



(11) **EP 4 238 430 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
06.09.2023 Bulletin 2023/36

(51) International Patent Classification (IPC):
A24F 40/20^(2020.01) A24F 40/465^(2020.01)

(21) Application number: **21931614.8**

(52) Cooperative Patent Classification (CPC):
A24F 40/20; A24F 40/465

(22) Date of filing: **19.03.2021**

(86) International application number:
PCT/JP2021/011471

(87) International publication number:
WO 2022/195868 (22.09.2022 Gazette 2022/38)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(72) Inventor: **KAWASAKI, Reijiro**
Tokyo 130-8603 (JP)

(71) Applicant: **Japan Tobacco Inc.**
Tokyo 105-6927 (JP)

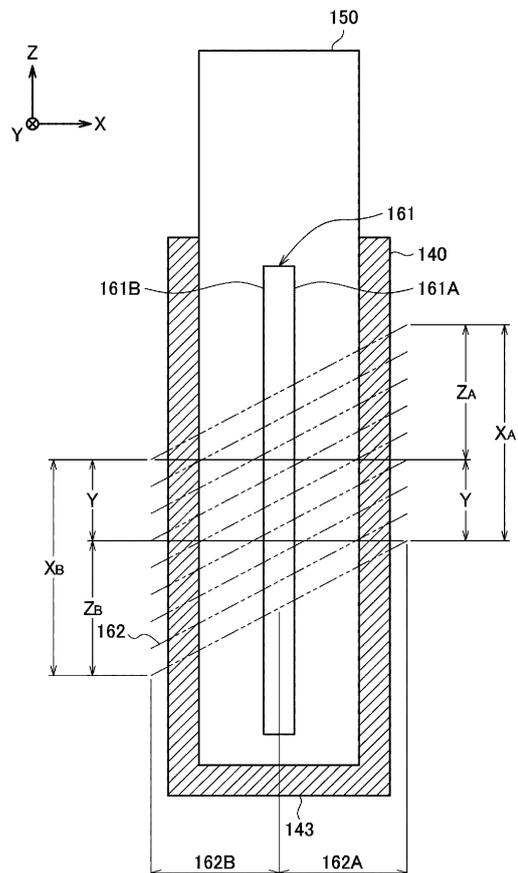
(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) **INHALATION DEVICE AND SYSTEM**

(57) [Problem] To provide a mechanism related to an electromagnetic induction source suited for an induction heating-type inhalation device.

[Solution] This inhalation device is provided with: a storage unit capable of storing a substrate containing an aerosol source and a susceptor in an internal space; and an electromagnetic induction source formed as a solenoid coil and disposed to surround the storage unit. In a state in which the susceptor is stored in a predetermined state in the storage unit, a first portion in the electromagnetic induction source located on the front side in the thickness direction of the susceptor and a second portion located on the back side thereof are disposed offset to each other in the longitudinal direction of the susceptor such that the proportion of the area of an overlapping region in which a first projection region in which the first portion is vertically projected on the front side surface of the susceptor and a second projection region in which the second portion is vertically projected on the back side surface of the susceptor overlap in the thickness direction is 0-90% relative to each of the area of the first projection region and the area of the second projection region.

FIG. 4



EP 4 238 430 A1

Description

Technical Field

5 **[0001]** The present invention relates to an inhaler device and a system.

Background Art

10 **[0002]** An inhaler device that generates a substance to be inhaled by a user, such as an electronic tobacco and a nebulizer, is widely used. For example, an inhaler device uses a substrate including an aerosol source for generating an aerosol, a flavor source for imparting a flavor component to the generated aerosol, and the like, to generate an aerosol with the imparted flavor component. The user is able to taste a flavor by inhaling the aerosol with the imparted flavor component, generated by the inhaler device. An action that the user takes to inhale an aerosol is also referred to as puff or puff action below.

15 **[0003]** An inhaler device of a type using an external heat source, such as a heating blade, has been the mainstream so far. However, in recent years, an induction heating-type inhaler device that generates an aerosol by inductively heating a susceptor with a solenoid-type coil as an electromagnetic induction source, as described in Patent Literature 1 below, has become a focus of attention.

20 Citation List

Patent Literature

25 **[0004]** Patent Literature 1: JP 6623175 B2

Summary of Invention

Technical Problem

30 **[0005]** However, Patent Literature 1 describes that an existing coil is used as an electromagnetic induction source but does not describe improvement in the technology of an electromagnetic induction source itself at all.

[0006] The present invention is contemplated in view of the above problem, and it is an object of the present invention to provide a mechanism related to an electromagnetic induction source compatible with an induction heating-type inhaler device.

35

Solution to Problem

[0007] To solve the above problem, an aspect of the present invention provides an inhaler device. The inhaler device includes a container capable of accommodating a substrate containing an aerosol source and a susceptor in thermal proximity to the aerosol source in an internal space, and an electromagnetic induction source configured as a solenoid-type coil and disposed so as to surround the container. In a state where the susceptor is accommodated in the container in a predetermined state, a first part of the electromagnetic induction source, located on a front side in a thickness direction orthogonal to a longitudinal direction of the susceptor, and a second part of the electromagnetic induction source, located on a back side in the thickness direction, are disposed in a state shifted from each other in the longitudinal direction of the susceptor such that a ratio of an area of an overlap area in which a first projection area obtained by projecting the first part perpendicularly onto a surface of the susceptor on the front side and a second projection area obtained by projecting the second part perpendicularly onto a surface of the susceptor on the back side overlap in the thickness direction to an area of each of the first projection area and the second projection area ranges from 0% to 90%.

40 **[0008]** A shape of the susceptor may be a sheet shape.

50 **[0009]** A thickness of the susceptor may range from 10 μm to 100 μm .

[0010] The susceptor may be made of a raw material that has ferromagnetism and of which a Curie point falls within a range of temperature that is reachable through induction heating by the electromagnetic induction source.

[0011] The susceptor may be made of steel use stainless (SUS) 430.

55 **[0012]** A distribution of the aerosol source may be different between a part of the substrate, proximate to a first non-overlap area that is an area other than the overlap area in the first projection area, or a second non-overlap area that is an area other than the overlap area in the second projection area, and a part of the substrate, proximate to the overlap area.

[0013] The aerosol source may be distributed by a larger amount in the part of the substrate, proximate to the first non-overlap area or the second non-overlap area, than in the part of the substrate, proximate to the overlap area.

[0014] A longitudinal direction of the internal space may substantially coincide with the longitudinal direction of the susceptor, and the first part and the second part may be disposed in a state shifted from each other in the longitudinal direction of the internal space such that, in a state where the susceptor is accommodated in the container in the predetermined state, a ratio of an area of the overlap area to an area of each of the first projection area and the second projection area ranges from 0% to 90%.

[0015] A longitudinal direction of the internal space may substantially differ from the longitudinal direction of the susceptor, and the longitudinal direction of the susceptor may be inclined with respect to the longitudinal direction of the internal space such that, in a state where the susceptor is accommodated in the container in the predetermined state, a ratio of an area of the overlap area to an area of each of the first projection area and the second projection area ranges from 0% to 90%.

[0016] The susceptor may be included in the substrate.

[0017] The container may have an opening, and the substrate may be inserted in the internal space through the opening, a mark may be applied to each of a surface of the inhaler device around the opening and a surface of the substrate, and a position of the mark applied to the surface of the inhaler device around the opening and a position of the mark applied to the surface of the substrate may coincide with each other when the susceptor is accommodated in the container in the predetermined state.

[0018] The container may have an opening, and the substrate may be inserted in the internal space through the opening, and each of the internal space and the substrate may have a shape allowing the substrate to be inserted into the internal space when the susceptor is accommodated in the container in the predetermined state.

[0019] To solve the above problem, another aspect of the present invention provides a system. The system includes a substrate containing an aerosol source and including a susceptor in thermal proximity to the aerosol source, and an inhaler device including a container capable of accommodating the substrate in an internal space, and an electromagnetic induction source configured as a solenoid-type coil and disposed so as to surround the container. In a state where the substrate is accommodated in the container in a predetermined state, a first part of the electromagnetic induction source, located on a front side in a thickness direction orthogonal to a longitudinal direction of the susceptor, and a second part of the electromagnetic induction source, located on a back side in the thickness direction, are disposed in a state shifted from each other in the longitudinal direction of the susceptor such that a ratio of an area of an overlap area in which a first projection area obtained by projecting the first part perpendicularly onto a surface of the susceptor on the front side and a second projection area obtained by projecting the second part perpendicularly onto a surface of the susceptor on the back side overlap in the thickness direction to an area of each of the first projection area and the second projection area ranges from 0% to 90%.

Advantageous Effects of Invention

[0020] As described above, according to the present invention, a mechanism related to an electromagnetic induction source compatible with an induction heating-type inhaler device is provided.

Brief Description of Drawings

[0021]

[FIG. 1] FIG. 1 is a schematic diagram that schematically illustrates a configuration example of an inhaler device.

[FIG. 2] FIG. 2 is a view that illustrates an example of a physical configuration around a holder according to a present embodiment.

[FIG. 3] FIG. 3 is a view that illustrates an example of a physical configuration around the holder according to the present embodiment in a state where a stick substrate is accommodated in the holder in a predetermined state.

[FIG. 4] FIG. 4 is a view that illustrates an example of a cross section taken along the line A-A in FIG. 3.

[FIG. 5] FIG. 5 is a view that illustrates an example of a cross section taken along the line B-B in FIG. 3.

[FIG. 6] FIG. 6 is a view for illustrating a first modification.

[FIG. 7] FIG. 7 is a view for illustrating another example of the first modification.

[FIG. 8] FIG. 8 is a view for illustrating a second modification.

Description of Embodiments

[0022] Hereinafter, a preferred embodiment of the present invention will be described in detail with reference to the attached drawings. In the specification and the drawings, like reference signs denote structural elements having substantially the same functional configurations, and the description will not be repeated.

