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(54) **MICROWAVE HEATING ASSEMBLY, AND AEROSOL GENERATION DEVICE AND AEROSOL GENERATING SYSTEM**

(57) A microwave heating assembly (10), and an aerosol generation device (1) and an aerosol generating system (100) are provided. The microwave heating assembly (10) comprises a cavity (11) and an inner conductor (12). The cavity (11) comprises a first annular wall (113), and a first end wall (111) and a second end wall (112), which are respectively arranged at two ends of the first annular wall (113). The first end wall (111), the second end wall (112) and the first annular wall (113) together define a resonant cavity (110). The inner conductor (12) is arranged in the resonant cavity (110), and is provided with a connecting end (121), which is connected to and electrically conducts the first end wall (111), and a supporting end (122), which is opposite the connecting end (121) and is used for allowing an aerosol-generating substance (6) to bear against same. An atomization cavity (1121) for accommodating and heating the aerosol-generating substance (6) is formed between the supporting end (122) and the second end wall (112), and the second end wall (112) is provided with a socket (1120) for allowing the aerosol-generating substance (6) to be inserted into the atomization cavity (1121). Microwave heating can achieve rapid and uniform heating of the aerosol-generating substance (6), and it is not necessary to insert the inner conductor (12) into the aerosol-generating substance (6), such that it is convenient to put in and take out the aerosol-generating substance (6).

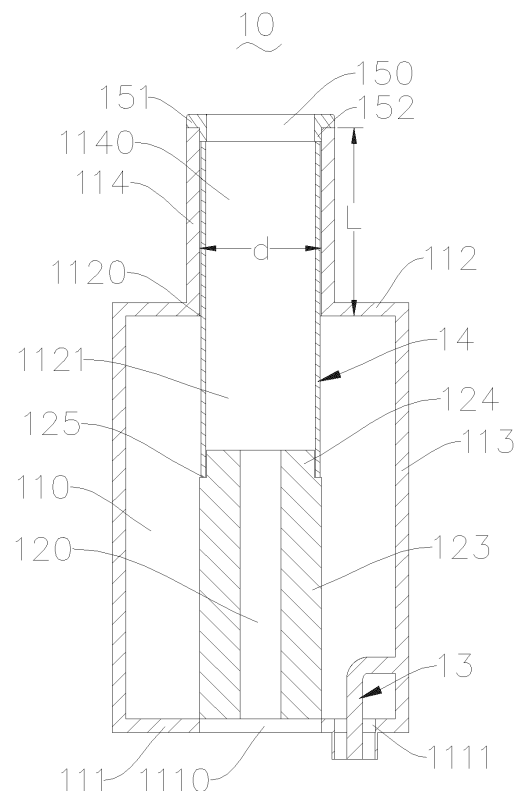


Figure 4

**Description**FIELD

5 **[0001]** The present invention the field of atomization, and more particularly to a microwave heating assembly, and an aerosol generation device and an aerosol generating system.

BACKGROUND

10 **[0002]** A regular heat-not-burning type aerosol generation device generally adopts resistor heating means to heat an aerosol-generating substance. The resistor heating means applies an external electrical power source to heat a resistor element, and the resistor element, after being heated, transfers heat through conduction to the aerosol-generating substance. This technique is a mature one and has a simple structure. However, the resistor heating means has the following deficiencies: (1) the resistor heating being localized heating, and due to the poor property of heat conduction  
 15 of the aerosol-generating substance, there exists a certain temperature gradient, readily causing issues of ununiform heating and local high temperature to affect the mouthfeel and consistency of taste; (2) during the course of vaping, the heating element continuously raises temperature, resulting in potential risk of safety and readily generating harmful substance due to high temperature cracking; and (3) the resistor heating means is a contact heating means, and the aerosol-generating substance is long kept in contact with the heating element and may cause carbon deposit, producing  
 20 burnt taste and being difficult to clean.

SUMMARY

25 **[0003]** The technical issue that the present invention aims to resolve is to provide, in view of the deficiency of the prior art described above, an improved microwave heating assembly, and an aerosol generation device and an aerosol generating system including the microwave heating assembly.

**[0004]** The technical solution that the present invention adopts to resolve the technical issue is to construct a microwave heating assembly, which comprises:

30 a cavity, the cavity comprising a first annular wall, a first end wall and a second end wall, the first end wall and the second end wall respectively arranged at two ends of the first annular wall in an axial direction, the first end wall, the second end wall, and the first annular wall jointly defining a resonant cavity;

a coaxial feeding line having one end inserted into the resonant cavity to feed microwave into the resonant cavity; and

35 an inner conductor arranged in the resonant cavity, the inner conductor having a connecting end connected to and conducting electricity with respect to the first end wall and a supporting end opposite to the connecting end to support an aerosol-generating substance;

40 an atomization cavity for receiving and heating the aerosol-generating substance being formed between the supporting end and an inside wall surface of the second end wall, the second end wall having an insertion opening through which the aerosol-generating substance is inserted into the atomization cavity.

45 **[0005]** In some embodiments, the cavity further comprises a second annular wall extending from the second end wall extending in the axial direction away from the first end wall, an inside wall surface of the second annular wall defining a shielding cavity, the second annular wall, the insertion opening, and the atomization cavity communicating in sequence with each other to form an accommodation space for receiving the aerosol-generating substance.

**[0006]** In some embodiments, the first annular wall and the second annular wall are both of a circular tubular form.

**[0007]** In some embodiments, the shielding cavity has a bore diameter of 8-12mm and a length of 10-25mm.

50 **[0008]** In some embodiments, a bore diameter of the shielding cavity is greater than an outside diameter of a matching aerosol-generating substance by 0.6-3mm.

**[0009]** In some embodiments, the microwave heating assembly further comprises an accommodation tube arranged in the accommodation space for receiving the aerosol-generating substance, the accommodation tube comprising a wave-transmitting material.

55 **[0010]** In some embodiments, the accommodation tube comprises quartz glass or a plastic material.

**[0011]** In some embodiments, the accommodation tube is fitted over the supporting end of the inner conductor.

**[0012]** In some embodiments, the inner conductor is formed with an air ingress passage axially penetrating therethrough and in communication with the atomization cavity.

**[0013]** In some embodiments, the first end wall has an air ingress opening in communication with the air ingress passage.

**[0014]** In some embodiments, the resonant cavity (110) is designed to operate in the TEM mode, either as a  $\lambda/4$  coaxial resonator or as a capacitively loaded coaxial resonator.

**[0015]** In some embodiments, one end of the coaxial feeding line is in contact with and conducting with respect to an inside wall surface of the resonant cavity and/or an outside wall surface of the inner conductor.

