the cavity bottom portion toward a side of the insertion port.

[0016] The internal heater may have a cone shape or a truncated cone shape.

[0017] The side peripheral portion may further have a third region adjacent to the second region and including the insertion port, and the external heater may not be disposed in the third region.

[0018] A leading end position of the internal heater may be in correspondence with the second region or the third region in the side peripheral portion.

[0019] Note that solutions to problems in the present invention can be employed in combination as far as possible.

Advantageous Effects of Invention

[0020] According to the present invention, it is possible to provide a non-combustible heating-type smoking device that is able to suppress aerosol generated by heating from condensing and deliver a sufficient amount of the aerosol to a smoking person.

Brief Description of Drawings

[0021]

[Fig. 1] Fig. 1 is a schematic view of an internal structure of a non-combustible heating-type smoking device according to Embodiment 1.

[Fig. 2] Fig. 2 is a schematic view of a configuration of a non-combustible heating-type smoking article to be used in a non-combustible heating-type smoking device.

[Fig. 3] Fig. 3 is a schematic view of a longitudinal section of a heating device.

[Fig. 4] Fig. 4 is a perspective view of an overall structure of a heating device.

[Fig. 5] Fig. 5 is a view of a state in which a tobacco rod of a non-combustible heating-type smoking article is inserted into a receiving cavity through an insertion port in a heating device.

[Fig. 6] Fig. 6 is a view of a state in which a tobacco rod of a non-combustible heating-type smoking article is inserted into a receiving cavity through an insertion port in a heating device.

[Fig. 7] Fig. 7 is a time chart indicating operation states of an external heater and an internal heater during heating control.

[Fig. 8] Fig. 8 is a graph for describing transition of surface temperatures of an external heater and an internal heater during heating control.

[Fig. 9] Fig. 9 is a graph indicating results of a temperature measurement test.

[Fig. 10] Fig. 10 is a graph indicating results of a temperature measurement test.

[Fig. 11] Fig. 11 is a graph indicating results of a temperature measurement test.

[Fig. 12] Fig. 12 is a graph indicating results of a temperature measurement test.

[Fig. 13] Fig. 13 is a view of an article-temperature measurement position of a tobacco rod.

[Fig. 14] Fig. 14 is a view of a modification of an internal heater in a heating device.

[Fig. 15] Fig. 15 is a view of a modification of an internal heater in a heating device.

[Fig. 16] Fig. 16 is a view of a modification of an internal heater in a heating device.

Description of Embodiments

[0022] Herein, an embodiment of a non-combustible heating-type smoking device according to the present invention will be described on the basis of the drawings. Note that dimensions, materials, shapes of components, relative arrangements thereof, and the like are described in the present embodiments with no intention to limit the technical scope of the invention thereto only unless specific description is provided in particular.

<Embodiment 1>

[0023] Fig. 1 is a schematic view of an internal structure of a non-combustible heating-type smoking device 1 according to Embodiment 1. The non-combustible heating-type smoking device 1 includes a housing 2 that is a housing for housing various types of constituent parts. In the housing 2, a heating device 3, a controller (control unit) 4, a power source 5, and the like are housed.

[0024] Fig. 2 is a schematic view of a configuration of a non-combustible heating-type smoking article 10 to be used in the non-combustible heating-type smoking device 1. The non-combustible heating-type smoking article 10 includes a tobacco rod 11 and a mouthpiece portion 12. Hereinafter, an end of the non-combustible heating-type smoking article 10 on the side of the tobacco rod 11 is referred to as the leading end, and an end portion thereof on the side of the mouthpiece portion 12 is referred to as the base end. The tobacco rod 11 is constituted by a filling material 111 containing cut tobacco and an aerosol-source material, and wrapping paper 112 that wraps the filling material 111. The material of the cut tobacco is not particularly limited and can be a publicly known material, such as laminas and midribs. The filling material 111 contains an aerosol-source material that generates aerosol. The type of the aerosol-source material is not particularly limited, and a substance extracted from various natural products can be selected, as appropriate, in accordance with an intended use. As examples of the aerosol-source material, glycerin, propylene glycol, triacetin, 1,3-butane-

diol, mixture thereof, and the like can be presented. As examples of the filling material 111 containing cut tobacco and an aerosol-source material, there can be presented a restructured tobacco base material that is obtained by preparing liquid, gel, sol, or slurry, which is a soft solid body, by kneading homogenized tobacco, such as tobacco fine particles, with, as an additive, a binding agent, a gelling agent, a crosslinking agent, a flavor, a hydrophilic flavor, a lipophilic flavor, a viscosity modifier, a moisturizing agent, a reinforcing material, and the like and then subjecting the liquid, gel, sol, or slurry to a drying process, a dehydrating process, a sheet-making process, and extrusion molding. The restructured tobacco base material are, for example, sheet tobacco, cut sheet tobacco, tobacco granules, and the like. The filling material 111 may contain a flavor. The type of the flavor is not particularly limited.

[0025] The mouthpiece portion 12 includes a filter segment or the like in which cellulose acetate molded into, for example, a columnar shape is wrapped by roll-up paper. During smoking, the mouthpiece portion 12 filters portion of aerosol generated at the tobacco rod 11. Of course, the mouthpiece portion 12 may include segments other than the filter segment. The tobacco rod 11 and the mouthpiece portion 12 are mutually connected by being integrally rolled up by tip paper 13.

[0026] Fig. 3 is a schematic view of a longitudinal section of a heating device 3. Specifically, a sectional structure of the heating device 3 in A-A arrow-view section in Fig. 1 is illustrated in Fig. 3. Fig. 4 is a perspective view of an overall structure of the heating device 3.

[0027] The heating device 3 includes a heater housing 31 having a bottomed cylindrical shape. The heater housing 31 has a bottom portion 311 having a disc shape and a cylindrical outer cylinder wall 312 extending from the bottom portion 311. An open end of the outer cylinder wall 312 in the heater housing 31 is open toward the outside of the housing 2 through an opening portion provided in the housing 2 and forms a receiving cavity 34, which is a columnar cavity portion into which the tobacco rod 11 of the non-combustible heating-type smoking article 10 is insertable.

[0028] Here, on the leading end side of the outer cylinder wall 312 of the heater housing 31, a thick portion 313 having an inner diameter smaller by one step than the other parts is formed. The leading end of the outer cylinder wall 312 mentioned here is an end portion of the outer cylinder wall 312 opposite to the base end thereof connected to the bottom portion 311. In addition, a cavity side peripheral wall 32 having a cylindrical shape is provided on the inner side of the outer cylinder wall 312 of the heater housing 31. The outer diameter of the cavity side peripheral wall 32 is equal to the inner diameter of the thick portion 313 of the outer cylinder wall 312. As illustrated in Fig. 3, an annular hollow air thermal-insulation portion 37 is formed between the inner surface of the outer cylinder wall 312 of the heater housing 31 and an outer peripheral surface 32b of the cavity side peripheral

eral wall 32. At the leading end of the cavity side peripheral wall 32, an insertion port 38 opening to enable insertion of the tobacco rod 11 is formed. The end portion of the cavity side peripheral wall 32 opposite to the leading end side where the insertion port 38 is formed is referred to as a base end 32c.

[0029] On the side of the bottom portion 311 of the heater housing 31, a heat-resistant cup 33 having a bottomed cylindrical shape is provided. The heat-resistant cup 33 is formed of a heat-resistant material, for example, aluminum or the like and has a cavity bottom portion 331 having a disc shape and a cavity side peripheral wall 332 extending from the cavity bottom portion 331. The cavity bottom portion 331 of the heat-resistant cup 33 is disposed in a state of being stacked on the inner side of the bottom portion 311 of the heater housing 31 and forms the cavity bottom portion of the receiving cavity 34. The cavity side peripheral wall 32 and the cavity side peripheral wall 332 form a side peripheral portion of the receiving cavity 34.

[0030] As illustrated in Fig. 3 and Fig. 4, in the heating device 3, the heat-resistant cup 33 and the cavity side peripheral wall 32 form the receiving cavity 34, which is a cavity portion for receiving the tobacco rod 11. In addition, as illustrated in Fig. 3 and Fig. 4, the cavity side peripheral wall 32 is provided with an annular external heater 35 facing the receiving cavity 34. The external heater 35 is housed in a recessed portion of the cavity side peripheral wall 32 so as to be flush with an inner peripheral surface 32a of the cavity side peripheral wall 32. Here, the sign 35a denotes a heating surface facing the receiving cavity 34. The annular external heater 35 is disposed over the whole circumference along the inner peripheral surface 32a of the cavity side peripheral wall 32. In other words, the external heater 35 is disposed over the whole circumference of the side peripheral portion in the circumferential direction of the receiving cavity 34. Note that the sign CL1 indicated in Fig. 3 denotes the center axis of the heater housing 31. The center axis CL1 is, at the same time, the center axis of each of the receiving cavity 34 and the cavity side peripheral wall 32.

[0031] As illustrated in Fig. 3 and Fig. 4, an internal heater 36 is provided in the receiving cavity 34. The internal heater 36 has a truncated cone shape and projects vertically from a center portion of the bottom portion 311 of the heater housing 31 toward the side of the receiving cavity 34. A through hole 33a is formed at a center portion of the cavity bottom portion 331 of the heat-resistant cup 33, and the internal heater 36 is inserted through the through hole 33a to thereby project from the cavity bottom portion 331 toward the side of the receiving cavity 34. The center axis of the internal heater 36 is the same as the center axis CL of the heater housing 31 (the receiving cavity 34). The sign 36a denotes the base end portion of the internal heater 36, and the sign 36b denotes the leading end portion of the internal heater 36. The internal heater 36 extends from the cavity bottom portion 331 toward the insertion port 38 and is tapered gradually from

the base end portion 36a toward the leading end portion 36b. Although the types of the internal heater 36 and the external heater 35 are not particularly limited, for example, a steel material on which a heat generating wire (for example, nichrome, iron chrome, iron nickel, and the like) is disposed to be laid out, or a ceramic heater, a sheath heater (Sheathed Heater), or the like is usable. Note that the sheath heater is a heater in which a heat wire is covered together with a filler by a metal pipe.

[0032] In the present embodiment, the cavity side peripheral wall 32 is formed of a known heat insulating and heat resistant material to resist the heat of the external heater 35 and suppress the heat of the external heater 35 from dispersing. As a material to be used for the cavity side peripheral wall 32 having such heat insulation capacity and heat resistance capacity, there can be presented, for example, an alumina silica ceramic material, resins of highly heat-resistant PEEK (polyether ether ketone), PPS (polyphenylene sulfide), PTFE (polytetrafluoroethylene), and the like.

[0033] In the present embodiment, the inner peripheral surface 32a of the cavity side peripheral wall 32, an inner peripheral surface 332a of the cavity side peripheral wall 332 of the heat-resistant cup 33, and the heating surface 35a of the external heater 35 are flush with each other without a step, and thus, the inner diameter of the receiving cavity 34 is constant in the direction of the center axis CL1. In the present embodiment, the inner diameter of the receiving cavity 34 may be equal to the outer diameter of the tobacco rod 11 or may be slightly larger than the outer diameter of the tobacco rod 11.