<1. Configuration Example of Inhaler Device>

5 [0023] An inhaler device according to the present configuration example generates an aerosol by heating a substrate containing an aerosol source by means of induction heating (IH). Hereinafter, the present configuration example will be described with reference to FIG. 1.

10 [0024] FIG. 1 is a schematic diagram that schematically illustrates a configuration example of an inhaler device. As illustrated in FIG. 1, an inhaler device 100 according to the present configuration example includes a power supply 111, a sensor 112, a notifier 113, a memory 114, a communicator 115, a controller 116, a susceptor 161, an electromagnetic induction source 162, and a holder 140. A user inhales in a state where a stick substrate 150 is held by the holder 140. Hereinafter, structural elements will be sequentially described.

15 [0025] The power supply 111 stores electric power. The power supply 111 supplies electric power to the structural elements of the inhaler device 100. The power supply 111 can be a rechargeable battery, such as a lithium ion secondary battery. The power supply 111 may be charged when connected to an external power supply with a universal serial bus (USB) cable or the like. Alternatively, the power supply 111 may be charged with a wireless power transmission technology in a state not connected to a power transmitting device. Other than the above, only the power supply 111 may be allowed to be removed from the inhaler device 100 or may be allowed to be replaced with a new power supply 111.

20 [0026] The sensor 112 detects various items of information regarding the inhaler device 100. The sensor 112 outputs the detected information to the controller 116. In an example, the sensor 112 is a pressure sensor, such as a capacitor microphone, a flow sensor, or a temperature sensor. When the sensor 112 detects a numeric value resulting from user's inhalation, the sensor 112 outputs, to the controller 116, information indicating that the user has inhaled. In another example, the sensor 112 is an input device that receives information input by the user, such as a button and a switch. Particularly, the sensor 112 can include a button for instructions to start or stop generating an aerosol. The sensor 112 outputs, to the controller 116, information input by the user. In another example, the sensor 112 is a temperature sensor that detects the temperature of the susceptor 161. The temperature sensor, for example, detects the temperature of the susceptor 161 in accordance with an electric resistance value of the electromagnetic induction source 162. The sensor 112 may detect the temperature of the stick substrate 150 held by the holder 140 in accordance with the temperature of the susceptors 161.

25 [0027] The notifier 113 notifies the user of information. In an example, the notifier 113 is a light-emitting device, such as a light emitting diode (LED). In this case, the notifier 113 emits light in a different pattern of light, for example, when the state of the power supply 111 is a charging required state, when the power supply 111 is in being charged, or when there is an abnormality in the inhaler device 100. The pattern of light here is a concept including color, the timing to turn on or off, and the like. The notifier 113 may be a display device that displays an image, a sound output device that outputs sound, or a vibration device that vibrates, in addition to or instead of the light-emitting device. Other than the above, the notifier 113 may notify information indicating that the user is allowed to inhale. The information indicating that the user is allowed to inhale is notified when the temperature of the stick substrate 150 heated by electromagnetic induction reaches a predetermined temperature.

30 [0028] The memory 114 stores various items of information for the operation of the inhaler device 100. The memory 114 is, for example, a non-volatile storage medium, such as a flash memory. An example of the pieces of information stored in the memory 114 is information regarding an operating system (OS) of the inhaler device 100, such as the content of control over various structural elements by the controller 116. Another example of the items of information stored in the memory 114 is information regarding user's inhalation, such as the number of times of inhalation, inhalation time, and an accumulated inhalation time period.

35 [0029] The communicator 115 is a communication interface for transmitting and receiving information between the inhaler device 100 and another device. The communicator 115 performs communication that conforms with any wired or wireless communication standard. A wireless local area network (LAN), a wired LAN, Wi-Fi (registered trademark), Bluetooth (registered trademark), or the like can be adopted as such a communication standard. In an example, the communicator 115 transmits information regarding user's inhalation to a smartphone in order to display the information regarding user's inhalation on the smartphone. In another example, the communicator 115 receives new information on the OS from a server in order to update the information on the OS, stored in the memory 114.

40 [0030] The controller 116 functions as an arithmetic processing unit and a control unit and controls the overall operations in the inhaler device 100 in accordance with various programs. The controller 116 includes an electronic circuit, such as a central processing unit (CPU) and a microprocessor. The controller 116 may further include a read only memory (ROM) that stores programs and arithmetic parameters to be used, and a random access memory (RAM) that temporarily stores variable parameters as needed. The inhaler device 100 executes various pieces of processing in accordance with control by the controller 116. Feeding of electric power from the power supply 111 to another structural element, charging of the power supply 111, detection of information by the sensor 112, notification of information by the notifier 113, storing and reading of information by the memory 114, and transmitting and receiving of information by the communicator 115 each are an example of the pieces of processing to be controlled by the controller 116. Other pieces of

processing to be executed by the inhaler device 100, such as input of information to each structural element and processing based on information output from each structural element, are controlled by the controller 116.

5 [0031] The holder 140 has an internal space 141. The holder 140 holds the stick substrate 150 while accommodating part of the stick substrate 150 in the internal space 141. The holder 140 has an opening 142 that allows the internal space 141 to communicate with outside. The holder 140 holds the stick substrate 150 that is inserted into the internal space 141 through the opening 142. For example, the holder 140 is a tubular body having the opening 142 and a bottom 143 at the ends, and defines the columnar internal space 141. The holder 140 can be formed such that the inside diameter is smaller than the outside diameter of the stick substrate 150 in at least part of the tubular body in the height direction of the tubular body. The holder 140 can hold the stick substrate 150 such that the stick substrate 150 inserted in the internal space 141 is pressed from the outer circumference. The holder 140 also has the function to define a flow path for air passing through the stick substrate 150. An air inlet hole that is an inlet for air into the flow path is disposed at, for example, the bottom 143. On the other hand, an air outlet hole that is an outlet for air from the flow path is the opening 142.

15 [0032] The stick substrate 150 is a stick member. The stick substrate 150 includes a substrate 151 and an inhalation port 152.

20 [0033] The substrate 151 includes an aerosol source. When the aerosol source is heated, the aerosol source is atomized to generate an aerosol. The aerosol source may be, for example, a substance derived from tobacco, such as a processed substance obtained by forming shredded tobacco or tobacco raw material into a granular form, a sheet form, or a powder form. The aerosol source may contain a substance not derived from tobacco and made from a plant other than tobacco (for example, mint, a herb, or the like). In an example, the aerosol source may contain a flavor component, such as menthol. When the inhaler device 100 is a medical inhaler, the aerosol source may contain a medicine for a patient to inhale. The aerosol source is not limited to a solid and may be, for example, a liquid, such as polyhydric alcohol and water. Examples of the polyhydric alcohol include glycerine and propylene glycol. At least part of the substrate 151 is accommodated in the internal space 141 of the holder 140 in a state where the stick substrate 25 150 is held by the holder 140.

30 [0034] The inhalation port 152 is a member to be held in a mouth of the user during inhalation. At least part of the inhalation port 152 protrudes from the opening 142 in a state where the stick substrate 150 is held by the holder 140. When the user inhales with the inhalation port 152 protruding from the opening 142 in his or her mouth, air flows into the holder 140 through the air inlet hole (not illustrated). Air flowing in passes through the internal space 141 of the holder 140, that is, passes through the substrate 151, and reaches the inside of the mouth of the user together with an aerosol that is generated from the substrate 151.

35 [0035] The stick substrate 150 further includes the susceptor 161. The susceptor 161 produces heat by electromagnetic induction. The susceptor 161 is made of a conductive raw material, such as a metal. In an example, the susceptor 161 is a metal sheet. The susceptor 161 is disposed in proximity to the aerosol source. In the example illustrated in FIG. 1, the susceptor 161 is included in the substrate 151 of the stick substrate 150.

40 [0036] Here, the susceptor 161 is disposed in thermal proximity to the aerosol source. The state where the susceptor 161 is in thermal proximity to the aerosol source means that the susceptor 161 is disposed at a position where heat generated at the susceptor 161 is transferred to the aerosol source. For example, the susceptor 161 is included in the substrate 151 together with the aerosol source and surrounded by the aerosol source. With this configuration, heat generated from the susceptor 161 can be efficiently used to heat the aerosol source.

[0037] The susceptor 161 may be untouchable from outside of the stick substrate 150. For example, the susceptor 161 may be disposed so as to be embedded in the stick substrate 150.

45 [0038] The electromagnetic induction source 162 causes the susceptor 161 to produce heat by electromagnetic induction. The electromagnetic induction source 162 is, for example, a coiled conductive wire wound around the outer circumference of the holder 140. When the electromagnetic induction source 162 is supplied with alternating current from the power supply 111, the electromagnetic induction source 162 generates a magnetic field. The electromagnetic induction source 162 is disposed at a position where the internal space 141 of the holder 140 overlaps the generated magnetic field. Thus, when the magnetic field is generated in a state where the stick substrate 150 is held by the holder 140, eddy current is generated in the susceptor 161, and Joule heat is generated. Subsequently, the aerosol source included in the stick substrate 150 is heated and atomized by the Joule heat to generate an aerosol. In an example, when the sensor 112 detects that predetermined user input is performed, electric power may be supplied to generate an aerosol. When the temperature of the stick substrate 150 inductively heated by the susceptor 161 and the electromagnetic induction source 162 reaches a predetermined temperature, the user is allowed to inhale. After that, when the sensor 112 detects that the predetermined user input is performed, supply of electric power may be stopped. In another 55 example, in a period during which the sensor 112 detects that the user has inhaled, electric power may be supplied to generate an aerosol.

[0039] In terms of the point that an aerosol can be generated by combining the inhaler device 100 with the stick substrate 150, a combination of the inhaler device 100 with the stick substrate 150 may be regarded as one system.

<2. Induction Heating>

[0040] Induction heating will be described in detail below.

5 [0041] Induction heating is a process of causing a varying magnetic field to enter a conductive physical object to heat the physical object. A magnetic field generator that generates a varying magnetic field and a conductive heated object that is heated when exposed to a varying magnetic field relate to induction heating. An example of the varying magnetic field is an alternating magnetic field. The electromagnetic induction source 162 illustrated in FIG. 1 is an example of the magnetic field generator. The susceptor 161 illustrated in FIG. 1 is an example of the heated object.

