



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

(43) Date of publication:
27.10.2021 Bulletin 2021/43

(51) Int Cl.:
A24F 40/465 (2020.01)

(21) Application number: **19898135.9**

(86) International application number:
PCT/KR2019/018324

(22) Date of filing: **23.12.2019**

(87) International publication number:
WO 2020/130752 (25.06.2020 Gazette 2020/26)

(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
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Inno-It Co., Ltd.**
Busan 48308 (KR)

(72) Inventor: **KWON, Joong Hak**
Gimhae-si Gyeongsangnam-do 50883 (KR)

(74) Representative: **Müller Hoffmann & Partner**
Patentanwälte mbB
St.-Martin-Strasse 58
81541 München (DE)

(30) Priority: **21.12.2018 KR 20180167863**

(54) **FINE PARTICLE GENERATION APPARATUS HAVING INDUCTION HEATER**

(57) The present invention relates to an induction heating fine particle generating device comprising: an excitation coil; a susceptor reacting with the excitation coil such that induction heating occurs due to eddy current losses; a susceptor temperature obtaining unit for obtaining the temperature of the susceptor; and an insulating part for shielding heat between the susceptor and the excitation coil.

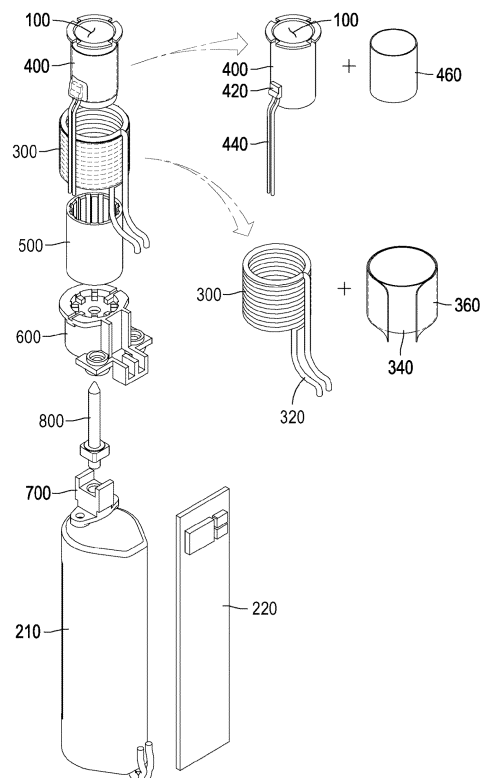


Fig. 4

Description

TECHNICAL FIELD

[0001] The present invention relates to a fine particle generating device having an induction heater.

BACKGROUND ART

[0002] FIG. 1 is a view showing a prior art induction heating device for heating an aerosol-forming substrate described in International Publication WO 2015/177255. The induction heating device 1 includes a device housing 10, which may be made of plastic, and a DC power source having a rechargeable battery 11a.

[0003] The induction heating device 1 includes a docking port 12 having a pin 12a for docking the induction heating device 1 with a charging station or a charging apparatus for charging the rechargeable battery 11a. In addition, the induction heating device 1 includes a power supply electronic equipment 13 configured to operate at a desired frequency, e.g., at a frequency of 5 MHz. The power supply electronic equipment 13 is electrically connected to the rechargeable battery 11a through a suitable electric connection 13a.

[0004] A tobacco-containing solid aerosol forming substrate 20 including a susceptor 21 is received in a cavity 14 at an extreme end of the device housing 10, and in operation, an inductor L2 (a cylindrical inductor coil wound in a helical type) is inductively coupled to the susceptor 21 of the tobacco-containing solid aerosol forming substrate 20 of a smoking article 2. A filter part 22 of the smoking article 2 is arranged outwardly of the cavity 14 of the induction heating device 1, and in operation, a consumer may inhale an aerosol through the filter part 22.

[0005] An induction heating device includes an inductor arranged thermally adjacent to the aerosol-forming substrate, and the aerosol-forming substrate includes a susceptor. An alternating magnetic field of the inductor creates eddy current and hysteresis losses, which cause the susceptor to heat the aerosol-forming substrate to a temperature that allows it to release volatile components able to form an aerosol. Since the heating of the susceptor is carried out in a non-contact manner, it is not possible to directly measure the temperature of the aerosol-forming substrate. This makes it difficult for a user to determine when to puff away while smoking.

DISCLOSURE OF THE INVENTION

[0006] An object of the present invention is to provide an induction heating fine particle generating device which includes a susceptor as its part to directly measure the temperature of the susceptor and therefore easily control heating of the susceptor. Another object of the present invention is to provide an induction heating fine particle generating device, in which a magnetic heating element heated by an excitation coil transfers heat to the excita-

tion coil, while being heated, which leads to an improvement in efficiency.

[0007] In view of this, the present invention provides an induction heating fine particle generating device comprising: an excitation coil; a susceptor reacting with the excitation coil such that induction heating occurs due to eddy current losses; and an insulating member for shielding heat between the susceptor and the excitation coil. The present invention also provides an induction heating fine particle generating device comprising: an excitation coil; a liquid storage space; and a heating member provided as a susceptor to vaporize a liquid.

[0008] Therefore, according to a further aspect of the present invention, there is provided a grippable and portable-sized fine particle generating device with an induction heater that has a cavity into which a smoking article containing an aerosol-forming substrate and wrapped in wrapping paper can be inserted and that heats the aerosol-forming substrate of the smoking article inserted into the cavity to form an aerosol, the fine particle generating device comprising: an excitation coil provided in the device and wound in multiple times; a metal susceptor provided inside the excitation coil to be surrounded by the excitation coil in the device, made of a hollow cylindrical thin plate defining the cavity, and heated to a temperature of 400 °C or lower by induction heating due to eddy current losses, by reacting with the excitation coil, the inner surface of the susceptor being brought into contact with at least part of the outer surface of the wrapping paper of the smoking article inserted into the cavity, the induction-heated susceptor heating the aerosol-forming substrate in the wrapping paper by heat transfer to form an aerosol; an insulating part provided between the susceptor and the excitation coil in the device to prevent heat of the susceptor from being transferred to the excitation coil; a structure provided in the device to support at least part of one of the susceptor and the excitation coil; a susceptor temperature obtaining unit provided in the device to obtain the temperature of the susceptor; a rechargeable battery provided in the device to function as a direct current power source; and a control unit electrically connected to the excitation coil, the susceptor temperature obtaining unit and the battery, and supplied with direct current power from the battery, to supply an alternating current having a resonance frequency or an alternating current having a frequency different from the resonance frequency to the excitation coil depending on the temperature of the susceptor and heat the susceptor to a desired temperature by induction heating.

[0009] Preferably, the fine particle generating device may further comprise a susceptor inserted through a lower center portion of the smoking article inserted into the cavity to heat the aerosol-forming substrate in the smoking article in direct contact with the aerosol-forming substrate.

[0010] Preferably, the susceptor may be made of a stainless steel thin plate.

[0011] Preferably, the insulating part may be an air lay-

er provided between the susceptor and the excitation coil.

[0012] Preferably, the structure for supporting at least part of one of the susceptor and the excitation coil may be an insulating plastic structure made of heat resistant plastic and provided between the susceptor and the excitation coil to function as an insulating part for preventing heat of the susceptor from being transferred to the excitation coil. Preferably, the insulating plastic structure may be an insulating pipe for supporting at least part of the susceptor on the outside of the susceptor, the excitation coil being wound around the outer surface of the structure.

[0013] Preferably, a thermal insulator ring made of ceramic powder having low thermal conductivity may be separately interposed between the insulating plastic structure and the susceptor to support the susceptor and prevent heat of the susceptor from being leaked to the outside.

[0014] Preferably, a ferrite sheet may be wrapped around the outer surface of the excitation coil in contact with the excitation coil to prevent a magnetic flux from being leaked to the outside of the excitation coil.

[0015] Preferably, a graphite sheet may be wrapped around the outer surface of the excitation coil to radiate heat of the excitation coil to the outside.

[0016] Preferably, a laminate sheet of the ferrite sheet and the graphite sheet may be wrapped around the outer surface of the excitation coil to prevent a magnetic flux from being leaked to the outside of the excitation coil and radiate heat of the excitation coil to the outside.

[0017] Preferably, the fine particle generating device may further comprise a pressure sensor provided in an airflow passage communicating with the cavity to sense a negative pressure caused by a puff of a user for the smoking article inserted into the cavity.

[0018] Preferably, the susceptor temperature obtaining unit may calculate the temperature of the susceptor based on current and voltage changes detected by a current sensor and a voltage sensor which measure changes in the current and voltage for heating the susceptor depending on the inductance or reactance varying with changes in the temperature of the susceptor.

[0019] Preferably, the susceptor temperature obtaining unit may be a temperature sensor brought into contact with the outer surface of the susceptor to sense a change in resistance depending on the change in the temperature of the susceptor to measure the temperature, a lead wire of the temperature sensor being electrically connected to the control unit.

[0020] Preferably, the temperature sensor and the lead wire of the temperature sensor may be surrounded by a heat resistant shrinkable tube, which surrounds the outside of the susceptor, and brought into contact with the outer surface of the susceptor. Preferably, the smoking article may comprise a liquid cartridge therein.

[0021] Preferably, the liquid cartridge may comprise a liquid or gel composition containing glycerin VG.

[0022] Preferably, the smoking article may further

comprise a tobacco filler at the upstream or downstream of the liquid cartridge.

[0023] Preferably, the smoking article may further include a filter and a tube, the filter, tube and liquid cartridge being wrapped in single wrapping paper.

[0024] Preferably, the smoking article may comprise a tobacco filler containing glycerin VG. Preferably, the smoking article may further include a filter and a tube, the filter, tube and tobacco filler being wrapped in single wrapping paper.

[0025] An induction heating fine particle generating device according to the present invention has an advantage in that it includes a susceptor as its part to directly measure the temperature of the susceptor and therefore easily control heating of the susceptor.

[0026] An induction heating fine particle generating device according to the present invention has an advantage in that a magnetic heating element can be heated by a one-piece excitation coil wound in a cylindrical shape, with an insulating pipe provided between the magnetic heating element and the excitation coil, which prevents overheating of the excitation coil and improves heating efficiency of the magnetic heating element.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a view showing a prior art induction heating device for heating an aerosol-forming substrate.

FIG. 2 is a schematic exploded sectional view showing a preferred example of a smoking article which can be used in the present invention.

FIG. 3 is a schematic exploded sectional view showing another preferred example of the smoking article which can be used in the present invention.

FIG. 4 is an exploded perspective view showing a fine particle generating device according to a first embodiment of the present invention.

FIG. 5 is an exploded sectional view showing the fine particle generating device according to the first embodiment of the present invention.

FIG. 6 is a perspective view showing an insulating pipe which can be used in the fine particle generating device according to the first embodiment of the present invention.

FIG. 7 is a view showing a first inner part which can be used in the fine particle generating device according to the first embodiment of the present invention.

FIG. 8 is a view showing a heat stick which can be used in the fine particle generating device according to the first embodiment of the present invention.

FIG. 9 is a view showing a second inner part which can be used in the fine particle generating device according to the first embodiment of the present invention.

FIG. 10 is a sectional view showing the fine particle generating device according to the first embodiment

of the present invention.

FIG. 11 is a sectional view showing a fine particle generating device according to a second embodiment of the present invention.

FIG. 12 is an exploded perspective view showing the fine particle generating device according to the second embodiment of the present invention.

FIG. 13 is a sectional view showing part of a fine particle generating device according to a third embodiment of the present invention.

FIG. 14 is a sectional view showing part of a fine particle generating device according to a fourth embodiment of the present invention.

FIG. 15 is a view showing one embodiment of a circuit block diagram for induction heating in the fine particle generating device according to the present invention.

FIG. 16 is a view showing another embodiment of the circuit block diagram for induction heating in the fine particle generating device according to the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0028] Certain embodiments will now be illustrated in the drawings and described in detail in the description, although various changes and modification can be made thereto. Features and advantages of the present invention and the manner of obtaining them will become more apparent by reference to the following description of the embodiments of the invention, taken in conjunction with the accompanying drawings. The present invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein.

[0029] As used herein, the singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0030] It will be further understood that the terms "comprises", "comprising", "includes" and/or "including", when used herein, specify the presence of stated features or components, but do not preclude the presence or addition of one or more other features or components.

[0031] In the following embodiments, the terms "upstream" and "downstream" are used to describe the relative positions of segments of a smoking article in relation to the direction in which a user draws in air through the smoking article. The smoking article includes an upstream end (through which air enters) and an opposite downstream end (through which air exits). In use, the user draws on the downstream end of the smoking article. The downstream end is downstream of the upstream end. The term "end" may also be described as "extreme end".

[0032] The drawings are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Because the size and thickness of each configuration shown in the drawings

are arbitrarily shown for better understanding and ease of description, the present invention is not limited thereto. Example embodiments of the present invention will now be described in detail with reference to the accompanying drawings, so that the present invention can be easily implemented by a person of ordinary skill in the art. However, the present invention may be implemented in various different ways, without being limited to the described embodiments.

