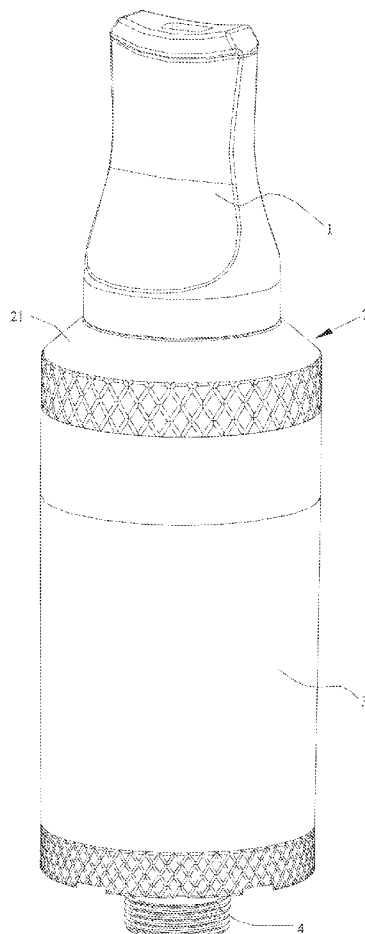




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(19) **United States**(12) **Patent Application Publication**
Zhu(10) **Pub. No.: US 2016/0007654 A1**(43) **Pub. Date: Jan. 14, 2016**(54) **ELECTRONIC CIGARETTES HAVING
REFILLABLE TOP AND REPLACEABLE
HEATING ELEMENT**(71) Applicant: **Xiaochun Zhu**, Shenzhen (CN)(72) Inventor: **Xiaochun Zhu**, Shenzhen (CN)(21) Appl. No.: **14/464,368**(22) Filed: **Aug. 20, 2014****Related U.S. Application Data**(63) Continuation of application No. PCT/CN2014/
081816, filed on Jul. 8, 2014.**Publication Classification**(51) **Int. Cl.**
A24F 47/00 (2006.01)(52) **U.S. Cl.**
CPC **A24F 47/008** (2013.01)(57) **ABSTRACT**

The present invention relates to an e-cigarette. The e-cigarette includes: a connecting assembly, a removable mouth piece, an e-liquid tank, a vaporizing assembly, and a rotatable vaporizer tube. The connecting assembly includes: a mouth piece connector, a connecting ring, an e-liquid injection plate, and one or more e-liquid injection holes. Removable mouth piece has a mouth piece plug to be inserted into the mouth piece connector. The e-liquid tank has an e-liquid tank separation plate for dividing e-liquid tank into an upper e-liquid chamber and a lower e-liquid chamber. E-liquid tank is connected to the connecting assembly. Vaporizing assembly is detachably connected to a lower end of e-liquid tank. Rotatable vaporizer tube is disposed on e-liquid tank separation plate. The rotatable vaporizer tube is insertably connected to the mouth piece 1 through the connecting assembly. The rotatable vaporizer tube is also connected to an air exhaust of the vaporizing assembly.