**[0016]** In some embodiments, the cavity comprises an electrically conductive material, and/or a first electrically conductive layer is arranged on an inside wall surface of the cavity.

**[0017]** In some embodiments, the inner conductor comprises an electrically conductive material, and/or a second electrically conductive layer is arranged on an outside wall surface of the inner conductor.

**[0018]** The present invention also provides an aerosol generation device, which comprises a microwave source and the microwave heating assembly of any one of the above items, the coaxial feeding line being connected to the microwave heating assembly and the microwave source.

**[0019]** In some embodiments, the microwave source is a solid state microwave source.

**[0020]** In some embodiments, microwave frequencies adopted in the microwave source include 915MH, 2450MHZ, and 5800MHZ.

**[0021]** The present invention further provides an aerosol generating system, which comprises an aerosol-generating substance and the aerosol generation device of any one of the above items, the aerosol-generating substance comprising an atomization section receivable in the atomization cavity.

**[0022]** In some embodiments, the atomization section comprises an atomizable material and a wave-absorbing material mixed with each other.

**[0023]** In some embodiments, the wave-absorbing material comprises a dielectric polarization material, and/or a magnetic material, and/or an electrical resistance material.

**[0024]** In some embodiments, the wave-absorbing material is of a plate form, a spherical form, a block form, or a fiber form.

**[0025]** Implementation of the present invention at least provides the following advantageous effects. The present invention uses microwave to heat the aerosol-generating substance, and can fulfill rapid and uniform heating of the aerosol-generating substance; the resonant cavity is a coaxial resonant cavity of a TEM mode, realizing miniaturization of the resonant cavity; the inner conductor adopts a non-inserting design of which the inner conductor does not insert into the aerosol-generating substance, making the aerosol-generating substance convenient to put in and take out.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0026]** Further description of the present invention will be provided below with reference to the attached drawings and embodiments, and in the drawings:

FIG 1 is a schematic three-dimensional structure diagram of an aerosol generating system according to some embodiments of the present invention;

FIG 2 is a schematic longitudinal cross-sectional diagram of the aerosol generating system shown in FIG 1;

FIG 3 is a schematic three-dimensional structure diagram of a microwave heating assembly shown in FIG 2;

FIG 4 is a schematic longitudinal cross-sectional diagram of the microwave heating assembly shown in FIG 3;

FIG 5 is a schematic cross-sectional diagram of a first alternative for the aerosol-generating substance shown in FIG 2;

FIG 6 is a schematic cross-sectional diagram of a second alternative for the aerosol-generating substance shown in FIG 2; and

FIG 7 is a schematic cross-sectional diagram of a third alternative for the aerosol-generating substance shown in FIG 2.

#### DESCRIPTION OF THE EMBODIMENTS

**[0027]** For clearer understanding of the technical features, objectives, and advantages of the present invention, embodiments of the present invention will be described in further detail with reference to the attached drawings. The following description expounds numerous specific details for full understanding of the present invention. However, the present

invention can be implemented in various ways other than what illustrated herein. Those having ordinary skill in the art may contemplate similar improvement without departing from the content of the present invention, and accordingly, the present invention is not limited to the specific embodiments disclosed hereinafter.

**[0028]** In the description of the present invention, it is appreciated that the terms "center", "longitudinal", "transverse", "length", "width", "thickness", "up", "down", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", "clockwise", "counterclockwise", "axial", "radial", and "circumferential" as used herein to indicate directional or positional relationships are based on the directional or positional relationships depicted in the attached drawings, or the directional or positional relationships that a product of the present invention is commonly placed in regular uses thereof, and are adopted for the purposes of easy description of the present invention and for simplifying the description, rather than suggesting or implying a device or component so indicated must take a specific direction, or be constructed or operated in a specific direction, and thus should not be construed as limiting to the present invention.

**[0029]** Further, the terms "first" and "second" are used solely for the purposes of description and should not be construed as suggesting or implying relative importance or implicitly indicating the quantity of the technical feature so indicated. Thus, features that are defined as "first" and "second" explicitly or implicitly include at least one of such features. In the description of the present invention, "multiple" refers to at least two, such as two or three, unless a clear limitation is explicitly given otherwise.

**[0030]** In the present invention, unless being specifically defined or constrained, the terms "mounting", "interconnecting", "connecting", and "fixing" should be interpreted in a broad sense, for example, as being fixedly connected, or being detachably connected, or being combined as a one piece; or being mechanically connected or being electrically connected; or being directly connected or indirectly connected by means of an intervening medium, or being in communication between interiors of two elements or an interacting relationship between two elements, unless otherwise specified. For those having ordinary skill in the art, the specific meaning of such terms as used in the present invention can be appreciated according to any specific situation that they are applied.

**[0031]** In the present invention, unless otherwise specifically indicated and constrained, a first feature being "on" or "under" a second feature can be the first and second features are set in direct contact with each other and may also include the first and second features are not in direct contact with each other, or the first and second features are set in indirect contact by means of an intermediate medium. Further, the first feature being arranged "on", "above", and "upward" of the second feature can be the first feature being located exactly upward of or obliquely upward of the second feature, or just indicating a horizontal altitude of the first feature being greater than that of the second feature. The first feature being arranged "below", "under", and "downward" of the second feature can be the first feature being located exactly downward of or obliquely downward of the second feature, or just indicating a horizontal altitude of the first feature being less than that of the second feature.

**[0032]** It is noted that when an element is referred to as being "fixed on" or "arranged on" another element, it can be directly set on said another element, or there can be an element intervening therebetween. When an element is described as being "connected to" another element, it can be directly connected to said another element, or there can be an element intervening therebetween. The terms "vertical", "horizontal", "up", "down", "left", "right", and the like expressions are adopted for the purposes of illustration, and are not used as being an indication of the sole way of implementation.

**[0033]** FIGS. 1-2 illustrate an aerosol generating system 100 according to some embodiments of the present invention. The aerosol generating system 100 comprises an aerosol generation device 1 and an aerosol-generating substance 6 inserted into and connected with the aerosol generation device 1. The aerosol-generating substance 6 can be of a cylindrical form and comprises an atomization section 61 in which an atomizable material 611 is disposed and a vaping mouth section 62 arranged at an upper side of the atomization section 61 in an axial direction. The aerosol generation device 1 is operable to bake and heat, at a low temperature, the aerosol-generating substance 6 inserted therein and connected thereto, in order to release an aerosol extract from the atomizable material 611 in a not-burning condition. The aerosol generation device 1 can be of a cylindrical form, and understandably, in other embodiments, the aerosol generation device 1 can also be of other shapes, such as an elliptic cylinder form and a square prism form.