10 [0042] When a varying magnetic field is generated from the magnetic field generator in a state where the magnetic field generator and the heated object are disposed in a relative position such that the varying magnetic field generated from the magnetic field generator enters the heated object, eddy current is induced in the heated object. When the eddy current flows through the heated object, Joule heat according to the electrical resistance of the heated object is generated to heat the heated object. Such heating is also referred to as Joule heating, ohmic heating, or resistance heating.

15 [0043] The heated object may have magnetism. In this case, the heated object is further heated by magnetic hysteresis heating. Magnetic hysteresis heating is a process of causing a varying magnetic field to enter a magnetic object to heat the object. When a magnetic field enters a magnetic substance, magnetic dipoles contained in the magnetic substance are aligned along the magnetic field. Therefore, when a varying magnetic field enters a magnetic substance, the orientations of the magnetic dipoles change with the varying magnetic field applied. With such reorientation of the magnetic dipoles, heat is generated in the magnetic substance, and the heated object is heated.

20 [0044] Magnetic hysteresis heating typically occurs at a temperature lower than or equal to a Curie point and does not occur at a temperature exceeding the Curie point. A Curie point is a temperature at which a magnetic substance loses its magnetic properties. For example, when the temperature of a heated object having a ferromagnetism at a temperature lower than or equal to a Curie point exceeds the Curie point, a reversible phase transition from ferromagnetism to paramagnetism occurs in the magnetism of the heated object. When the temperature of the heated object exceeds the Curie point, magnetic hysteresis heating does not occur any more, so the rate of increase in temperature reduces.

25 [0045] The heated object is desirably made of a conductive material. The heated object is further desirably made of a material having ferromagnetism. This is because, in the latter case, heating efficiency can be increased by a combination of resistance heating and magnetic hysteresis heating. For example, the heated object is made of one or more raw materials selected from a raw material group consisting of aluminum, iron, nickel, cobalt, conductive carbon, copper, stainless steel, and the like.

30 [0046] In both resistance heating and magnetic hysteresis heating, heat is not generated by heat conduction from an external heat source but generated in the heated object. Therefore, a steep increase in temperature and a uniform heat distribution in the heated object can be implemented. This can be implemented by appropriately designing the material and shape of the heated object and the magnitude and orientation of the varying magnetic field. In other words, a steep increase in temperature and a uniform heat distribution in the stick substrate 150 can be implemented by appropriately designing the distribution of the susceptor 161 included in the stick substrate 150. Therefore, it is possible to shorten time for preheating, and it is also possible to improve the quality of a flavor tasted by the user.

35 [0047] Since induction heating directly heats the susceptor 161 included in the stick substrate 150, it is possible to efficiently heat the substrate as compared to when the stick substrate 150 is heated from the outer circumference or the like with an external heat source. When heating using an external heat source is performed, the external heat source is inevitably higher in temperature than the stick substrate 150. On the other hand, when induction heating is performed, the electromagnetic induction source 162 does not become higher in temperature than the stick substrate 150. Therefore, the temperature of the inhaler device 100 can be maintained at low temperatures as compared to when an external heat source is used, so it is a great benefit in relation to user's safety.

40 [0048] The electromagnetic induction source 162 generates a varying magnetic field by using electric power supplied from the power supply 111. In an example, the power supply 111 may be a direct current (DC) power supply. In this case, the power supply 111 supplies alternating-current power to the electromagnetic induction source 162 via a DC/AC (alternate current) inverter. In this case, the electromagnetic induction source 162 can generate an alternating magnetic field.

<3. Technical Features>

45 [0049] FIG. 2 is a view that illustrates an example of a physical configuration around the holder 140 according to the present embodiment. FIG. 3 is a view that illustrates an example of a physical configuration around the holder 140 according to the present embodiment in a state where the stick substrate 150 is accommodated in the holder 140 in a predetermined state. FIG. 4 is a view that illustrates an example of a cross section taken along the line A-A in FIG. 3. FIG. 5 is a view that illustrates an example of a cross section taken along the line B-B in FIG. 3.

[0050] The holder 140 is an example of a container capable of accommodating the stick substrate 150 and the susceptor 161 in the internal space 141. As illustrated in FIG. 2, the electromagnetic induction source 162 is configured as a solenoid-type coil and disposed so as to surround the holder 140. The solenoid-type coil here means a coil in which a conductive material, such as copper, is wound with one or more turns, and a winding shape may be a rectangular shape or a circular shape and is not limited.

[0051] As illustrated in FIGS. 4 and 5, the susceptor 161 is formed in a sheet shape. The sheet plane of the susceptor 161 expands in a longitudinal direction and in a widthwise direction and is formed so as to define a front and a back in a thickness direction. The longitudinal direction, the widthwise direction, and the thickness direction of the susceptor 161 are orthogonal to one another.

[0052] The susceptor 161 is made of a raw material that has ferromagnetism and of which a Curie point falls within a range of temperature that is reachable through induction heating by the electromagnetic induction source 162. In an example, the susceptor 161 may be made of steel use stainless (SUS) 430. In this case, the Curie point of SUS 430 that is a component of the susceptor 161 falls within a range of temperature that the susceptor 161 is reachable through induction heating by the electromagnetic induction source 162. The range of temperature that the susceptor 161 is reachable through induction heating by the electromagnetic induction source 162 ranges from 0°C to 350°C in an example.

[0053] The electromagnetic induction source 162 generates a varying magnetic field in the space surrounded by the coil, that is, the internal space 141, by using electric power supplied from the power supply 111. As illustrated in FIG. 2, in a state where the stick substrate 150 is held by the holder 140, the susceptor 161 is surrounded by the coil. Therefore, the varying magnetic field generated from the electromagnetic induction source 162 enters the susceptor 161 to generate eddy current. Specifically, eddy current in a direction opposite to a direction in which current flows through the electromagnetic induction source 162 flows in the cross section of the susceptor 161. The eddy current flows from the surface of the susceptor 161 intensively in a range of current penetration depth δ expressed by the following expression. With the eddy current, the susceptor 161 is heated.

[Expression 1]

$$\delta = 5.03 \times 10^{-5} (\rho / \mu r f)^{0.5} \quad (1)$$

[0054] Here, δ is current penetration depth [mm]. ρ is specific resistance [Ω m]. μr is relative permeability. f is heating frequency [Hz].

[0055] A Z-axis direction illustrated in FIGS. 2 to 5 is the longitudinal direction of the internal space 141 and is a direction in which the stick substrate 150 is inserted and removed. In the following description, it is assumed that, in the Z-axis direction, a direction in which the stick substrate 150 is removed is positive and a direction in which the stick substrate 150 is inserted is negative.

[0056] As illustrated in FIGS. 2 to 4, part of the electromagnetic induction source 162 located on the front side of the susceptor 161 and part of the electromagnetic induction source 162 located on the back side of the susceptor 161 are disposed in a state shifted in the Z-axis direction across the holder 140. An X-axis direction is a direction in which a shift of the electromagnetic induction source 162 in the Z-axis direction across the holder 140 is largest. In the following description, an X-axis positive direction is also referred to as front side, and an X-axis negative direction is also referred to as back side.

[0057] A Y-axis direction is a direction orthogonal to the X-axis direction and the Z-axis direction. Typically, the Y-axis direction is a direction in which a shift of the electromagnetic induction source 162 in the Z-axis direction across the holder 140 is smallest.

[0058] As illustrated in FIGS. 3 to 5, the longitudinal direction of the susceptor 161 substantially coincides with the Z-axis direction, the widthwise direction of the susceptor 161 substantially coincides with the Y-axis direction, and the thickness direction of the susceptor 161 substantially coincides with the X-axis direction. The distal end of the stick substrate 150 reaches the bottom 143 of the holder 140. This state is a state where the susceptor 161 (that is, the stick substrate 150 including the susceptor 161) is accommodated in (held by) the holder 140 in the predetermined state. It is assumed that the phrase "substantially coincides" includes not only complete coincidence but also a state shifted by smaller than a few degrees.

[0059] As illustrated in FIG. 4, in a state where the stick substrate 150 is accommodated in the holder 140 in the predetermined state, a first part 162A and a second part 162B of the electromagnetic induction source 162 are disposed in a state shifted from each other in the longitudinal direction of the susceptor 161 such that the ratio of the area of an overlap area Y to the area of each of a first projection area X_A and a second projection area X_B ranges from 0% to 90%. In other words, the electromagnetic induction source 162 is disposed such that each of $Y/X_A \times 100\%$ and $Y/X_B \times 100\%$ ranges from 0% to 90%, that is, the first part 162A and the second part 162B are in a state shifted from each other in the Z-axis direction. With this configuration, as will be described below, the susceptor 161 can be efficiently heated.

[0060] The first projection area X_A is an area obtained by projecting the first part 162A of the electromagnetic induction source 162, located on the front side of the susceptor 161, perpendicularly onto the surface 161A of the susceptor 161 on the front side. Here, the first projection area X_A is an area surrounded by a line obtained by projecting both ends of the first part 162A in the Z-axis direction perpendicularly onto the surface 161A of the susceptor 161 on the front side. In other words, the first projection area X_A includes not only an area obtained by actually projecting a coil but also an area placed between parts of the coil.

[0061] The second projection area X_B is an area obtained by projecting the second part 162B of the electromagnetic induction source 162, located on the back side of the susceptor 161, perpendicularly onto the surface 161B of the susceptor 161 on the back side. Here, the second projection area X_B is an area surrounded by a line obtained by projecting both ends of the second part 162B in the Z-axis direction perpendicularly onto the surface 161B of the susceptor 161 on the back side. In other words, the second projection area X_B includes not only an area obtained by actually projecting a coil but also an area placed between parts of the coil.