100

100

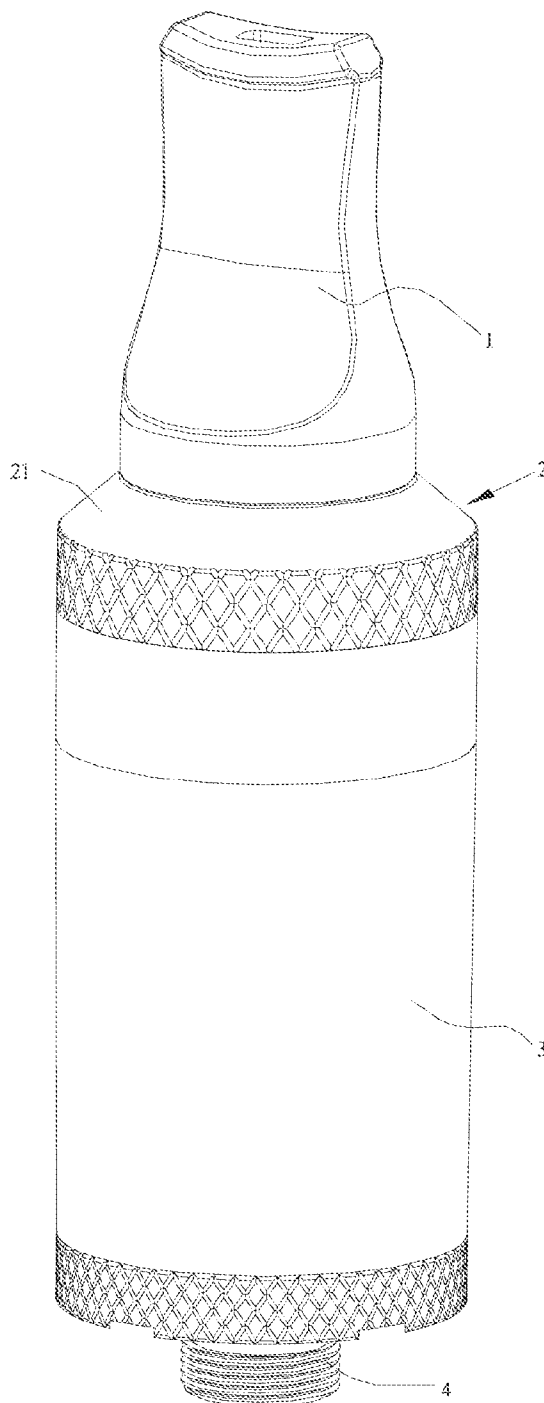


FIG. 1

100

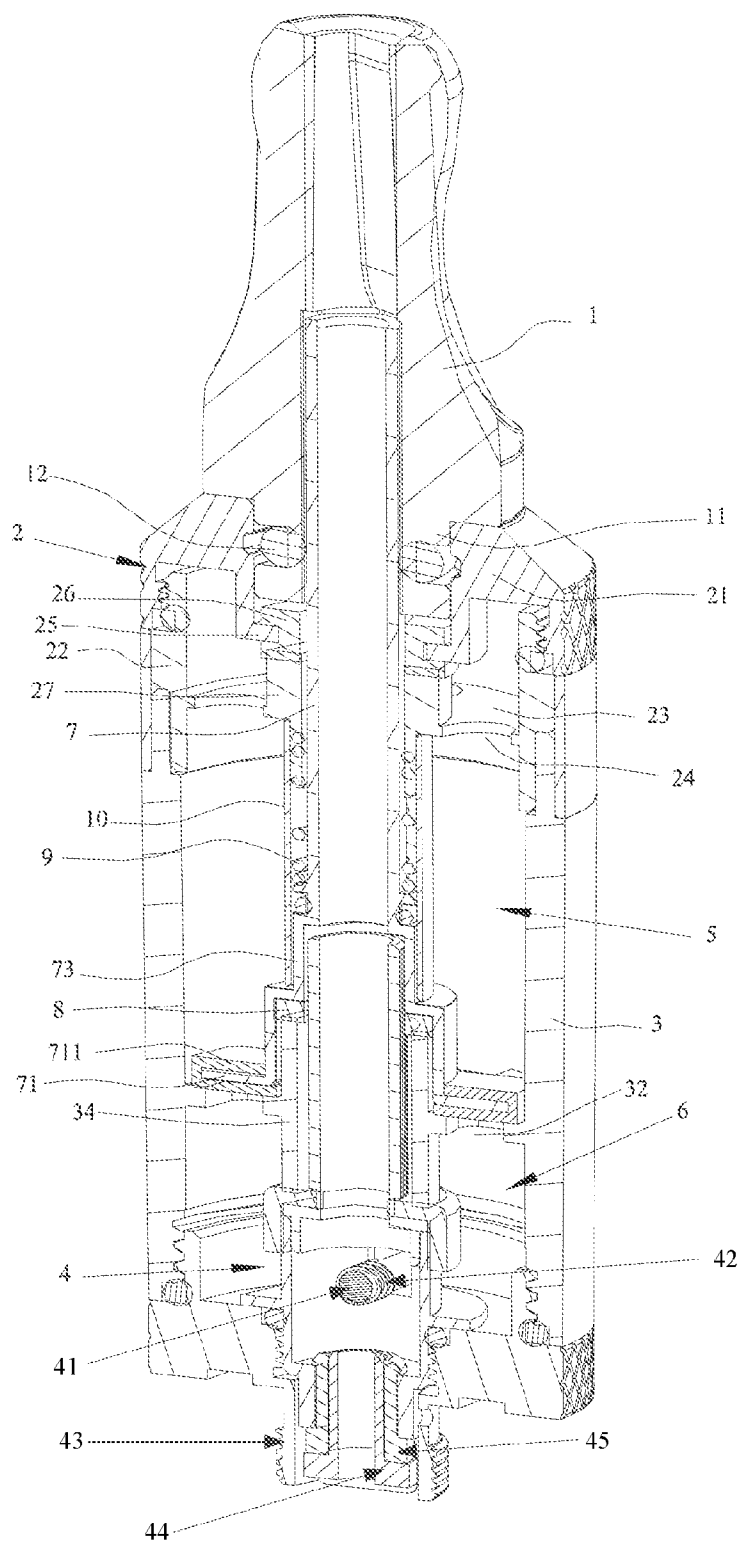


FIG. 2

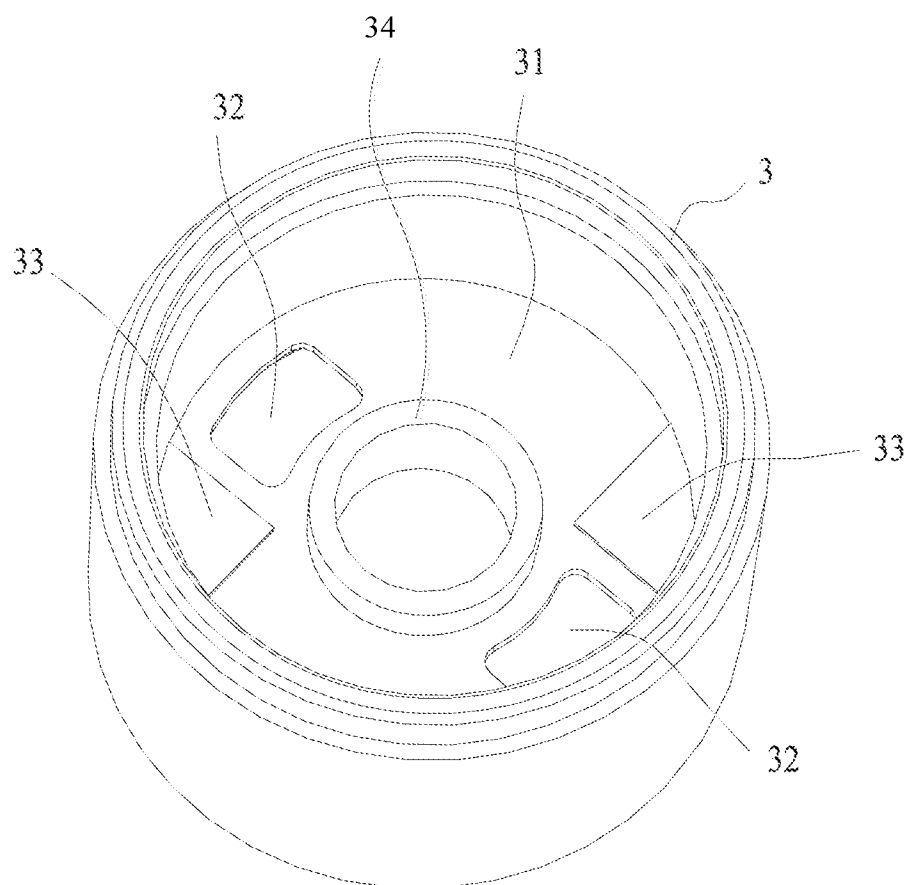


FIG. 3

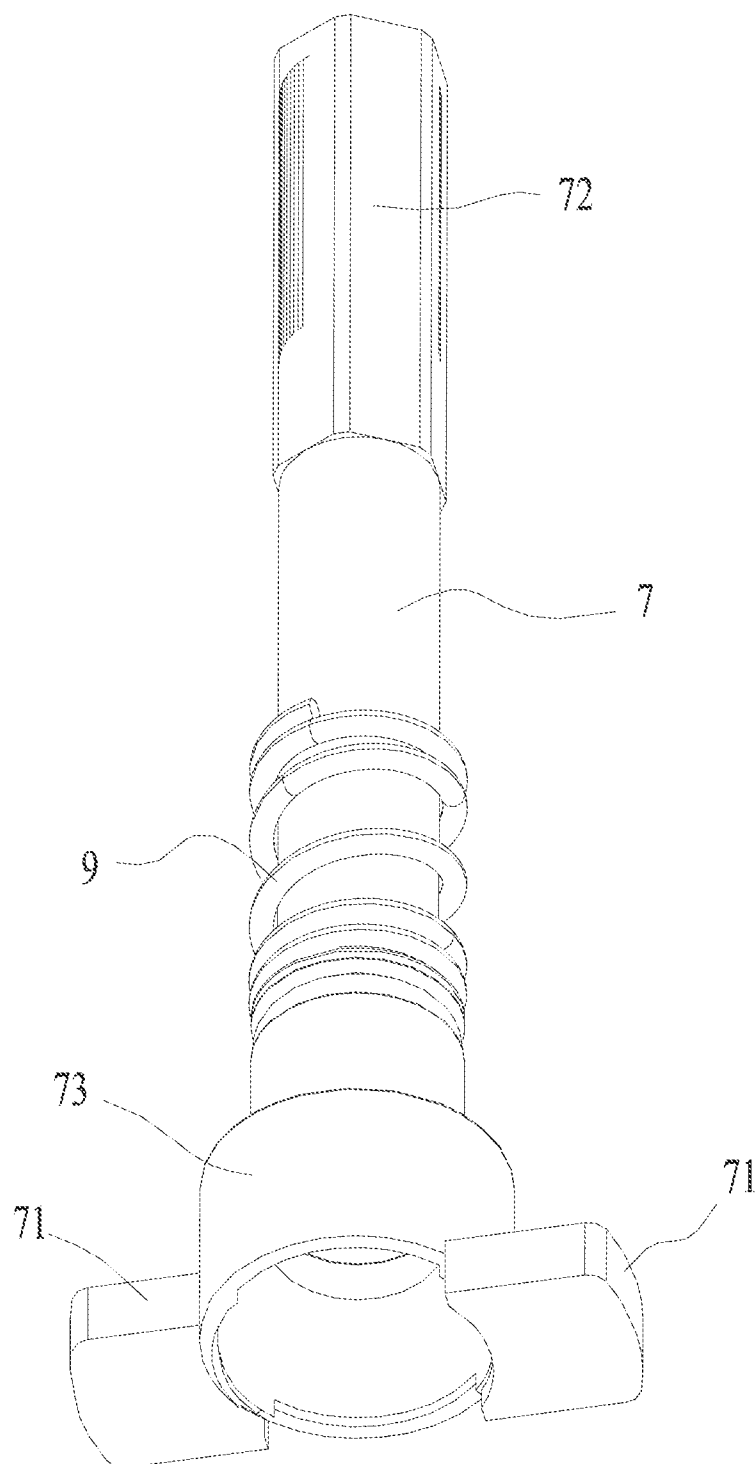


FIG. 4

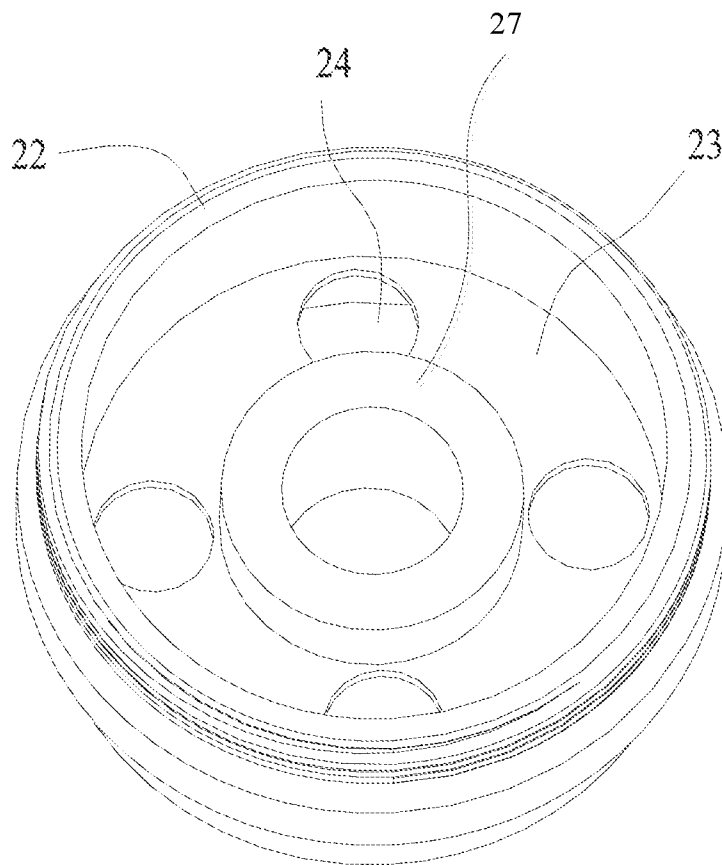


FIG. 5

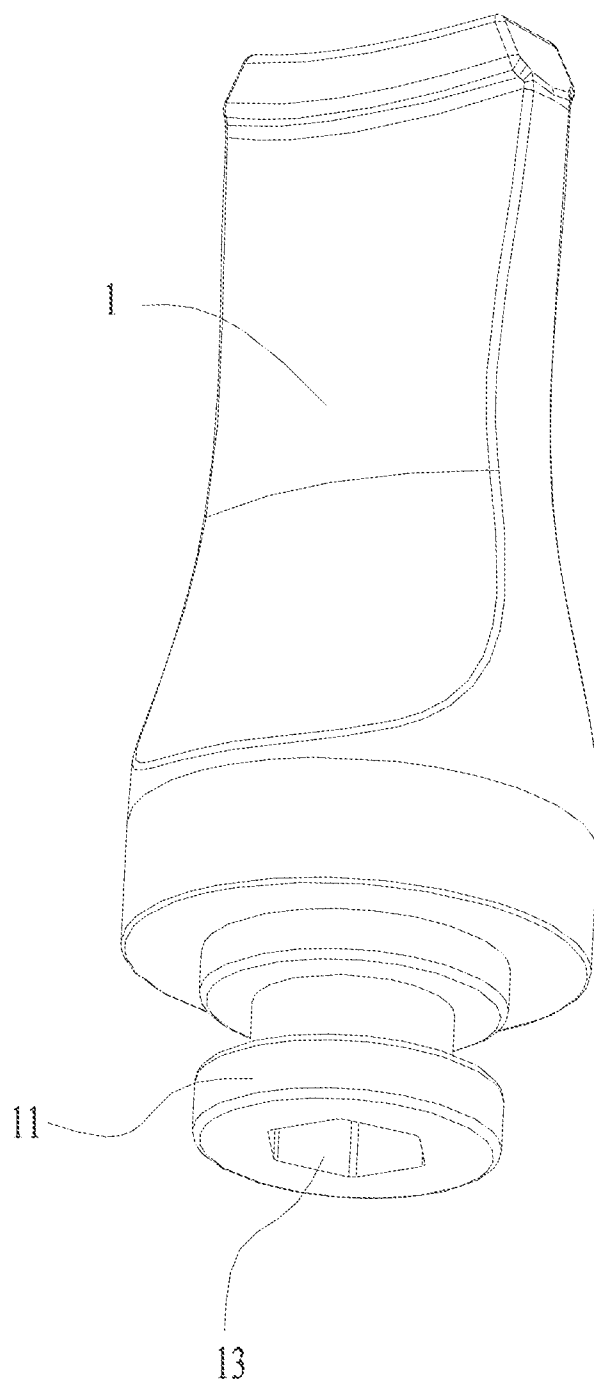


FIG. 6

ELECTRONIC CIGARETTES HAVING REFILLABLE TOP AND REPLACEABLE HEATING ELEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of International Patent Application No. PCT/CN2014/081816, filed with the State Intellectual Property Office of China on Jul. 8, 2014, entitled "Electronic Cigarette Having Refillable Top and Replaceable Heating Elements", by Xiaochun ZHU, the disclosures of which are incorporated herein in their entireties by reference.