[0033] A liquid cartridge which can be inserted into a smoking article for generating an aerosol by heating, and a heating smoking article including the liquid cartridge, that can be used in a fine particle generating device according to a preferred embodiment of the present invention, will now be described with reference to the accompanying drawings. For easy explanation, components of the heating smoking article will be described individually, together with a description of the liquid cartridge therein. Here, the heating smoking article is intended to indicate a smoking article which is heated by electrical resistance or induction heating, not by burning, to generate an aerosol for inhalation by a user. The smoking article contains a proper amount of aerosol-forming substrate and/or shredded tobacco to take an equivalent number of puffs to a single traditional cigarette. The smoking article does not generate a significant amount of aerosol after generating a preset amount of aerosol and will be discarded by the user after used once.

[0034] Referring to FIGS. 2 and 3, a heating smoking article 50 which can be used in the fine particle generating device according to the present invention contains a liquid composition, such as typical shredded tobacco and glycerin, as an aerosol-forming substrate, which will be described below. The heating smoking article 50 according to a first preferred embodiment of the present invention has a laminate structure composed of shredded tobacco 58 located at an upstream end as an aerosol-forming substrate, a liquid cartridge 56 located directly downstream thereof as another aerosol-forming substrate, a tube 54 located directly downstream thereof that provides an aerosol passage, and a filter 52 functioning as a mouthpiece. The relative positions of the liquid cartridge 56 and the shredded tobacco or tobacco filler 58 may be reversed. Alternatively, the shredded tobacco or tobacco filler 58 can be omitted as shown in FIG. 3, or the liquid cartridge 56 can be omitted as in the heating smoking article 50 on markets.

[0035] The liquid cartridge 56 according to the present invention includes a liquid or gel composition; a liquid or gel absorbent soaked with the liquid or gel composition; and wrapping paper wrapped around the side of the liquid or gel absorbent in a cylindrical shape measuring 7 to 20 mm long and 5 to 8 mm in diameter, wherein the liquid or gel absorbent has a sufficient absorption rate to absorb 70 to 120 mg of liquid composition and keep it in the liquid cartridge. The cylindrical shape measuring 7 to 20 mm long and 5 to 8 mm in diameter meets the standard for regular cigarettes or heating smoking articles being cur-

rently used. When the liquid cartridge 56 of the above standard is inserted into the heating smoking article and wrapped in a separate piece of wrapping paper 60, the user will see no difference between the regular cigarettes and the heating smoking articles.

[0036] The present invention is characterized in that the liquid absorbent of the liquid cartridge 56 of the above standard absorbs 70 to 120 mg of liquid or gel composition, and this numerical range indicates the amount of liquid composition that provides an aerosol derived from the liquid composition when the user inhales an aerosol from the shredded tobacco of a single cigarette stick for the heating smoking article. If the amount of liquid or gel composition absorbed by the liquid absorbent is less than the above lower limit (70 mg), the amount of aerosol derived from the liquid composition when the user inhales an aerosol from the shredded tobacco in the heating smoking article would be insufficient. Thus, the amount of liquid composition absorbed by the liquid cartridge should be equal to or greater than the above lower limit (70 mg). If the amount of liquid or gel composition absorbed by the absorbent exceeds the above upper limit (120 mg), it would be difficult to keep the liquid composition absorbed in the absorbent in the liquid cartridge of the above standard, causing the liquid composition to flow out of the liquid cartridge. Thus, the amount of liquid or gel composition absorbed by the liquid cartridge 56 should be equal to or less than the above upper limit (120 mg). A desirable range is between 80 and 110 mg, and a more desirable range is between 90 and 105 mg.

[0037] Another characteristic of the present invention is that the liquid absorbent in the liquid cartridge 56 of the above standard has a sufficient absorption rate to keep the liquid composition having the above range in the liquid cartridge. That is, the liquid composition remains absorbed by the liquid absorbent in the liquid cartridge, without flowing out of the liquid cartridge. Here, the absorption means that the absorbent is soaked with the liquid composition which does not flow out. As described below, the filter, tube, liquid cartridge, and tobacco filler are wrapped in the wrapping paper to form the heating smoking article, wherein the liquid cartridge is brought into direct contact with the tobacco filler or tube or filter without a separate member downstream or upstream, and the liquid composition absorbed by the liquid absorbent of the liquid cartridge is stored in the liquid absorbent, but does not flow out toward the tobacco filler or tube or filter. To this end, preferably, the amount of the liquid composition by the liquid absorbent is 0.13 to 0.32 mg/mm³ per unit volume of the liquid absorbent. This numerical limitation is set for a similar reason to why the numerical limitation is set on the amount of liquid composition absorbed by the absorbent of the present invention. That is, if the amount of liquid composition absorbed by the liquid absorbent is not sufficient, i.e., less than the above lower limit (0.13 mg/mm³), the amount of aerosol derived from the liquid composition when the user inhales an aerosol from the shredded tobacco in the

heating smoking article would be insufficient. Thus, the amount of liquid composition absorbed by the liquid cartridge should be equal to or greater than the lower limit (0.13 mg/mm³). If the amount of liquid composition absorbed by the liquid absorbent exceeds the above upper limit (0.32 mg/mm³), it would be difficult to keep the liquid composition absorbed in the liquid absorbent in the liquid cartridge of the above standard, causing the liquid composition to flow out of the liquid cartridge.

[0038] The liquid composition contains glycerin VG and optionally contains glycerin PG, water, and flavorings. The liquid composition contains 70 to 100 wt% glycerin VG, 0 to 20 wt% glycerin PG, and 0 to 10 wt% water and further contains flavorings added in an amount that is 10 % or less of the total weight of the resulting liquid composition. According to a preferred embodiment, the present invention uses a liquid composition made of 100 wt% glycerin VG. According to another preferred embodiment, the present invention uses a liquid composition made of 80 wt% glycerin VG and 20 wt% glycerin PG. According to a further preferred embodiment, the present invention uses a liquid composition made of 75 wt% glycerin VG, 20 wt% glycerin PG, and 5 wt% water. According to a yet further preferred embodiment, the present invention further contains flavorings added in an amount that is 10 % or less of the total weight of the resulting liquid composition. For example, the flavorings may include licorice, sucrose, fructose syrup, isosweet, cocoa, lavender, cinnamon, cardamom, celery, cascarrilla, fenugreek, cascarrilla, sandalwood, bergamot, geranium, honey essence, rose oil, vanilla, lemon oil, orange oil, mint oil, caraway, cognac, jasmine, chamomile, menthol, ylang-ylang, salvia, spearmint, ginger, coriander, or coffee, etc. In addition, the liquid composition may or may not contain nicotine.

[0039] According to a preferred embodiment, the liquid absorbent of the present invention is made by crumpling or rolling a strip made of a melamine-based foam resin with a thickness of 2 to 3 mm into a cylindrical shape. According to another preferred embodiment, the liquid absorbent of the present invention is made by processing a melamine-based foam resin into a cylindrical shape, and more preferably, the liquid absorbent made of the melamine-based foam resin has a weight of 0.01 to 0.013 mg/mm³ per unit volume. According to test results for the heating smoking article including the liquid cartridge having the liquid absorbent soaked with 100 mg of liquid composition, the liquid composition remained absorbed in the liquid absorbent, without flowing out, during the test, and a sufficient amount of aerosol derived from the liquid composition was observed.

[0040] According to a further preferred embodiment, the liquid absorbent of the present invention is made by crumpling or folding or rolling pulp or a fabric containing pulp into a cylindrical shape or by processing it into a cylindrical shape, and more preferably, the liquid absorbent made of pulp or a fabric containing pulp has a weight of 0.25 to 0.4 mg/mm³ per unit volume. According to test

results for the heating smoking article including the liquid cartridge having the liquid absorbent soaked with 100 mg of liquid composition, the liquid composition remained absorbed in the liquid absorbent, without flowing out, during the test, and a sufficient amount of aerosol derived from the liquid composition was observed.

[0041] According to a yet further preferred embodiment, the liquid absorbent of the present invention is made by crumpling or rolling a cotton woven fabric or non-woven fabric into a cylindrical shape or by processing it into a cylindrical shape, and more preferably, the liquid absorbent made of a cotton woven fabric or non-woven fabric has a weight of 0.2 to 0.35 mg/mm³ per unit volume. According to test results for the heating smoking article including the liquid cartridge having the liquid absorbent soaked with 100 mg of liquid composition, the liquid composition remained absorbed in the liquid absorbent, without flowing out, during the test, and a sufficient amount of aerosol derived from the liquid composition was observed.

[0042] According to a yet further preferred embodiment, the liquid absorbent of the present invention is made by crumpling or rolling a bamboo fiber woven fabric or non-woven fabric into a cylindrical shape or by processing it into a cylindrical shape, and more preferably, the liquid absorbent made of a bamboo fiber woven fabric or non-woven fabric has a weight of 0.15 to 0.25 mg/mm³ per unit volume. According to test results for the heating smoking article including the liquid cartridge having the liquid absorbent soaked with 100 mg of liquid composition, the liquid composition remained absorbed in the liquid absorbent, without flowing out, during the test, and a sufficient amount of aerosol derived from the liquid composition was observed.

[0043] In the smoking article which can be applied to the fine particle generating device according to the present invention, the gel aerosol-forming substrate cartridge contains a gel aerosol-forming substrate which is present in a gel or solid phase at normal temperature and vaporized into an aerosol in a temperature range of 150 to 300 °C and which contains glycerin VG, water and gelatin and optionally contains glycerin PG; a gel receptor for receiving the gel aerosol-forming substrate; and wrapping paper wrapped around the side of the gel receptor in a cylindrical shape measuring 7 to 20 mm long and 5 to 8 mm in diameter. The cylindrical shape measuring 7 to 20 mm long and 5 to 8 mm in diameter meets the standard for regular cigarettes or heating smoking articles being currently used. When the gel aerosol-forming substrate cartridge of the above standard is inserted into the heating smoking article and wrapped in a separate piece of wrapping paper, the user will see no difference between the regular cigarettes and the heating smoking articles.

[0044] Here, the gel aerosol-forming substrate includes a liquid composition made of 80 to 100 wt% glycerin VG and 0 to 20 wt% glycerin PG, contains gelatin having a weight of 1 to 6 g in 100 ml of mixture of 60 to

80 wt% liquid composition and 20 to 40 wt% water at a volume ratio, and optically contains flavorings added less than 10 wt% of the total weight of the resulting liquid composition. Here, preferably, the liquid composition may be included in the gel receptor at an amount of 70 to 120 mg. Alternatively, the liquid composition may be included in the gel receptor at an amount of 0.13 to 0.32 mg/mm³ per unit volume of the gel receptor.

[0045] According to a preferred embodiment, the wrapping paper 60 is made by attaching aluminum foil to paper, and wrapped in a cylindrical shape so that the aluminum foil comes into contact with the liquid absorbent. As can be seen from the construction of the liquid cartridge shown in FIGS. 2 and 3, the liquid absorbent is wrapped in the wrapping paper, in the case of which the wrapping paper can be provided by attaching aluminum foil to paper, and may be wrapped in a cylindrical shape so that the aluminum foil comes into contact with the liquid absorbent. As a result, preferably, there is a need for the wrapping paper (made by attaching aluminum foil to paper) to wrap around the liquid cartridge 56, and there is a need for the wrapping paper 60 shown in FIGS. 2 and 3 to wrap around the filter 52, the tube 54, the liquid cartridge 56 and/or the tobacco filler 58 arranged in series (as described above, their order can be changed and one of them can be omitted). The types of the wrapping paper will be described later.

[0046] As shown in FIGS. 2 and 3, the heating smoking article 50 which can be used in the fine particle generating device according to the present invention may include the tube 54 for providing an aerosol passage, wherein PLA may be inserted into the tube 54 to reduce the temperature of the aerosol to prevent the user from getting burned while inhaling the aerosol.

[0047] As shown in FIGS. 2 and 3, the filter 52 functioning as the mouthpiece allows the aerosol to pass therethrough and blocks the inflow of the liquid. The filter may be made of pulp in a cylindrical or tube shape. On the other hand, the filter contains a flavoring component to increase the user's satisfaction. For example, the flavoring component may include licorice, sucrose, fructose syrup, isosweet, cocoa, lavender, cinnamon, cardamom, celery, cascarilla, fenugreek, cascarilla, sandalwood, bergamot, geranium, honey essence, rose oil, vanilla, lemon oil, orange oil, mint oil, caraway, cognac, jasmine, chamomile, menthol, ylang-ylang, salvia, spearmint, ginger, coriander, or coffee, etc.

[0048] In some cases, the liquid composition may contain nicotine without the tobacco filler 58 of shredded tobacco, and the tube and the filter may be stacked sequentially on the liquid cartridge and wrapped in the wrapping paper to constitute the heating smoking article 50.

[0049] The heating smoking article 50 is usually wrapped in the wrapping paper 60 composed of multiple layers, such as first wrapping paper wrapped around the liquid cartridge, second wrapping paper wrapped around the liquid cartridge and the tobacco filler of shredded tobacco altogether, downstream or upstream from the first

wrapping paper, third wrapping paper wrapped around the liquid cartridge, the tobacco filler and the tube altogether, and fourth wrapping paper wrapped around the whole parts of the heating smoking article. In this manner, the heating smoking article can be obtained through a number of stages of wrapping. In some cases, a process of forming the liquid cartridge can be carried out separately or through a continuous line.