[0062] The overlap area Y is an area in which the first projection area X_A and the second projection area X_B overlap in the thickness direction. In the first projection area X_A , an area other than the overlap area Y is also referred to as first non-overlap area Z_A . In the second projection area X_B , an area other than the overlap area Y is also referred to as second non-overlap area Z_B .

[0063] As illustrated in FIG. 5, in the overlap area Y, the electromagnetic induction source 162 is present on both front and back sides of the susceptor 161. Therefore, on both front and back sides of the susceptor 161, eddy current 20 flows in a direction opposite to a direction in which current 10 flows through the electromagnetic induction source 162. Therefore, in the overlap area Y, eddy currents respectively flowing on the front and back sides of the susceptor 161 can interfere to cancel out each other. As a result, current is hard to flow in the cross section of the susceptor 161, and heating is impaired.

[0064] On the other hand, in the first non-overlap area Z_A and the second non-overlap area Z_B , the electromagnetic induction source 162 is present only on one of the front and back sides of the susceptor 161. For this reason, in these areas, on one of the front and back sides of the susceptor 161, eddy current 20 flows in a direction opposite to a direction in which current 10 flows through the electromagnetic induction source 162. Therefore, in these areas, eddy currents on the front and back sides do not interfere with each other, so the susceptor 161 is suitably heated without impairment.

[0065] Impairment of heating in the above-described overlap area Y becomes more serious with an increase in the temperature of the susceptor 161. The specific resistance ρ of a metal increases with an increase in temperature. Through the expression (1), the current penetration depth δ increases with an increase in specific resistance ρ . For a magnetic material having ferromagnetism, such as SUS 430, the relative permeability μ_r reduces as the temperature increases and approaches a Curie point, and the relative permeability μ_r becomes one when the temperature exceeds the Curie point. Therefore, through the expression (1), the current penetration depth δ increases as the relative permeability μ_r reduces. In this way, the current penetration depth δ of the eddy current 20 increases with an increase in temperature. Since interference of the eddy current 20 flowing on each of the front and back sides of the susceptor 161 increases as the current penetration depth δ increases, it is difficult for the susceptor 161 having a thin thickness to heat.

[0066] In this regard, in the present embodiment, parts of the electromagnetic induction source 162 respectively located on the front and back sides of the susceptor 161 are disposed in a state shifted from each other in the longitudinal direction of the susceptor 161. Thus, interference of eddy current flowing through each of the front and back sides of the susceptor 161 is reduced, so efficient heating can be implemented. It is desirable that the ratio of the area of the overlap area Y to the area of each of the first projection area X_A and the second projection area X_B is desirably smaller the better for the above-described reason. For example, it is effective that the ratio of the area of the overlap area Y to the area of each of the first projection area X_A and the second projection area X_B ranges from 0% to 60%.

[0067] It is presumable that the current penetration depth δ reaches 10 [μm] to 200 [μm] within the range of temperature that the susceptor 161 is reachable through induction heating by the electromagnetic induction source 162. In contrast, the thickness of the susceptor 161 may range from 10 [μm] to 100 [μm]. With this configuration, since eddy current flows in one direction over all the area in the thickness direction in the first non-overlap area Z_A and the second non-overlap area Z_B , rapid heating is possible.

[0068] A distribution of an aerosol source may be different between a part of the stick substrate 150, proximate to the first non-overlap area Z_A or the second non-overlap area Z_B , and a part of the stick substrate 150, proximate to the overlap area Y. The temperature more easily increases in the first non-overlap area Z_A and the second non-overlap area Z_B than in the overlap area Y, and this tendency is further remarkable in a range over the Curie point. In other words, a part of the stick substrate 150, proximate to the first non-overlap area Z_A or the second non-overlap area Z_B , more easily increases in temperature, while a part of the stick substrate 150, proximate to the overlap area Y, is hard to increase in temperature. In this regard, with this configuration, it is possible to generate a favorable aerosol by distributing an aerosol source according to the degree of increase in temperature. The word "proximity" here means to be located at the same position or a close position in the longitudinal direction of the stick substrate 150.

[0069] Particularly, a larger amount of aerosol source may be distributed to a part of the stick substrate 150, proximate

to the first non-overlap area Z_A or the second non-overlap area Z_B , than to a part of the stick substrate 150, proximate to the overlap area Y. With this configuration, since a larger amount of aerosol source is distributed to a part of the stick substrate 150, proximate to the first non-overlap area Z_A or the second non-overlap area Z_B , that is, a part of the stick substrate 150, that more easily increases in temperature, it is possible to generate a large amount of aerosol.

<4. Modifications>

<4.1. First Modification>

[0070] When the stick substrate 150 is rotatable relative to the holder 140 about a Z-axis as a rotation axis, a relative positional relationship between the susceptor 161 and the electromagnetic induction source 162 can change. In this case, it can be difficult to provide a state where the stick substrate 150 is accommodated in the holder 140 in a predetermined state as illustrated in FIGS. 3 to 5.

[0071] For example, when the stick substrate 150 is rotated 90° from the example illustrated in FIGS. 3 to 5, parts of the electromagnetic induction source 162, respectively located on the front and back sides of the susceptor 161 (that is, located on the positive side and the negative side in the Y-axis direction), are disposed in a state where parts of the electromagnetic induction source 162 have substantially no shift in the Z-axis direction across the holder 140. Therefore, the ratio of the area of the overlap area Y to the area of each of the first projection area X_A and the second projection area X_B is substantially 100%, so it can be difficult to perform efficient heating.

[0072] It is desirable to provide a mechanism of easily implementing a state where the stick substrate 150 is accommodated in the holder 140 in the predetermined state. Hereinafter, an example of the mechanism will be described with reference to FIGS. 6 and 7.

[0073] FIG. 6 is a view for illustrating a first modification. FIG. 6 illustrates an external appearance of the inhaler device 100 and the stick substrate 150 in a state where the stick substrate 150 is accommodated in the holder 140 in the predetermined state. As illustrated in FIG. 6, marks 31, 32 may be respectively applied to the surface of the inhaler device 100 around the opening 142 and the surface of the stick substrate 150. The position of the mark 31 applied to the surface of the inhaler device 100 around the opening 142 and the position of the mark 32 applied to the surface of the stick substrate 150 may coincide with each other when the stick substrate 150 is accommodated in the holder 140 in the predetermined state. The user is prompted to insert the stick substrate 150 into the internal space 141 such that, as illustrated in FIG. 6, the mark 31 that is an arrow and the mark 32 that is an arrow are opposed to each other. When the stick substrate 150 is inserted in the internal space 141 such that the mark 31 that is an arrow and the mark 32 that is an arrow are opposed to each other, the stick substrate 150 is accommodated in the holder 140 in the predetermined state as illustrated in FIGS. 3 to 5.

[0074] With this configuration, the user is able to easily implement a state where the stick substrate 150 is accommodated in the holder 140 in the predetermined state by just adjusting the position of the mark 31 with the position of the mark 32 and inserting the stick substrate 150 into the internal space 141.

[0075] FIG. 7 is a view for illustrating another example of the first modification. FIG. 7 illustrates a cross section around the holder 140 in a state where the stick substrate 150 is accommodated in the holder 140 in a predetermined state. As illustrated in FIG. 7, the internal space 141 and the stick substrate 150 may have such a shape that the stick substrate 150 can be inserted in the internal space 141 when the stick substrate 150 is accommodated in the holder 140 in the predetermined state.

[0076] In the example illustrated in FIG. 7, the sectional shape of each of the internal space 141 and the stick substrate 150 is a rectangular shape having long sides and short sides, and the stick substrate 150 is allowed to be inserted only in a state where the long sides and the short sides of the respective sectional shapes coincide with each other. Particularly, the short sides of the sectional shape of the internal space 141 are formed in the X-axis direction, and the long sides of the sectional shape of the internal space 141 are formed in the Y-axis direction. The susceptor 161 is disposed in the stick substrate 150 such that the thickness direction of the susceptor 161 is parallel to the widthwise direction of the cross section of the stick substrate 150. Therefore, as illustrated in FIG. 7, when the stick substrate 150 is inserted in the internal space 141, the thickness direction of the susceptor 161 substantially coincides with the X-axis direction. In other words, the stick substrate 150 is accommodated in the holder 140 in a predetermined state.

[0077] With this configuration, the user is able to easily implement a state where the stick substrate 150 is accommodated in the holder 140 in a predetermined state by just inserting the stick substrate 150 into the internal space 141.

[0078] The sectional shape of each of the holder 140 and the stick substrate 150 is not limited to a rectangular shape illustrated in FIG. 7 and may be, for example, an elliptical shape or the like.

<2. Second Modification>

[0079] In the above embodiment, an example in which the longitudinal direction of the internal space 141 and the

longitudinal direction of the susceptor 161 substantially coincide with each other has been described; however, the present invention is not limited to this example. The longitudinal direction of the internal space 141 and the longitudinal direction of the susceptor 161 may be substantially different from each other. The phrase "substantially different" means a state shifted by larger than or equal to a few degrees. This example will be described with reference to FIG. 8.

5 **[0080]** FIG. 8 is a view for illustrating a second modification. FIG. 8 illustrates a cross section around the holder 140 in a state where the stick substrate 150 is accommodated in the holder 140 in a predetermined state. As illustrated in FIG. 8, the longitudinal direction of the susceptor 161 may be inclined with respect to the longitudinal direction of the stick substrate 150. The longitudinal direction of the susceptor 161 may be inclined with respect to the longitudinal direction of the internal space 141 (that is, the Z-axis direction). However, in a state where the stick substrate 150 is accommodated in the holder 140 in the predetermined state, the longitudinal direction of the susceptor 161 may be inclined with respect to the longitudinal direction of the internal space 141 such that the ratio of the area of the overlap area Y to the area of each of the first projection area X_A and the second projection area X_B ranges from 0% to 90%. With this configuration, similar advantageous effects to those of the above embodiment are obtained. In other words, parts of the electromagnetic induction source 162, respectively located on the front and back sides of the susceptor 161, are disposed in a state shifted from each other in the longitudinal direction of the susceptor 161. Thus, interference of eddy current flowing through each of the front and back sides of the susceptor 161 is reduced, so efficient heating can be implemented.

