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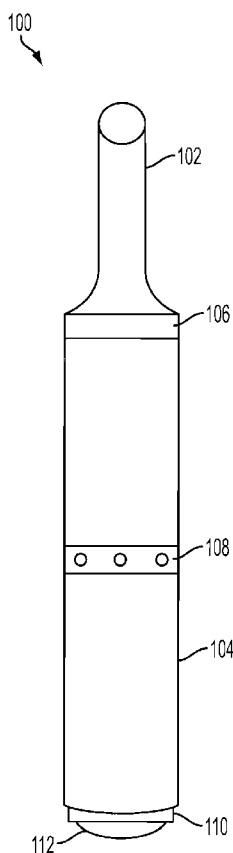
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[Continued on next page]

(54) Title: A SYSTEM AND METHOD FOR PROVIDING A LASER-BASED LIGHTING SYSTEM FOR SMOKABLE MATERIAL



(57) Abstract: This invention generally relates to a smoking device that uses a laser diode to light a smokable material that is stored within the smoking device. The smoking device is preferably a portable device that allows for insertion of a smokable material, and which ignites the smokable material using a battery-powered laser diode. The smoking device includes a coupling interface that requires all housing components to be secured prior to activation of the laser diode, thereby preventing the surrounding environment from exposure to laser beams and laser radiation.

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**A SYSTEM AND METHOD FOR PROVIDING A LASER-BASED LIGHTING SYSTEM  
FOR SMOKABLE MATERIAL**

**BACKGROUND**

Cross-Reference to Related Application

[001] This application claims the benefit of U.S. Provisional Application No. 61/313,408, filed on March 12, 2010, the contents of which are hereby incorporated by reference in their entirety.

Field of Invention

[002] This invention generally relates to systems and methods for providing a laser-based lighting system for smokable material, and more specifically, to a portable device for lighting and smoking tobacco products.

Description of Related Art

[003] Traditional cigarettes are consumed by lighting an end of a tobacco-filled paper rod and drawing air predominately through the lit end of the rod by suction at a mouthpiece end of the cigarette. Furthermore, traditional smoking pipes are consumed by filling an open-air bowl with tobacco, and directly lighting the tobacco with a flame. Traditional cigarettes and smoking pipes produce sidestream smoke during smoldering between puffs, which can irritate and annoy non-smokers that may be in the vicinity of a smoker. Furthermore, once lit, traditional cigarettes and smoking pipes must be fully consumed or be discarded. Re-lighting is possible, however, this is usually an undesirable option to many smokers as the flavor, taste, and odor quality may be reduced after re-lighting a used cigarette or a bowl of tobacco in a smoking pipe.

[004] Additionally, lighters, especially those which are portable and intended to be carried in a pocket or purse, generally comprise a container or reservoir for fuel, and a nozzle or wick in communication with the reservoir and an igniter for producing a flame. Such lighters must be filled periodically, or, as is more common, discarded when the fuel supply is exhausted. Inasmuch as a supply of replenishing fuel is usually not available, the lighter becomes useless upon exhaustion of the fuel. The fuel itself is usually a liquefied gas or a flammable liquid which often has an unpleasant odor, and it is not uncommon that the fuel will leak out of the reservoir over a period of time, which, especially in the case of flammable liquid fuel, can present a safety hazard, as does the use of an open flame. Lighters relying upon a flame are difficult to use in windy conditions, and the art is replete with devices for rendering the lighter at least partially windproof.

[005] Thus, there exists a need for a system and method for providing a laser-based lighting system for smokable material that overcomes the aforementioned challenges.

#### SUMMARY

[006] In an embodiment, this invention relates to a portable smoking device, comprising: a base; a mouthpiece attached to the base via a connection means; a laser diode located within the base; a power source coupled to the laser diode; and a chamber configured to hold a smokable material.

[007] In another embodiment, this invention relates to an ignition device for smokable material, comprising: a base containing a laser diode and a power supply; a mouthpiece attached to the base; a chamber coupled to the base, the chamber configured to hold a smokable material; and an

ignition switch, wherein the laser diode is configured to emit a laser beam towards the chamber upon activation of the ignition switch.