[0002] Some references, if any, which may include patents, patent applications and various publications, may be cited and discussed in the description of this invention. The citation and/or discussion of such references, if any, is provided merely to clarify the description of the present invention and is not an admission that any such reference is "prior art" to the invention described herein. All references listed, cited and/or discussed in this specification are incorporated herein by reference in their entireties and to the same extent as if each reference was individually incorporated by reference.

FIELD

[0003] The present invention generally relates to the field of electronic cigarette (or e-cigarette), and more particularly to electronic cigarettes having refillable top and replaceable heating element, and methods of using the electronic cigarettes having refillable top and replaceable heating element.

BACKGROUND

[0004] The background description provided herein is for the purpose of generally presenting the context of the disclosure. Work of the presently named inventors, to the extent it is described in this background section, as well as aspects of the description that may not otherwise qualify as prior art at the time of filing, are neither expressly nor impliedly admitted as prior art against the present disclosure.

[0005] It is well known that smoking cigarette is harmful to smoker's health. The active ingredient in a cigarette is mainly nicotine. During smoking, nicotine, along with tar aerosol droplets produced in the cigarette burning, are breathed into the alveolus and absorbed quickly by the smoker. Once nicotine is absorbed into the blood of the smoker, nicotine then produces its effect on the receptors of the smoker's central nervous system, causing the smoker relax and enjoy an inebriety similar to that produced by an exhilarant.

[0006] The electronic cigarette is sometimes referred as electronic vaporizing device, personal vaporizer (PV), or electronic nicotine delivery system (ENDS). It is a battery-powered device which simulates tobacco smoking. It generally uses a heating element that vaporizes a liquid solution (e-liquid). Some solutions contain a mixture of nicotine and a variety of flavorings, while others release a flavored vapor without nicotine. Many are designed to simulate smoking experience, such as cigarette smoking or cigar smoking. Some of them are made with similar appearance, while others are made considerably different in appearance.

[0007] Conventionally, the e-liquid in the e-cigarette is stored in an e-liquid supplying reservoir at the bottom of the e-cigarette. The e-liquid supplying reservoir contains various types of fibers such as cotton, polypropylene fiber, terylene

fiber, or nylon fiber. The e-liquid is soaked in these fibers and the liquid solution is passed through these fibers to a heating element to be vaporized. The e-liquid is vaporized on the heating element with fibers. Although it is possible to achieve the transfer of e-liquid through the fiber, but when these fibers are used, it is difficult to control the quantity of the e-liquid passed through the fiber, as well as the quantity and speed of e-liquid vaporization, resulting poor tastes, and e-liquid waste. In addition, e-liquid supplying reservoir is usually located at the bottom of the e-cigarette, and in order to pour the e-liquid to soak the fibers, the e-cigarette has to be turned upside down such that its mouthpiece is facing down, causing e-liquid leakage through the heating element. Such leakage causes pollution and it is not healthy and sanitary.

[0008] There are two type of e-cigarette: disposable e-cigarette, and refillable e-cigarette. Disposable e-cigarette is manufactured with certain amount of e-liquid in the product. When the e-liquid packed in the disposable e-cigarette is used up, it is no longer usable. The disposable e-cigarette is not refillable. On the other hand, when the e-liquid in e-liquid tank is used up, the user can refill the e-liquid so the entire e-cigarette is reusable. However, currently, the refill process is cumbersome, and difficult. With conventional fiber filled e-liquid tank, the fiber and the e-liquid in the e-liquid tank may leak out. The contact between the heating element and the e-liquid in the tank is not optimum such that a portion of the heat from the heating element is wasted, and the vaporization efficiency is low.

[0009] Therefore, heretofore unaddressed needs exist in the art to address the aforementioned deficiencies and inadequacies.

SUMMARY

[0010] In one aspect, the present invention relates to an electronic cigarette. In certain embodiments, the electronic cigarette includes: a connecting assembly, a removable mouth piece, an e-liquid tank, a vaporizing assembly, and a rotatable vaporizer tube. The connecting assembly has an upper end, an open lower end, a mouth piece connector and a connection ring. The mouth piece connector has an upper end, and an opposite, lower end. The connecting ring has an upper end, and an opposite, lower end, and an e-liquid injection plate with one or more e-liquid injection holes. The upper end is screwably and sealably connected to the lower end of the mouth piece connector. The removable mouth piece has an upper end, an opposite, lower end, and a mouth piece plug at the lower end of the removable mouth piece. The upper end is detachably connected to the mouth piece plug of the mouth piece. The e-liquid tank has an upper end and an opposite, lower end, an e-liquid tank separation plate configured to separate the e-liquid tank into an upper e-liquid chamber and a lower e-liquid chamber. The upper end of the e-liquid tank is insertably connected to the open lower end of the connecting assembly. The vaporizing assembly is detachably connected to the lower end of the e-liquid tank. The rotatable vaporizer tube is placed on top of the e-liquid tank separation plate. The rotatable vaporizer tube has an upper end insertably connected to the mouth piece through the connecting assembly, and an opposite, lower end connected to an air exhaust of the vaporizing assembly.

[0011] In certain embodiments, the e-liquid tank may be refilled by removing the removable mouth piece, and injecting e-liquid into the upper e-liquid chamber of the e-liquid tank through the one or more e-liquid injection holes of the

connecting assembly. The mouth piece connector includes: a pressure ring, a first protrusion ring, and a first sealing ring. The pressure ring is disposed at the lower end of the mouth piece connector. The first protrusion ring is disposed at center of the e-liquid injection plate. The first sealing ring is placed between the first protrusion ring and the pressure ring for sealing the space between the first protrusion ring and the pressure ring. Each of the pressure ring, the first protrusion ring, and the first sealing ring has a center through hole adapted for accommodating the rotatable vaporizer tube. In certain embodiments, the through holes of the pressure ring, the first protrusion ring, and the first sealing ring are coaxial.

[0012] In certain embodiments, the mouth piece plug of the mouth piece has a circular sealing groove and a mouth piece seal ring. The mouth piece seal ring is configured to seal an insertable connection between the mouth piece and the mouth piece connector. The e-liquid tank separation plate includes one or more e-liquid release holes. These e-liquid release holes are configured to release e-liquid from the upper e-liquid chamber of the e-liquid tank to the lower e-liquid chamber of the e-liquid tank. These e-liquid release holes are evenly and symmetrically distributed on the e-liquid tank separation plate around the central axis of the rotatable vaporizer tube.

[0013] In certain embodiments, the mouth piece has a polygon shaped mouth piece hole. The upper end of the rotatable vaporizer tube has a polygon connecting tube having the same polygon shape and the polygon connecting tube is snugly-fitted inside of the polygon shaped mouth piece hole such that the rotatable vaporizer tube can be rotated by rotating the mouth piece. The polygon shape can be one of a triangle, a quadrilateral, a pentagon, a hexagon, a heptagon, an octagon, a nonagon, a decagon, a dodecagon, and an n-gon.