[0034] Here, the signs R1 to R3 indicated in Fig. 3 denote a first region to a third region in the cavity side peripheral wall 32 (side peripheral portion). The first region R1 in the cavity side peripheral wall 32 is a region that includes the base end 32c where the cavity bottom portion 331 is provided. The second region R2 in the cavity side peripheral wall 32 is a region positioned on the side of the insertion port 38 to be adjacent to the first region R1 and is a region in which the external heater 35 is disposed in a partial section or the whole section thereof. That is, the second region R2 has a meaning as a region that defines a maximum range in which the external heater 35 is formed, and the external heater 35 is disposed in the whole region or a partial region of the second region R2. The third region R3 in the cavity side peripheral wall 32 is a region that is adjacent to the second region and that includes the insertion port 38. The first region R1 to the third region R3 are regions formed along the center axis CL1 of the receiving cavity 34 and are formed in the order of the first region R1, the second region R2, and the third region R3 from the cavity bottom portion 331 toward the insertion port 38. The length in the direction of the center axis CL1 of each of the first region R1 to the third region R3 can be changed, as appropriate. As illustrated in Fig. 3, the external heater 35 is disposed only in the second region R2 in the cavity side peripheral wall 32, and the external heater 35 is not disposed in the

first region R1 and the third region R3. In the example illustrated in Fig. 3, the external heater 35 is disposed in the whole section of the second region R2 of the cavity side peripheral wall 32; however, the external heater 35 may be provided in only a partial section of the second region R2.

[0035] Each of Fig. 5 and Fig. 6 is a view of a state in which the tobacco rod 11 of the non-combustible heating-type smoking article 10 is inserted into the receiving cavity 34 through the insertion port 38 in the heating device 3. The internal heater 36 of the heating device 3 in the present embodiment has a truncated cone shape and is tapered toward the leading end portion 36b, which enables the internal heater 36 to penetrate with respect to the tobacco rod 11 (the filling material 111) when the tobacco rod 11 (the filling material 111) is inserted into the receiving cavity 34. In the present embodiment, insertion of the tobacco rod 11 into the receiving cavity 34 is completed at a point of time when a leading end surface 11a (refer to Fig. 2) of the tobacco rod 11 comes into contact with the bottom portion of the receiving cavity 34, that is, the cavity bottom portion 331 of the heat-resistant cup 33. As illustrated in Fig. 5, in the state in which insertion of the tobacco rod 11 with respect to the receiving cavity 34 has been completed, a rear end portion 11b of the tobacco rod 11 is positioned in correspondence with the third region R3 of the above-described cavity side peripheral wall 32. The sign PI indicated in Fig. 3 denotes a position (hereinafter referred to as "received-rod rear end position") corresponding to the rear end portion 11b of the tobacco rod 11 in the state in which insertion of the tobacco rod 11 with respect to the receiving cavity 34 has been completed. In the present embodiment, a clearance between the received-rod rear end position PI and the external heater 35 is set to about 1 mm, which is a comparatively small clearance.

[0036] The heating device 3 having the aforementioned structure includes the external heater 35 disposed at a side peripheral portion of the receiving cavity 34, and the internal heater 36 disposed near the center of a cross section of the receiving cavity 34 along the center axis CL1. The external heater 35 and the internal heater 36 of the heating device 3 generate heat by being supplied with electric power from the power source 5. The power source 5 may be, for example, a rechargeable lithium ion battery but is not particularly limited. Although connection between the power source 5 and each of the external heater 35 and the internal heater 36 in the heating device 3 is not illustrated in Fig. 1, the external heater 35 and the internal heater 36 are each connected to the power source. A controller 4 is electrically connected to the power source 5, and the controller 4 controls power supply from the power source 5 with respect to the external heater 35 and the internal heater 36. The non-combustible heating-type smoking device 1 is provided with a user interface (for example, an operation button and the like), not illustrated, operable by a user (smoking person), and the controller 4 is electrically connected to the user inter-

face. The controller 4 performs control relating to the operation of the heating device 3 (the external heater 35 and the internal heater 36) by detecting the operation with respect to the user interface by a user. Hereinafter, control of the external heater 35 and the internal heater 36 by the controller 4 in the non-combustible heating-type smoking device 1 will be described.

[0037] For example, in a state in which the power of the non-combustible heating-type smoking device 1 is turned off, when a predetermined turn-on operation is performed on an operation button of the non-combustible heating-type smoking device 1 by a user, the controller 4 starts power supply from the power source 5 to the heating device 3 and performs heating control that heats the tobacco rod 11 in a state of being received, as illustrated in Fig. 5, in the receiving cavity 34 of the heating device 3. Fig. 7 is a time chart indicating operation states of the external heater 35 and the internal heater 36 during the heating control of the heating device 3 executed by the controller 4. Fig. 8 is a graph for describing transition of surface temperatures of the external heater 35 and the internal heater 36 during the heating control.

[0038] In Fig. 7, the time T0 represents a time (hereinafter referred to as "heating start time") at which a turn-on operation with respect to the operation button of the non-combustible heating-type smoking device 1 is detected by the controller 4. As illustrated in Fig. 7, the controller 4 starts power supply from the power source 5 with respect to only the external heater 35 at the heating-device start time.

[0039] Next, at the time T1, the controller 4 starts power supply from the power source 5 with respect to the internal heater 36 while continuing power supply from the power source 5 to the external heater 35. Hereinafter, the time T1 is referred to as "internal heating start time". Next, at the time T2, the controller 4 stops power supply from the power source 5 with respect to the external heater 35 while continuing power supply from the power source 5 to the internal heater 36. Hereinafter, the time T2 is referred to as "external heating stop time". Next, at the time T3 after a lapse of a predetermined smoking period since the time T0 (heating start time), power supply from the power source 5 with respect to the internal heater 36 is stopped. Hereinafter, the time T3 is referred to as "heating stop time".

[0040] As described above, the non-combustible heating-type smoking device 1 in the present embodiment causes only the external heater 35 to operate at the heating start time at which heating with respect to the tobacco rod 11 is started and performs preheating (initial heating) of the tobacco rod 11. Here, the external heater 35 is disposed along the cavity side peripheral wall 32 positioned at the outer peripheral portion (side surface) of the receiving cavity 34 and thus can efficiently heat the outer peripheral portion of the tobacco rod 11 received in the receiving cavity 34. That is, it is possible to efficiently preheat, in particular, the outer peripheral portion of the tobacco rod 11 before heating of the tobacco rod 11 by

the internal heater 36 is started at the time T1 (internal heating start time). Here, a period from the time T0 (heating start time) to the time T1 (internal-heater start time) is referred to as "preheating period". The preheating period can be set as a period from the heating start time (that is, start of preheating) to a point of time when an elapsed time since the heating start time reaches a predetermined set time or when the temperature of the external heater 35 reaches a predetermined set temperature. For example, during the preheating period, the controller 4 may set the set temperature to control the external heater 35 at 300°C.

[0041] The tobacco rod 11 is heated by both the external heater 35 and the internal heater 36 during a period (hereinafter referred to as "simultaneous heating period") from the heating start time to a point of time when an elapsed time since the heating start time reaches a predetermined set time or when the temperature of the external heater 35 reaches a predetermined set temperature, that is, from the time T1 (internal heating start time) to the time T2 (external heating stop time). As described above, the internal heater 36 is disposed to have the same axis as the center axis CL1 of the receiving cavity 34. Therefore, the heat of the internal heater 36 penetrating the tobacco rod 11 (the filling material 111) is transmitted radially from the center side toward the outer peripheral side of the tobacco rod 11. As a result, it is possible to efficiently heat the tobacco rod 11 and possible to volatilize an aerosol-source material (for example, glycerin and the like) contained in the filling material 111 of the tobacco rod 11 and a flavor component contained in cut tobacco in a short period and generate aerosol containing a flavor component.

[0042] In the filling material 111 of the tobacco rod 11 containing an aerosol-source material (for example, glycerin and the like), water (moisture) in the filling material 111 first evaporates with an increase in the article temperature. The evaporation occurs at around the boiling point (100°C) of water. It is considered that, when the article temperature of the filling material 111 in the tobacco rod 11 is further increased, nicotine whose atmospheric boiling point is about 250°C next starts to be volatilized, and, when the article temperature is further increased, glycerin whose atmospheric boiling point is 290°C evaporates and sucked as aerosol. As is obvious for a person skilled in the art, various types of components in various forms are contained in a tobacco raw material, and these components are present as chemical compounds. It is thus considered that, scientifically, principle components evaporate (are volatilized) in the order of the boiling points thereof although simple evaporation events do not occur only in the vicinity of the boiling point of a pure substance, such as water, nicotine, and glycerin described above.

[0043] As illustrated in Fig. 8, the controller 4 controls the temperature of the external heater 35 to be higher than the temperature of the internal heater 36 during the simultaneous heating period (times T1 to T2). For exam-

ple, during the simultaneous heating period, the controller 4 sets the set temperature of the external heater 35 to 300°C and the set temperature of the internal heater 36 to 250°C and control the external heater 35 and the internal heater 36. In the present embodiment, the temperature of the outer peripheral portion of the tobacco rod 11 is increased rapidly and efficiently by the external heater 35 in contact with or close to the outer peripheral portion during the preheating period of the tobacco rod 11, and the temperature of the external heater 35 is controlled to be higher than the temperature of the internal heater 36 also during the subsequent simultaneous heating period. Consequently, it is possible to actively increase the temperature of the outer peripheral portion of the tobacco rod 11 having difficulty in receiving heat from the internal heater 36 due to a distance from the internal heater 36 and having a likelihood of easily receiving an influence (heat radiation loss) of outdoor air. That is, it is possible to efficiently heat the center side in the cross section of the tobacco rod 11 by the internal heater 36 and to efficiently heat, by the external heater 35, the outer peripheral portion of the tobacco rod 11 having difficulty in receiving heat of the internal heater 36 and having a likelihood of easily receiving an influence (heat radiation loss) of outdoor air. Consequently, it is possible to uniformly heat the entirety of the tobacco rod 11 to a temperature at which an aerosol-source material is sufficiently volatilized.

[0044] It is also possible to reduce total power consumption, compared with when both the external heater 35 and the internal heater 36 are operated during the preheating period, by heating the tobacco rod 11 with only the external heater 35 during the preheating period and causing the internal heater 36 to operate after a lapse of the preheating period by following the operation of the external heater 35.

[0045] In addition, it is possible to suppress condensation (dew condensation/liquefaction) of an aerosol-source material that has been once volatilized from occurring at the outer peripheral portion of the tobacco rod 11 by, as described above, actively heating the outer peripheral portion of the tobacco rod 11 during the preheating period and the simultaneous heating period by the external heater 35. Therefore, it is possible to sufficiently ensure the delivery amount of aerosol during, in particular, initial smoking and possible to improve the smoke voluminous feel.