[008] In yet another embodiment, this invention relates to a modular smoking device, comprising: a base; a mouthpiece; a chamber configured to be positioned between the base and the mouthpiece, the chamber further configured to hold a smokable material; and an ignition source located adjacent to the chamber.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[009] These and other embodiments of this invention will be discussed with reference to the following exemplary and non-limiting illustrations, in which like elements are numbered similarly, and wherein:

[010] FIG. 1 is a view of a modular laser-based smoking device according to an embodiment of this invention;

[011] FIG. 2 is an exploded view of a modular laser-based smoking device according to an embodiment of this invention;

[012] FIG. 3 is an exploded internal view of a modular laser-based smoking device according to an embodiment of this invention;

[013] FIG. 4 is an exploded view of a modular laser-based smoking device having a magnetic coupling interface;

[014] FIG. 5 is a view of a coupling interface with a recessed switch;

[015] FIG. 6 is a view of a coupling interface with a 1-Wire mechanism;

[016] FIG. 7 is a view of a unitary laser-based smoking device according to an embodiment of this invention;

[017] FIG. 8 is a view of a unitary laser-based smoking device with a retracted chamber; and

[018] FIG. 9 is a view of an extended mouthpiece attached to a unitary laser-based smoking device.

### **DETAILED DESCRIPTION OF EMBODIMENTS**

[019] Before the present method and hardware enablement are described, it is to be understood that this invention is not limited to the particular methodologies, and hardware described, as these may vary. It is also to be understood that the terminology used in the description is for the purpose of describing the particular versions or embodiments only, and is not intended to limit the scope of the present invention which will be limited only by the appended claims. The words "comprising," "having," "containing," and "including," and other forms thereof, are intended to be equivalent in meaning and be open ended in that an item or items following any one of these words is not meant to be an exhaustive listing of such item or items, or meant to be limited to only the listed item or items. The disclosed embodiments are merely exemplary of the invention, which may be embodied in various forms.

[020] FIG. 1 is a view of a modular laser-based smoking device according to an embodiment of this invention. The smoking device 100 includes a mouthpiece 102, a base 104, an indicator 108, and a switch 112. The mouthpiece 102 and the base 104 are threadably connected to one another at a coupling interface 106. In an embodiment, the mouthpiece 102 and the base 104 can be connected by any attachment means, including, but not limited to, a push- or snap-on

mechanism. The base 104 can contain various electronic circuitry, such as a power source, laser diode, and a microcontroller, which are described in more detail below. The smoking device 100 is portable. In an embodiment, the smoking device 100 is hand-held, so that the smoking device 102 is compact enough to fit in a user's pocket or held within the palm of their hand, similar to a traditional cigarette lighter. In another embodiment, the smoking device 102 is a table-top or vehicle-mountable device.

**[021]** In an embodiment, the switch 112 is mounted on a tailcap 110 that is removably attached to the base 104. The switch 112 can be any type of button, knob, lever, rotary dial, touch-sensitive mechanism, screw-type switch, or slide control that can be used to toggle activation of the smoking device 100. In another embodiment, the switch 112 is coupled to another portion of the base 104, such as a lateral side of the base 104, or alternatively, the switch 112 can be coupled to the mouthpiece 102. In an embodiment, the switch 112 is recessed within the tailcap 110 or the base 104.

**[022]** In another embodiment, a safety mechanism, such as a safety switch or button is coupled to the circuitry, the power supply, and/or the laser diode. The safety mechanism may require that the user input a code or sequence to unlock the smoking device 100 for use.

**[023]** In yet another embodiment, the smoking device 100 contains a transceiver, such as a short-range transceiver that uses the Bluetooth, RFID, or Zigbee communication protocol. The switch is a remote switch that is separate from the smoking device 100, and which can wirelessly communicate with the transceiver, and activate the smoking device 100. In this embodiment, the

smoking device 100 can be in the user's mouth or hand, and the switch can be, for example, in the user's pocket.

[024] The smoking device 100 includes an indicator 108 that emits a light output when the laser diode is active and/or when the switch 112 is activated. In an embodiment, the indicator 108 contains at least one light-emitting diode (LED) that blinks or flashes upon engagement of the switch 112. In another embodiment, the indicator 108 is a LED strip or band that encircles or circumscribes the base 104. In yet another embodiment, the indicator includes a speaker capable of emitting an audible sound, such as a beep, tone, or melody. The indicator 108 can be coupled to any portion of the base 104, mouthpiece 102, or switch 112.

[025] In another embodiment, the indicator 108 can illuminate to various color to indicate different operating conditions of the smoking device 100, the laser diode, and/or the power supply. For example, a "red" LED can indicate that the smoking device is locked, and inoperable, a "blue" LED can indicate that the laser diode is active, and a "yellow" LED can indicate a low battery status.

[026] FIG. 2 is an exploded view of a modular laser-based smoking device according to an embodiment of this invention. The mouthpiece 102 includes a connector 206 that is configured to mate with a connector 202 on the base 104. In an embodiment, the connector 206 and connector 202 are threadably engaged with a screw-type action. However, the connector 206 and connector 202 can be any type of push- or snap-type connectors, and can include male and female interlocking portions, as described in FIG. 5.