15 **[0081]** It is assumed that the predetermined state in the present modification means a state where the widthwise direction of the susceptor 161 substantially coincides with the Y-axis direction and the distal end of the stick substrate 150 reaches the bottom 143 of the holder 140.

<5. Supplement>

25 **[0082]** The preferred embodiment of the present invention has been described in detail with reference to the attached drawings; however, the present invention is not limited to those examples. It is obvious that persons having ordinary skill in the art in the field of technology to which the present invention belongs can conceive of various modifications or alterations within the scope of the technical idea recited in the claims, and these can also be naturally interpreted as belonging to the technical scope of the present invention.

30 **[0083]** For example, in the above embodiment, an example in which the susceptor 161 has a sheet shape and the sectional shape is a rectangular shape has been described; however, the present invention is not limited to this example. For example, the sectional shape of the susceptor 161 may be any shape, such as a rounded corner rectangular shape, a square shape, a circular shape, and an elliptical shape. The surface of the susceptor 161 may be flat or may change like waving or the like.

35 **[0084]** For example, in the above embodiment, an example in which the susceptor 161 is included in the substrate 151 has been described; however, the present invention is not limited to this example. In other words, the susceptor 161 can be disposed at any position at which the susceptor 161 is in thermal proximity to the aerosol source. In an example, the susceptor 161 may be formed in a blade shape and disposed so as to protrude from the bottom 143 of the holder 140 into the internal space 141. When the stick substrate 150 is inserted into the holder 140, the stick substrate 150 is inserted such that the blade-shaped susceptor 161 sticks into the substrate 151 from an end of the stick substrate 150 in an insertion direction. In this case, the susceptor 161 is disposed in the internal space 141 such that the holder 140 accommodates the susceptor 161 constantly in a predetermined state.

40 **[0085]** The following configurations also belong to the technical scope of the present invention.

45 (1) An inhaler device includes

a container capable of accommodating a substrate containing an aerosol source and a susceptor in thermal proximity to the aerosol source in an internal space, and an electromagnetic induction source configured as a solenoid-type coil and disposed so as to surround the container, wherein

50 in a state where the susceptor is accommodated in the container in a predetermined state, a first part of the electromagnetic induction source, located on a front side in a thickness direction orthogonal to a longitudinal direction of the susceptor, and a second part of the electromagnetic induction source, located on a back side in the thickness direction, are disposed in a state shifted from each other in the longitudinal direction of the susceptor such that a ratio of an area of an overlap area in which a first projection area obtained by projecting the first part perpendicularly onto a surface of the susceptor on the front side and a second projection area obtained by projecting the second part perpendicularly onto a surface of the susceptor on the back side overlap in the thickness direction to an area of each of the first projection area and the second projection area ranges from 0% to 90%.

(2) In the inhaler device according to the above (1),
a shape of the susceptor is a sheet shape.

(3) In the inhaler device according to the above (1) or (2),
a thickness of the susceptor ranges from 10 μm to 100 μm .

(4) In the inhaler device according to any one of the above (1) to (3),
the susceptor is made of a raw material that has ferromagnetism and of which a Curie point falls within a range of
temperature that is reachable through induction heating by the electromagnetic induction source.

(5) In the inhaler device according to the above (4),
the susceptor is made of steel use stainless (SUS) 430.

(6) In the inhaler device according to any one of the above (1) to (5),
a distribution of the aerosol source is different between a part of the substrate, proximate to a first non-overlap area
that is an area other than the overlap area in the first projection area, or a second non-overlap area that is an area
other than the overlap area in the second projection area, and a part of the substrate, proximate to the overlap area.

(7) In the inhaler device according to the above (6),
the aerosol source is distributed by a larger amount in the part of the substrate, proximate to the first non-overlap
area or the second non-overlap area, than in the part of the substrate, proximate to the overlap area.

(8) In the inhaler device according to any one of the above (1) to (7),

a longitudinal direction of the internal space substantially coincides with the longitudinal direction of the susceptor,
and

the first part and the second part are disposed in a state shifted from each other in the longitudinal direction of
the internal space such that, in a state where the susceptor is accommodated in the container in the predeter-
mined state, a ratio of an area of the overlap area to an area of each of the first projection area and the second
projection area ranges from 0% to 90%.

(9) In the inhaler device according to any one of the above (1) to (8),

a longitudinal direction of the internal space substantially differs from the longitudinal direction of the susceptor,
and

the longitudinal direction of the susceptor is inclined with respect to the longitudinal direction of the internal
space such that, in a state where the susceptor is accommodated in the container in the predetermined state,
a ratio of an area of the overlap area to an area of each of the first projection area and the second projection
area ranges from 0% to 90%.

(10) In the inhaler device according to any one of the above (1) to (9),
the susceptor is included in the substrate.

(11) In the inhaler device according to the above (10),

the container has an opening, and the substrate is inserted in the internal space through the opening,
a mark is applied to each of a surface of the inhaler device around the opening and a surface of the substrate, and
a position of the mark applied to the surface of the inhaler device around the opening and a position of the mark
applied to the surface of the substrate coincide with each other when the susceptor is accommodated in the
container in the predetermined state.

(12) In the inhaler device according to the above (10) or (11),

the container has an opening, and the substrate is inserted in the internal space through the opening, and
each of the internal space and the substrate has a shape allowing the substrate to be inserted into the internal
space when the susceptor is accommodated in the container in the predetermined state.

(13) A system includes

a substrate containing an aerosol source and including a susceptor in thermal proximity to the aerosol source, and
an inhaler device including a container capable of accommodating the substrate in an internal space, and an
electromagnetic induction source configured as a solenoid-type coil and disposed so as to surround the container,
wherein

in a state where the substrate is accommodated in the container in a predetermined state, a first part of the
electromagnetic induction source, located on a front side in a thickness direction orthogonal to a longitudinal

direction of the susceptor, and a second part of the electromagnetic induction source, located on a back side in the thickness direction, are disposed in a state shifted from each other in the longitudinal direction of the susceptor such that a ratio of an area of an overlap area in which a first projection area obtained by projecting the first part perpendicularly onto a surface of the susceptor on the front side and a second projection area obtained by projecting the second part perpendicularly onto a surface of the susceptor on the back side overlap in the thickness direction to an area of each of the first projection area and the second projection area ranges from 0% to 90%.

Reference Signs List

[0086]

- 100 inhaler device
- 111 power supply
- 112 sensor
- 113 notifier
- 114 memory
- 115 communicator
- 116 controller
- 140 holder (container)
- 141 internal space
- 142 opening
- 143 bottom
- 150 stick substrate
- 151 substrate
- 152 inhalation port
- 161 susceptor
- 161A front-side surface of the susceptor
- 161B back-side surface of the susceptor
- 162 electromagnetic induction source
- 162A first part
- 162B second part
- 10 current flowing through the electromagnetic induction source
- 20 eddy current flowing on the surface of the susceptor
- 31, 32 mark
- X_A first projection area
- X_B second projection area
- Y overlap area
- Z_A first non-overlap area
- Z_B second non-overlap area

Claims

1. An inhaler device comprising:

a container capable of accommodating a substrate containing an aerosol source and a susceptor in thermal proximity to the aerosol source in an internal space; and
 an electromagnetic induction source configured as a solenoid-type coil and disposed so as to surround the container, wherein

in a state where the susceptor is accommodated in the container in a predetermined state, a first part of the electromagnetic induction source, located on a front side in a thickness direction orthogonal to a longitudinal direction of the susceptor, and a second part of the electromagnetic induction source, located on a back side in the thickness direction, are disposed in a state shifted from each other in the longitudinal direction of the susceptor such that a ratio of an area of an overlap area in which a first projection area obtained by projecting the first part perpendicularly onto a surface of the susceptor on the front side and a second projection area obtained by projecting the second part perpendicularly onto a surface of the susceptor on the back side overlap in the thickness direction to an area of each of the first projection area and the second projection area ranges

from 0% to 90%.

2. The inhaler device according to claim 1, wherein
a shape of the susceptor is a sheet shape.

5

3. The inhaler device according to claim 1 or 2, wherein
a thickness of the susceptor ranges from 10 μm to 100 μm .

10

4. The inhaler device according to any one of claims 1 to 3, wherein
the susceptor is made of a raw material that has ferromagnetism and of which a Curie point falls within a range of
temperature that is reachable through induction heating by the electromagnetic induction source.

15

5. The inhaler device according to claim 4, wherein
the susceptor is made of steel use stainless (SUS) 430.

20

6. The inhaler device according to any one of claims 1 to 5, wherein
a distribution of the aerosol source is different between a part of the substrate, proximate to a first non-overlap area
that is an area other than the overlap area in the first projection area, or a second non-overlap area that is an area
other than the overlap area in the second projection area, and a part of the substrate, proximate to the overlap area.

7. The inhaler device according to claim 6, wherein
the aerosol source is distributed by a larger amount in the part of the substrate, proximate to the first non-overlap
area or the second non-overlap area, than in the part of the substrate, proximate to the overlap area.

25

8. The inhaler device according to any one of claims 1 to 7, wherein

a longitudinal direction of the internal space substantially coincides with the longitudinal direction of the susceptor,
and

30

the first part and the second part are disposed in a state shifted from each other in the longitudinal direction of
the internal space such that, in a state where the susceptor is accommodated in the container in the predeter-
mined state, a ratio of an area of the overlap area to an area of each of the first projection area and the second
projection area ranges from 0% to 90%.

35

9. The inhaler device according to any one of claims 1 to 8, wherein

a longitudinal direction of the internal space substantially differs from the longitudinal direction of the susceptor,
and

40

the longitudinal direction of the susceptor is inclined with respect to the longitudinal direction of the internal
space such that, in a state where the susceptor is accommodated in the container in the predetermined state,
a ratio of an area of the overlap area to an area of each of the first projection area and the second projection
area ranges from 0% to 90%.