[0046] In particular, according to the non-combustible heating-type smoking device 1 in the present embodiment, as illustrated in Fig. 5, the external heater 35 is positioned at the base end side (the side of the mouth-piece portion 12) of the tobacco rod 11 received in the receiving cavity 34. It is thus possible to intensively heat, in particular, the region on the base end side of the outer peripheral portion in the tobacco rod 11 by the external heater 35. This provides an advantage that it is possible to effectively suppress condensation of aerosol generated on the leading end side (upstream side) of the tobacco

rod 11 from occurring on the base end side (downstream side) of the tobacco rod 11.

[0047] Here, the external-heater width dimension, which is the length of the external heater 35 extending in the direction of the center axis CL1 of the receiving cavity 34, is preferably at least a dimension more than or equal to one-third the tobacco rod 11. Consequently, it is possible to sufficiently preheat the outer peripheral portion of the tobacco rod 11 during the preheating period of the tobacco rod 11 before the start of heating by the internal heater 36.

[0048] After the temperature of the entirety of the tobacco rod 11 is sufficiently increased, as described above, during the simultaneous heating period, the temperature of the tobacco rod 11 can be maintained at a temperature at which condensation of aerosol does not occur by only heating with the internal heater 36. The controller 4 thus stops the operation of the external heater 35 at a point of time when the external heating stop time (time T2) is reached. At this time, the controller 4 stops the operation of the external heater 35 before the temperature of the internal heater 36 exceeds the temperature of the external heater 35. The external heating stop time (time T2) at which the operation of the external heater 35 is stopped can be set as a point of time when an elapsed time since the heating start time (that is, start of preheating) reaches a predetermined set time or when the temperature of the external heater 35 reaches a predetermined set temperature. Alternatively, various forms can be employed, and the operation of the external heater 35 may be stopped at a point of time when a certain period has elapsed since the temperature of the external heater 35 has reached a predetermined set temperature.

[0049] After the external heating stop time (time T2) has passed, the tobacco rod 11 is heated by only the internal heater 36, and the temperature of the external heater 35 decreases naturally. Therefore, as illustrated in Fig. 8, the temperature of the internal heater 36 exceeds the temperature of the external heater 35 at an intermediate point in a period (hereinafter referred to as "internal heating period") from the external heating stop time (time T2) to the heating stop time (time T3).

[0050] Heating efficiency in heating the tobacco rod 11 is excellent in the internal heater 36 disposed at a center portion, compared with the external heater 35 disposed on the outer peripheral side of the receiving cavity 34. It is thus possible to generate aerosol stably and continuously by heating the tobacco rod 11 with only the internal heater 36, in which heating efficiency is excellent, during a remaining smoking period in which conditions for suppressing easy condensation of aerosol are met due to the temperature of the entirety of the tobacco rod 11 being increased sufficiently during the simultaneous heating period.

[0051] After stopping the operation of the external heater 35, the controller 4 may control power supply from the power source 5 to the internal heater 36 so as to increase the temperature of the internal heater 36 com-

pared with the temperature before stopping of the operation of the external heater 35. For example, the controller 4 may change the set temperature of the internal heater 36 from 250°C to 350°C. The set temperature of the internal heater 36 in the internal heating period is preferably set to an appropriate temperature that enables stable and continuous volatilization of an aerosol-source material contained in the tobacco rod 11 through heating with only the internal heater 36. When, as described above, the set temperature of the internal heater 36 is increased after stopping of the operation of the external heater 35, the power consumption of the internal heater 36 increases. It is however possible to reduce the power consumption as a total because the operation of the external heater 35 is stopped.

[0052] At the time T3 (heating stop time) after a lapse of a predetermined smoking period since the heating start time (time TO), the controller 4 stops power supply from the power source 5 to the internal heater 36.

[0053] Figs. 9 to 12 show results of a temperature measurement test in which transition of the surface temperature of the external heater 35, the surface temperature of the internal heater 36, and the article temperature of the tobacco rod 11 when heating control of the heating device 3 was performed by the controller 4 was measured. Fig. 13 is a diagram indicating an article-temperature measurement position of the tobacco rod 11.

[0054] In the temperature measurement test, as the article temperature of the tobacco rod 11, temperatures at a first measurement position MP1 to a third measurement position MP3, illustrated in Fig. 13, were measured. The clearance between each of the measurement positions MP1 to MP3 and the side peripheral surface (the inner peripheral surface 32a of the cavity side peripheral wall 32) of the receiving cavity 34 in the radial direction of the receiving cavity 34 is 1.5 mm. The clearance between each of the measurement positions MP1 to MP3 and the base end portion 36a of the internal heater 36 in the radial direction of the receiving cavity 34 is 1.5 mm.

[0055] As illustrated in Fig. 13, the first measurement position MP1 to the third measurement position MP3 are arranged in the order of the first measurement position MP 1, the second measurement position MP2, and the third measurement position MP3 from the side of the cavity bottom portion 331. In the direction of the center axis CL1 of the receiving cavity 34, the clearance between the cavity bottom portion 331 and the first measurement position MP1 is 2 mm. The clearance between the first measurement position MP1 and the second measurement position MP2 is 5 mm. The clearance between the second measurement position MP2 and the third measurement position MP3 is 6 mm. The clearance between the third measurement position MP3 and the received-rod rear end position PI is 2 mm. In the heating control, the elapsed time since the heating start time to the internal-heater start time is set to 6 seconds, the elapsed time since the heating start time to the external heating stop time is set to 20 seconds, and the elapsed time since the

heating start time to the heating stop time is set to 420 seconds.

[0056] In each of Fig. 10 to Fig. 12, the temperature transition indicated by a solid line indicates temperature transition (hereinafter referred to as "example") at each of the measurement positions MP1 to MP3 when the heating control according to the present embodiment described with Fig. 7 and Fig. 8 is performed. The temperature transition indicated by a dashed line indicates temperature transition (hereinafter referred to as "comparative example") at each of the measurement positions MP1 to MP 3 when the heating control is performed by using only the internal heater 36, without the use of the external heater. The two-dot chain line indicated in each of Fig. 10 to Fig. 12 indicates the target article temperature in heating of the tobacco rod 11. The target article temperature is, for example, 150°C. As illustrated in Fig. 10 to Fig. 12, at the first measurement position MP1 and the second measurement position MP2, which are present at positions corresponding to the first region R1 in the cavity side peripheral wall 32, there is no remarkable difference in the heating control between the example and the comparative example. It is considered that an influence of the external heater 35 is small since the first measurement position MP1 and the second measurement position MP2 are both distanced from the external heater 35 and comparatively close to the internal heater 36. Meanwhile, as illustrated in Fig. 12, there is a remarkable difference at the third measurement position MP3 between the example and the comparative example. The target article temperature can be easily reached in a shorter time in the example than in the comparative example, and an advantage of the example with respect to the comparative example is confirmed.

[0057] As described above, the non-combustible heating-type smoking device 1 in the present embodiment includes the internal heater 36 that is disposed in the receiving cavity 34 and that heats the tobacco rod 11 from inside to thereby volatilize the aerosol-source material, and the external heater 35 that is disposed at the side peripheral portion of the receiving cavity 34 and that preheats the outer peripheral portion of the tobacco rod 11 at least during the preheating period of the tobacco rod 11 to thereby suppress condensation of aerosol generated during the operation of the internal heater 36. Consequently, the temperature of the outer peripheral portion of the tobacco rod 11, which has difficulty in receiving heat from the internal heater and has a likelihood of easily receiving an influence (heat radiation loss) of outdoor air, can be previously increased sufficiently during the preheating period by the external heater. It is thus possible to suppress occurrence of condensation of aerosol generated during the operation of the internal heater 36. Therefore, it is possible to sufficiently ensure the delivery amount of aerosol during smoking and possible to improve the smoke voluminous feel.

[0058] In the aforementioned embodiment, the external heater 35 is not disposed in the first region R1 includ-

ing the base end 32c at which the cavity bottom portion 331 of the cavity side peripheral wall 32 (side peripheral portion) is provided and the third region R3 including the insertion port 38, and the external heater 35 is disposed in the second region R2 positioned closer than the first region R1 to the insertion port 38. It is thus possible to intensively heat, of the outer peripheral portion in the tobacco rod 11, in particular, the region on the base end side by the external heater 35. Consequently, the aerosol generated on the leading end side (upstream side) of the tobacco rod 11 can be effectively suppressed from condensing on the base end side (downstream side) of the tobacco rod 11.

[0059] In particular, the internal heater 36 in the present embodiment has a tapered shape whose diameter decreases from the base end portion 36a toward the leading end portion 36b, and therefore, the amount of heat radiation with respect to the tobacco rod 11 tends to be smaller at the leading end portion 36b of the internal heater 36 than that on the base end side. However, it is possible to suitably compensate for a lacking amount of heat radiation at the leading end portion 36b of the internal heater 36 by disposing the external heater 35 around (a position corresponding to the leading end portion 36b of the internal heater 36) the leading end portion 36b of the internal heater 36. By not disposing the external heater 35 in the first region R1 where the amount of heat radiation from the internal heater 36 can be sufficiently ensured, it is also possible to efficiently heat the base end region in the outer peripheral portion of the tobacco rod 11 by the external heater 35 while suppressing power consumption of the power source 5.

[0060] Further, in the present embodiment, the external heater 35 is not disposed in the third region R3 in the cavity side peripheral wall 32 (side peripheral portion). It is thus possible to suppress, for example, the filter segment positioned at the front end portion of the mouthpiece portion 12 from burning or melting due to the heat of the external heater 35 when the external heater 35 is operated.

[0061] In the present embodiment, an example in which the shape of the internal heater 36 is a truncated cone shape has been described. By employing the internal heater 36 having a shape thus tapered from the side of the cavity bottom portion 331 toward the side of the insertion port 38, the internal heater 36 is enabled to easily penetrate the filling material 111 of the tobacco rod 11 inserted into the receiving cavity 34. In addition, it is possible to favorably maintain the contact state between the internal heater 36 and the filling material 111 in the state in which the internal heater 36 penetrate the filling material 111. As a result, generated heat of the internal heater 36 is easily transmitted to the filling material 111, which can improve efficiency in heating of the filling material 111. Note that, although the internal heater 36 is caused to penetrate the filling material 111 of the tobacco rod 11 inserted into the receiving cavity 34 in the present embodiment, the internal heater 36 may be inserted into a

recessed portion formed on an end surface of the filling material 111 on the leading end side (upstream side) in the tobacco rod 11.

[0062] Various shapes can be employed for the internal heater 36. For example, the internal heater 36 may have a conic solid shape (cone or pyramid shape) or a frustum shape (truncated cone or pyramid shape) and have a shape tapered from the side of the cavity bottom portion 331 toward the side of the insertion port 38. For example, instead of the truncated cone shape, a cone shape may be employed. The internal heater 36 may have a columnar shape. In this case, a conical portion may be formed at the columnar part of the internal heater 36 on the leading end side thereof. The internal heater 36 may have n-fold symmetry with respect to the center axis CL1 of the receiving cavity 34, and n may be a whole number more than or equal to 3.