**[0034]** The aerosol generation device 1 may comprise a microwave heating assembly 10, a microwave source 20, an electrical power module 40, a control module 30, and a casing 50. Among these, the microwave heating assembly 10, the microwave source 20, the control module 30, and the electrical power module 40 are all received in the casing 50.

**[0035]** The microwave source 20 and the electrical power module 40 are electrically connected with the control module 30 respectively. The electrical power module 40 is configured to provide an electrical power supply to the microwave source 20 and the control module 30, and is received in a bottom portion of the casing 50. The microwave source 20 is configured to generate microwave and transmit the microwave source to the microwave heating assembly 10, and is received in a middle portion of the casing 50 and is located between the electrical power module 40 and the microwave source 20 in an axial direction. In some embodiments, the microwave source 20 may be a solid-state microwave source, which fulfills low-voltage battery-based electrical power supply (such as 12-48V), and meanwhile, the size is smaller and low-power output control is more accurate. The solid-state source of microwave adopts a microwave frequency including, but not limited to, 915MHZ, 2450MHZ, and 5800MHZ. The control module 30 is configured to control the

microwave source 20 to generate microwave, such as controlling activation/deactivation, microwave frequency, and microwave power of the microwave source 20.

**[0036]** As shown in FIGS. 2-4, the microwave heating assembly 10 comprises a cavity 11 that forms a resonant cavity 110, an inner conductor 12 arranged in the resonant cavity 110 and a coaxial feeding line 13 inserted into the resonant cavity 110 to feed microwave into the resonant cavity 110.

**[0037]** Specifically, the cavity 11 may comprise a first annular wall 113 and a first end wall 111 and a second end wall 112 respectively arranged at two ends of the first annular wall 113 in the axial direction. The first annular wall 113 can be of a circular tubular form, and the first end wall 111 and the second end wall 112 are of a flat plate form and are respectively arranged on and close the two ends of the first annular wall 113 in the axial direction. The first end wall 111, the second end wall 112, and the first annular wall 113 jointly define the resonant cavity 110 in a cylindrical form. The resonant cavity 110 is a coaxial resonant cavity of a TEM mode, including a  $\lambda/4$  coaxial resonator or a capacitively loaded coaxial resonator. Adopting transmission of a microwave coaxial line, and a heating measure with  $\lambda/4$  coaxial resonator or capacitively loaded coaxial resonator effectively miniaturize the resonant cavity 110. The second end wall 112 has a socket 1120 for receiving insertion of the aerosol-generating substance 6 therein.

**[0038]** Preferably, the cavity 11 further comprises a second annular wall 114. The second annular wall 114 extends upwards in the axial direction from a circumference of the socket 1120, meaning axially extending in a direction away from the first end wall 111. An outside diameter of the second annular wall 114 is smaller than an outside diameter of the first annular wall 113. The first annular wall 113, the first end wall 111, and the second end wall 112 are received in an upper portion of the casing 50, and the second annular wall 114 partly projects outside of the casing 50. A top wall of the casing 50 has an opening 51 through which the second annular wall 114 extends outwards.

**[0039]** The second annular wall 114 is of a circular tubular form, of which an inside wall surface defines a shielding cavity 1140. The shielding cavity 1140 is configured to allow the aerosol-generating substance 6 to insert therein and reduce microwave leak during heating of the aerosol-generating substance 6. A non-contacting arrangement is adopted between the shielding cavity 1140 and the aerosol-generating substance 6, meaning a bore diameter of the shielding cavity 1140 is slightly greater than an outside diameter of the aerosol-generating substance 6. The shielding cavity 1140 adopts circular cutoff waveguide, of which the bore diameter is  $d$  (mm), and a length (axial length) is  $L$  (mm). According to the transmission theory of microwave circular waveguide, an attenuation coefficient formula of microwave energy transmitting in a circular waveguide is:

$$\alpha = 8.69 \times 2\pi \sqrt{\frac{1}{\lambda^2} - \frac{1}{\lambda_c^2}} \quad (\text{Formula 1})$$

where  $\alpha$  (dB/m) is the attenuation coefficient of microwave in the circular waveguide;  $\lambda_0$  (m) is microwave heating wavelength;  $\lambda_c$  (m) is the cutoff wavelength in the circular waveguide for different modes.

**[0040]** For a circular waveguide having a radius of  $R$  ( $R=d/2$ ), the cutoff wavelength for a  $TE_{11}$  mode in the primary mode of transmission is:

$$\lambda_c = 2\pi R/u_{11} = 3.41 * d/2 \quad (\text{Formula 2})$$

where  $u_{11} = 1.841$ , which is the minimum root value of Bessel function associated with the  $TE_{11}$  mode, the primary mode in the transmission of the circular waveguide.

**[0041]** The bore diameter of the shielding cavity 1140 can be designed according to the outside diameter of a matching aerosol-generating substance 6, and optionally, the bore diameter of the shielding cavity 1140 can be greater than the outside diameter of the aerosol-generating substance 6 by 0.6-3mm. For example, when the outside diameter of the matching aerosol-generating substance 6 is 7mm, the bore diameter  $d$  of the shielding cavity 1140 is designed to be  $d=8\text{mm}$ , and then,  $\lambda_c=13.64\text{mm}$ . For the microwave heating frequency within the resonant cavity 110 being 2.45G, applying Formula 1 may obtain  $\alpha \approx 4\text{dB/mm}$ , meaning for each 1mm increase of the waveguide length of the shielding cavity 1140, microwave energy is attenuated by 4dB. Assuming  $L=15\text{mm}$ , the amount of microwave attenuation is 60 dB, meaning it is attenuated to 1/1,000,000 of its original value.

**[0042]** Inserting commonly used microwave heating frequencies and bore diameters of the shielding cavity 1140 required for the aerosol-generating substance 6 into Formula 1 and 2 for calculation to obtain the following:

| Frequency (MHz) | d (mm) | L (mm) | $\alpha$ (dB/mm) | Attenuation (dB) |
|-----------------|--------|--------|------------------|------------------|
| 915             | 8      | 16     | 4.0              | 64.0             |
| 2450            | 8      | 16     | 4.0              | 63.6             |
| 5800            | 8      | 16     | 3.9              | 61.8             |
| 915             | 10     | 20     | 3.2              | 63.9             |
| 2450            | 10     | 20     | 3.2              | 63.4             |
| 5800            | 10     | 20     | 3.0              | 60.4             |

**[0043]** It is known from the above that with the shielding cavity 1140 being made at a proper length, microwave leak during heating of the aerosol-generating substance 6 can be effectively prevented, ensuring safety of product use. In some embodiments, the bore diameter d of the shielding cavity 1140 can be 8-12mm, and the length L can be 10-25mm.