[0050] Alternatively, in order to reduce the manufacturing time and cut down the manufacturing cost, packaging of different materials or different thicknesses may be added to the inside of the outermost wrapping paper wrapped around the whole parts of the heating smoking article to wrap them altogether.

[0051] As shown in FIGS. 2 and 3, in the liquid cartridge which can be applied to the fine particle generating device according to one embodiment of the present invention, the liquid absorbent with the liquid composition absorbed in it is wrapped in the wrapping paper serving as a housing. In addition, the tube and the filter are stacked sequentially at the downstream end of the liquid cartridge. The filter and the tube are wrapped in the wrapping paper, together with the liquid cartridge. The liquid composition remains absorbed in the liquid absorbent in the liquid cartridge, without flowing out of the liquid cartridge, and is vaporized by heating to generate an aerosol. Preferably, the wrapping paper is made of a material that does not deform when heated to a high temperature or when in contact with liquid, or that does not generate harmful components. Alternatively, the wrapping paper may be made of a metal thin film or metal foil, or as described above, may be made by attaching a metal thin film or metal foil to wrapping paper.

[0052] The filter 52 provided at the downstream of the liquid cartridge 56 may have a hollow portion for generating an airflow, but a filter without a hollow portion may also be used. The filter may be composed of one or more segments and may include at least one of a tube filter, a cooling structure and a recess filter, for example. The tube filter has an inner hollow portion. The tube filter and the recess filter may be made of cellulose acetate and the tube functioning as the cooling structure may be made of pure polylactic acid or a combination of polylactic acid and another degradable polymer. More specifically, the filter may be made of acetate, paper, PP, etc. and the wrapping paper wrapped around the filter may be classified into regular paper, porous paper, perforated paper, non-wrapped acetate (NWA), etc. In addition, the filter types may be classified into a mono filter composed of one segment and a composite (double, triple, etc.) filter composed of a number of segments. The filter may be made of acetate tow, plasticizer, activated charcoal, X-DNA, and wrapping paper. The acetate tow refers to an aggregate of continuous filaments of cellulose acetate, which plays a major role in determining draw resistance, which is the most important characteristic of the filter. The properties of the acetate tow is determined in denier. The plasticizer makes cellulose acetate fibers soft and

flexible to form bonds at the contact points between the fibers and make a fiber bundle more rigid. Triacetin is used as a plasticizer for cigarette filters. The activated charcoal, which is one of the absorbents, contains carbon as the main constituent and can be classified by particle size and nature. Source materials used for the activated charcoal include plant materials, such as wood, sawdust, and fruit stones (coconut husk, bamboo, peach seeds, etc.). X-DNA refers to functional particles that are extracted from sea algae and then condensed and processed. As compared with the activated charcoal mainly used for cigarette filters, X-DNA does not affect the taste of cigarettes and exhibits strong anticarcinogenic effects.

[0053] The wrapping paper 60 serves to maintain the shape of a filter plug during the manufacture of the filter. The wrapping paper is required to satisfy physical properties, such as porosity, tensile strength, extension, thickness, glue adhesion, etc. For example, the liquid cartridge 56 may be 14.0 mm long, the filter 52 or the tube 54 may be 2.5 mm long, and the tobacco filler 58 may be 9.0 mm long. The preferred numerical values may be changed as the liquid cartridge 56 or the tobacco filler 58 is omitted as described above.

[0054] FIG. 4 is an exploded perspective view showing a fine particle generating device according to a first embodiment of the present invention and FIG. 5 is an exploded sectional view showing the fine particle generating device according to the first embodiment of the present invention.

[0055] The fine particle generating device according to the first embodiment of the present invention is a grippable and portable-sized fine particle generating device which has a cavity 100 into which a smoking article 50 containing an aerosol-forming substrate and wrapped in wrapping paper 60 can be inserted and which heats the aerosol-forming substrate of the smoking article 50 inserted into the cavity to form an aerosol. Electrical components are arranged in a lower casing and an upper casing (not shown) of this fine particle generating device. In a space defined by the lower casing and the upper casing, a rechargeable battery 210 functioning as a direct current power source in the present invention and a control board 220 constituting a control unit in the present invention are arranged at a lower portion thereof, while electrical components actually used for heating are arranged at an upper portion thereof. A cover casing is coupled to the upper casing to surround the upper casing. The subject matter of the present invention relates to the grippable and portable-sized fine particle generating device. The rechargeable battery 210 can be rechargeable through a charging means such as a USB cable, and the user can insert the smoking article 50 into the cavity 100 of the charged fine particle generating device, heat the susceptor by induction heating to generate an aerosol in the smoking article 50, and inhale the aerosol, which will be described below. In this case, the battery 210 functions as a direct current power source and is supplied to an excitation coil 300 as an alternating current through

the control unit 220, as described below. The grippable and portable-sized fine particle generating device can be easily carried and used by the user.

[0056] The electrical components used for heating are parts for induction heating, such as an excitation coil 300 wound in multiple times in a cylindrical shape, and a susceptor (magnetic heating element) 400 and 800 reacting with the excitation coil 300 such that induction heating occurs due to eddy current losses. Here, the susceptor is preferably a heat pipe 400 provided inside the excitation coil 300 to be surrounded by the excitation coil 300 in the device, made of a hollow cylindrical thin plate defining the cavity 100 into which the smoking article 50 can be inserted, and heated to a temperature of 400 °C or lower by induction heating due to eddy current losses, by reacting with the excitation coil. The susceptor may be heated to a temperature of 1,000 °C or higher depending on the magnitude of the alternating current applied to the excitation coil 300, whereas, in the present invention, the susceptor is heated to a temperature of 400 °C or lower, as stated above. The susceptor is heated to a temperature between 100 and 400 °C depending on the magnitude of the alternating current applied to the excitation coil 300 to heat the aerosol-forming substrate of the smoking article 50 inserted into the cavity 100 and generate the aerosol. According to a preferred embodiment, the target temperature may range between 200 and 350 °C, and according to a more preferred embodiment, the target temperature may range between 200 and 320 °C (for example, the target temperature may be set to 280 °C). In some cases, the target temperature may range between 150 and 250 °C (for example, the target temperature may be set to 180 °C). This may vary depending on whether an aerosol is generated from liquid or gel glycerin, or a tobacco filler, or a tobacco filler soaked with glycerin. In any case, an aerosol generated in the smoking article 50 is inhaled into the user's mouth through the tube 54 and the filter 52. If the temperature of the aerosol is too high, even if the aerosol is cooled through the inhalation, the user may feel discomfort or get burned. Moreover, too much aerosol may be generated, making it difficult to take multiple puffs. With this taken into consideration, the target temperature of the susceptor should be preset. For these reasons, the above upper limit is set on the target temperature of the susceptor. According to a preferred embodiment, the temperature of a generated aerosol measured after it passes through the tube 54 and the filter 52 may be a mouth end temperature, which should be lower than 50 °C, preferably 45 °C or lower, not to cause the user to feel discomfort. A desirable temperature range for the aerosol at the mouth end is 25 to 45 °C, and a more desirable temperature range for the aerosol at the mouth end is 30 to 40 °C.

[0057] There can be one or plural susceptors. In the first embodiment of the present invention, the heat pipe 400 and the heat stick 800 provided in the casing serve as the susceptor. Here, the inner surface of the heat pipe

400 which is a susceptor is brought into contact with at least part of the outer surface of the wrapping paper 60 of the smoking article 50 inserted into the cavity 100 outside the generally cylindrical smoking article 50, the induction-heated susceptor heats the aerosol-forming substrate in the wrapping paper 60 by heat transfer, and the heat stick 800 is inserted into the smoking article 50 to heat the aerosol-forming substrate of the smoking article 50. Both the heat pipe 400 and the heat stick 800 are produced in a thin shape, and the heat stick 800 is a thin hollow rod with a top tip end closed.

[0058] The heat pipe 400 or the heat stick 800 provided in the first embodiment may be provided alone. If the heat pipe 400 is provided alone (as in a second embodiment), as described above, the inner surface of the heat pipe 400 which is a susceptor is brought into contact with at least part of the outer surface of the wrapping paper 60 of the smoking article 50 inserted into the cavity 100 outside the generally cylindrical smoking article 50, and the induction-heated susceptor heats the aerosol-forming substrate in the wrapping paper 60 by heat transfer. The induction-heated heat pipe 400 heats the aerosol-forming substrate such as glycerin or shredded tobacco in the tobacco filler 58 or the aerosol-forming substrate such as glycerin in the liquid cartridge 56 inside the smoking article 50 by heat transfer, without directly contacting the tobacco filler 58 or the liquid cartridge 56 in the smoking article 50, to generate the aerosol. Accordingly, even if the smoking article 50 is removed from the cavity 100 after a sufficient amount of aerosol is generated from the aerosol-forming substrate, residues of the smoking article 50 are little or not left in the cavity 100.

[0059] The smoking article 50 can be inserted into the cavity 100 defined by the heat pipe 400. After the smoking article 50 is inserted into the cavity 100, it is heated by the induction-heated susceptor. Then, after a given amount of aerosol is generated, i.e., if the user does not want to inhale the aerosol from the smoking article 50, the used smoking article 50 is removed from the cavity 100 and discarded. The cavity 100 should be sufficiently large to receive the smoking article 50. However, if a distance between the inner surface of the heat pipe 400 defining the cavity 100 to the outer surface of the smoking article 50 is large, sufficient heat may not be transferred from the induction-heated heat pipe 400 to the aerosol-forming substrate of the smoking article 50. Therefore, preferably, the inner surface of the heat pipe 400 is brought into contact with at least part of the outer surface of the wrapping paper 60 of the smoking article 50 inserted into the cavity 100.

[0060] The present invention is characterized in that a temperature sensor 420 is provided on the outer surface of the heat pipe 400 which functions as a susceptor and defines the cavity 100 in the center. The temperature sensor 420, which functions as a susceptor temperature obtaining unit for obtaining the temperature of the susceptor, is a temperature sensor 420 brought into contact with the outer surface of the heat pipe 400 which is the

susceptor to sense a change in resistance depending on the change in the temperature of the susceptor to measure the temperature, a lead wire 440 of the temperature sensor being electrically connected to the control board 220 which is the control unit. The temperature sensor 420 and the lead wire 440 of the temperature sensor is surrounded by a heat resistant shrinkable tube, which surrounds the outside of the heat pipe 400 which is the susceptor, and brought into contact with the outer surface of the heat pipe 400. Using the shrinkable tube to surround the temperature sensor 420 and the lead wire 440 of the temperature sensor ensures a rigid surface contact between the temperature sensor 420 and the heat pipe 400, which facilitates the temperature sensor 420 to sense the change in the resistance depending on the change in the temperature of the heat pipe 400. The present invention is characterized in that the susceptor is heated to a temperature of 400 °C or lower by induction heating. Within this temperature range, the heat resistant shrinkable tube can hold the temperature sensor 420 and the lead wire 440 of the temperature sensor in position with sufficiently elasticity, without being degraded. In this way, the temperature sensor 420 is fixed to the outer surface of the heat pipe 400, which ensures a contact between the temperature sensor 420 and the surface of the susceptor and improves efficiency of the working process, without needing a separate equipment or process for installing the temperature sensor 420. In the prior art, the susceptor is provided in the smoking article, which makes it impossible to directly contact the temperature of the subsector. On the contrary, in the present invention, the temperature of the susceptor can be directly measured by the temperature sensor 420, or as discussed later, the temperature of the susceptor can be calculated by measuring a current and voltage applied to the excitation coil, as a result of which it is possible to control an alternating current supplied to the excitation coil depending on the temperature of the susceptor in induction heating of the susceptor.

[0061] The excitation coil 300, which is wound in multiple times, supplies an alternating current to the susceptor to cause induction heating to the susceptor due to eddy current losses. If intense heat is transferred to the excitation coil 300, it increases the resistance of the excitation coil 300 itself. Therefore, as described later, there is a need for a means provided between the susceptor and the excitation coil to prevent heat of the susceptor from being transferred to the excitation coil 300. On the other hand, it is necessary to radiate heat transferred from the susceptor to the excitation coil 300 to the outside to reduce the temperature of the excitation coil 300. To this end, preferably, a graphite sheet 360 is wrapped around the outer surface of the excitation coil 300. The graphite sheet 360 serves to radiate heat of the excitation coil 300 to the outside. In addition, if a ferrite sheet 340 is wrapped around the outer surface of the excitation coil 300, it can prevent a magnetic leakage to the outside of the excitation coil 300, which results in concentrating the

magnetic force from the excitation coil 300 to the susceptor inside the excitation coil 300. Wrapping one or more of the graphite sheet and the ferrite sheet around the outer surface of the excitation coil 300 achieves the aforementioned effects. More preferably, as shown in the drawing, a laminate sheet of the ferrite sheet 340 and the graphite sheet 360 may be wrapped around the outside of the excitation coil 300.