[0063] In the example illustrated in Fig. 5, the leading end portion 36b of the internal heater 36 in the heating device 3 is disposed at a position corresponding to the leading end (an end portion on the side of the insertion port 38) of the second region R2 in the cavity side peripheral wall 32 (side peripheral portion). The position of the leading end portion 36b is, however, not limited thereto. For example, as in the modification illustrated in Fig. 14, the leading end portion 36b of the internal heater 36 may be disposed at a position corresponding to an intermediate portion of the second region R2. As in the modification illustrated in Fig. 15, the leading end portion 36b of the internal heater 36 may be disposed at a position corresponding to the third region R3. As in the modification illustrated in Fig. 16, the leading end portion 36b of the internal heater 36 may be disposed at a position corresponding to the first region R1.

[0064] An embodiment and modifications have been described above. However, the non-combustible heating-type smoking device according to the present invention is not limited thereto, and the embodiment 149+14 and the modifications can be combined together as far as possible.

Reference Signs List

[0065]

- | | |
|----|--|
| 1 | non-combustible heating-type smoking device |
| 2 | housing |
| 3 | heating device |
| 4 | controller |
| 5 | power source |
| 10 | non-combustible heating-type smoking article |
| 11 | tobacco rod |
| 12 | mouthpiece portion |
| 34 | receiving cavity |
| 35 | external heater |
| 36 | internal heater |

Claims

1. A non-combustible heating-type smoking device comprising:

a receiving cavity for receiving a tobacco rod containing cut tobacco and an aerosol-source material;
 an internal heater that is disposed in the receiving cavity to penetrate a tobacco rod inserted into the receiving cavity or to be inserted into a recessed portion formed on an end surface of the tobacco rod, the internal heater being configured to heat the tobacco rod from inside to volatilize the aerosol-source material; and
 an external heater that is disposed at a side peripheral portion of the receiving cavity and suppresses condensation of aerosol generated during operation of the internal heater by preheating an outer peripheral portion of the tobacco rod during at least a period of preheating the tobacco rod.

2. The non-combustible heating-type smoking device according to claim 1, further comprising:

a control unit that controls the internal heater and the external heater,
 wherein the control unit performs control to cause a temperature of the external heater to be higher than a temperature of the internal heater in a simultaneous heating period in which both the internal heater and the external heater are operated.

3. The non-combustible heating-type smoking device according to claim 2,
 wherein, at a point of time when an elapsed time since a start of preheating of the tobacco rod by the external heater reaches a predetermined set time or when a temperature of the external heater reaches a predetermined set temperature, the control unit stops operation of the external heater but continues the operation of the internal heater.

4. The non-combustible heating-type smoking device according to claim 3,
 wherein, after an operation stop of the external heater, the control unit increases a temperature of the internal heater compared with that before the operation stop of the external heater.

5. The non-combustible heating-type smoking device according to any one of claims 2 to 4,
 wherein, to start preheating of the tobacco rod, the control unit causes only the external heater to operate to thereby start the preheating and causes the internal heater to operate by following operation of

the external heater.

6. The non-combustible heating-type smoking device according to any one of claims 1 to 5,

wherein the receiving cavity has an insertion port positioned on a leading end side of the side peripheral portion and opening to enable insertion of the tobacco rod, and a cavity bottom portion positioned on a base end side of the side peripheral portion,
 wherein the side peripheral portion has a first region including a base end at which the cavity bottom portion is provided and a second region positioned on a side of the insertion port to be adjacent to the first region, and
 wherein the external heater is not disposed in the first region while being disposed in the second region.

7. The non-combustible heating-type smoking device according to claim 6,
 wherein the external heater is disposed over a whole circumference in a circumferential direction of the side peripheral portion in a partial section or a whole section of the second region.

8. The non-combustible heating-type smoking device according to claim 6 or claim 7,
 wherein the internal heater has n-fold symmetry with respect to a center axis of the receiving cavity, n being a whole number more than or equal to 3.

9. The non-combustible heating-type smoking device according to any one of claims 6 to 8,
 wherein the internal heater has a columnar shape and includes a conical portion formed on a leading end side thereof.

10. The non-combustible heating-type smoking device according to any one of claims 6 to 8,
 wherein the internal heater has a conic solid shape or a frustum shape and has a shape tapered from a side of the cavity bottom portion toward a side of the insertion port.

11. The non-combustible heating-type smoking device according to any one of claims 6 to 8,
 wherein the internal heater has a cone shape or a truncated cone shape.

12. The non-combustible heating-type smoking device according to any one of claims 6 to 11,
 wherein the side peripheral portion further has a third region adjacent to the second region and including the insertion port, and the external heater is not disposed in the third region.

13. The non-combustible heating-type smoking device according to claim 12, wherein a leading end position of the internal heater is in correspondence with the second region or the third region in the side peripheral portion.