10. The inhaler device according to any one of claims 1 to 9, wherein
the susceptor is included in the substrate.

45

11. The inhaler device according to claim 10, wherein

the container has an opening, and the substrate is inserted in the internal space through the opening,
a mark is applied to each of a surface of the inhaler device around the opening and a surface of the substrate, and
a position of the mark applied to the surface of the inhaler device around the opening and a position of the mark
applied to the surface of the substrate coincide with each other when the susceptor is accommodated in the
container in the predetermined state.

50

12. The inhaler device according to claim 10 or 11, wherein

55

the container has an opening, and the substrate is inserted in the internal space through the opening, and
each of the internal space and the substrate has a shape allowing the substrate to be inserted into the internal
space when the susceptor is accommodated in the container in the predetermined state.

13. A system comprising:

5 a substrate containing an aerosol source and including a susceptor in thermal proximity to the aerosol source; and an inhaler device including a container capable of accommodating the substrate in an internal space, and an electromagnetic induction source configured as a solenoid-type coil and disposed so as to surround the container, wherein

10 in a state where the substrate is accommodated in the container in a predetermined state, a first part of the electromagnetic induction source, located on a front side in a thickness direction orthogonal to a longitudinal direction of the susceptor, and a second part of the electromagnetic induction source, located on a back side in the thickness direction, are disposed in a state shifted from each other in the longitudinal direction of the susceptor such that a ratio of an area of an overlap area in which a first projection area obtained by projecting the first part perpendicularly onto a surface of the susceptor on the front side and a second projection area obtained by projecting the second part perpendicularly onto a surface of the susceptor on the back side overlap in the thickness direction to an area of each of the first projection area and the second projection area ranges from 0% to 90%.