**[0044]** An inside wall surface of the cavity 11 is electrically conductive. In some embodiments, the cavity 11 can be made of an electrically conductive material, for example metals, such as aluminum, copper, gold, silver, or stainless steel. In some other embodiments, it is feasible to arrange an electrically conductive layer on the inside wall surface of the cavity 1 to make the inside wall surface thereof electrically conductive. The electrically conductive layer can be for example a metal plating layer, such as gold plating, silver plating, or copper plating, and under this condition, the cavity 1 can be made of an electrically conductive material, or an electrically non-conductive material.

**[0045]** The inner conductor 12 is arranged in the resonant cavity 110 and is coaxial with the resonant cavity 110, and an outside diameter of the inner conductor 12 is smaller than an inside diameter of the resonant cavity 110. The inner conductor 12 comprises a connecting end 121 that is connected to the first end wall 111 and is electrically conductive, and a supporting end 122 that is opposite to the connecting end 121 in an axial direction. The supporting end 122 is configured to support the aerosol-generating substance 6 thereon. An axial length of the inner conductor 12 is smaller than an axial length of the resonant cavity 110, so that an atomization cavity 1121 is formed between the supporting end 122 of the inner conductor 12 and the second end wall 112. The shielding cavity 1140 and the atomization cavity 1121 are sequentially arranged in the axial direction and communicated with each other. The atomization cavity 1121 is configured to receive the atomization section 61 of the aerosol-generating substance 6 and carry out heating and atomizing on the atomization section 61. Electrical field intensity between the supporting end 122 of the inner conductor 12 and the second end wall 112 is the strongest, and the atomization cavity 1121 is arranged at the location of the strongest electrical field intensity to enhance microwave energy coupling, increase an energy coupling efficiency and shorten pre-heating time.

**[0046]** An outside wall surface of the inner conductor 12 is electrically conductive, in order to form microwave radiation in the resonant cavity 110 after microwave is fed into the resonant cavity 110. In some embodiments, the inner conductor 12 can be made of a metallic material or other materials of high electrically conductive performance, and the metallic material is preferred. In some other embodiments, an electrically conductive layer can be arranged on the outside wall surface of the inner conductor 12 to make the outside wall surface thereof electrically conductive. The electrically conductive layer can be for example a metal plating layer, such as gold plating, silver plating, or copper plating, and under this condition, the inner conductor 12 can be made of an electrically conductive material, or an electrically non-conductive material.

**[0047]** Further, the inner conductor 12 is of a hollow circular tubular form, through which an air ingress passage 120 is formed axially to communicate with the atomization cavity 1121. The air ingress passage 120 can be arranged coaxial with the resonant cavity 110. The first end wall 111 has an air ingress opening 1110 in communication with the air ingress passage 120.

**[0048]** A feed-in aperture 1111 is formed in a cavity wall of the resonant cavity 110. One end of the coaxial feeding line 13 is connected to the microwave source 20, and an opposite end is inserted through the feed-in aperture 1111 into the resonant cavity 110 to feed a microwave signal of the microwave source 20 into the resonant cavity 110. The one end of the coaxial feeding line 13 that is inserted into the resonant cavity 110 is in contact with and conducting with respect to an inside wall surface of the resonant cavity 110 and/or an outside wall surface of the inner conductor 12. Specifically, in the instant embodiment, the feed-in aperture 1111 is arranged in the first end wall 111, and the one end of the coaxial feeding line 13 that is inserted into the resonant cavity 110 is of an L-shape, contacting and conducting with an inside wall surface of the first annular wall 113. Understandably, in other embodiments, the one end of the coaxial feeding line 13 that is inserted into the resonant cavity 110 can be of other shapes, such as a linear form, an arc form, or a U-shaped form, provided it can contact and conduct with the inside wall surface of the resonant cavity 110 or the outside wall surface of the inner conductor 12.

**[0049]** Further, the microwave heating assembly 10 further comprises an accommodation tube 14 received in the shielding cavity 1140 and the atomization cavity 1121. The accommodation tube 14 is of a circular tubular form, of which an inside wall surface defines an accommodation space 140 for receiving the aerosol-generating substance 6. The accommodation tube 14 is made of a wave transmitting material, and preferably, the loss tangent of the material is smaller than 0.1. In some embodiments, the accommodation tube 14 may be made of quartz glass or a plastic material, such as polytetrafluoroethylene and polyether ether ketone (PEEK). A non-contacting arrangement is adopted between the accommodation tube 14 and the aerosol-generating substance 6, such as by way of loose fitting, meaning an inside diameter of the accommodation tube 14 is greater than an outside diameter of the aerosol-generating substance 6, in order to prevent carbon deposit generated by the aerosol-generating substance from sticking to an inside wall of the accommodation tube 14, thereby making the accommodation tube 14 easy to clean. Understandably, in other embodiments, a contacting arrangement may be adopted between the accommodation tube 14 and the aerosol-generating substance 6.

**[0050]** A lower end of the accommodation tube 14 is fitted to the outside of an upper end of the inner conductor 12 to ease mounting and positioning of the accommodation tube 14. Specifically, the inner conductor 12 may comprise a main body portion 123 and a fitting portion 124 arranged on an upper end of the main body portion 123 in an axial direction. An outside diameter of the main body portion 123 is greater than an outside diameter of the fitting portion 124, so as to form a stepped surface 125 between an outside wall surface of the main body portion 123 and an outside wall surface of the fitting portion 124. The lower end of the accommodation tube 14 is fitted outside the fitting portion 124, and a lower end surface of the accommodation tube 14 is supported on the stepped surface 125.

**[0051]** Further, in some embodiments, the microwave heating assembly 10 may further comprise an end cap 15 arranged at an upper end of the second annular wall 114. The end cap 15 is of an annular form and is formed, in a manner of axially penetrating therethrough, with a through-hole 150 in communication with the accommodation space 140. The through-hole 150 is configured to allow insertion of the aerosol-generating substance 6 therethrough, and also, circumferential positioning of the aerosol-generating substance 6 can be fulfilled with the through-hole 150. Specifically, in the instant embodiment, the end cap 15 comprises a lid portion 151 of an annular form and an insertion portion 152 that is of an annular form extending downward from a lower end surface of the lid portion 151. The insertion portion 152 is inserted into an upper end of the second annular wall 114, and has an outside diameter matching an inside diameter of the second annular wall 114, with a lower end surface of the insertion portion 152 supported on an upper end surface of the accommodation tube 14. An outside diameter of the end cap 15 is greater than the outside diameter of the insertion portion 152 and may correspond to the outside diameter of the second annular wall 114. The lower end surface of the end cap 15 is supported on the upper end surface of the second annular wall 114.