[0062] An insulating part is provided between the excitation coil 300 and the susceptor, in particular the heat pipe 400 to prevent heat of the susceptor from being transferred to the excitation coil 300. As one preferred example, the insulating part may be a separate air layer 530 (see FIGS. 13 and 14) or an insulating pipe 500 (see FIGS. 4 through 6). FIG. 6 is a perspective view showing the insulating pipe which can be used in the induction heating fine particle generating device according to the first embodiment of the present invention. The smooth outer periphery of the insulating pipe 500 serves to support the windings of the excitation coil 300, and axial grooves 510 are circumferentially arranged on the entire inner periphery of the insulating pipe 500 to form an air layer for insulation and minimize the contact area between the heat pipe 400 and the insulating pipe 500. Although the inner shape of the insulating pipe 500 provided in the first embodiment has the axial grooves 510, wedge grooves, spiral grooves, annular grooves and mesh-like grooves may be employed so far as they can minimize the contact surface. Minimizing the contact surface will minimize conductive heat transfer from the induction-heated susceptor to the insulating pipe.

[0063] Placing the insulating pipe 500 between the excitation coil 300 and the susceptor can prevent induction heat generated in the susceptor from being transferred to the excitation coil 300. If intense heat generated in the susceptor is transferred to the excitation coil 300, it increases the resistance of the excitation coil 300 itself, which reduces the strength of the magnetic field induced by the excitation coil 300 and then reduces induction heating occurring in the susceptor. Thus, placing the insulating part such as the insulating pipe 500 or the air layer between the excitation coil 300 and the susceptor improves induction heating occurring in the susceptor. In addition, there is less energy loss, which makes it possible to easily control the heating temperature of the susceptor.

[0064] The heat pipe 400 and the heat stick 800 are made of a metal material which can be magnetized by the excitation coil 300. According to a preferred embodiment, stainless steel is used. Stainless steel is available at a low cost, is easily processed into a thin plate cylinder due to excellent processability, and has an excellent magnetizing property to function as a susceptor for heating. A first inner part 600 supports a lower end of the heat pipe 400 and fixes the heat stick 800, and a second inner part 700 is coupled to a lower portion of the first inner part 600 to fix the heat stick 800 together with the first inner part 600. The first inner part 600 and the second

inner part 700 may be made of heat resistant plastic to resist heating of the heat pipe 400 and the heat stick 800. The first inner part 600 and the second inner part 700 may be formed of engineering plastic such as PEEK by injection molding.

[0065] An insulating film using a filler having an insulating and shielding function may be attached to the outer wall of the insulating pipe 500 applied for insulation, to improve insulation efficiency of the insulating pipe 500. Examples of the insulating filler may include ceramic powder such as zirconia having low thermal conductivity, and ceramic powder such as porous silica gel, porous alumina, and aerogel.

[0066] Alternatively, an insulating paint using a filler having an insulating and shielding function may be applied to the outer wall of the insulating pipe 500 applied for insulation, to improve insulation efficiency of the insulator. Examples of the insulating filler may include ceramic powder such as zirconia having low thermal conductivity, and ceramic powder such as porous silica gel, porous alumina, and aerogel.

[0067] As another example, the insulating pipe with the inner grooves may be replaced by a hollow tube. Heat generated in the susceptor can be restricted to the aerosol generation site using the hollow tube, which leads to improved efficiency. A porous insulator such as zeolite and aerosol powder may be filled in the hollow tube, but most preferably, an air layer is formed in the hollow tube. Even the hollow tube which has not been filled can sufficiently obtain the insulating effect using the air layer.

[0068] FIG. 7 is a view showing the first inner part provided in the induction heating fine particle generating device according to the first embodiment of the present invention. Referring to FIGS. 4, 5 and 7, a circular groove 610 is provided in the top of the first inner part 600, such that part of the lower end of the heat pipe 400 is inserted into and supported in the circular groove 610. Here, for the insulation of the heat pipe 400, a plurality of ribs 612 are formed on the circular groove 610 and arranged at intervals from the bottom of the circular groove 610. That is, an air layer is formed between the bottom of the circular groove 610 and the bottom of the heat pipe 400. In addition, a through hole 614 is provided to pass through the side of the circular groove 610, such that the air flows in and out through an airflow passage discussed later. This airflow passage forms an airflow passage communicating with the cavity 100 defined by the heat pipe 400, and a pressure sensor (not shown) for sensing a negative pressure caused by a puff of the user for the smoking article 50 inserted into the cavity 100 is provided in position on the airflow passage. The pressure sensor senses a negative pressure caused by a puff of the user for the smoking article 50 inserted into the cavity 100, which can be used by the control unit to count the number of puffs, more preferably, to calculate an accumulated puff amount. In this embodiment as well as the other embodiments, the pressure sensor may be provided in position on the airflow passage communicating with the cavity

100 to sense the negative pressure caused by the puff of the user for the smoking article 50 inserted into the cavity 100. A hole 616 is formed in the bottom center of the circular groove 610, through which the upper portion of the heat stick 800 passes, such that part of the upper portion of the heat stick 800 is positioned in the heat pipe 400. In addition, a guide portion 620 for guiding the lead wire of the excitation coil 300 is provided at one side of the outer surface of the first inner part 600. The lead wire 320 of the excitation coil 300 is drawn out through the guide portion 620 to make an electrical contact with the control board 220. Also, fixing portions 630 may be provided to fix the first inner part 600 to brackets for fixing the battery 210 and the control board 220. In the first embodiment of the present invention, the first inner part 600 and the brackets are screwed to each other, thus the fixing portions 630 are screw holes. On the other hand, part of the heat stick 800 is positioned at the lower portion of the first inner part 600, and a receiving portion 640 (see FIG. 5) into which the second inner part 700 for fixing the heat stick 800 is fixedly inserted is also provided at the lower portion of the first inner part 600. Optionally, if the heat stick 800 is not provided, the second inner part 700 is not required. In this case, the center hole 616 may not be formed as in the second embodiment described below, or alternatively, the space for the center hole 616 and the space of the receiving portion 640 for receiving the second inner part 700 may be used as a space for an airflow passage and a space for a pressure sensor. In any case, needless to say, the pressure sensor should be installed on the airflow passage communicating with the smoking article 50 inserted into the cavity 100.

[0069] FIG. 8 is a view showing the heat stick provided in the induction heating fine particle generating device according to the first embodiment of the present invention. Referring to FIGS. 4, 5 and 8, the heat stick 800 includes an upper rod 810 positioned in the heat pipe 400, passing through the first inner part 600, a flange portion 820 for determining the position so that the heat stick 800 can be positioned in the heat pipe 400, passing through the first inner part 600 by a certain length, and for aiding in fixing the heat stick 800, and a lower rod 830 protruding from the bottom of the flange portion 820. Here, the heat stick 800 is a hollow rod with a top tip end closed. An air layer is formed in the center of the heat stick 800 to give an insulating effect, and the hollow shape has an advantage of facilitating induction heating. As shown, the heat stick 800 may be formed in a rod shape. In the case of a solid rod shape of FIG. 8, it may be made of a plate type material having the same shape as that of the section of the center thereof. Alternatively, the heat stick may be produced in a cross shape of these plate type materials. In any case, the heat stick 800 is made merely by processing a magnetizable metal material, preferably, a stainless steel thin plate. Since it is not required to install an additional component (such as heater patterns) on the heat stick 800 which is a workpiece, the heat stick only has to be formed in a desired shape and

fixed to a fixing structure therefor. As already described, the heat stick 800 has an advantage in that it is inserted into the smoking article 50 and brought into direct contact with the aerosol-forming substrate of the smoking article 50 to heat it using induction heat. That is, the heat stick directly contacts the inside of the smoking article and transfers heat. However, if the used smoking article 50 is removed from the cavity 100, residues of the aerosol-forming substance in the smoking article 50 are likely to be left in the cavity 100, which requires cleaning. As a result, there will be an increasing need for the heat stick 800 so far as it can maintain the above advantage and minimize the above disadvantage by the fact that the heat stick 800 has a suitable shape to be easily inserted into the smoking article 50 and to be removed from the smoking article 50 to prevent residues of the smoking article 50 from falling into the cavity 100. When the shape of the heat stick 800 allows such insertion and removal, it can achieve the above advantage and minimize the above disadvantage.

[0070] FIG. 9 is a view showing the second inner part provided in the induction heating fine particle generating device according to the first embodiment of the present invention.

[0071] Referring to FIGS. 4 through 9, the second inner part 700 is fixedly inserted into the receiving portion 640 (see FIG. 5) formed at the lower portion of the first inner part 600, and the flange portion 820 and the lower rod 830 of the heat stick 800 are engaged therewith to fix the heat stick 800. An upper portion 710 of the second inner part 700 is complementary in shape to the flange portion 820 of the heat stick 800. In addition, an insertion groove 720 into which the lower rod 830 of the heat stick 800 is inserted is provided in the center of the upper portion 710. Further, a fastening portion 730 for fastening to the first inner part 600 is provided at the lower portion. In the first embodiment, the first inner part 600 and the second inner part 700 are screwed to each other, so the fastening portion 730 is a fastening boss with a screw groove.

[0072] FIG. 10 is a sectional view showing the induction heating fine particle generating device according to the first embodiment of the present invention. Here, the air introduced through a hole formed in the cover casing (not shown) is transferred, via an airflow hole 140 formed in the upper casing, through the through hole 614 (see FIG. 7) of the first inner part 600 and an airflow passage space 120, into the heat pipe 400, and the smoking article 50 inserted into the heat pipe 400 is heated to generate fine particles or aerosol for inhalation by the user.

[0073] Although both the heat pipe 400 and the heat stick 800 are used as the susceptor in the first embodiment, the heat pipe 400 may be made of a non-magnetizable material not to heat but to receive the smoking article 50, and only the heat stick 800 may be used as the susceptor in other embodiments.

[0074] FIG. 11 is a sectional view showing an induction heating fine particle generating device according to a second embodiment of the present invention and FIG.

12 is an exploded perspective view showing the induction heating fine particle generating device according to the second embodiment of the present invention. The induction heating fine particle generating device according to the second embodiment of the present invention only includes the heat pipe 400 into which the smoking article 50 is inserted as a susceptor and does not include the heat stick. Therefore, it only includes the first inner part 600 for supporting the heat pipe 400 and does not include the second inner part unlike the first embodiment. The first inner part 600 provided in the second embodiment does not have a through hole in the bottom since the heat stick does not pass therethrough. The other construction is similar to that of the first embodiment. A plurality of ribs are provided to allow the lower end of the heat pipe 400 to float, and a through hole is provided on the side to allow the inflow of the air.

[0075] Although the components of the smoking article 50 are shown in an exaggerated manner, the cavity 100 of the heat pipe 400 functioning as the susceptor should be large enough to house the aerosol-forming substrate 56 and 58 of the smoking article 50. Thus, as the heat pipe is heated, the aerosol-forming substrate 56 and 58 is heated to generate an aerosol in the smoking article 50.

[0076] The construction of the second embodiment is the same as that of the first embodiment except that it does not include the heat stick as described above. In particular, the pressure sensor installed in position can sense a negative pressure caused by the inhalation of the user from the smoking article 50 through the airflow passage space 120.

[0077] FIG. 13 is a sectional view showing an induction heating fine particle generating device according to a third embodiment of the present invention and FIG. 14 is a sectional view showing an induction heating fine particle generating device according to a fourth embodiment of the present invention.

[0078] The third and fourth embodiments are different from the first and second embodiments in that the heat pipe 400 functioning as the susceptor is not positioned in the insulating pipe 500 and the air layer 530 is clearly provided between an insulating structure 520 (see FIG. 14) and the heat pipe 400 functioning as the susceptor. The air layer 530 functions as an insulating part to block heat from the heat pipe 400 to the excitation coil 300.

[0079] Similar to the first and second embodiments, the lower end of the heat pipe 400 is supported by a first inner part having a little different shape, which is referred to as a first inner part supporting portion 650. However, similar to the first and second embodiments, it supports the lower end of the heat pipe 400.

[0080] The upper end of the heat pipe 400 is supported by an insulating structure 520 corresponding to the insulating pipe of the first and second embodiments. The insulating structure 520 supports the upper end of the heat pipe 400 and provides a space for the excitation coil 300 to be wound around on its outer periphery. As described above, the air layer 530 and the insulating structure 520

can minimize heat transfer from the heat pipe 400 which is the susceptor to the excitation coil 300.

[0081] A shrinkable tube 460 is provided on the outer surface of the heat pipe 400 to hold the temperature 420 and the lead wire 440 of the temperature sensor to contact the heat pipe 400, and a laminate sheet of the graphite sheet 360 and the ferrite sheet 340 is wrapped around the outer surface of the excitation coil 300. In addition, in the fourth embodiment, thermal insulator rings 560 and 562 made of ceramic powder having low thermal conductivity may be separately interposed in a position where the first inner part supporting portion 650 and the insulating structure 520 which are the insulating plastic structures support the heat pipe 400 which is the susceptor, to thereby support the heat pipe 400 and prevent heat of the heat pipe from being transferred to the outside through the structure.

[0082] FIG. 15 is a view showing one embodiment of a circuit block diagram for induction heating in the induction heating fine particle generating device according to the present invention.

[0083] Referring to FIG. 15, the induction heating fine particle generating device according to the present invention heats a susceptor 2007 by induction heating. More specifically, an MCU 2001 controls a power boosting circuit 2002 to amplify a DC voltage supplied from a battery 2003 for induction heating and supply a direct current to an induction heater control logic 2004. The power boosting circuit 2002 is adopted for stable power supply to heat the susceptor 2007 by induction heating when the battery 2003 is used as a power source for induction heating. The MCU 2001 also inputs an PWM signal to the induction heater control logic 2004. The induction heater control logic 2004 performs a switching operation depending on the PWM signal input from the MCU 2001 to convert the direct current supplied from the power boosting circuit 2002 into an alternating current and supply it to a coil 2006 to heat the susceptor 2007 by induction heating.