20

25

30

35

40

45

50

55

FIG. 1

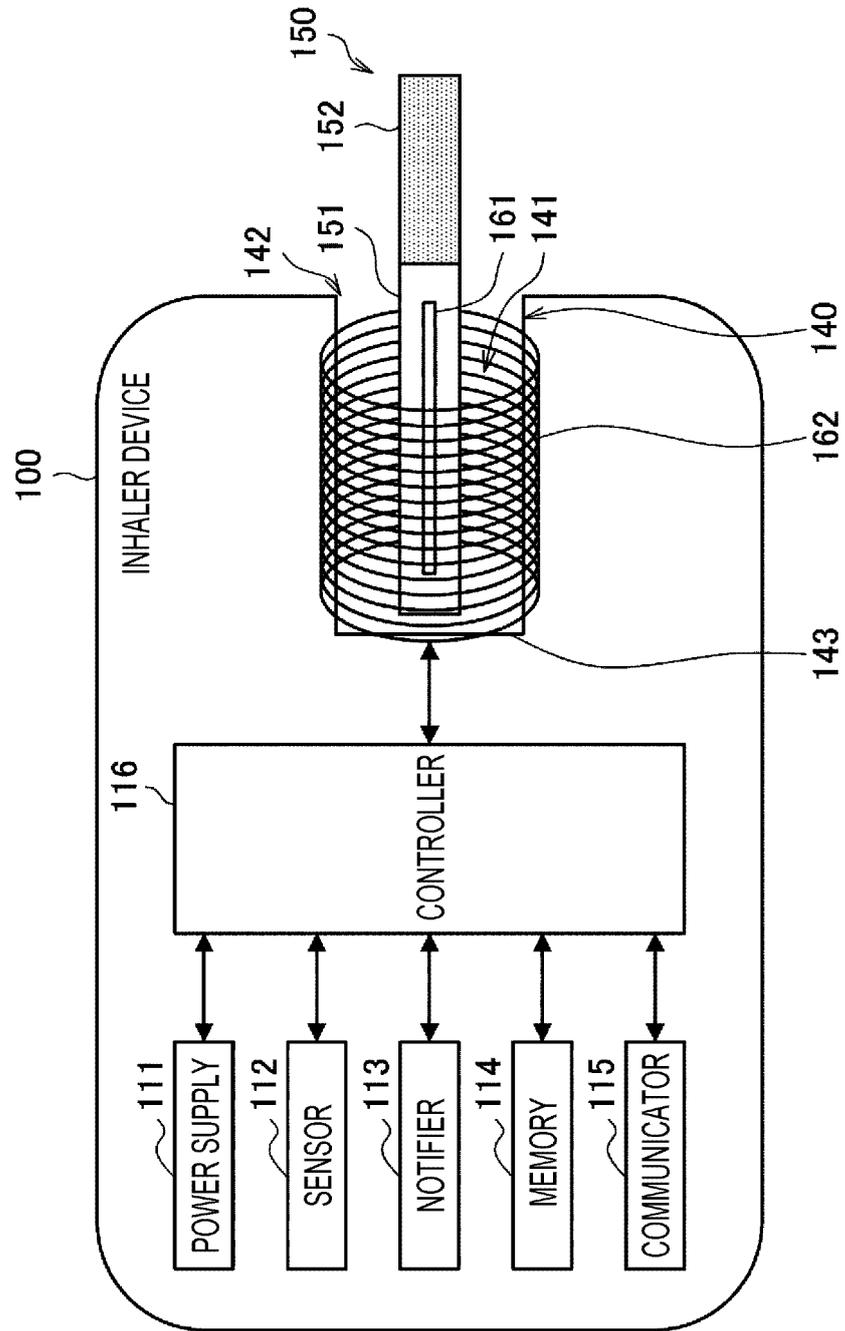


FIG. 2

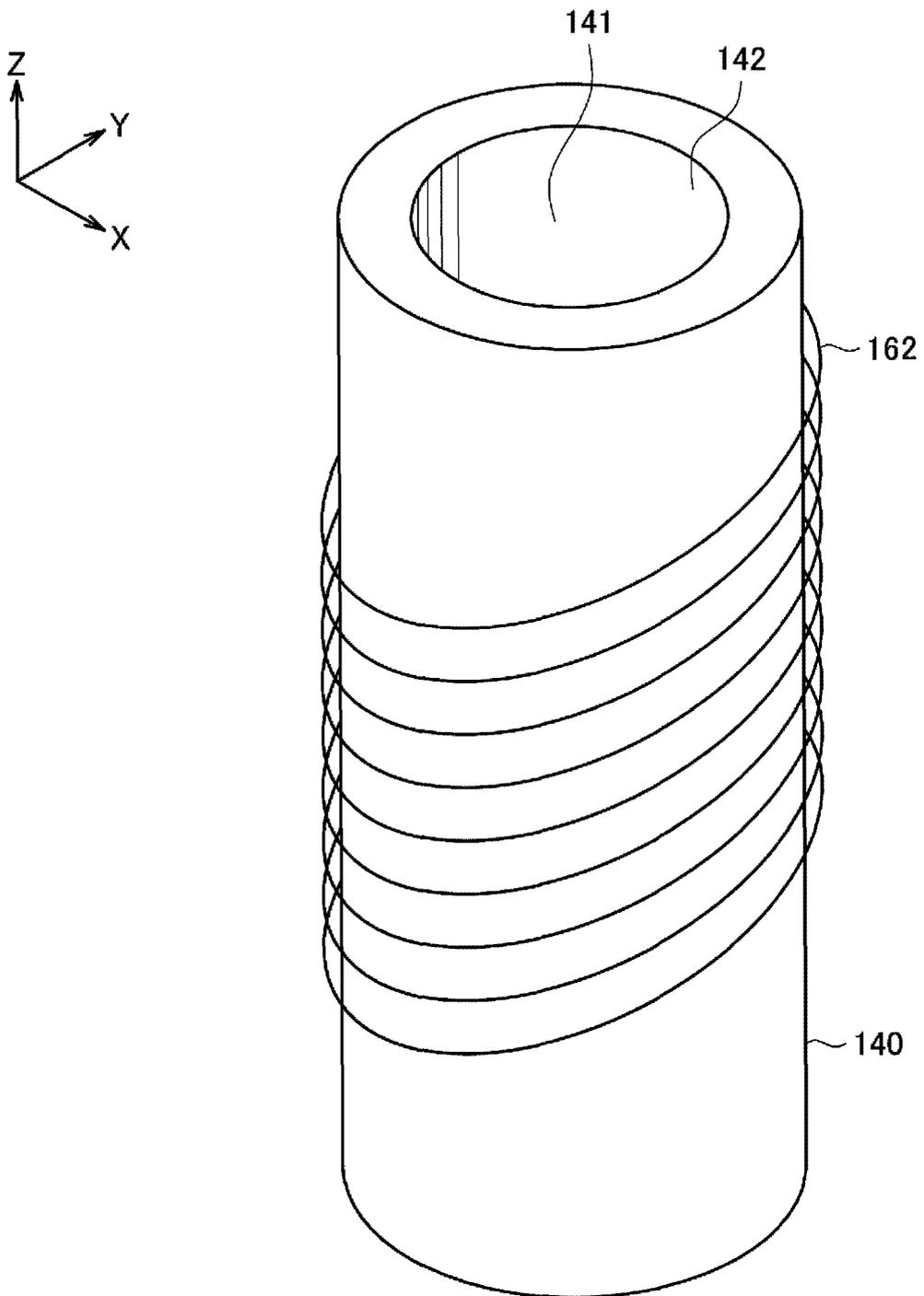


FIG. 3

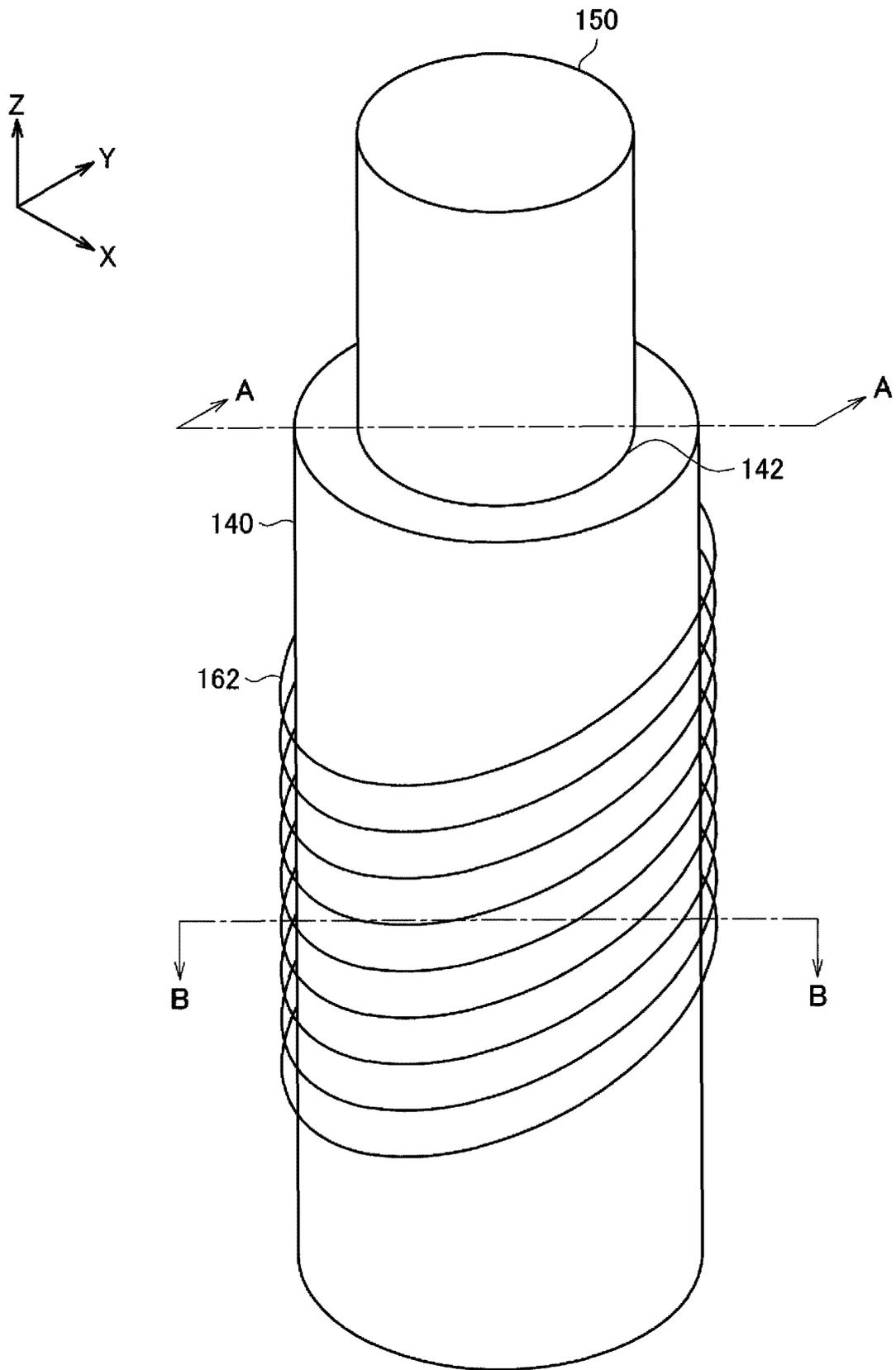


FIG. 4

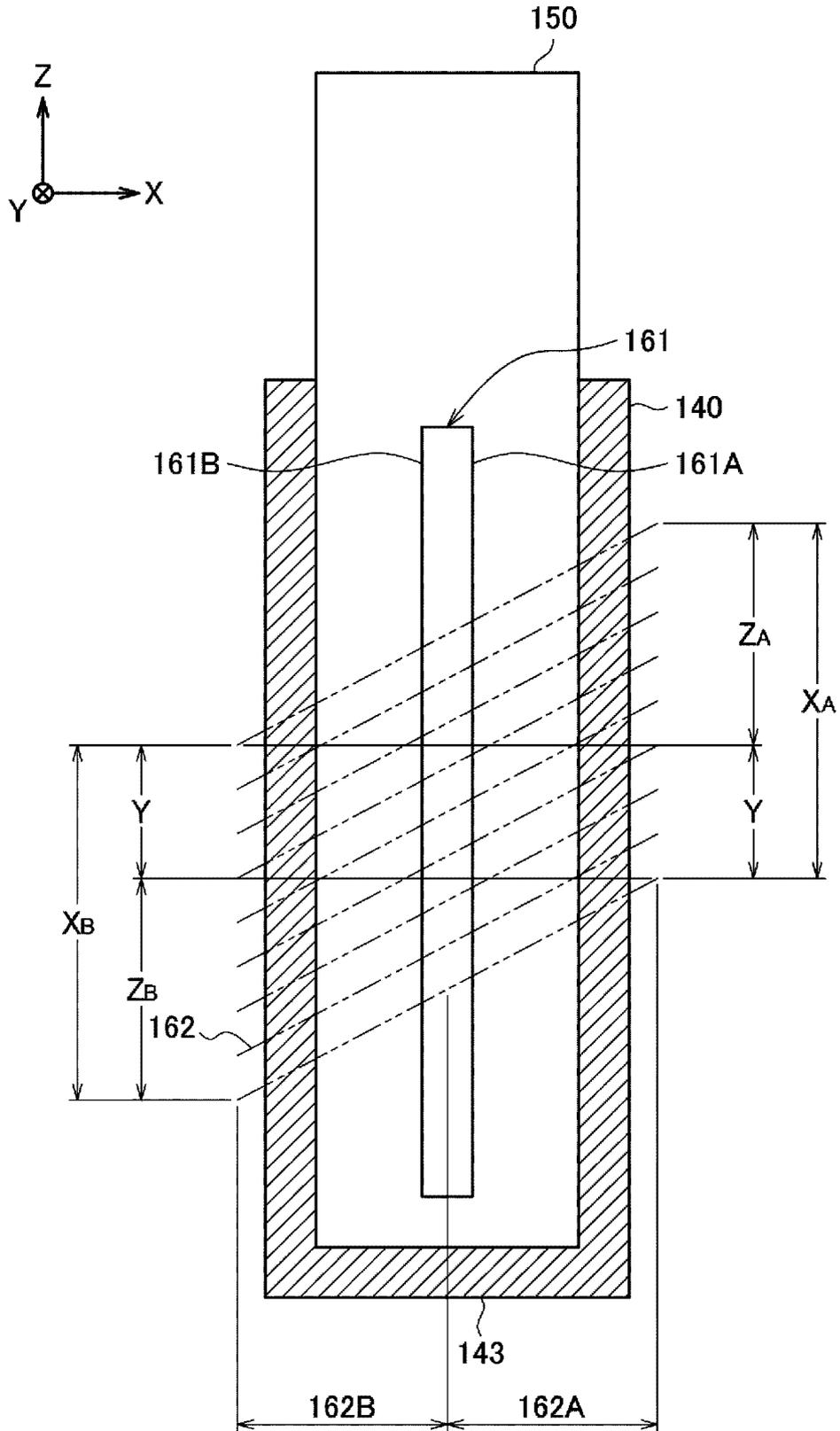


FIG. 5

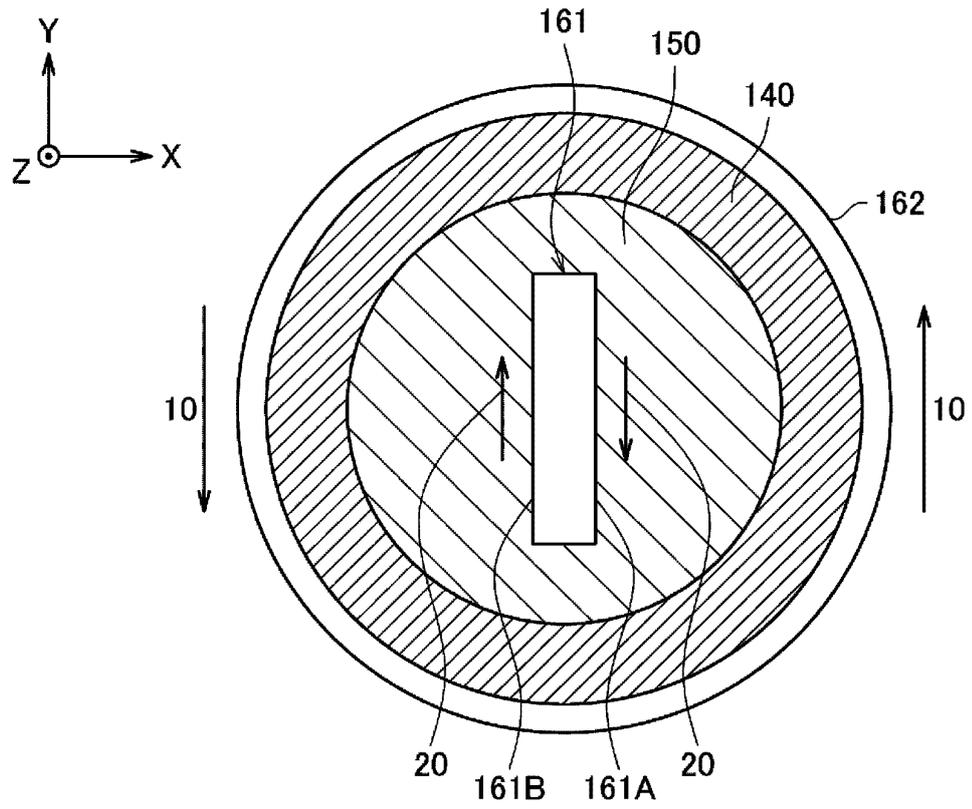


FIG. 6

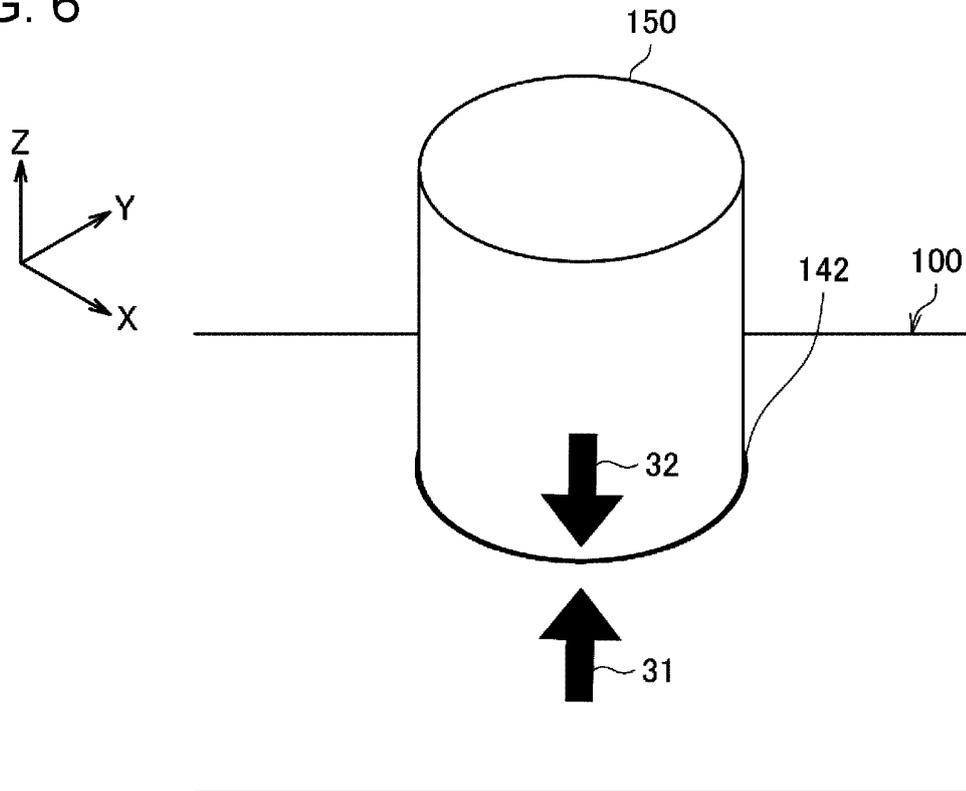


FIG. 7

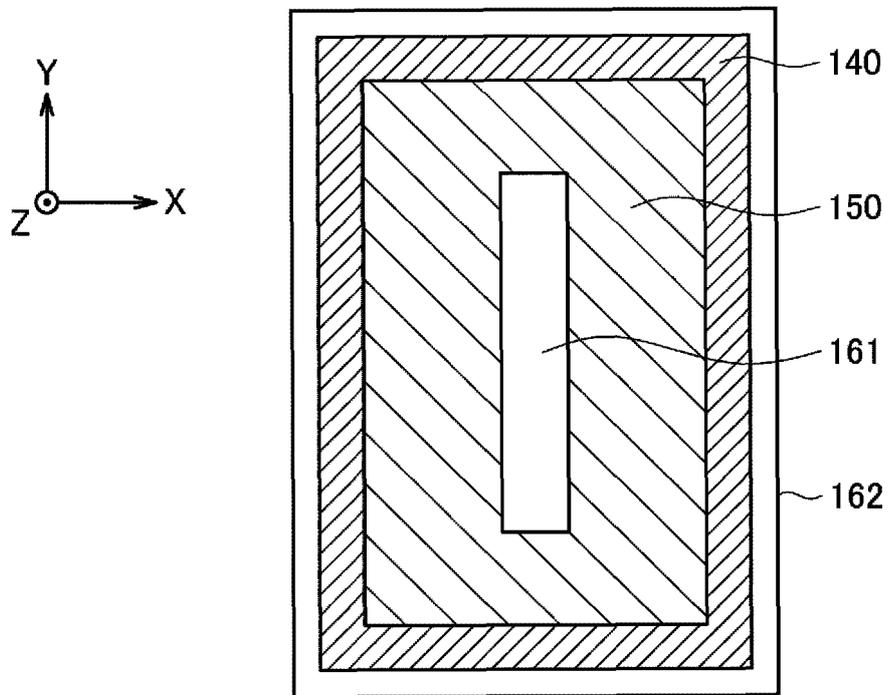
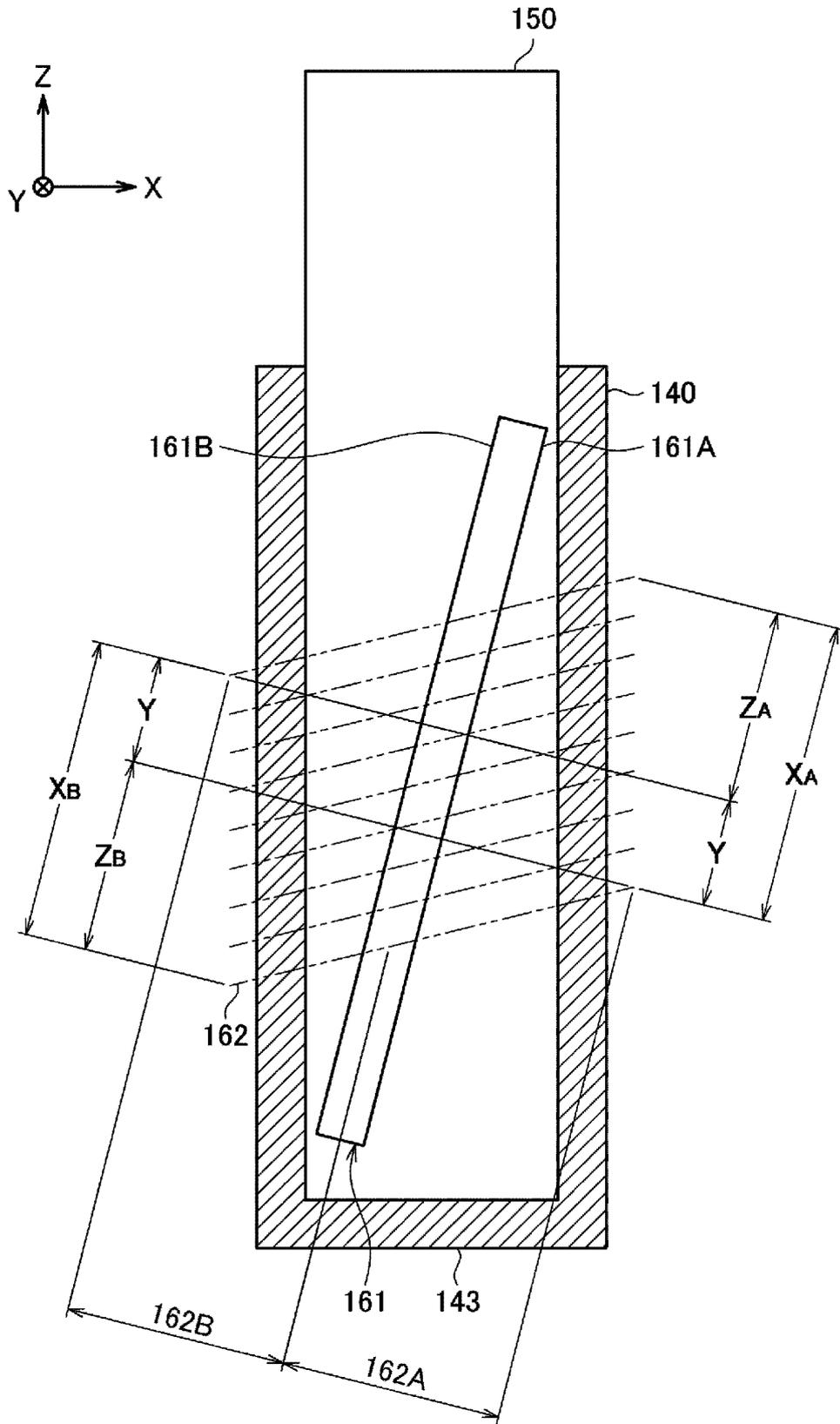


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/011471

5	A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. A24F40/20 (2020.01) i, A24F40/465 (2020.01) i FI: A24F40/465, A24F40/20	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED	
	Minimum documentation searched (classification system followed by classification symbols) Int.Cl. A24F40/20, A24F40/465	
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2021 Registered utility model specifications of Japan 1996-2021 Published registered utility model applications of Japan 1994-2021	
20	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
25	Y A	WO 2020/064686 A1 (PHILIP MORRIS PRODUCTS S.A.) 02 April 2020 (2020-04-02), fig. 1-3
		1-5, 8-13 6-7
	Y	JP 51-41233 Y2 (MITSUI ENGINEERING & SHIPBUILDING CO., LTD.) 07 October 1976 (1976-10-07), fig. 4-6
		1-5, 8-13
30	Y A	JP 2005-209608 A (NIPPON STEEL CORP.) 04 August 2005 (2005-08-04), paragraph [0042], fig. 3, 4
		1-5, 8-13 6-7
	Y	US 3031555 A (ROSS, N. V.) 24 April 1962 (1962-04-24), fig. 4, 5
		1-5, 8-13
35	Y	JP 2018-530311 A (BRITISH AMERICAN TOBACCO (INVESTMENTS) LIMITED) 18 October 2018 (2018-10-18), paragraph [0042]
		9-12
40	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> See patent family annex.
	* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
	"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
45	"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
	"O" document referring to an oral disclosure, use, exhibition or other means	
	"P" document published prior to the international filing date but later than the priority date claimed	
50	Date of the actual completion of the international search 07 April 2021	Date of mailing of the international search report 18 May 2021
55	Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/011471

5

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

10

15

20

25

30

35

40

45

50

55

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2019/185745 A1 (NICOVENTURES TRADING LIMITED) 03 October 2019 (2019-10-03), fig. 10	11-12
Y	US 2020/0154785 A1 (R.J. REYNOLDS TOBACCO COMPANY) 21 May 2020 (2020-05-21), paragraph [0054]	11-12
Y	WO 2020/020747 A1 (PHILIP MORRIS PRODUCTS S.A.) 30 January 2020 (2020-01-30), fig. 14, 15	12

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 6623175 B [0004]