[0014] In certain embodiments, the rotatable vaporizer tube on the e-liquid tank separation plate has one or more e-liquid stoppers disposed symmetrically around the axis of the rotatable vaporizer tube, and each of the e-liquid stoppers corresponds to one of the e-liquid release holes on the e-liquid tank separation plate. The e-liquid tank separation plate has one or more e-liquid stop protrusions, and each of the e-liquid stop protrusions corresponds to one of the e-liquid release holes as well, such that a user can turn on the e-liquid flow, turn off the e-liquid flow, and control the amount of e-liquid flow. When the rotatable vaporizer tube is rotated to an "on" position, the e-liquid in the upper e-liquid chamber is released to the lower e-liquid chamber. When the rotatable vaporizer tube is rotated to an "off" position, the e-liquid in the upper e-liquid chamber is not released to the lower e-liquid chamber. When the rotatable vaporizer tube is rotated to a position between the "on" position and the "off" position, the amount of the e-liquid released from the upper e-liquid chamber to the lower e-liquid chamber is controlled by the user.

[0015] In certain embodiments, the e-liquid tank separation plate also includes a second protrusion ring. The rotatable vaporizer tube includes a sleeve. The sleeve is placed outside of the second protrusion ring, and sealed by a sealing gasket. The rotatable vaporizer tube also includes: a spring, and a metal tube. The spring is sleeved outside of the rotatable vaporizer tube. The spring has an upper end connected to the connecting assembly, and an opposite, lower end connected to the sleeve. The metal tube is sleeved outside of the spring. The spring is installed pressurized such that the resilient force of the spring acts on the e-liquid chamber separator to seal the e-liquid release holes when the rotatable vaporizer tube is turned to the "off" position. In certain embodiment, each of

the e-liquid chamber separator has a second sealing element for providing additional sealing between the e-liquid chamber separator and the e-liquid tank separation plate.

[0016] In certain embodiments, the vaporizing assembly has: one or more e-liquid media, one or more heating wires, a DC power source connector, and an insulation layer. The one or more e-liquid media receive e-liquid from the lower e-liquid chamber. Each of the one or more heating wires has a positive terminal, and a negative terminal for connecting to a DC power source, heating and vaporizing the received e-liquid in the e-liquid media. The DC power source connector is screwably connected to a DC power source. The DC power source connector has a positive terminal, and a negative terminal. The positive terminal is electrically connected to each of the positive terminals of the one or more heating wires. The negative terminal is electrically connected to each of the negative terminals of the one or more heating wires. The insulation layer is placed between the positive terminal and the negative terminal to insulate the positive terminal and the negative terminal. The e-liquid media is made of at least one of cotton, organic cotton, ceramic bar, polypropylene fiber, terylen fiber, and nylon fiber.

[0017] In another aspect, the present invention relates to a method of using a refillable e-cigarette. In certain embodiments, the method includes one or more of following operations: filling the refillable e-cigarette with e-liquid, connecting a DC power supply to a DC power source connector of the e-cigarette, rotating a mouth piece to allow the e-liquid in an upper e-liquid chamber to flow to a lower e-liquid chamber and soak one or more of e-liquid media, turning on the DC power supply to energize one or more heating wires and to vaporize the e-liquid soaked in the one or more of e-liquid media, and sucking the vaporized e-liquid from the mouth piece. The operation of filling the refillable e-cigarette with e-liquid may include one or more of these operations: removing a mouth piece from the e-cigarette, and injecting e-liquid into the upper e-liquid chamber through one or more e-liquid injection holes on a connection assembly of the e-cigarette. The operation of turning the mouth piece includes the operations of: rotating the mouth piece in one direction to allow the e-liquid in the upper e-liquid chamber to flow to the lower e-liquid chamber, and rotating the mouth piece in an opposite direction to stop the e-liquid flow. The operation of turning the mouth piece also includes an operation of rotating the mouth piece one direction to increase the e-liquid flow from the upper e-liquid chamber to the lower e-liquid chamber, and rotating the mouth piece in an opposite direction to decrease the e-liquid flow.

[0018] In certain embodiments, the method of using the refillable e-cigarette includes an operation of replacing a vaporizer assembly of the e-cigarette by unscrewing the vaporizing assembly from a lower end of the e-cigarette and screwing on a new replacement vaporizing assembly.

[0019] These and other aspects of the present invention will become apparent from the following description of the preferred embodiment taken in conjunction with the following drawings, although variations and modifications therein may be effected without departing from the spirit and scope of the novel concepts of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The accompanying drawings illustrate one or more embodiments of the invention and, together with the written description, serve to explain the principles of the invention.

Wherever possible, the same reference numbers are used throughout the drawings to refer to the same or like elements of an embodiment. The drawings do not limit the present invention to the specific embodiments disclosed and described herein. The drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the invention, and wherein:

[0021] FIG. 1 is a perspective view of an e-cigarette having refillable top and replaceable heating element according to certain embodiments of the present invention;

[0022] FIG. 2 shows a perspective cross sectional view of the e-cigarette according to one embodiment of the present invention;

[0023] FIG. 3 shows a perspective view of an e-liquid tank separator of the e-cigarette according to one embodiment of the present invention;

[0024] FIG. 4 shows a perspective view of a rotatable vaporizer tube of the e-cigarette according to one embodiment of the present invention;

[0025] FIG. 5 shows a perspective view of a connecting ring of the e-cigarette according to one embodiment of the present invention; and

[0026] FIG. 6 shows a perspective view of a mouth piece of the e-cigarette according to another embodiment of the present invention.

DETAILED DESCRIPTION

[0027] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like reference numerals refer to like elements throughout.

[0028] It will be understood that when an element is referred to as being “on” another element, it can be directly on the other element or intervening elements may be present therebetween. In contrast, when an element is referred to as being “directly on” another element, there are no intervening elements present. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items.

[0029] It will be understood that, although the terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

[0030] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. 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. It will be further understood that the terms “comprises” and/or “comprising,” or “includes” and/or “including” or “has” and/or “having” when used herein, specify the presence of

stated features, regions, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, regions, integers, steps, operations, elements, components, and/or groups thereof.

[0031] Furthermore, relative terms, such as “lower” or “bottom”, “upper” or “top,” and “front” or “back” may be used herein to describe one element’s relationship to another element as illustrated in the Figures. It will be understood that relative terms are intended to encompass different orientations of the device in addition to the orientation depicted in the Figures. For example, if the device in one of the figures is turned over, elements described as being on the “lower” side of other elements would then be oriented on “upper” sides of the other elements. The exemplary term “lower”, can therefore, encompass both an orientation of “lower” and “upper,” depending of the particular orientation of the figure. Similarly, if the device in one of the figures is turned over, elements described as “below” or “beneath” other elements would then be oriented “above” the other elements. The exemplary terms “below” or “beneath” can, therefore, encompass both an orientation of above and below.