[0084] The MCU 2001 inputs the PWM signal to the induction heater control logic 2004 to transfer a resonance frequency obtained by values of the coil 2006 and a capacitor 2005 to increase the temperature of the susceptor 2007 in initial driving, and the induction heater control logic 2004 supplies the alternating current to the coil 2006 at the resonance frequency.

[0085] After a preset time elapses, the MCU 2001 inputs the PWM signal to the induction heater control logic 2004 to make a frequency distant from the resonance frequency not to increase the temperature of the susceptor 2007 any more, and accordingly, the induction heater control logic 2004 supplies the alternating current to the coil 2006 at the frequency distant from the resonance frequency.

[0086] The MCU 2001 can input the PWM signal to the induction heater control logic 2004 to adjust the frequency with the lapse of the preset time, and in some embodiments, the MCU 2001 may calculate the temperature of

the susceptor 2007 depending on values detected by a temperature sensor 2008 and a voltage sensor 2009, adjust the frequency of the PWM signal depending on the required temperature, and input the PWM signal to the induction heater control logic 2004, such that the induction heater control logic 2004 can control the frequency of the alternating current supplied to the coil 2006. More specifically, when the induction heater control logic 2004 supplies the alternating current to the coil 2006, the susceptor 2007 is heated by induction heating, the temperature of the susceptor 2007 is changed, and then the inductance or reactance is changed, as a result of which the current and voltage for heating the susceptor 2007 are changed. The temperature sensor 2008 measures the current supplied to the coil 2006 and inputs it to the MCU 2001, and the voltage sensor 2009 converts the alternating voltage supplied to the coil 2006 into the direct current voltage with a voltage level which can be read by the MCU, and inputs it to the MCU 2001, and the MCU 2001 calculates the temperature of the susceptor 2007 depending on changes in the current and voltage values input through the temperature sensor 2008 and the voltage sensor 2009 to sense a change in the temperature of the susceptor 2007, adjusts the frequency of the PWM signal depending on the required temperature, and inputs the PWM signal to the induction heater control logic 2004, such that the induction heater control logic 2004 can supply the alternating current to the coil 2006, adjusting its frequency depending on the PWM signal input from the MCU 2001.

[0087] FIG. 16 is a view showing another embodiment of the circuit block diagram for induction heating in the induction heating fine particle generating device according to the present invention. The components indicated by the same reference numerals as those of FIG. 15 perform the same operation. Referring to FIG. 16, a temperature sensor 2010 senses the temperature of the susceptor 2007 and inputs it to the MCU 2001, and the MCU 2001 senses a change in the temperature of the susceptor 2007 accordingly, adjusts the frequency of the PWM signal depending on the required temperature, and inputs the PWM signal to the induction heater control logic 2004, such that the induction heater control logic 2004 can supply the alternating current to the coil 2006, adjusting its frequency depending on the PWM signal input from the MCU 2001.

[0088] The induction heating fine particle generating device according to the present invention includes the susceptor as its part to directly measure the temperature of the susceptor and therefore easily control heating of the susceptor.

[0089] In the induction heating fine particle generating device according to the present invention, the magnetic heating element can be heated by the one-piece excitation coil wound in a cylindrical shape, with the insulating pipe provided between the magnetic heating element and the excitation coil, which prevents overheating of the excitation coil and improves heating efficiency of the mag-

netic heating element.

Claims

1. A grippable and portable-sized fine particle generating device with an induction heater that has a cavity into which a smoking article containing an aerosol-forming substrate and wrapped in wrapping paper can be inserted and that heats the aerosol-forming substrate of the smoking article inserted into the cavity to form an aerosol, the fine particle generating device comprising:

an excitation coil provided in the device and wound in multiple times;

a metal susceptor provided inside the excitation coil to be surrounded by the excitation coil in the device, made of a hollow cylindrical thin plate defining the cavity, and heated to a temperature of 400 °C or lower by induction heating due to eddy current losses, by reacting with the excitation coil, the inner surface of the susceptor being brought into contact with at least part of the outer surface of the wrapping paper of the smoking article inserted into the cavity, the induction-heated susceptor heating the aerosol-forming substrate in the wrapping paper by heat transfer to form an aerosol;

an insulating part provided between the susceptor and the excitation coil in the device to prevent heat of the susceptor from being transferred to the excitation coil;

a structure provided in the device to support at least part of one of the susceptor and the excitation coil;

a susceptor temperature obtaining unit provided in the device to obtain the temperature of the susceptor;

a rechargeable battery provided in the device to function as a direct current power source; and a control unit electrically connected to the excitation coil, the susceptor temperature obtaining unit and the battery, and supplied with direct current power from the battery, to supply an alternating current having a resonance frequency or an alternating current having a frequency different from the resonance frequency to the excitation coil depending on the temperature of the susceptor and heat the susceptor to a desired temperature by induction heating.

2. The fine particle generating device of claim 1, further comprising:

a susceptor inserted through a lower center portion of the smoking article inserted into the cavity to heat the aerosol-forming substrate in the smoking article in direct contact with the aerosol-forming substrate.

3. The fine particle generating device of claim 1 or 2, wherein the susceptor is made of a stainless steel thin plate.

4. The fine particle generating device of any one of claims 1 to 3, wherein the insulating part is an air layer provided between the susceptor and the excitation coil.

5. The fine particle generating device of any one of claims 1 to 4, wherein the structure for supporting at least part of one of the susceptor and the excitation coil is an insulating plastic structure made of heat resistant plastic and provided between the susceptor and the excitation coil to function as an insulating part for preventing heat of the susceptor from being transferred to the excitation coil.

6. The fine particle generating device of claim 5, wherein the insulating plastic structure is an insulating pipe for supporting at least part of the susceptor on the outside of the susceptor, the excitation coil being wound around the outer surface of the structure.

7. The fine particle generating device of claim 5, wherein a thermal insulator ring made of ceramic powder having low thermal conductivity is separately interposed between the insulating plastic structure and the susceptor to support the susceptor and prevent heat of the susceptor from being leaked to the outside.

8. The fine particle generating device of any one of claims 1 to 7, wherein a ferrite sheet is wrapped around the outer surface of the excitation coil in contact with the excitation coil to prevent a magnetic flux from being leaked to the outside of the excitation coil.

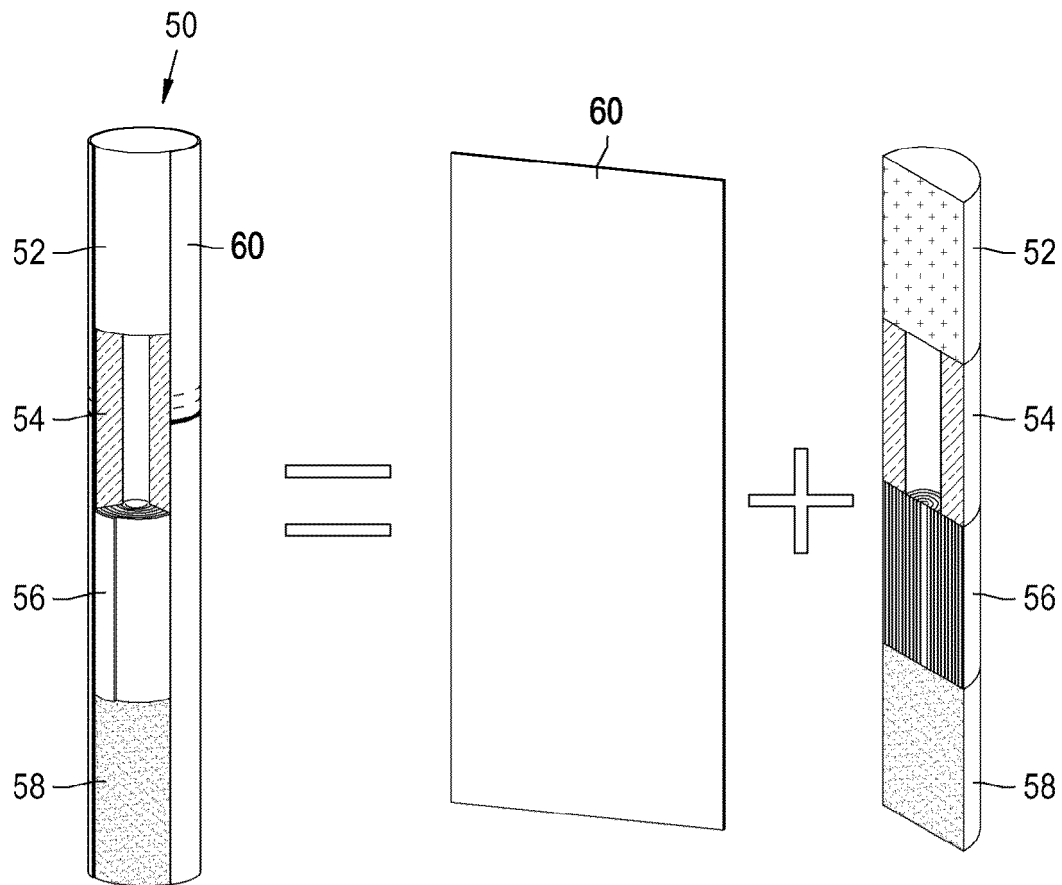
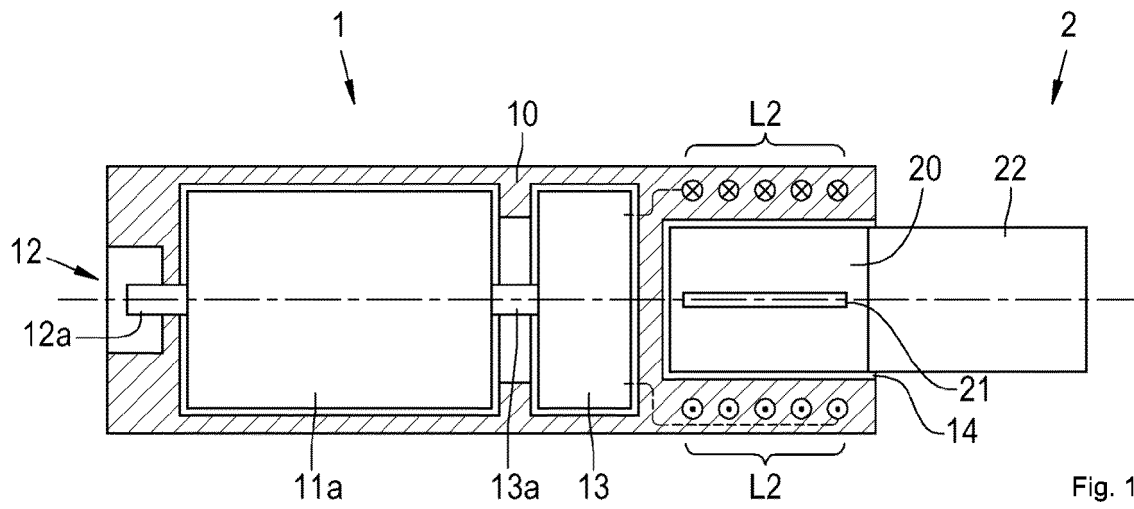
9. The fine particle generating device of any one of claims 1 to 8, wherein a graphite sheet is wrapped around the outer surface of the excitation coil to radiate heat of the excitation coil to the outside.

10. The fine particle generating device of any one of claims 1 to 9, wherein a laminate sheet of the ferrite sheet and the graphite sheet is wrapped around the outer surface of the excitation coil to prevent a magnetic flux from being leaked to the outside of the excitation coil and radiate heat of the excitation coil to the outside.

11. The fine particle generating device of any one of claims 1 to 10, further comprising:

a pressure sensor provided in an airflow passage communicating with the cavity to sense a negative pressure caused by a puff of a user for the smoking article inserted into the cavity.