**[0052]** When it is desired to heat the aerosol-generating substance 6, the aerosol-generating substance 6 is inserted through the through-hole 150 into the accommodation tube 14. After the aerosol-generating substance 6 is inserted, the atomization section 61 of the aerosol-generating substance 6 is received in the atomization cavity 1121, and a lower end surface of the aerosol-generating substance 6 is supported on an end surface of the supporting end 122 of the inner conductor 12. Microwave energy transmitted from the microwave source 20 transmits through the coaxial feeding line 13 to couple to interior of the resonant cavity 110 to induce resonance so as to then heat and atomize the atomization section 61 disposed in the resonant cavity 110 to release an aerosol extract from the atomization section 61 for vaping by a user.

**[0053]** The present invention utilizes the characteristics of non-contacting, wholeness, optionality, and instantaneity of microwave heating, and applies microwave to directly heat and atomize the aerosol-generating substance 6, achieving uniform and quick heating of the aerosol-generating substance 6, and realizing consistent atomization and enhancing mouthfeel to improve consumers' experiences of vaping. Further, the unique and reasonable structure design effectively realizes miniaturization for the aerosol generation device 1, achieving the goals of non-contacting and accurate atomization. Further, the inner conductor 12 adopts a non-inserting design of which the inner conductor 12 is not needed to be inserted into the aerosol-generating substance 6, making the aerosol-generating substance 6 convenient to put in and take out.

**[0054]** Further, due to the non-inserting design, a wave-absorbing material 612, 613, 614 can be added in the atomization section 61 of the aerosol-generating substance 6, see FIGS. 5-6. The wave-absorbing materials 612, 613, 614 are mixed with the atomizable material 611 to increase a temperature rise rate of the atomizable material 611 to shorten the pre-heating time. The wave-absorbing material may comprise a dielectric polarization material (such as wave-absorbing ceramics) and/or a magnetic material (such as ferrite) and/or an electrical resistance material (such as metallic graphite). The wave-absorbing materials can be of a configuration of plate, sphere, block, or fiber. For example, the wave-absorbing material 612 shown in FIG 5 is of a plate form, which can be a wave-absorbing ceramic plate and can be various shapes, such as a circular plate, a square plate, and an elliptic plate; the wave-absorbing material 613 shown in FIG 6 is of a fiber form; the wave-absorbing material 614 shown in FIG 7 is of a spherical form.

**[0055]** Understandably, each of the technical features described above can be combined in an arbitrary way without subjecting to any limitation.

**[0056]** The above embodiments are provided solely for illustrating the preferred ways of implementation of the present invention, and the descriptions thereof are made specific and in detail, but should not be construed as limiting to the scope of patent protection of the present invention. It is noted that for those having ordinary skill in the art, unconstrained combinations of the above-described features can be contemplated to make various variations and improvements, without departing from the inventive idea of the present invention, and these all belong to the protection scope of the present invention. Thus, alterations and modifications of equivalency to the claims of the present invention all belong to the scope of coverage of the claims of the present invention.

## Claims

### 1. A microwave heating assembly, comprising:

a cavity (11), the cavity (11) comprising a first annular wall (113), a first end wall (111) and a second end wall (112), the first end wall (111) and the second end wall (112) respectively arranged at two ends of the first annular wall (113) in an axial direction, the first end wall (111), the second end wall (112), and the first annular wall (113) jointly defining a resonant cavity (110);  
 a coaxial feeding line (13) having one end inserted into the resonant cavity (110) to feed microwave into the resonant cavity (110); and  
 an inner conductor (12) arranged in the resonant cavity (110), the inner conductor (12) having a connecting end (121) which is connected to the first end wall (111) and is electrically conductive and a supporting end (122) opposite to the connecting end (121) to support an aerosol-generating substance (6);  
 an atomization cavity (1121) for receiving and heating the aerosol-generating substance (6) being formed between the supporting end (122) and an inside wall surface of the second end wall (112), the second end wall (112) having a socket (1120) for allowing the aerosol-generating substance (6) to be inserted into the atomization cavity (1121).

2. The microwave heating assembly according to claim 1, wherein the cavity (11) further comprises a second annular wall (114) extending from the second end wall (112) in the axial direction away from the first end wall (111), an inside wall surface of the second annular wall (114) defining a shielding cavity (1140), the second annular wall (114), the socket (1120), and the atomization cavity (1121) communicating in sequence with each other to form an accommodation space (140) for receiving the aerosol-generating substance (6).

3. The microwave heating assembly according to claim 2, wherein the first annular wall (113) and the second annular wall (114) are both of a circular tubular form.

4. The microwave heating assembly according to claim 3, wherein the shielding cavity (1140) has a diameter of 8-12mm and a length of 10-25mm.

5. The microwave heating assembly according to claim 3, wherein a diameter of the shielding cavity (1140) is greater than an outside diameter of a matching aerosol-generating substance (6) by 0.6-3mm.

6. The microwave heating assembly according to claim 2, wherein the microwave heating assembly further comprises an accommodation tube (14) arranged in the accommodation space (140) for receiving the aerosol-generating substance (6), the accommodation tube (14) being made of a wave-transmitting material.

7. The microwave heating assembly according to claim 6, wherein the accommodation tube (14) is made of quartz glass or a plastic material.

8. The microwave heating assembly according to claim 6, wherein the accommodation tube (14) is fitted over the supporting end (122) of the inner conductor (12).

9. The microwave heating assembly according to claim 1, wherein the inner conductor (12) is formed with an air ingress passage (120) axially penetrating therethrough and in communication with the atomization cavity (1121).

10. The microwave heating assembly according to claim 9, wherein the first end wall (111) has an air ingress opening (1110) in communication with the air ingress passage (120).