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FIG. 1

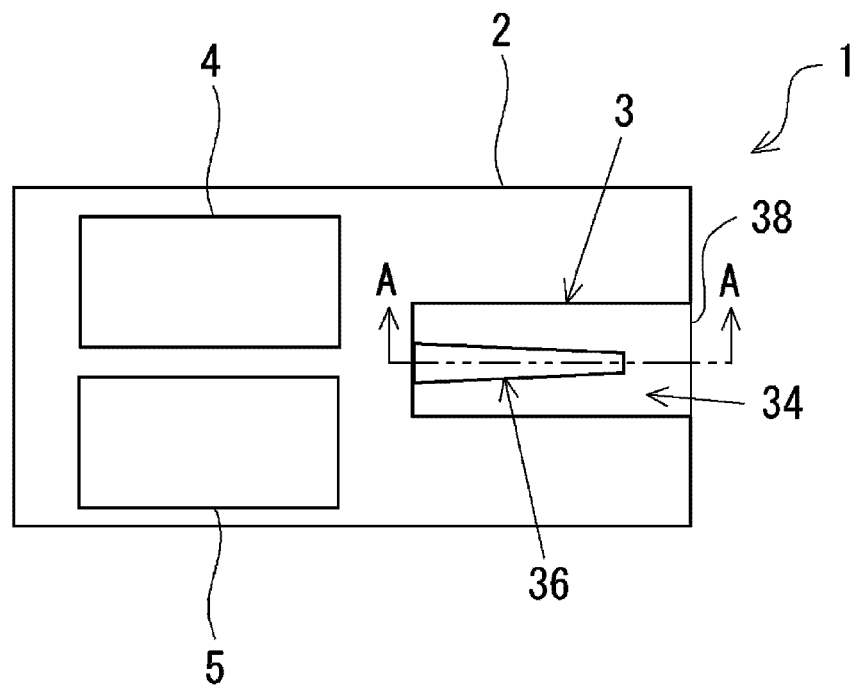


FIG. 2

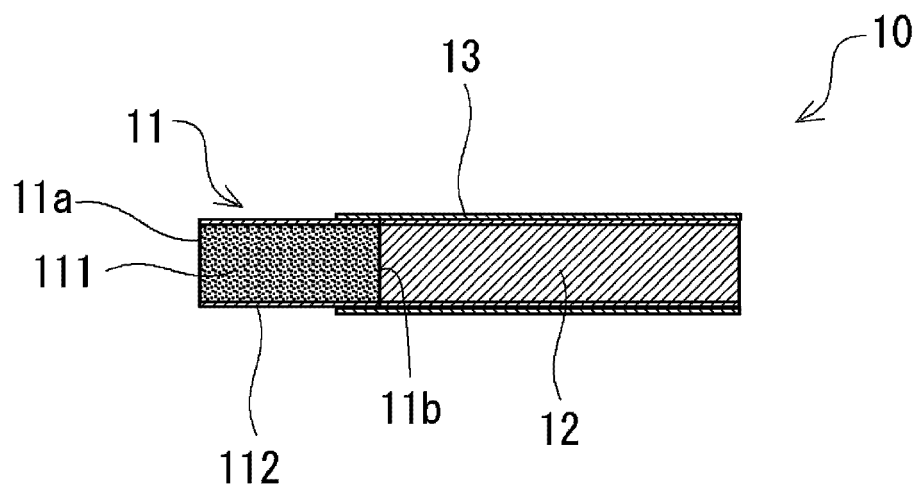


FIG. 3

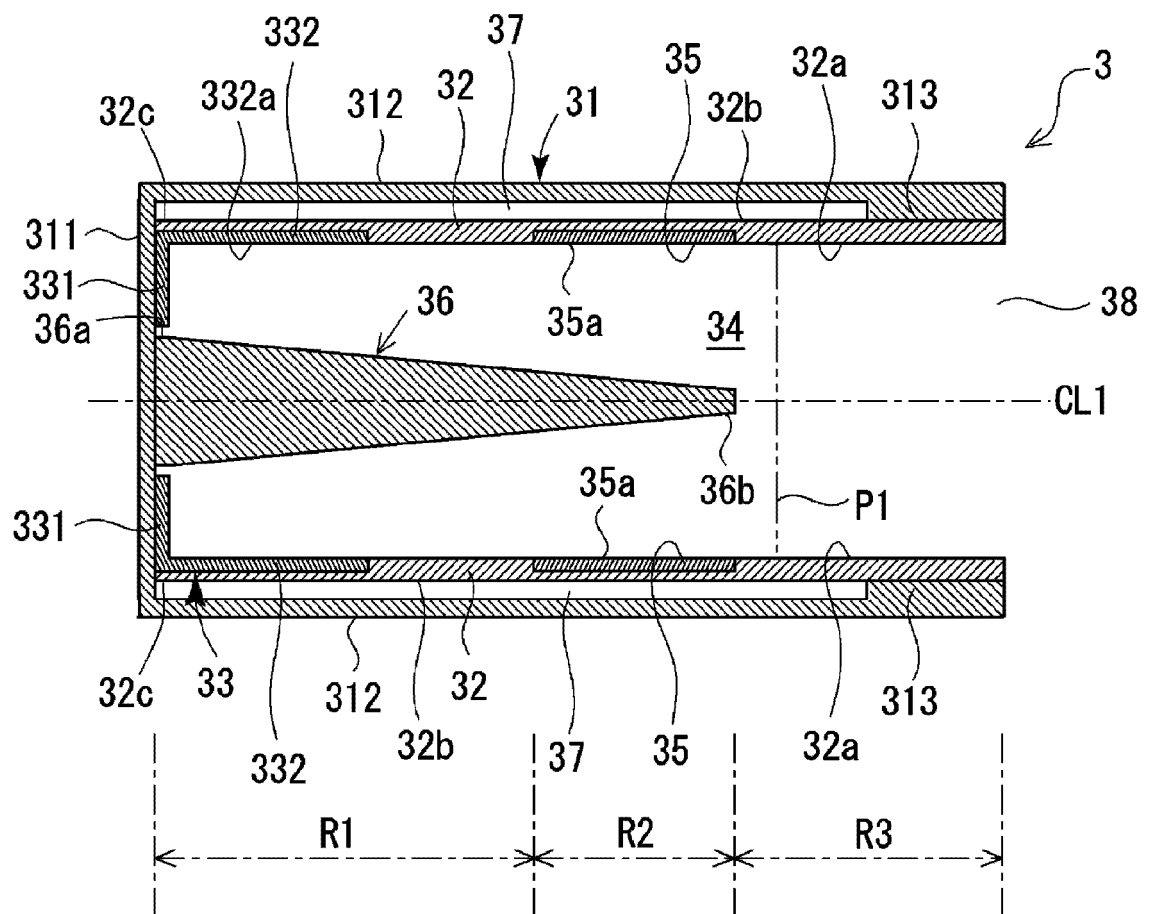


FIG. 4

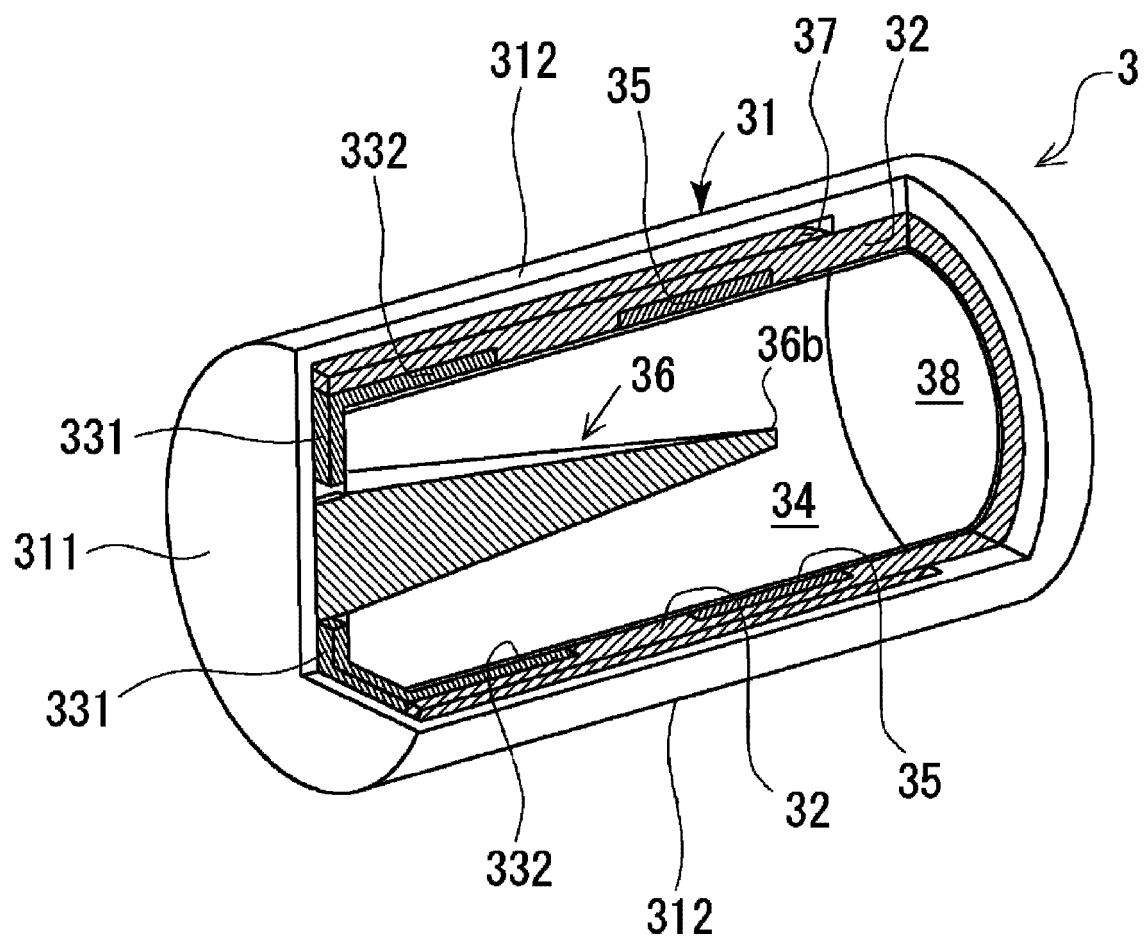


FIG. 5

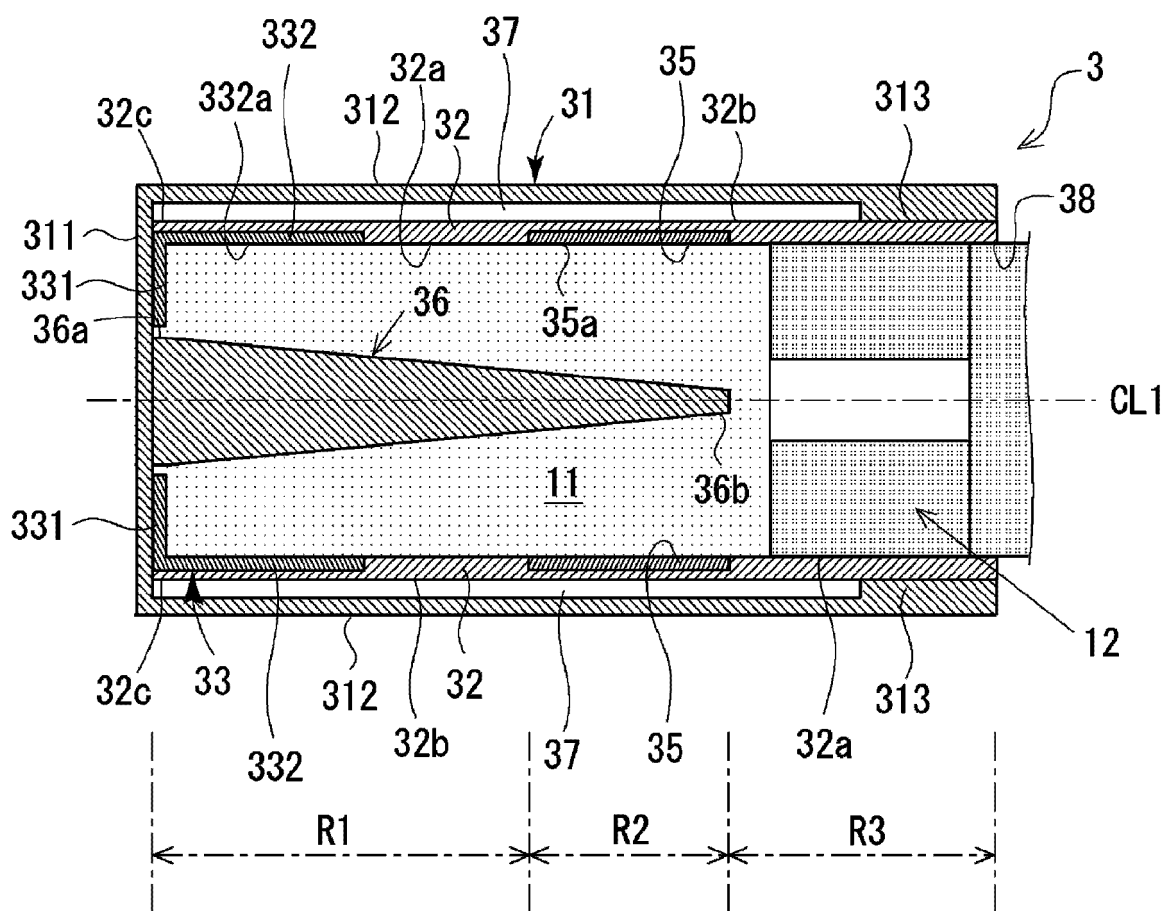


FIG. 6

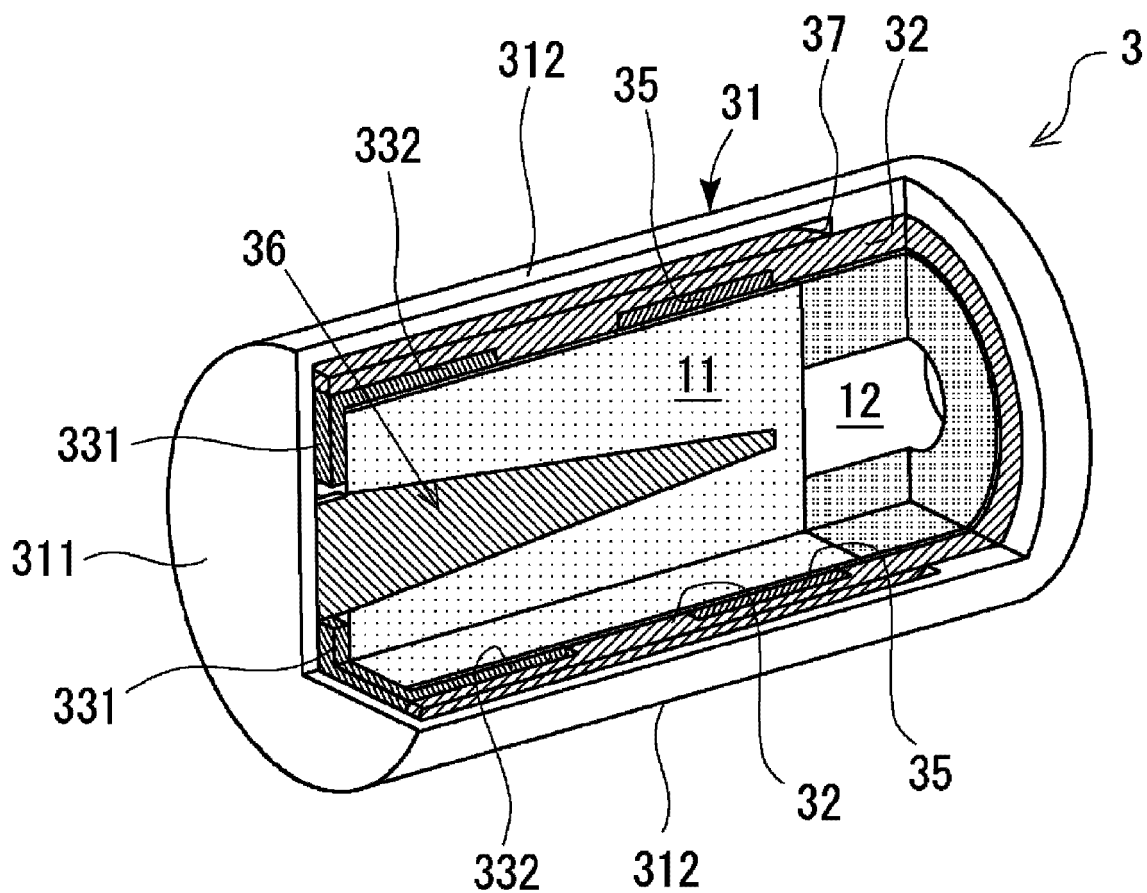


FIG. 7

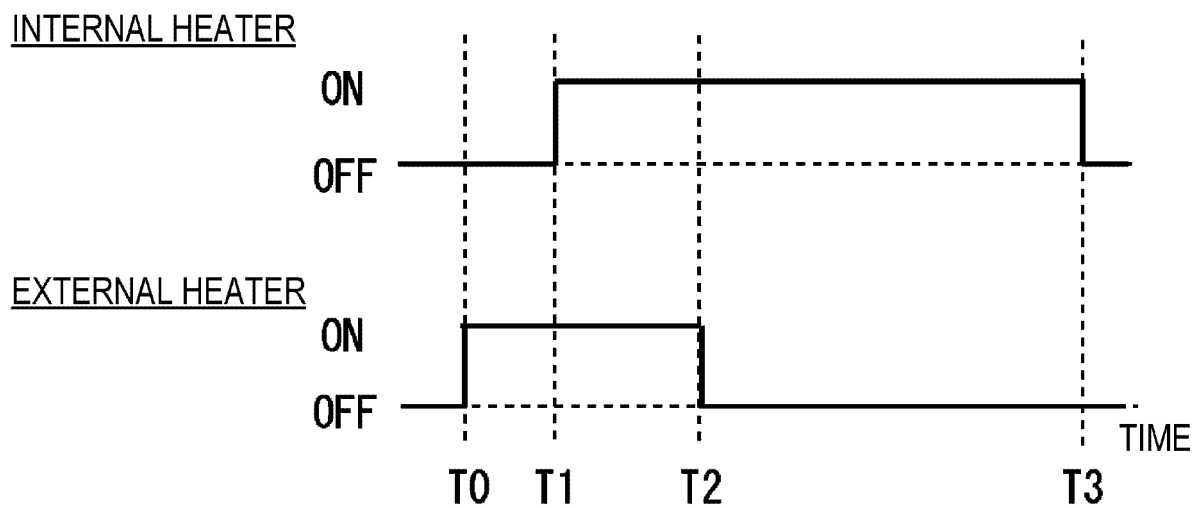


FIG. 8

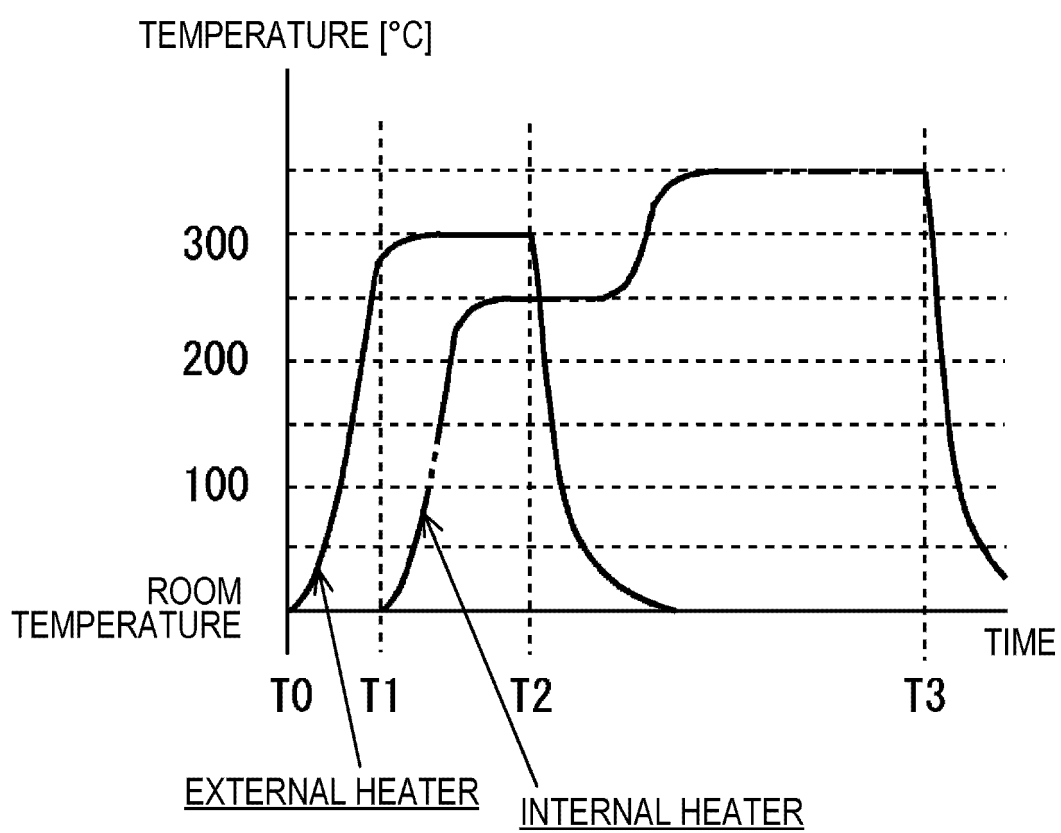