12. The fine particle generating device of any one of claims 1 to 11, wherein the susceptor temperature obtaining unit calculates the temperature of the susceptor based on current and voltage changes detected by a current sensor and a voltage sensor which measure changes in the current and voltage for heating the susceptor depending on the inductance or reactance varying with changes in the temperature of the susceptor. 5
- 10
13. The fine particle generating device of any one of claims 1 to 12, wherein the susceptor temperature obtaining unit is a temperature sensor brought into contact with the outer surface of the susceptor to sense a change in resistance depending on the change in the temperature of the susceptor to measure the temperature, a lead wire of the temperature sensor being electrically connected to the control unit. 15
- 20
14. The fine particle generating device of claim 13, wherein the temperature sensor and the lead wire of the temperature sensor are surrounded by a heat resistant shrinkable tube, which surrounds the outside of the susceptor, and brought into contact with the outer surface of the susceptor. 25
- 30
15. The fine particle generating device of any one of claims 1 to 14, wherein the smoking article comprises a liquid cartridge therein. 30
- 35
16. The fine particle generating device of claim 15, wherein the liquid cartridge comprises a liquid or gel composition containing glycerin VG. 35
- 40
17. The fine particle generating device of claim 15, wherein the smoking article further comprises a tobacco filler at the upstream or downstream of the liquid cartridge. 40
- 45
18. The fine particle generating device of claim 15, wherein the smoking article further comprises a filter and a tube, the filter, tube and liquid cartridge being wrapped in single wrapping paper. 45
- 50
19. The fine particle generating device of any one of claims 1 to 18, wherein the smoking article comprises a tobacco filler containing glycerin VG. 50
- 55
20. The fine particle generating device of claim 19, wherein the smoking article further comprises a filter and a tube, the filter, tube and tobacco filler being wrapped in single wrapping paper. 50
- 55