11. The microwave heating assembly according to any one of claims 1-10, wherein the resonant cavity (110) is designed to operate in the TEM mode, either as a  $\lambda/4$  coaxial resonator or as a capacitively loaded coaxial resonator.
- 5 12. The microwave heating assembly according to any one of claims 1-10, wherein one end of the coaxial feeding line (13) is in contact with and conducting with an inside wall surface of the resonant cavity (110) and/or an outside wall surface of the inner conductor (12).
- 10 13. The microwave heating assembly according to any one of claims 1-10, wherein the cavity (11) comprises an electrically conductive material, and/or a first electrically conductive layer is arranged on an inside wall surface of the cavity (11).
14. The microwave heating assembly according to any one of claims 1-10, wherein the inner conductor (12) comprises an electrically conductive material, and/or a second electrically conductive layer is arranged on an outside wall surface of the inner conductor (12).
- 15 15. An aerosol generation device, **characterized by** comprising a microwave source (20) and the microwave heating assembly (10) according to any one of claims 1-14, the coaxial feeding line (13) being connected to the microwave heating assembly (10) and the microwave source (20) respectively.
- 20 16. The aerosol generation device according to claim 15, wherein the microwave source (20) is a solid state microwave source.
17. The aerosol generation device according to claim 15, wherein microwave frequencies adopted in the microwave source (20) include 915MH, 2450MHZ, and 5800MHZ.
- 25 18. An aerosol generating system, **characterized by** comprising an aerosol-generating substance (6) and the aerosol generation device according to any one of claims 15-17, the aerosol-generating substance (6) comprising an atomization section (61) receivable in the atomization cavity (1121).
- 30 19. The aerosol generating system according to claim 18, wherein the atomization section (61) comprises an atomizable material (611) and a wave-absorbing material mixed with each other.
20. The aerosol generating system according to claim 19, wherein the wave-absorbing material comprises a dielectric polarization material, and/or a magnetic material, and/or an electrical resistance material.
- 35 21. The aerosol generating system according to claim 19, wherein the wave-absorbing material is of a plate form, a spherical form, a block form, or a fiber form.