[0032] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0033] As used herein, “around”, “about” or “approximately” shall generally mean within 20 percent, preferably within 10 percent, and more preferably within 5 percent of a given value or range. Numerical quantities given herein are approximates, meaning that the term “around”, “about” or “approximately” can be inferred if not expressly stated.

[0034] Many specific details are provided in the following descriptions to make the present invention be fully understood, but the present invention may also be implemented by using other manners different from those described herein, so that the present invention is not limited by the specific embodiments disclosed in the following.

[0035] The description will be made as to the embodiments of the present invention in conjunction with the accompanying drawings FIGS. 1 through 6. FIG. 1 shows a perspective view of an e-cigarette 100 having refillable top and replaceable heating element according to certain embodiments of the present invention. FIG. 2 shows a perspective cross sectional view of the e-cigarette 100 shown in FIG. 1. FIGS. 3-6 show perspective views of an e-liquid tank separator 31, a rotatable vaporizer tube 7, a connecting ring 22, and a mouth piece 1 of the e-cigarette 100 according to certain embodiments of the present invention.

[0036] In accordance with the purposes of this invention, as embodied and broadly described herein, this invention, in one aspect, relates to an electronic cigarette (e-cigarette) having refillable top and replaceable heating element.

[0037] Referring to FIGS. 1-3, in certain embodiments, the e-cigarette 100 includes: a removable mouth piece 1, a connecting assembly 2, an e-liquid tank 3, and a vaporizing assembly 4, as shown from the top to bottom in FIG. 1. The connecting assembly 2 has an upper end, an open lower end, a mouth piece connector 21 and a connection ring 22. The

connecting ring 22 is shown in FIG. 5, and has an upper end, and an opposite, lower end, and an e-liquid injection plate 23 having one or more e-liquid injection holes 24. In the center of the connection ring 22, the connecting ring 22 has a first protrusion ring 27. The mouth piece connector 21 has an upper end, and an opposite, lower end. The upper end of the mouth piece connector 21 is screwably and sealably connected to the lower end of the mouth piece connector 21. The removable mouth piece 1 has an upper end, an opposite, lower end, and a mouth piece plug 11 at the lower end of the removable mouth piece 1. The upper end of the mouth piece connector 21 is detachably connected to the mouth piece plug 11 of the mouth piece 1. As shown in FIG. 3, the e-liquid tank 3 has an upper end and an opposite, lower end, an e-liquid tank separation plate 31 configured to separate the e-liquid tank 3 into an upper e-liquid chamber 5 and a lower e-liquid chamber 6. The upper end of the e-liquid tank 3 is insertably connected to the open lower end of the connecting assembly 2. The vaporizing assembly 4 is detachably connected to the lower end of the e-liquid tank 3. A rotatable vaporizer tube 7 is placed on top of the e-liquid tank separation plate 31. The rotatable vaporizer tube 7 has an upper end insertably connected to the mouth piece 1 through the connecting assembly 2, and an opposite, lower end connected to an air exhaust of the vaporizing assembly 4.

[0038] In certain embodiments, the e-liquid tank separation plate 31 is shown in FIG. 3, and also includes, one or more e-liquid release holes 32, and one or more e-liquid stop protrusions 33, and a second protrusion ring 34 at the center. These e-liquid release holes 32 are configured to release e-liquid from the upper e-liquid chamber 5 of the e-liquid tank 3 to the lower e-liquid chamber 6 of the e-liquid tank 3. These e-liquid release holes 32 are evenly and symmetrically distributed on the e-liquid tank separation plate 31 around the central axis of the rotatable vaporizer tube 7. In certain embodiments, the number of e-liquid release holes 32 and the number of the e-liquid stop protrusions 33 are equal. The rotatable vaporizer tube 7 includes a sleeve 73, and one or more e-liquid chamber separators 71, disposed symmetrically around the axis of the e-liquid tank separation plate 31, and each of the e-liquid stoppers 71 corresponds to one of the e-liquid release holes 32 on the e-liquid tank separation plate 31. The number of the e-liquid chamber separators 71 is the same as the e-liquid release holes 32 and the e-liquid stop protrusions 33. Each of the e-liquid chamber separators 71 is used to cover each of corresponding e-liquid release holes 32, and stopped by each of corresponding e-liquid stop protrusions 33. The e-liquid stop protrusions 33 are used to stop the e-liquid chamber separators 71 from rotating further when the e-liquid release holes 32 are covered and the e-liquid is not released from the upper e-liquid chamber 5 to the lower e-liquid chamber 6. The sleeve 73 is placed outside of the second protrusion ring 34, and sealed by a sealing gasket 8. As shown in FIG. 4, the rotatable vaporizer tube 7 also includes: a spring 9, and a metal tube 10. The spring 9 is sleeved outside of the rotatable vaporizer tube 7. The spring 9 has an upper end connected to the connecting assembly 2, and an opposite, lower end connected to the sleeve 73. The metal tube 10 is sleeved outside of the spring 9. The spring 9 is installed pressurized such that the resilient force of the spring 9 acts on the e-liquid chamber separator 71 to seal the e-liquid release holes 32 when the rotatable vaporizer tube 7 is turned to the "off" position. In certain embodiment, each of the e-liquid chamber separators 71 has a second sealing element

711 for providing additional sealing between the e-liquid chamber separator 71 and the e-liquid tank separation plate 31.

[0039] Referring now to FIG. 6, in certain embodiments, the mouth piece plug 11 of the mouth piece 1 has a circular sealing groove and a mouth piece seal ring 12. The mouth piece seal ring 12 is configured to seal an insertable connection between the mouth piece 1 and the mouth piece connector 21. In certain embodiments, the mouth piece 1 has a polygon mouth piece hole 13. The upper end of the rotatable vaporizer tube 7 has a polygon connecting tube 72 having the same polygon shape as shown in FIG. The polygon connecting tube 72 is snugly-fitted inside of the polygon mouth piece hole 13 such that the rotatable vaporizer tube 7 can be rotated by rotating the mouth piece 1. The polygon shape can be one of a triangle, a quadrilateral, a pentagon, a hexagon, a heptagon, an octagon, a nonagon, a decagon, a dodecagon, and an n-gon.

[0040] In certain embodiments, the e-liquid tank 3 may be refilled by removing the removable mouth piece 1, and injecting e-liquid into the upper e-liquid chamber 5 of the e-liquid tank 3 through the one or more e-liquid injection holes 24 of the connecting assembly 2. In order to speed up the e-liquid refill process, the e-cigarette 100 may have multiple e-liquid injection holes 24. When multiple e-liquid injection holes 24 configuration is used, the e-liquid injection holes 24 are symmetrically distributed around the axis of the rotatable vaporizer tube 7. As shown in FIG. 2, and FIG. 5, in order to prevent the e-liquid from leaking through the connecting assembly 2, the mouth piece connector 21 includes: a pressure ring 25, a first protrusion ring 27, and a first sealing ring 26. The pressure ring 25 is disposed at the lower end of the mouth piece connector 21. The first protrusion ring 27 is disposed at center of the e-liquid injection plate 23. The first sealing ring 26 is placed between the first protrusion ring 27 and the pressure ring 25 for sealing the space between the first protrusion ring 27 and the pressure ring 25. Each of the pressure ring 25, the first protrusion ring 27, and the first sealing ring 26 has a center through hole adapted for accommodating the rotatable vaporizer tube 7. In certain embodiments, the through holes of the pressure ring 25, the first protrusion ring 27, and the first sealing ring 26 are coaxial.