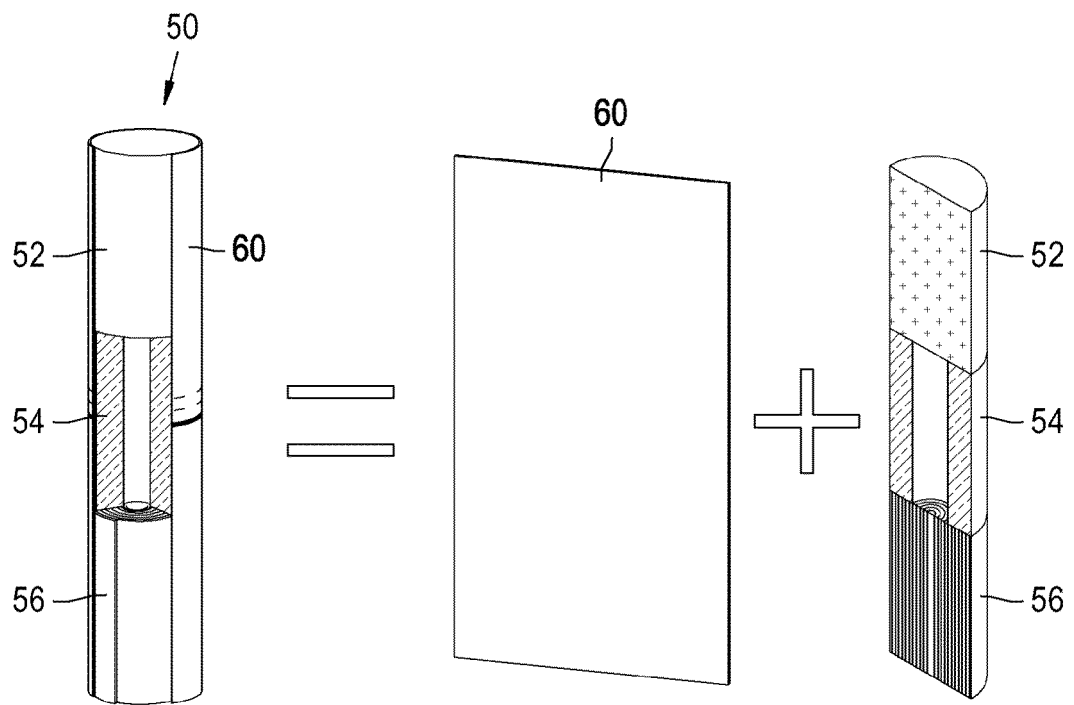


Fig. 3

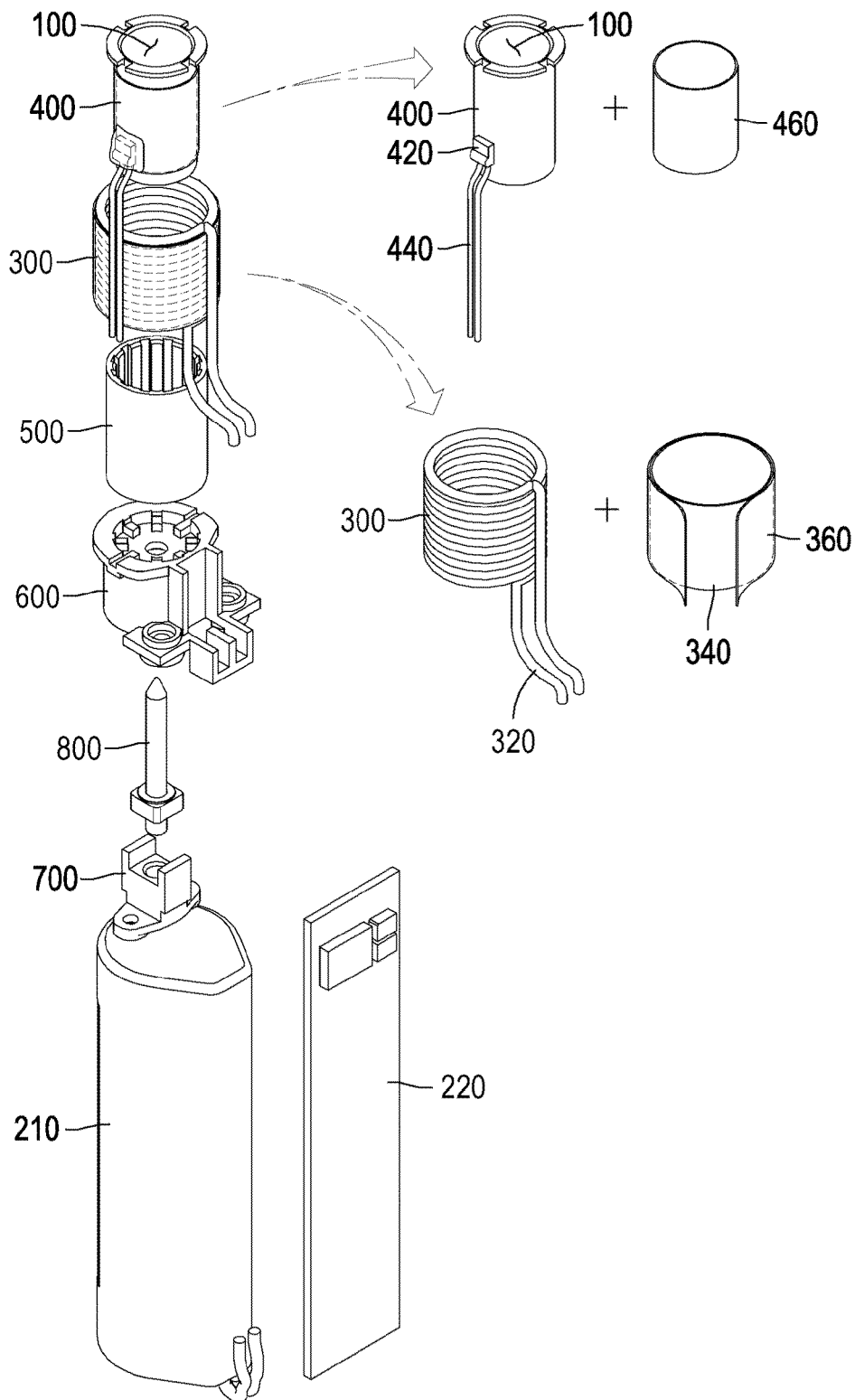


Fig. 4

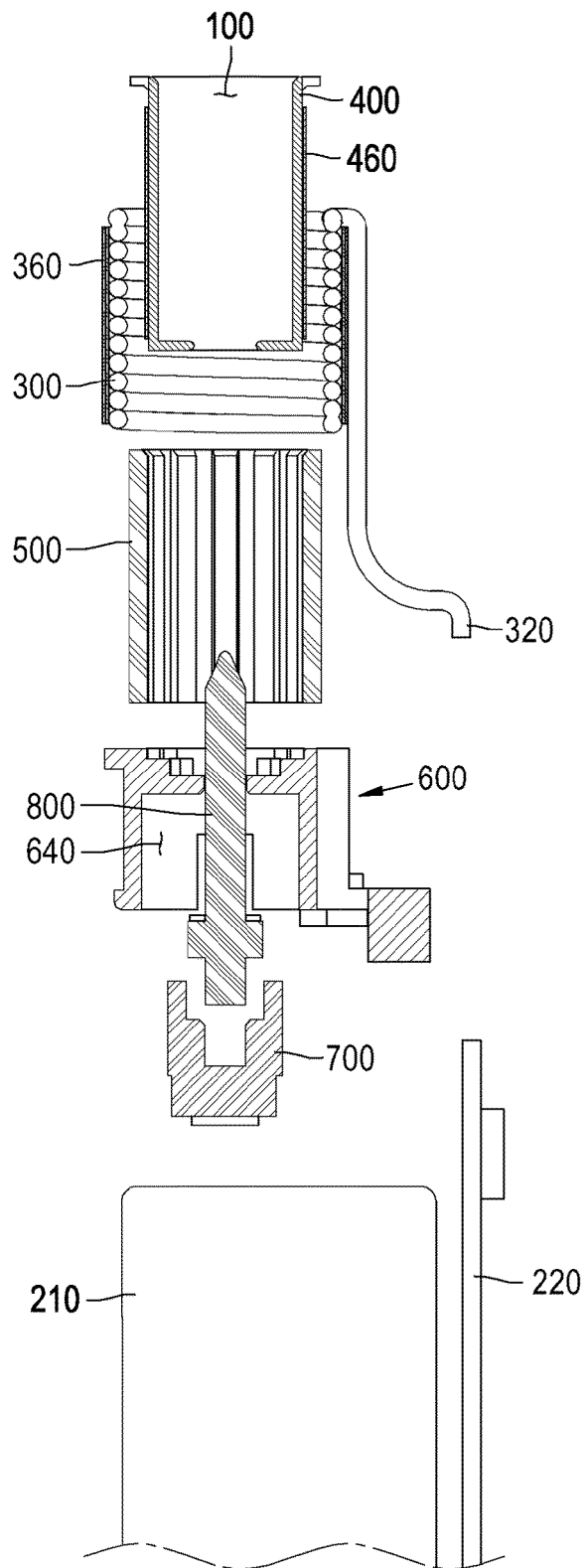


Fig. 5

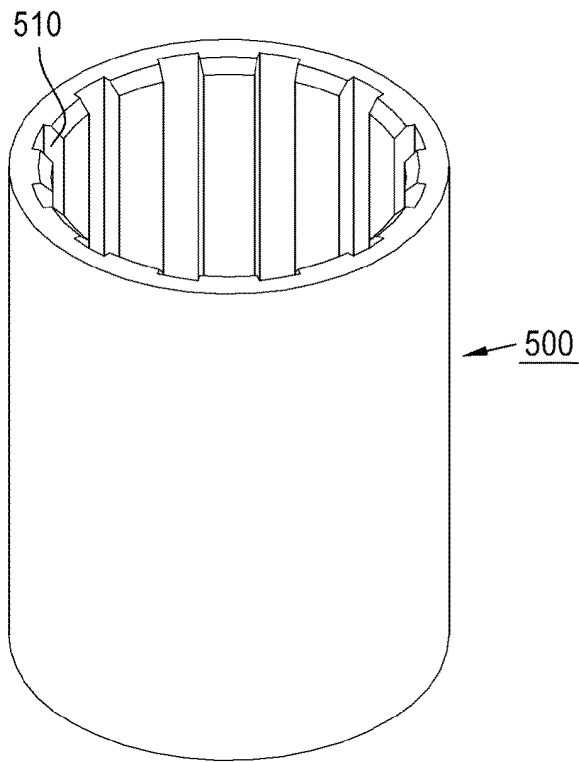


Fig. 6

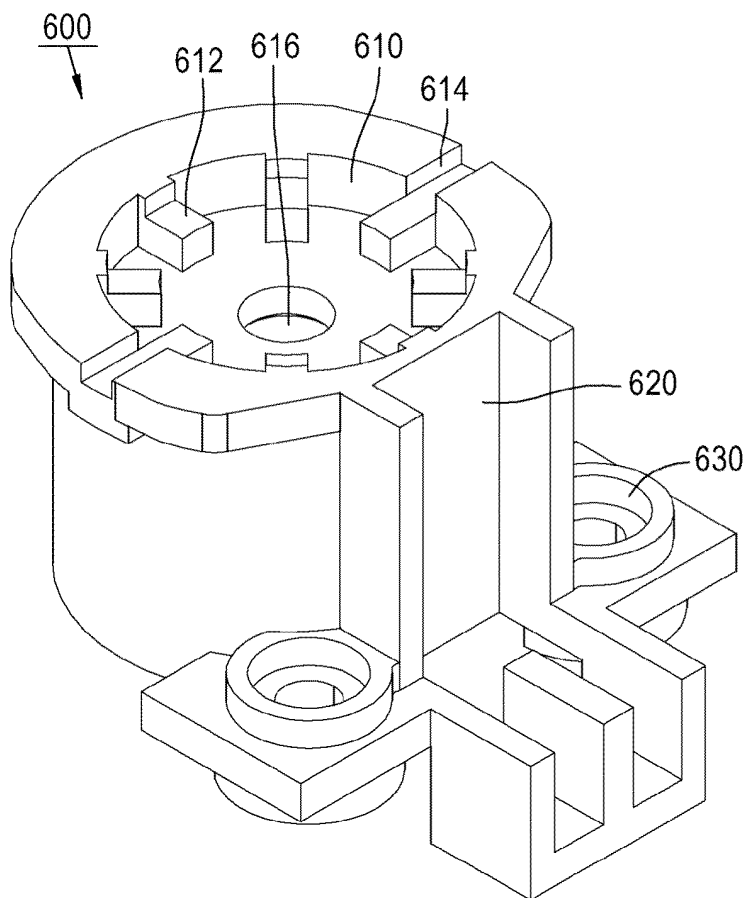


Fig. 7

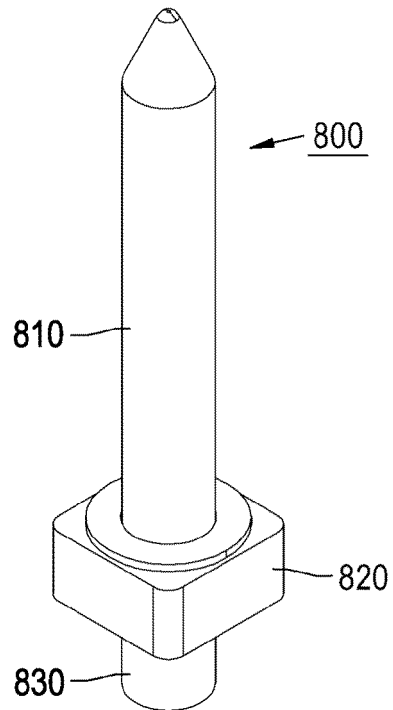


Fig. 8

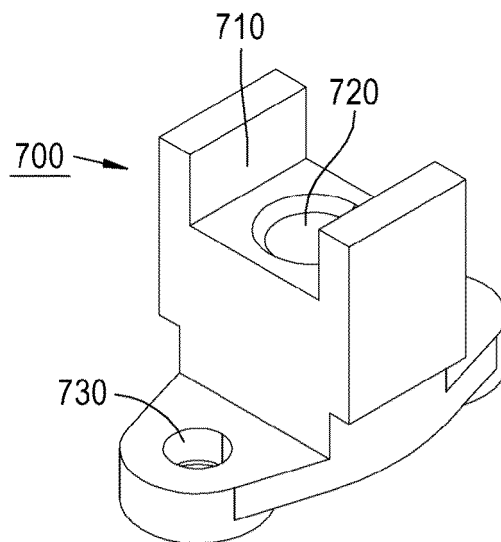


Fig. 9

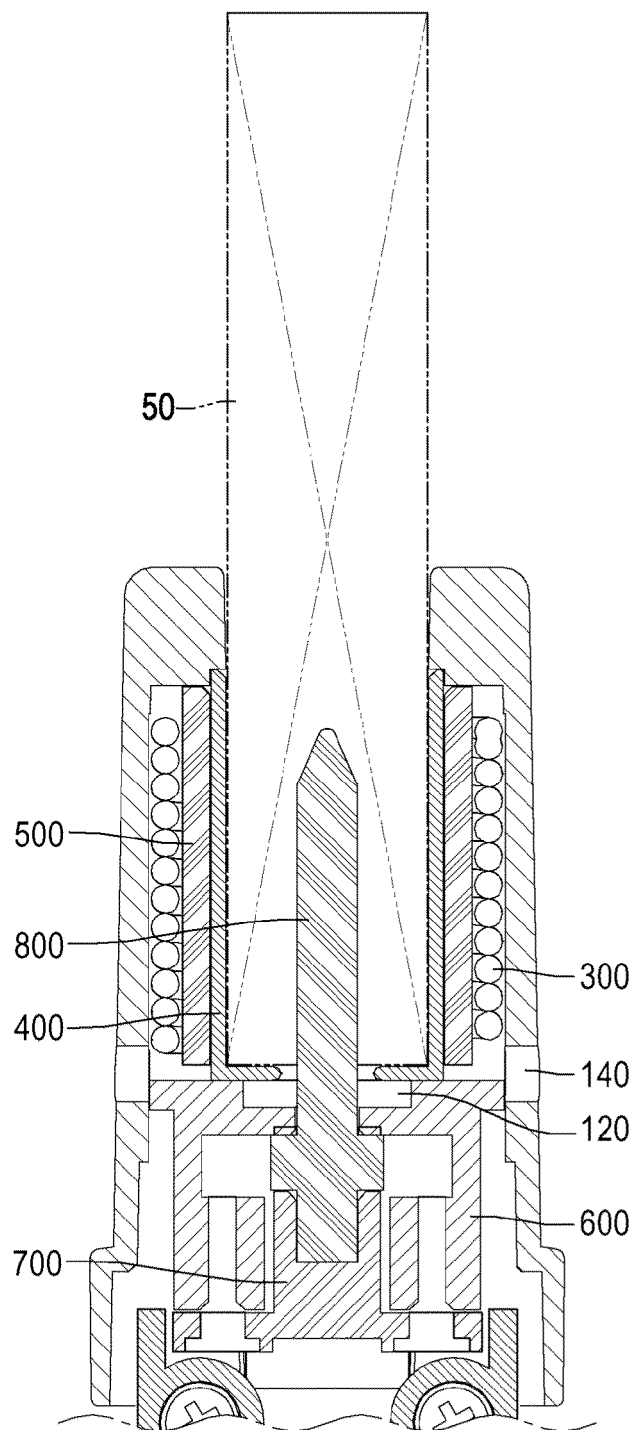


Fig. 10

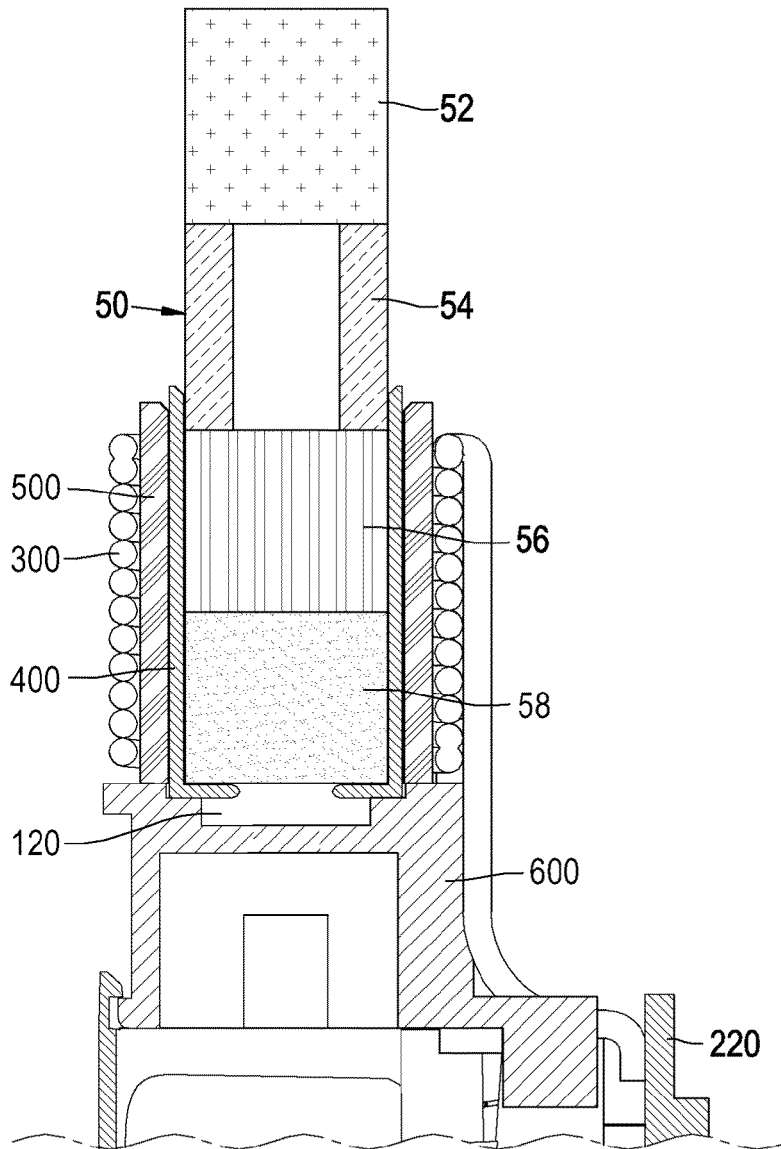


Fig. 11

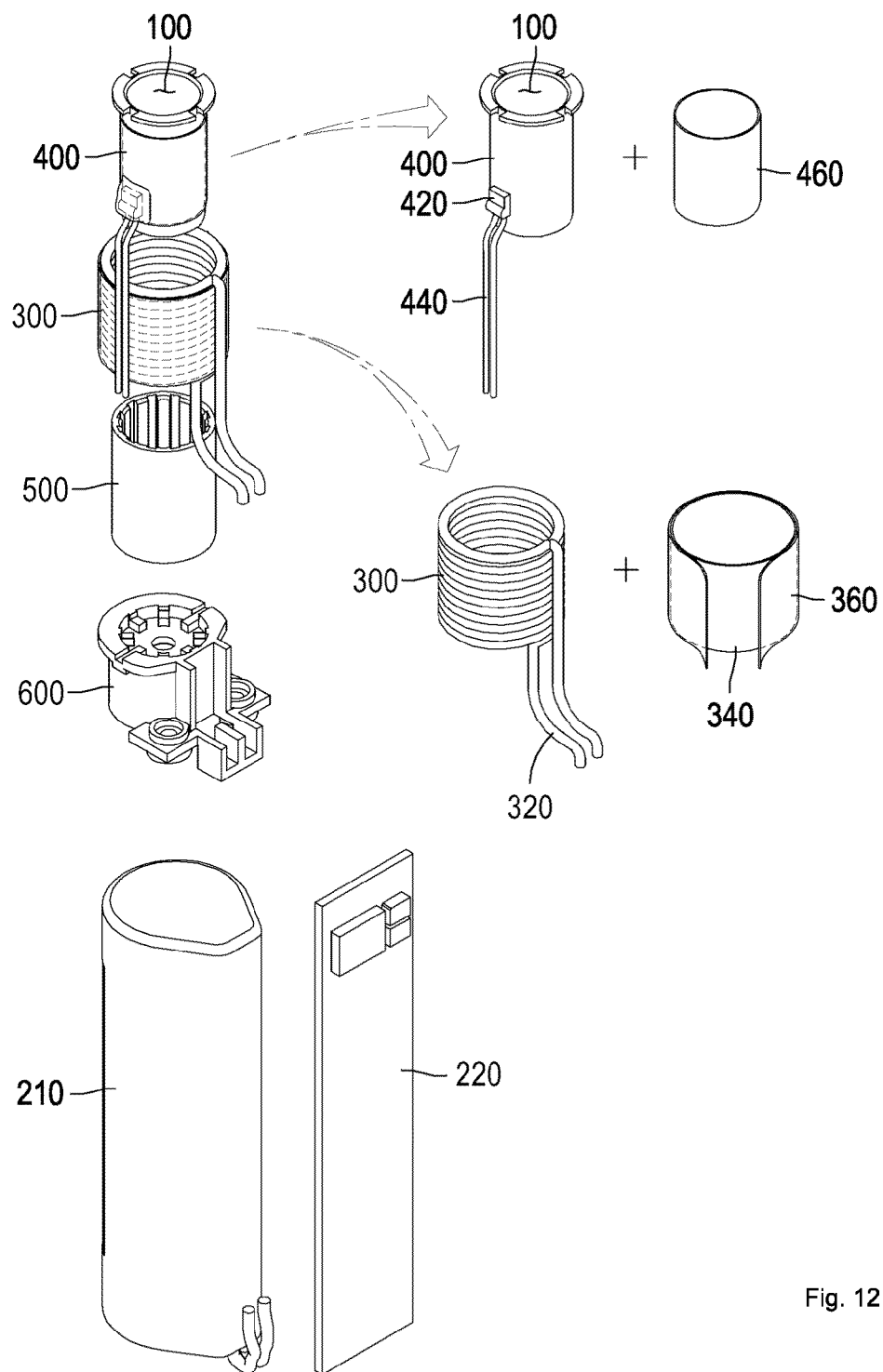


Fig. 12

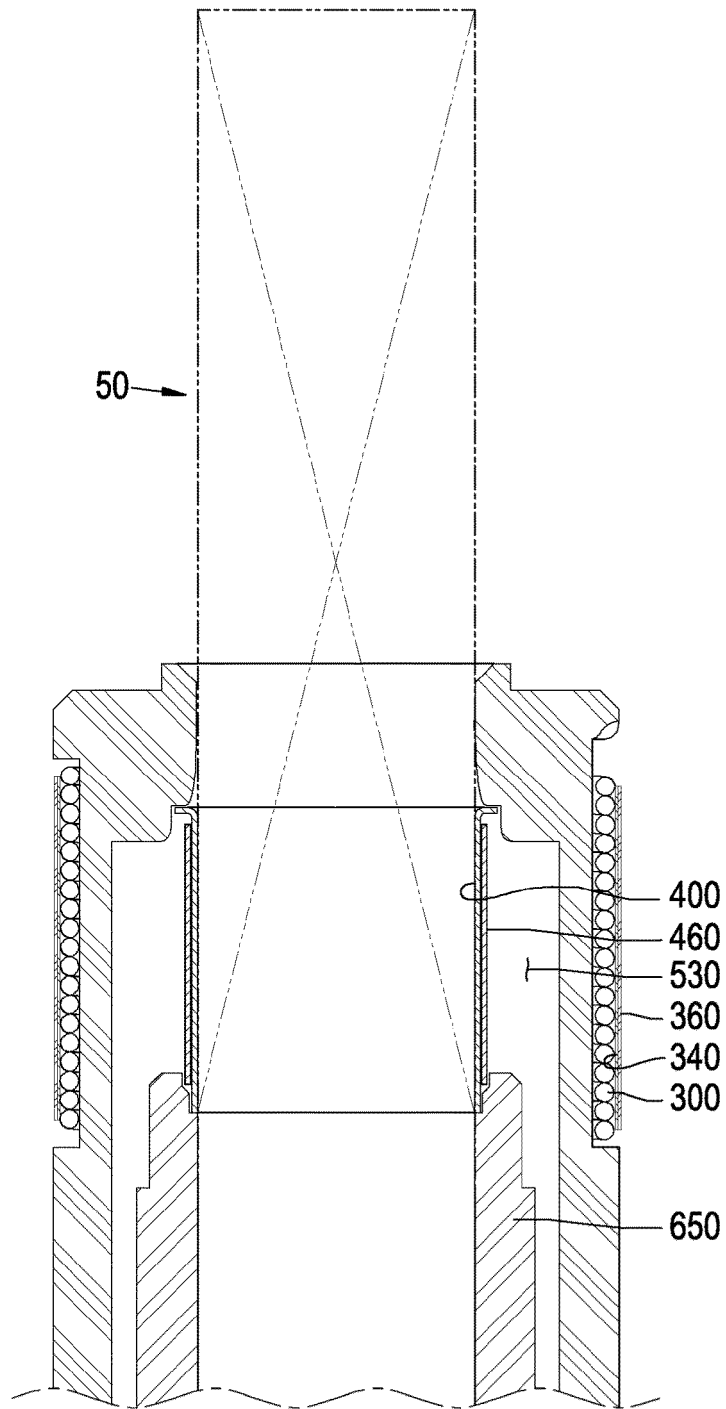


Fig. 13

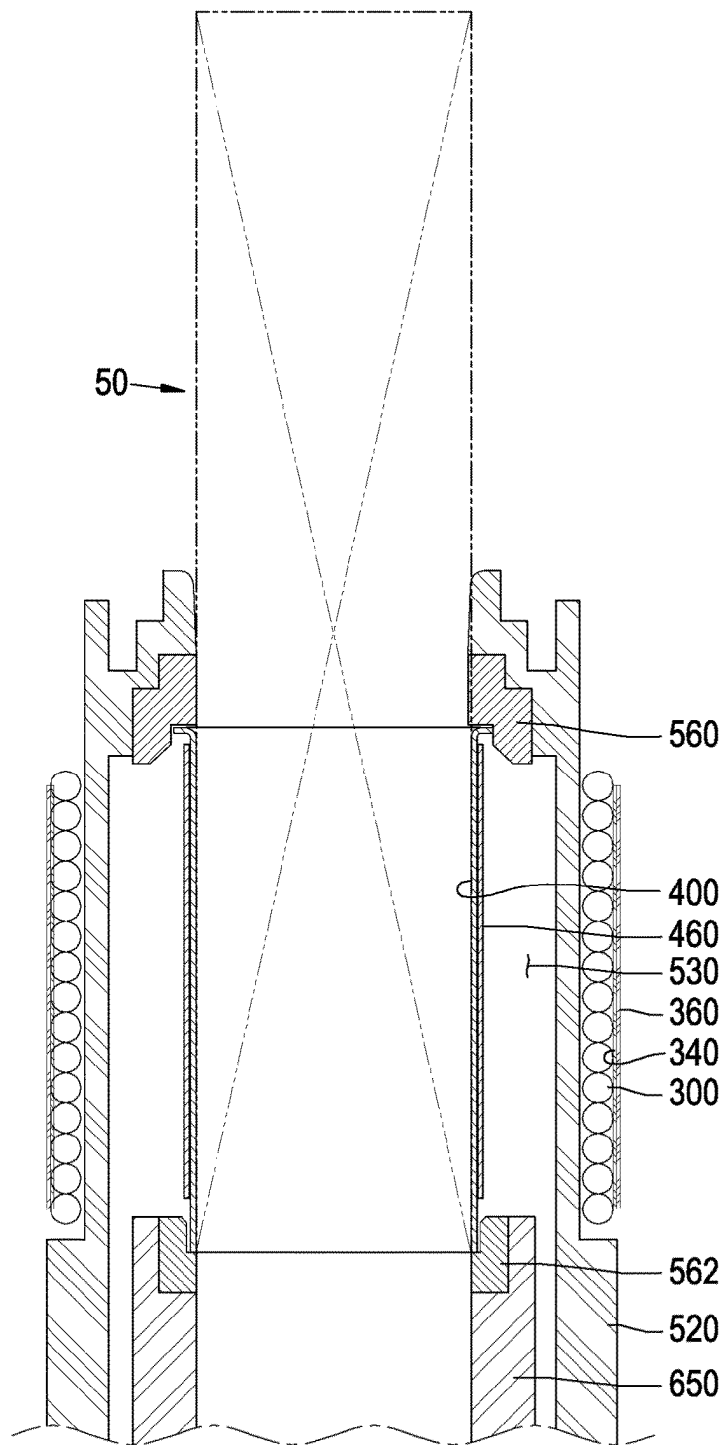


Fig. 14

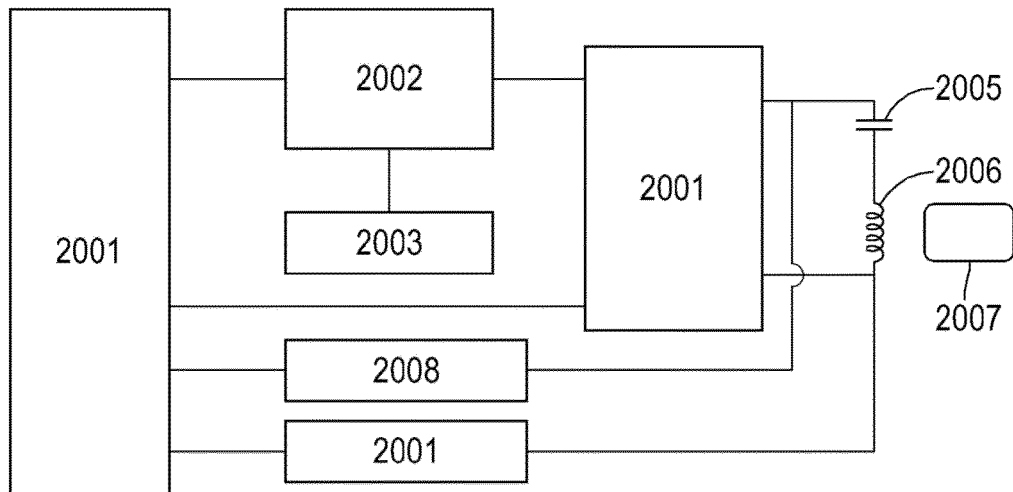


Fig. 15

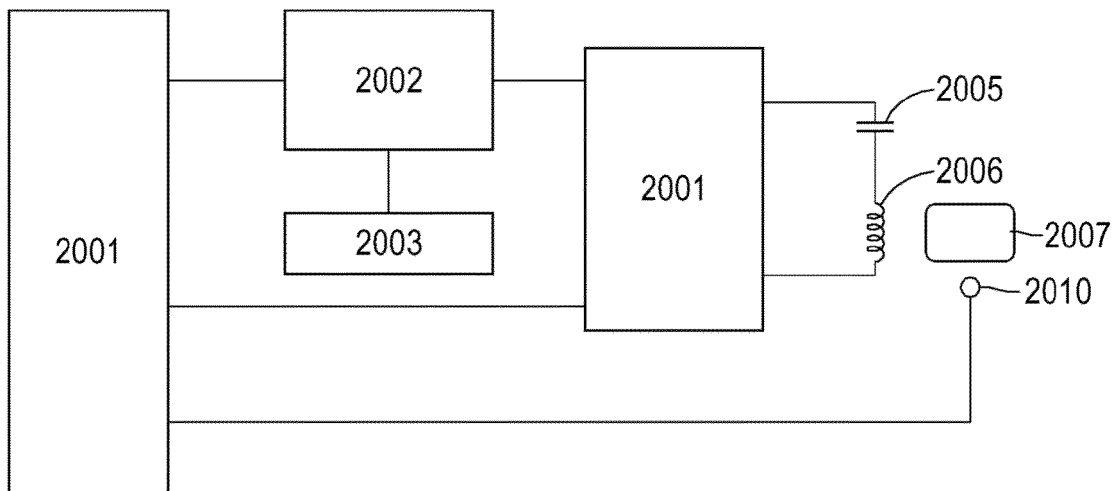


Fig. 16

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2019/018324

A. CLASSIFICATION OF SUBJECT MATTER

A24F 40/465(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 40/465; A24B 15/16; A24F 47/00; A61M 15/06

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

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: aerosol, heater, control, temperature, frequency, coil

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2015-0143877 A (PHILIP MORRIS PRODUCTS S.A.) 23 December 2015 See paragraph [0128]; claims 1-4, 14-18.	1-3
Y	KR 10-2018-0014088 A (NICOVENTURES HOLDINGS LIMITED) 07 February 2018 See paragraph [0060].	1-3
Y	KR 10-2017-0008730 A (PHILIP MORRIS PRODUCTS S.A.) 24 January 2017 See claims 1-5, 14-16.	1-3
A	KR 10-2018-0085365 A (KT & G CORPORATION) 26 July 2018 See the entire document.	1-3
A	KR 10-2018-0117606 A (PHILIP MORRIS PRODUCTS S.A.) 29 October 2018 See the entire document.	1-3

☐ 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

"E" earlier application or patent but published on or after the international filing date

"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)

"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

"&" document member of the same patent family

Date of the actual completion of the international search

08 APRIL 2020 (08.04.2020)

Date of mailing of the international search report

10 APRIL 2020 (10.04.2020)

Name and mailing address of the ISA/KR



Korean Intellectual Property Office
Government Complex Daejeon Building 4, 189, Cheongsu-ro, Seo-gu,
Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2019/018324