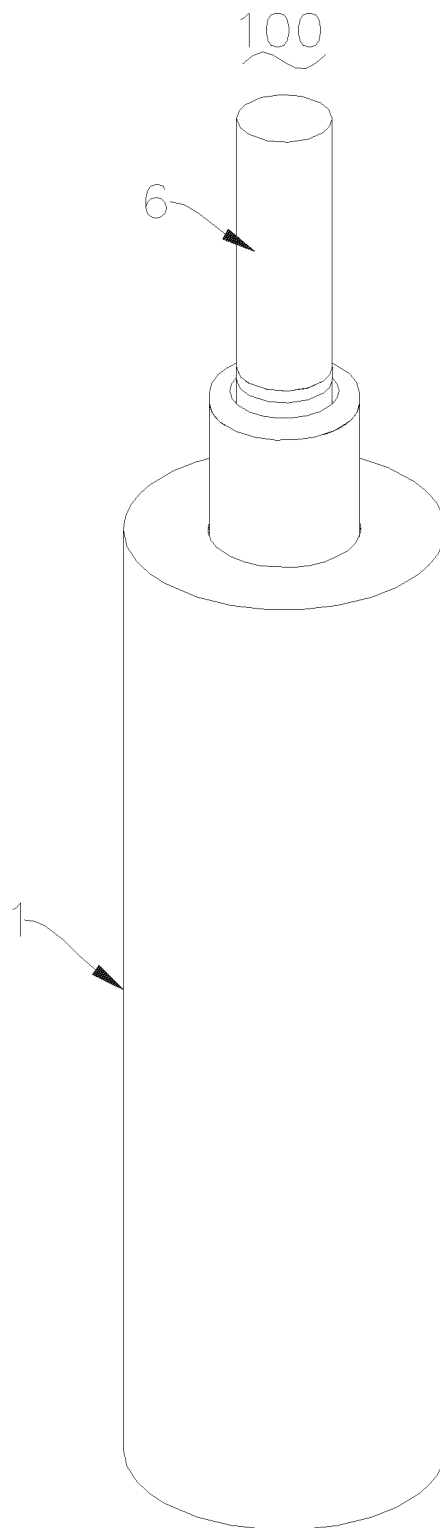


Figure 1

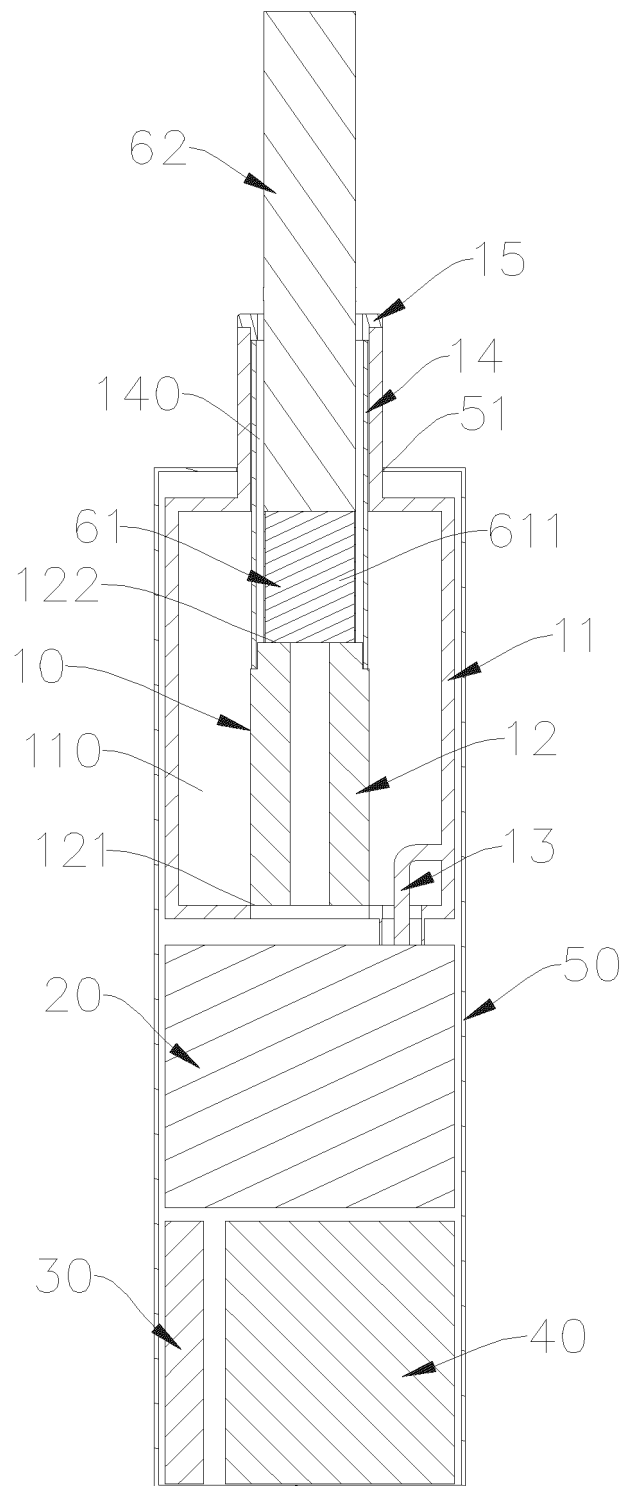


Figure 2

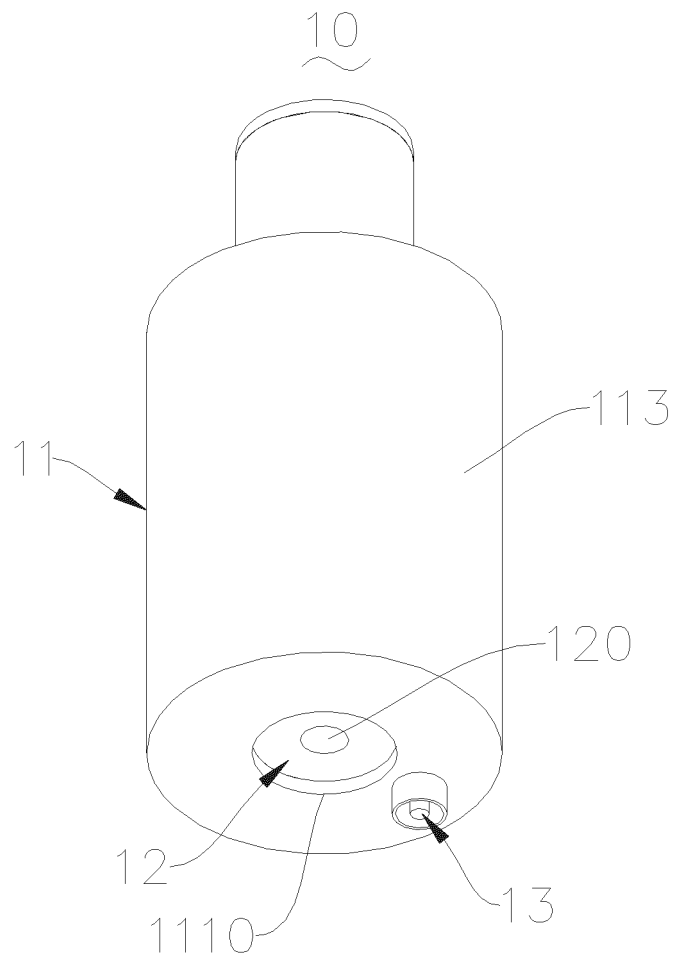


Figure 3

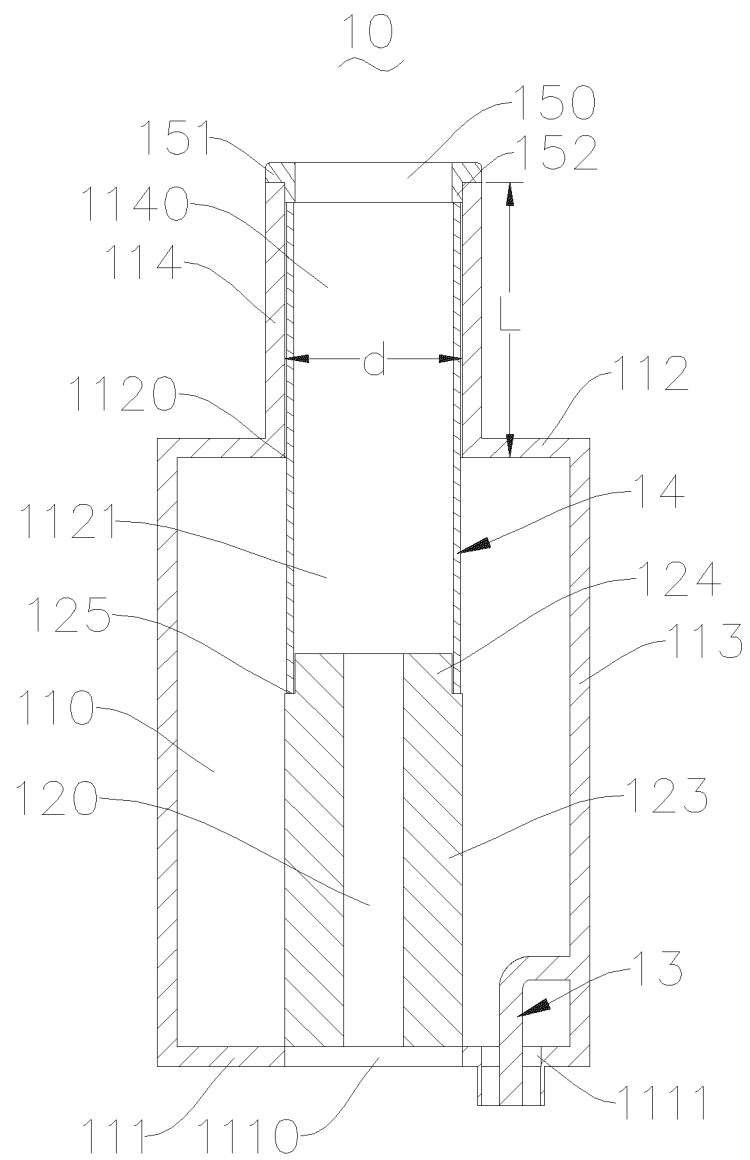


Figure 4

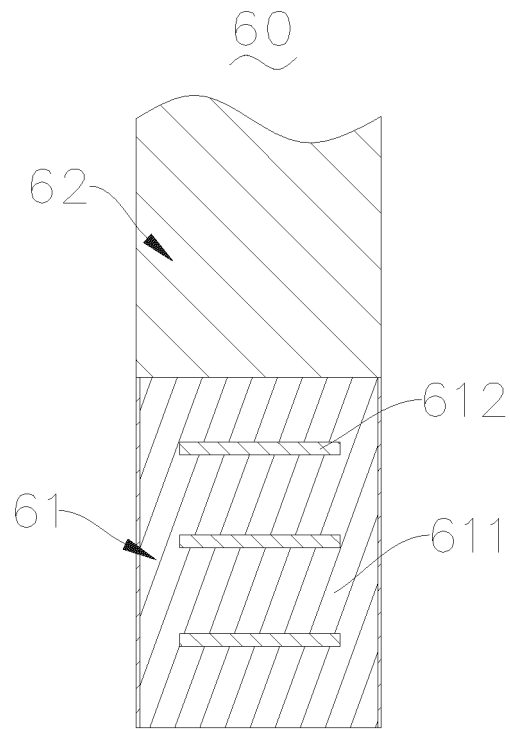


Figure 5

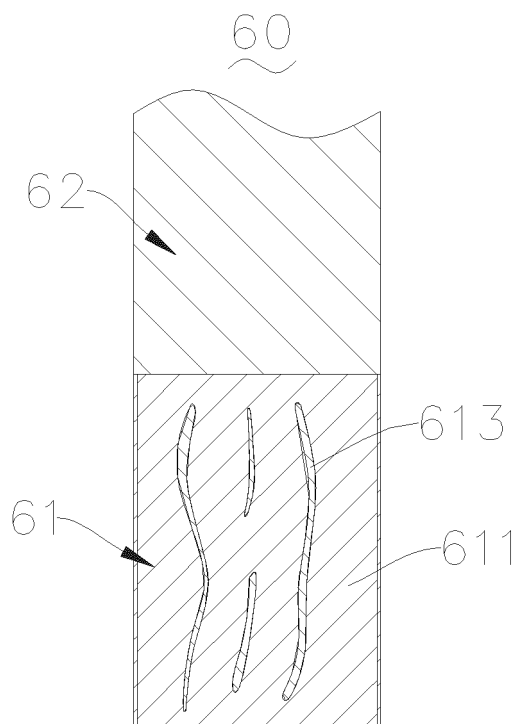


Figure 6

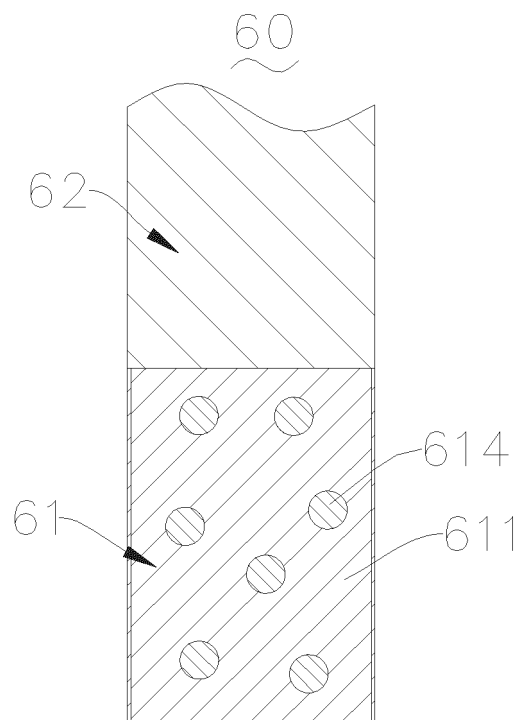


Figure 7

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/138159

**A. CLASSIFICATION OF SUBJECT MATTER**

A24F40/40(2020.01)i;A24F40/46(2020.01)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)

A24F

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

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

CNPAT, CNKI, WPI, EPODOC: 气溶胶, 雾化, 电子烟, 谐振腔, 微波, 内导体, 谐振柱, 基质, 插, 吸波, 同轴, 共轴, 轴线, aerosol, atomization, atomizing, atomizer, e-cigarette, resonant cavity, microwave, inner conductor, resonant column, substrate, insert, wave absorption, coaxial

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                         | Relevant to claim No. |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| PX        | CN 114711467 A (SHENZHEN SMOORE TECHNOLOGY LIMITED) 08 July 2022 (2022-07-08)<br>claims 1-21                                               | 1-21                  |
| PX        | CN 217743173 U (SHENZHEN SMOORE TECHNOLOGY LIMITED) 08 November 2022 (2022-11-08)<br>claims 1-21                                           | 1-21                  |
| X         | CN 113925221 A (SHENZHEN MAISHI TECHNOLOGY CO., LTD. et al.) 14 January 2022 (2022-01-14)<br>description, paragraphs 113-129, and figure 5 | 1-21                  |
| A         | EP 3636084 A1 (JT INTERNATIONAL S.A.) 15 April 2020 (2020-04-15)<br>entire document                                                        | 1-21                  |
| A         | US 2019307170 A1 (ZARIFIAN PEZHMAN et al.) 10 October 2019 (2019-10-10)<br>entire document                                                 | 1-21                  |

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

\* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

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“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

“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

“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

“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

“&amp;” document member of the same patent family

Date of the actual completion of the international search

01 February 2023

Date of mailing of the international search report

14 February 2023

Name and mailing address of the ISA/CN

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Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/138159

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| C. DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                             |                       |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------|
| Category*                              | Citation of document, with indication, where appropriate, of the relevant passages                          | Relevant to claim No. |