FIG. 9

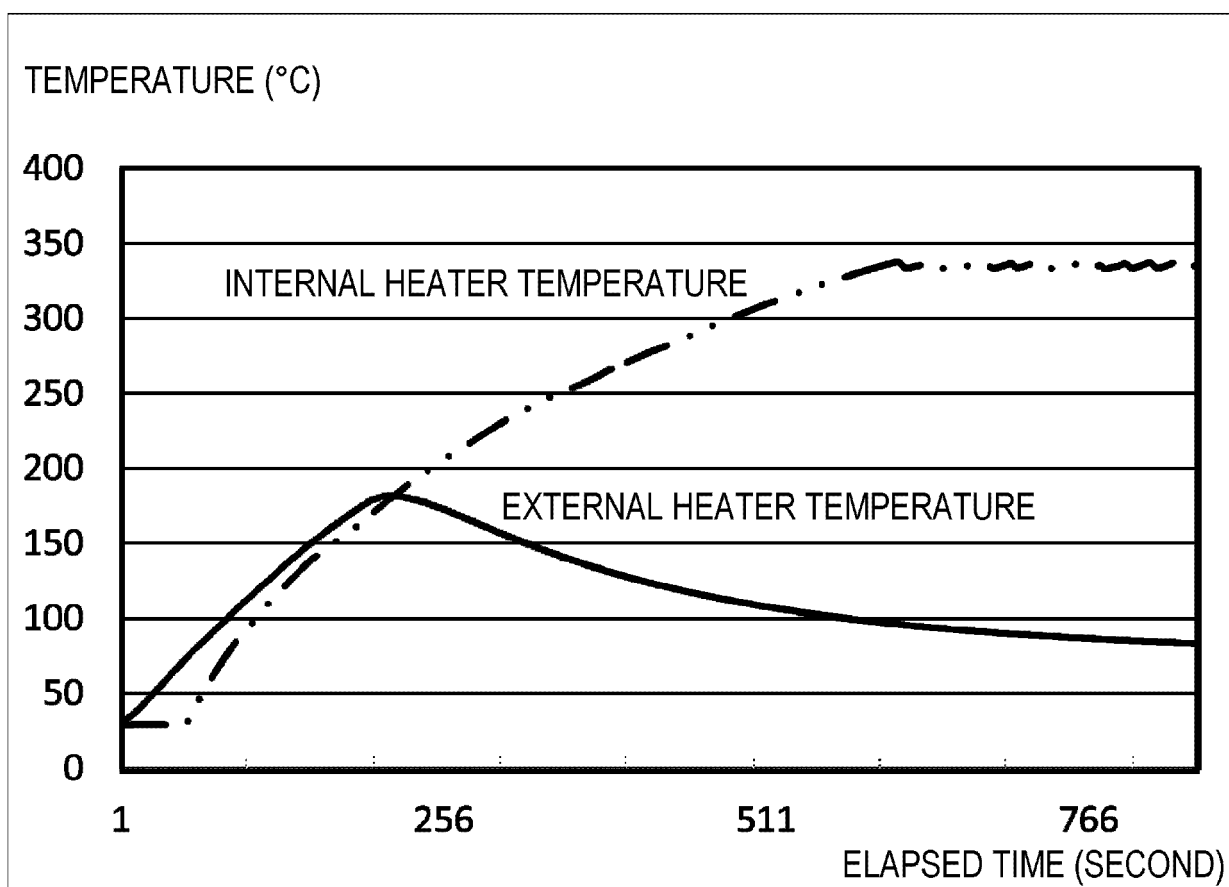


FIG. 10

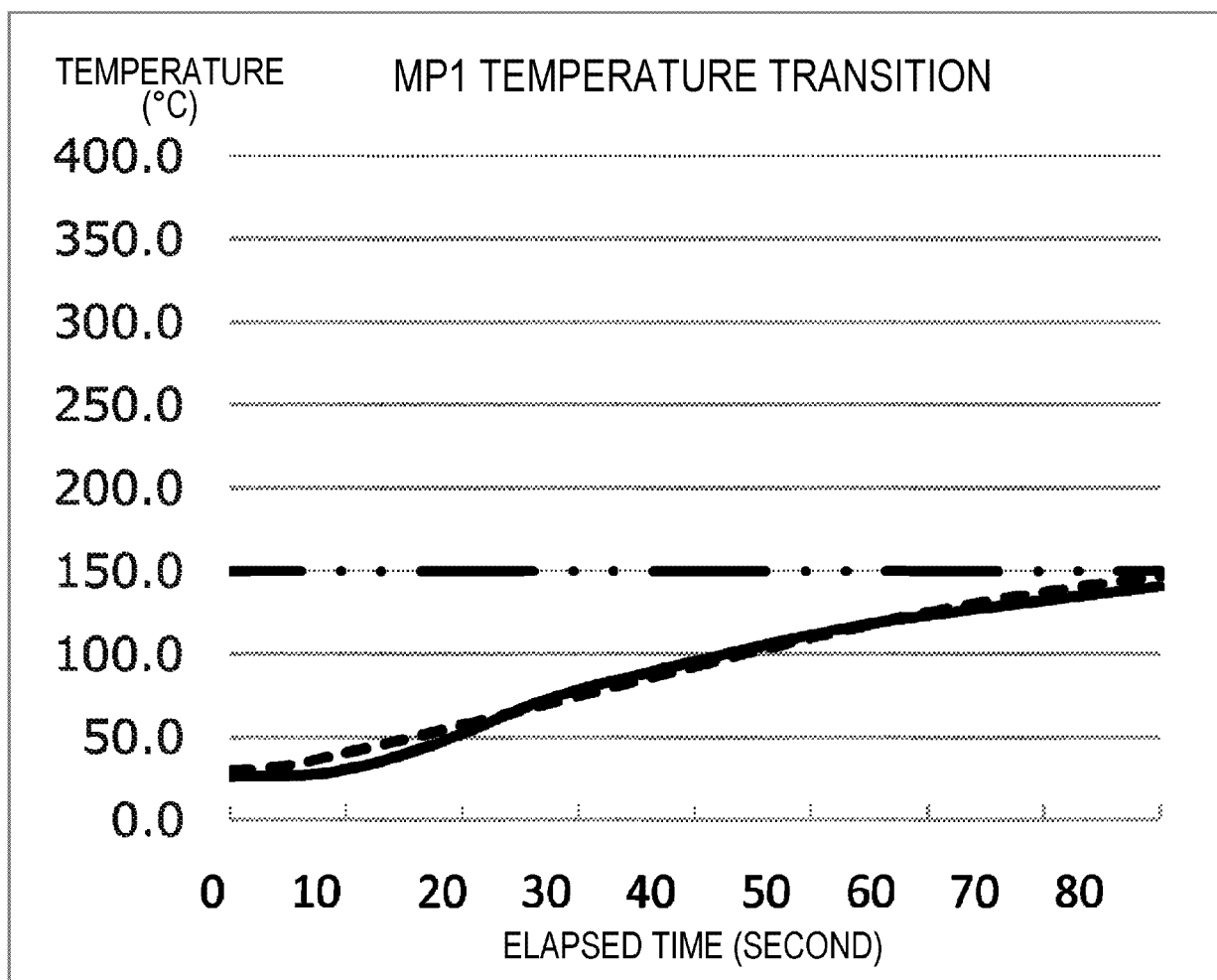


FIG. 11

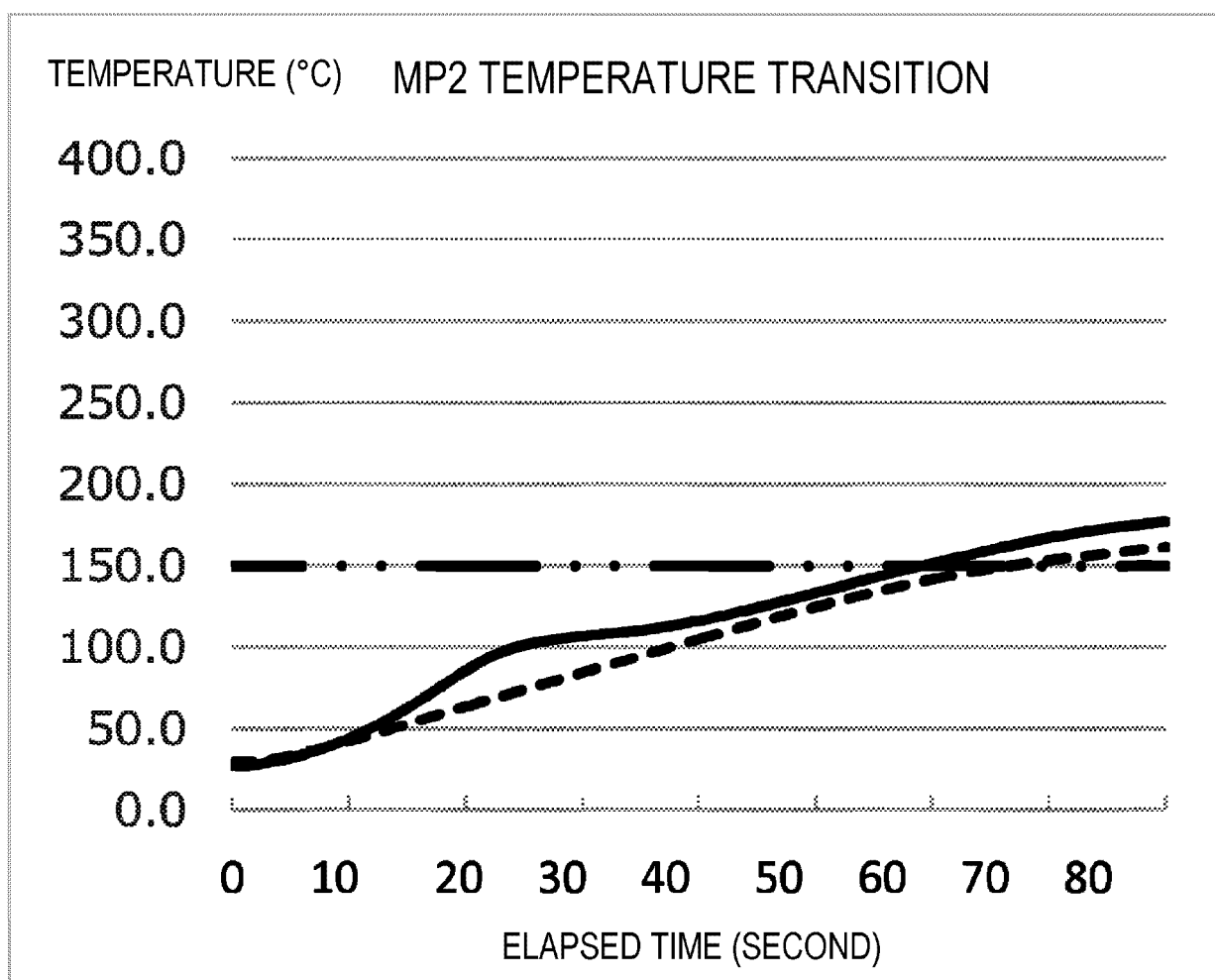


FIG. 12

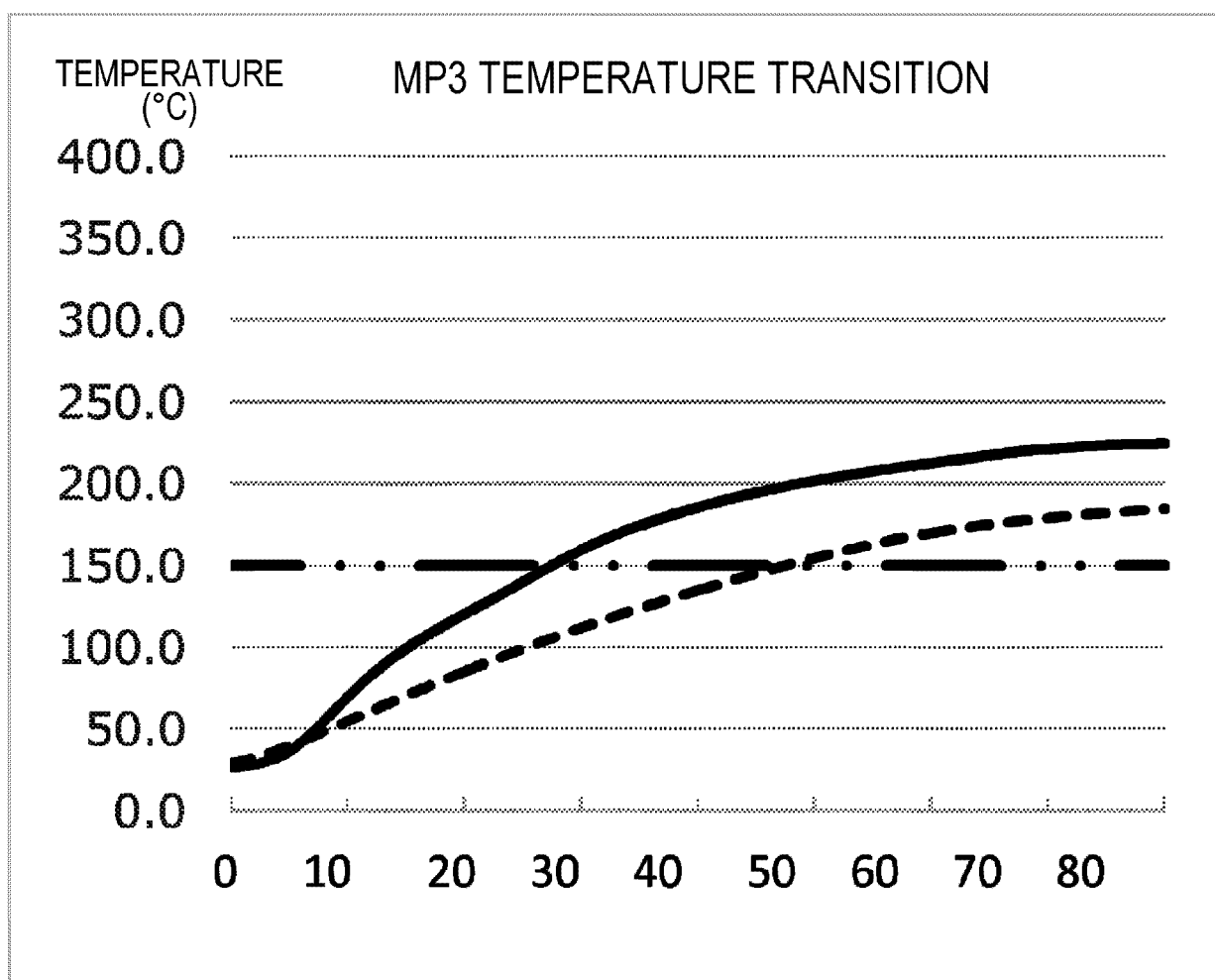


FIG. 13

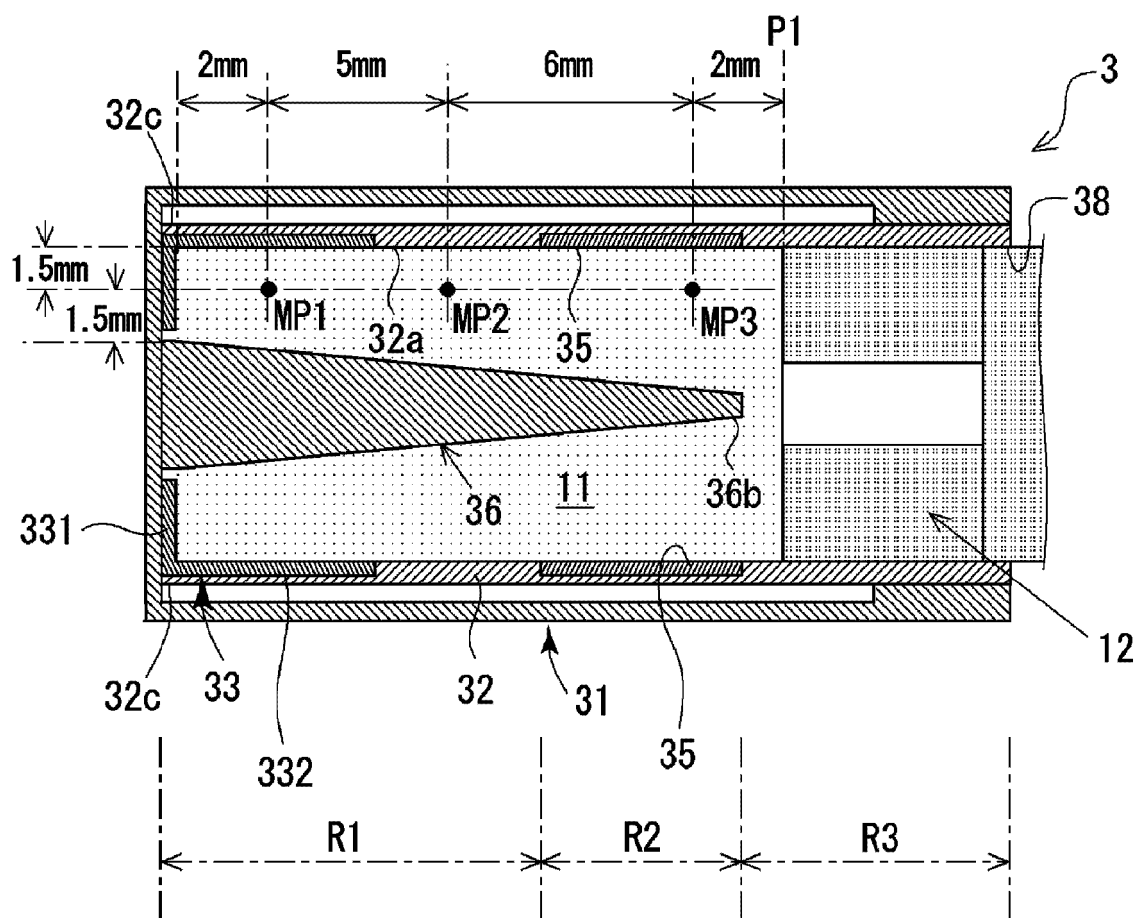


FIG. 14

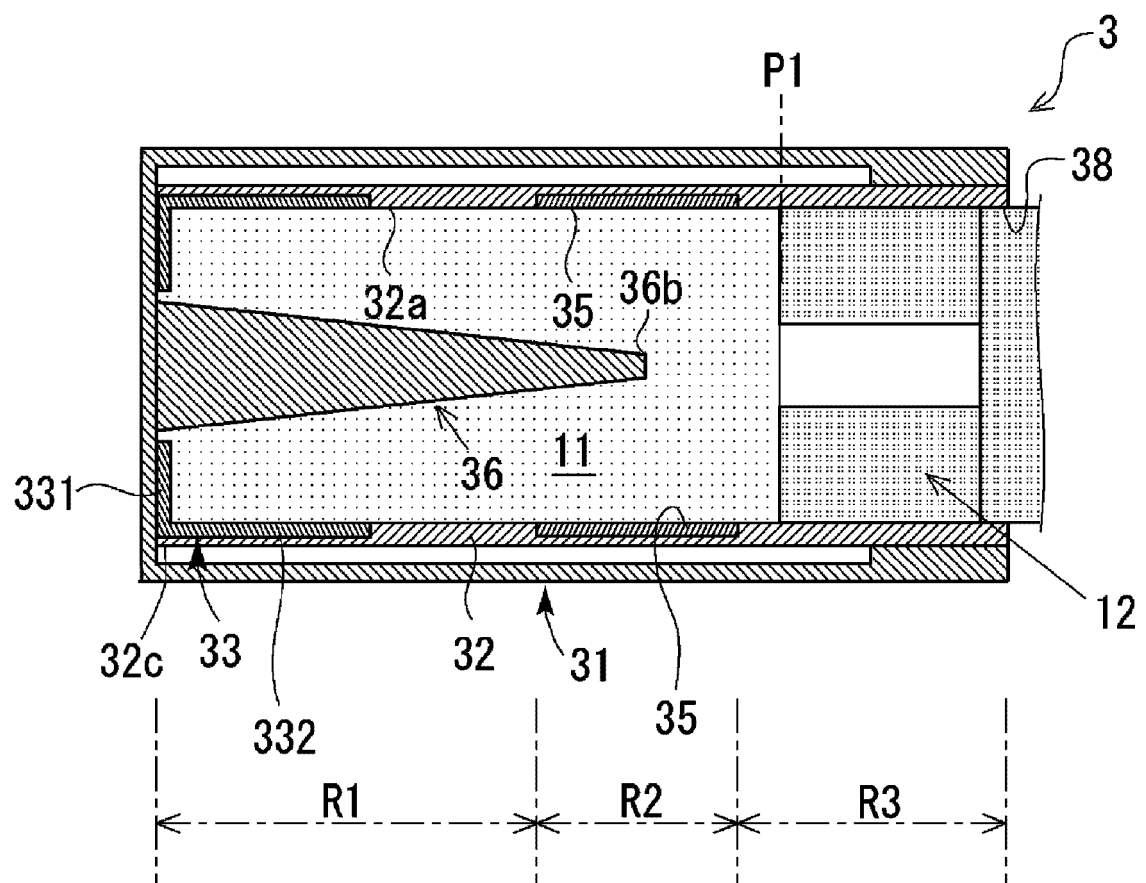


FIG. 15

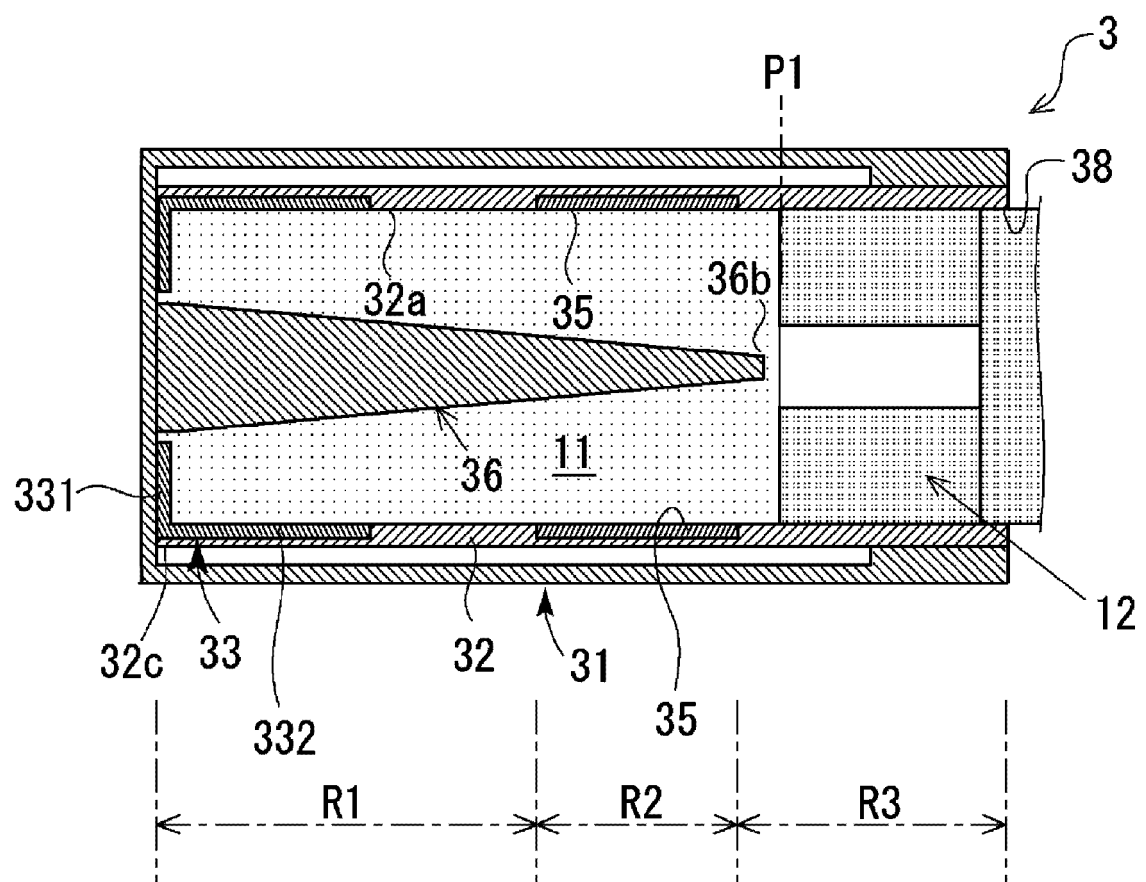
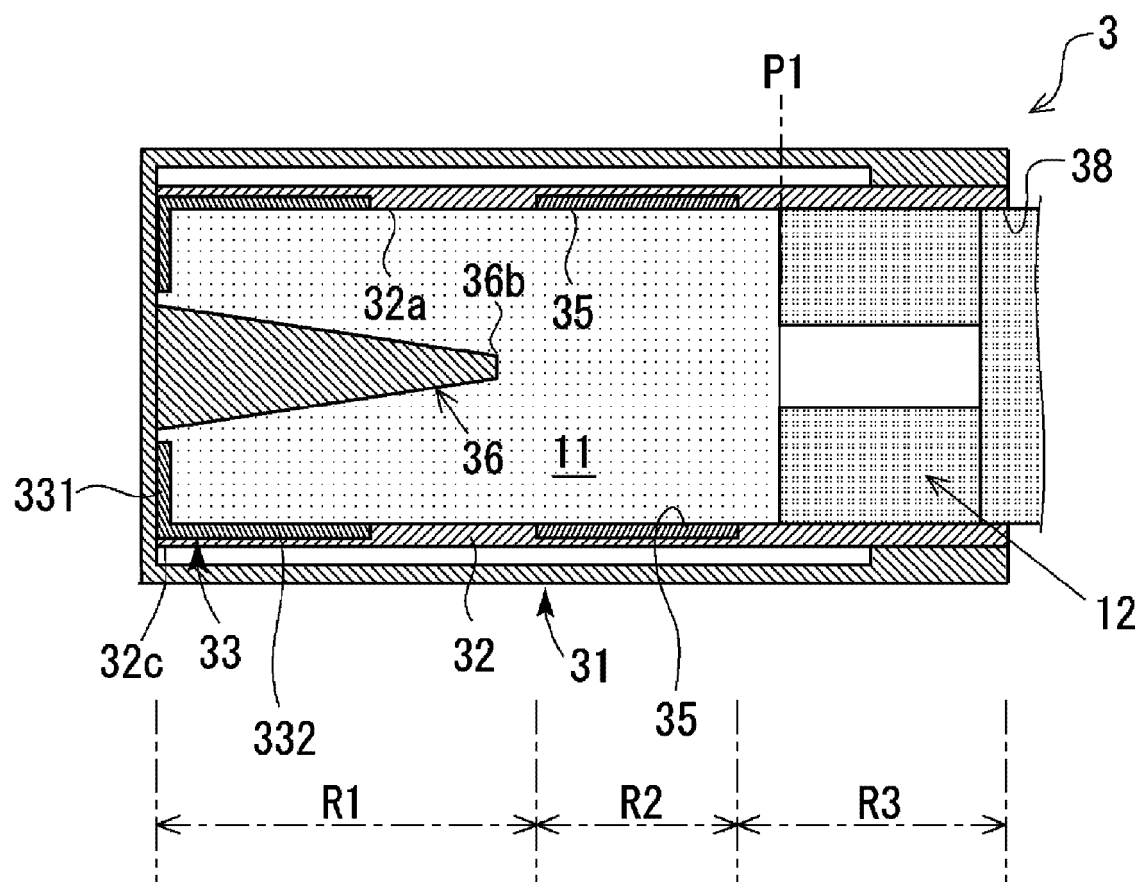


FIG. 16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/045294

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. A24F47/00 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl. A24F47/00, A61M15/06

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

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2019

Registered utility model specifications of Japan 1996-2019

Published registered utility model applications of Japan 1994-2019

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search
21.02.2019

Date of mailing of the international search report
05.03.2019

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/045294

C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/045294

C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	CN 203748672 U (SHENZHEN FIRST UNION TECH CO.) 06 August 2014, paragraphs [0028]-[0044], fig. 1-7 (Family: none)	1-13

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