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: **6-7, 14, 16-18, 20**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 6-7, 14, 16-18, and 20 refer to multiple dependent claims not meeting the requirement of PCT Rule 6.4(a), and thus are unclear.
3. ☒ Claims Nos.: **4-5, 8-13, 15, 19**
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2019/018324

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2015-0143877 A	23/12/2015	CN 105307525 A	03/02/2016
		CN 105307525 B	14/12/2016
		CN 105407750 A	16/03/2016
		CN 105407750 B	26/06/2018
		CN 106255429 A	21/12/2016
		CN 106455704 A	22/02/2017
		CN 106455704 B	12/07/2019
		EP 2975958 A1	27/01/2016
		EP 2975958 B1	01/03/2017
		EP 2996504 A1	23/03/2016
		EP 2996504 B1	16/11/2016
		EP 3145338 A1	29/03/2017
		EP 3145338 B1	06/11/2019
		EP 3145343 A1	29/03/2017
		EP 3145343 B1	18/10/2017
		JP 2016-525341 A	25/08/2016
		JP 2016-529874 A	29/09/2016
		JP 2017-519493 A	20/07/2017
		JP 2017-520234 A	27/07/2017
		JP 5986326 B1	12/08/2016
		JP 6077145 B2	08/02/2017
		JP 6653260 B2	26/02/2020
		JP 6666854 B2	18/03/2020
		KR 10-1656639 B1	22/09/2016
		KR 10-2015-0143892 A	23/12/2015
		KR 10-2017-0008722 A	24/01/2017
		KR 10-2017-0008730 A	24/01/2017
		US 10051890 B2	21/08/2018
		US 2016-0150825 A1	02/06/2016
		US 2017-0064996 A1	09/03/2017
		US 2017-0071250 A1	16/03/2017
		US 2017-0086508 A1	30/03/2017
		US 2019-0008210 A1	10/01/2019
		US 2019-0320720 A1	24/10/2019
		WO 2015-176898 A1	26/11/2015
		WO 2015-177263 A1	26/11/2015
		WO 2015-177265 A1	26/11/2015
		WO 2015-177294 A1	26/11/2015
KR 10-2018-0014088 A	07/02/2018	CN 107734981 A	23/02/2018
		EP 3313214 A1	02/05/2018
		EP 3313214 B1	05/06/2019
		EP 3494816 A1	12/06/2019
		JP 2018-523997 A	30/08/2018
		JP 6602405 B2	06/11/2019
		KR 10-2019-0110162 A	27/09/2019
		US 2018-0168227 A1	21/06/2018
		WO 2017-001820 A1	05/01/2017

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2019/018324

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2017-0008730 A	24/01/2017	CN 106255429 A EP 3145338 A1 EP 3145338 B1 JP 2017-519493 A JP 6666854 B2 US 2017-0086508 A1 WO 2015-176898 A1	21/12/2016 29/03/2017 06/11/2019 20/07/2017 18/03/2020 30/03/2017 26/11/2015
KR 10-2018-0085365 A	26/07/2018	None	
KR 10-2018-0117606 A	29/10/2018	CN 108697168 A EP 3422879 A1 JP 2019-510484 A US 2019-0090541 A1 WO 2017-149093 A1	23/10/2018 09/01/2019 18/04/2019 28/03/2019 08/09/2017

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

- WO 2015177255 A [0002]