[0041] When the rotatable vaporizer tube 7 is rotated to an "on" position, the e-liquid in the upper e-liquid chamber 5 is released to the lower e-liquid chamber 6 through the e-liquid release holes 32. When the rotatable vaporizer tube 7 is rotated to an "off" position, the e-liquid in the upper e-liquid chamber 5 flow is stopped by the e-liquid chamber separators 71. When the rotatable vaporizer tube 7 is rotated to a position between the "on" position and the "off" position, the amount of the e-liquid released from the upper e-liquid chamber 5 to the lower e-liquid chamber 6 may be precisely controlled by the user.

[0042] In certain embodiments, the vaporizing assembly 4 has: one or more e-liquid media 41, one or more heating wires 42, a DC power source connector 43, and an insulation layer 45. The one or more e-liquid media 41 receive e-liquid from the lower e-liquid chamber 6. Each of the one or more heating wires 42 has a positive terminal, and a negative terminal for connecting to a DC power source, heating and vaporizing the received e-liquid in the e-liquid media 41. The DC power source connector 43 is screwably connected to a DC power source. The DC power source connector 43 has a positive terminal 44, and a negative terminal 43. The positive terminal

44 is electrically connected to each of the positive terminals of the one or more heating wires **42**. The negative terminal **43** is electrically connected to each of the negative terminals of the one or more heating wires **42**. The insulation layer **45** is placed between the positive terminal **44** and the negative terminal **43** to insulate the positive terminal **44** and the negative terminal **43**. The e-liquid media **41** is made of at least one of cotton, organic cotton, ceramic bar, polypropylene fiber, terylen fiber, and nylon fiber.

[0043] In certain embodiments, when a user wants to smoke the e-cigarette **100**, the user rotates the rotatable vaporizer tube **7** by rotating the mouth piece **1** to allow the e-liquid in the upper e-liquid chamber **5** to flow to the lower e-liquid chamber **6** through the e-liquid release holes **32**. The quantity of the e-liquid released to the lower e-liquid chamber **6** can be precisely controlled by turning the mouth piece **1**. When the vaporizing assembly **4** is energized by connecting the vaporizing assembly **4** to the DC power supply, the vaporizing assembly **4** vaporizes the e-liquid soaked in the e-liquid media **41**. The suction by the user at the mouth piece **1** brings out the vaporized e-liquid from the vaporizing assembly **4**, through the rotatable vaporizing tube **7**.

[0044] In certain embodiments, when the e-liquid in the e-liquid tank **3** is used up, the user can remove the mouth piece connector **21** together with the mouth piece **1**, and injects e-liquid into the upper e-liquid chamber **5** through the e-liquid injection holes **24**. When the vaporizing assembly **4** is damaged or broken, the entire vaporizing assembly **4** can be replaced simply by unscrewing the vaporizing assembly **4** from the bottom of the e-cigarette **100** and replacing another new vaporizing assembly **4** on the e-cigarette **100**.

[0045] In another aspect, the present invention relates to a method of using a refillable e-cigarette **100**. In certain embodiments, the method includes one or more of following operations:

[0046] (a) filling the refillable e-cigarette **100** with e-liquid;

[0047] (b) connecting a DC power supply to a DC power source connector **43** of the e-cigarette **100**;

[0048] (c) rotating a mouth piece **1** to allow the e-liquid in an upper e-liquid chamber **5** to flow to a lower e-liquid chamber **6** of the e-liquid tank **3** and soak one or more of e-liquid media **41**;

[0049] (d) turning on the DC power supply to energize one or more heating wires **42** of a vaporizing assembly **4** and to vaporize the e-liquid soaked in the one or more of e-liquid media **41**; and

[0050] (e) sucking the vaporized e-liquid from the mouth piece **1**.

[0051] In certain embodiments, the operation of filling the refillable e-cigarette **100** with e-liquid may include one or more of these operations:

[0052] (a) removing a mouth piece connector **21** with the mouth piece **1** attached from the e-cigarette **100**; and

[0053] (b) injecting e-liquid into the upper e-liquid chamber **5** through one or more e-liquid injection holes **24** on a connecting ring **22** of a connection assembly **2** of the e-cigarette **100**.

[0054] In certain embodiments, the operation of turning the mouth piece **1** includes the operations of:

[0055] (a) rotating the mouth piece **1** in one direction to allow the e-liquid in the upper e-liquid chamber **5** to flow to the lower e-liquid chamber **6** through one or more e-liquid release holes **32**; and

[0056] (b) rotating the mouth piece **1** in an opposite direction to stop the e-liquid flow.

[0057] In certain embodiments, the operation of turning the mouth piece **1** also includes one or more following operations:

[0058] (a) rotating the mouth piece **1** in one direction to increase the e-liquid flow from the upper e-liquid chamber **5** to the lower e-liquid chamber **6**; and

[0059] (b) rotating the mouth piece **1** in an opposite direction to decrease the e-liquid flow.

[0060] In certain embodiments, the method of using the refillable e-cigarette **100** includes an operation of replacing a vaporizer assembly **4** of the e-cigarette **100** by unscrewing the vaporizing assembly **4** from a lower end of the e-cigarette **100** and screwing on a new replacement vaporizing assembly **4**.

[0061] The foregoing description of the exemplary embodiments of the invention has been presented only for the purposes of illustration and description and is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in light of the above teaching.

[0062] The embodiments were chosen and described in order to explain the principles of the invention and their practical application so as to activate others skilled in the art to utilize the invention and various embodiments and with various modifications as are suited to the particular use contemplated. Alternative embodiments will become apparent to those skilled in the art to which the present invention pertains without departing from its spirit and scope. Accordingly, the scope of the present invention is defined by the appended claims, the foregoing description and the exemplary embodiments described therein, and accompanying drawings.

What is claimed is:

1. An electronic cigarette, comprising:

a connecting assembly;

a removable mouth piece having an upper end, an opposite, lower end, and a mouth piece plug at the lower end;

an e-liquid tank having an upper end and an opposite, lower end, an e-liquid tank separation plate configured to separate the e-liquid tank into an upper e-liquid chamber and a lower e-liquid chamber;

a vaporizing assembly detachably connected to the lower end of the e-liquid tank;

a rotatable vaporizer tube located on top of the e-liquid tank separation plate, wherein the rotatable vaporizer tube having an upper end insertably connected to the mouth piece through the connecting assembly, and an opposite, lower end connected to an air exhaust of the vaporizing assembly.