| A                                      | CN 215913314 U (SHENZHEN SMOORE TECHNOLOGY LIMITED et al.) 01 March 2022 (2022-03-01)<br>entire document    | 1-21                  |
| A                                      | CN 215381427 U (SHENZHEN SMOORE TECHNOLOGY LIMITED) 04 January 2022 (2022-01-04)<br>entire document         | 1-21                  |
| A                                      | CN 214015950 U (TYXIN SEMICONDUCTOR (NANJING) CO., LTD.) 24 August 2021 (2021-08-24)<br>entire document     | 1-21                  |
| A                                      | CN 113729304 A (SHENZHEN SMOORE TECHNOLOGY LIMITED et al.) 03 December 2021 (2021-12-03)<br>entire document | 1-21                  |

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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.

**PCT/CN2022/138159**

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| Patent document<br>cited in search report |            |    | Publication date<br>(day/month/year) | Patent family member(s) | Publication date<br>(day/month/year) |
|-------------------------------------------|------------|----|--------------------------------------|-------------------------|--------------------------------------|
| CN                                        | 114711467  | A  | 08 July 2022                         | None                    |                                      |
| CN                                        | 217743173  | U  | 08 November 2022                     | None                    |                                      |
| CN                                        | 113925221  | A  | 14 January 2022                      | None                    |                                      |
| EP                                        | 3636084    | A1 | 15 April 2020                        | EP 3636084 B1           | 01 December 2021                     |
|                                           |            |    |                                      | ES 2905680 T3           | 11 April 2022                        |
|                                           |            |    |                                      | PL 3636084 T3           | 02 May 2022                          |
|                                           |            |    |                                      | PT 3636084 T            | 11 January 2022                      |
| US                                        | 2019307170 | A1 | 10 October 2019                      | None                    |                                      |
| CN                                        | 215913314  | U  | 01 March 2022                        | None                    |                                      |
| CN                                        | 215381427  | U  | 04 January 2022                      | None                    |                                      |
| CN                                        | 214015950  | U  | 24 August 2021                       | None                    |                                      |
| CN                                        | 113729304  | A  | 03 December 2021                     | None                    |                                      |

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