2. The electronic cigarette of claim 1, wherein the connecting assembly comprises:

an open lower end, and an opposite upper end, wherein the open lower end of the connecting assembly is connected to the upper end of the e-liquid tank;

a mouth piece connector having an upper end, and an opposite, lower end, wherein the upper end is detachably connected to the mouth piece plug of the mouth piece; and

a connecting ring having an upper end, and an opposite, lower end, and an e-liquid injection plate with one or more e-liquid injection holes, wherein the upper end is screwably and sealably connected to the lower end of the mouth piece connector, and the lower end is insertably connected to the upper end of the e-liquid tank.

3. The electronic cigarette of claim 2, wherein the e-liquid tank may be refilled by removing the removable mouth piece, and injecting e-liquid into the upper e-liquid chamber of the e-liquid tank through the one or more e-liquid injection holes of the connecting assembly.

4. The electronic cigarette of claim 2, wherein the mouth piece connector comprises

- a pressure ring disposed at the lower end of the mouth piece connector;
- a first protrusion ring disposed at center of the e-liquid injection plate; and
- a first sealing ring disposed between the first protrusion ring and the pressure ring for sealing the space between the first protrusion ring and the pressure ring,

wherein each of the pressure ring, the first protrusion ring, and the first sealing ring has a center through hole adapted for accommodating the rotatable vaporizer tube, and the through holes of the pressure ring, the first protrusion ring, and the first sealing ring are coaxial.

5. The electronic cigarette of claim 2, wherein the mouth piece plug of the mouth piece comprises: a circular sealing groove and a mouth piece seal ring configured to seal an insertable connection between the mouth piece and the mouth piece connector.

6. The electronic cigarette of claim 2, wherein the e-liquid tank separation plate comprises one or more e-liquid release holes configured to release e-liquid from the upper e-liquid chamber of the e-liquid tank to the lower e-liquid chamber of the e-liquid tank, wherein the one or more e-liquid release holes are evenly and symmetrically distributed on the e-liquid tank separation plate around the central axis of the rotatable vaporizer tube.

7. The electronic cigarette of claim 6, wherein the mouth piece comprises a polygon mouth piece hole, and the upper end of the rotatable vaporizer tube has a polygon connecting tube having the same polygon shape and the polygon connecting tube is snugly-fitted inside of the polygon mouth piece hole such that the rotatable vaporizer tube can be rotated by rotating the mouth piece.

8. The electronic cigarette of claim 7, wherein the polygon shape comprises a triangle, a quadrilateral, a pentagon, a hexagon, a heptagon, an octagon, a nonagon, a decagon, a dodecagon, and an n-gon.

9. The electronic cigarette of claim 7, wherein the rotatable vaporizer tube on the e-liquid tank separation plate comprises one or more e-liquid stoppers disposed symmetrically around the axis of the rotatable vaporizer tube, each of the e-liquid stoppers corresponds to one of the e-liquid release holes on the e-liquid tank separation plate, and the e-liquid tank separation plate comprises one or more e-liquid stop protrusions, each of the of the e-liquid stop protrusions corresponds to one of the e-liquid release holes, such that when the rotatable vaporizer tube is rotated to an "on" position, the e-liquid in the upper e-liquid chamber is released to the lower e-liquid chamber, when the rotatable vaporizer tube is rotated to an "off" position, the e-liquid in the upper e-liquid chamber is not released to the lower e-liquid chamber, and when the rotatable vaporizer tube is rotated to a position between the "on" position and the "off" position, the amount of the e-liquid released from the upper e-liquid chamber to the lower e-liquid chamber is controlled by a user.

10. The electronic cigarette of claim 9, wherein the e-liquid tank separation plate comprises a second protrusion ring, and

the rotatable vaporizer tube comprises a sleeve disposed outside of the second protrusion ring, and sealed by a sealing gasket 8.

11. The electronic cigarette of claim 10, wherein the rotatable vaporizer tube further comprises:

- a spring sleeved outside of the rotatable vaporizer tube, wherein the spring has an upper end connected to the connecting assembly, and an opposite, lower end connected to the sleeve; and
- a metal tube sleeved outside of the spring.

12. The electronic cigarette of claim 11, wherein the spring is installed pressurized such that the resilient force of the spring acts on the e-liquid chamber separator to seal the e-liquid release holes when the rotatable vaporizer tube is turned to the "off" position.

13. The electronic cigarette of claim 12, wherein each of the e-liquid chamber separator comprises a second sealing element 1 for providing additional sealing between the e-liquid chamber separator and the e-liquid tank separation plate.

14. The electronic cigarette of claim 1, wherein the vaporizing assembly comprises:

- one or more e-liquid media for receiving e-liquid from the lower e-liquid chamber;
- one or more heating wires, each of the heating wires has a positive terminal, and a negative terminal for vaporizing the received e-liquid in the e-liquid media;
- a DC power source connector screwably connected to an external DC power source, wherein the DC power source connector comprises a positive terminal connected to each of the positive terminals of the heating wires, and a negative terminal connected to each of the negative terminals of the heating wires; and
- an insulation layer disposed between the positive terminal and the negative terminal to insulate the positive terminal and the negative terminal.

15. The electronic cigarette of claim 13, wherein the e-liquid media comprise at least one of cotton, organic cotton, ceramic bar, polypropylene fiber, terylen fiber, and nylon fiber.

16. A method of using a refillable e-cigarette, comprising one or more of following operations:

- filling the refillable e-cigarette with e-liquid;
- connecting a DC power supply to a DC power source connector of the e-cigarette;
- rotating a mouth piece to allow the e-liquid in an upper e-liquid chamber to flow to a lower e-liquid chamber and soak one or more of e-liquid media;
- turning on the DC power supply to energize one or more heating wires of a vaporizing assembly and to vaporize the e-liquid soaked in the e-liquid media; and
- sucking the vaporized e-liquid from the mouth piece.

17. The method of claim 16, wherein the operation of filling the refillable e-cigarette with e-liquid comprising one or more of following operations:

- removing a mouth piece connector from the e-cigarette; and
- injecting e-liquid into the upper e-liquid chamber through one or more e-liquid injection holes on a connecting assembly of the e-cigarette.

18. The method of claim 16, wherein the operation of turning the mouth piece comprising:

- rotating the mouth piece in one direction to allow the e-liquid in the upper e-liquid chamber to flow to the lower e-liquid chamber; and

rotating the mouth piece in an opposite direction to stop the e-liquid flow.

19. The method of claim **16**, wherein the operation of turning the mouth piece comprising:

rotating the mouth piece in one direction to increase the e-liquid flow from the upper e-liquid chamber to the lower e-liquid chamber; and

rotating the mouth piece in an opposite direction to decrease the e-liquid flow.

20. The method of claim **16**, further comprising an operation of replacing a vaporizing assembly by unscrewing the vaporizing assembly from a lower end of the e-cigarette, and screwing on a new replacement vaporizing assembly.

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