[027] In an embodiment, a chamber 204 is located within the smoking device 100 when the base 104 and the mouthpiece 102 are connected together. The chamber 204 is configured to house any type of smokable material, such as tobacco. In an embodiment, the chamber 204 is made of glass, ceramic, or a combination thereof. The chamber 204 can also be made of any material or substance that is resistant to high heat. A molded ring, made from silicone, thermoplastic, polymer, or rubber, surrounds the chamber 204 and holds the chamber 204 in place within the coupling interface 106 when the base 104 and the mouthpiece 102 are secured together. The chamber 204 is replaceable and removable, so that it can be cleaned and sterilized after use.

[028] In an embodiment, the mouthpiece 102 is removable and replaceable, so that multiple users each with their own mouthpiece can share the same smoking device 100 in a healthy and sanitary way, i.e., without sharing the same mouthpiece. In yet another embodiment, the end of the mouthpiece can be fitted with a removable tip. Different users can each have a separate tip that is affixed to the end of the mouthpiece 102, allowing the users to share the same smoking device 100. In another embodiment, the base 104 is connected to an elongated pipe having a mouthpiece, such as those found in water pipes and hookah-smoking devices. In yet another embodiment, a removable cap 208 covers the mouthpiece 102 when the smoking device 100 is not in use.

[029] FIG. 3 is an exploded internal view of a modular laser-based smoking device according to an embodiment of this invention. In an embodiment, an airflow tube 304 is located within the mouthpiece 102. The airflow tube 304 is connected to the chamber 204 at one end, and to a

mouthpiece exit 310 at an opposite end. The airflow tube 304 can be in a coil, spiral, or zig-zag shape to increase the surface area that air must travel from the chamber 204 to the mouthpiece exit 310. When air is released from the chamber 204, it travels through the airflow tube 304 where it is cooled before exiting at the mouthpiece exit 310.

**[030]** In an embodiment, the airflow tube 304 is made of glass, ceramic, or a combination thereof. In another embodiment, the airflow tube 304 is made of a metal, thermoplastic, or polymer material.

**[031]** In another embodiment, the mouthpiece 102 can include an air filter, similar to filters found in traditional cigarettes. The air filter can reduce the amount of smoke, tar, and fine particles that are inhaled by the user during combustion of the smokable material. The air filter can also reduce the harshness of the smoke.

**[032]** In yet another embodiment, the mouthpiece 102 can include a pre-cooled liquid or gel surrounding the airflow tube 304 that assists in further cooling the smoke before it reaches the mouthpiece exit 310. Alternatively, the mouthpiece 102 can include a compressed air canister that provides cooled air around the airflow tube 304. The compressed air canister can be activated simultaneously with the laser diode upon engagement of the switch 112.

**[033]** The base 104 is substantially hollow, and contains a laser diode 306. The laser diode 306 can include a lens assembly to focus and direct the laser beam emitted from the laser diode 306. The laser diode 306 can be a single laser diode or a laser diode array. The laser diode 306 can be any type of laser device, such as a gas laser, chemical laser, dye laser, metal-vapor laser, solid-state laser, or semiconductor laser.

[034] In an embodiment, the laser diode 306 also acts as a heat sink, drawing heat away from the base 104, coupling interface 106 and the mouthpiece 102. The heat sink properties of the laser diode 306 prevents the base 104 and the smoking device 100 from becoming hot to a user's touch, and allows for a safe operation and handling by a user. Alternatively, a separate heat sink can be provided within the base 104 and/or the mouthpiece 102.

[035] In an embodiment, the laser diode 306 is not supplied power and/or is deactivated when the base 104 and the mouthpiece 102 are not securely connected together. Upon a secure connection between the base 104 and the mouthpiece 102, a microcontroller allows the laser diode 306 to be activated upon engagement of the switch 112. Thus, the smoking device 100 conforms to European IEC 60825-1 and CDRH Laser Notice 50 (Class 1) compliance standards, and the laser diode is capable of emission only when it is secured within the coupling interface 106.

[036] In an embodiment, a battery 308 is located within the base 104. The battery 308 can be inserted into the base 104 when the tail cap 110 is removed from the end of the base 104. The battery 308 can be any type of battery, including, but not limited to, alkaline, lithium, nickel cadmium, nickel-metal hydride, and lion. In another embodiment, the smoking device 100 includes a solar cell on the exterior of the base 104 or the mouthpiece 102. The solar cell provides renewable power to an internal power source housed within the smoking device 100.

[037] In another embodiment, the power source can be permanently affixed within the base 104. The power source can be charged with a connection to an external power supply, such as a wall outlet or car power outlet. The base 104 can be compatible with different types of adapters,

such as standard wall plug adapters, car power outlet adapters, and wireless charging adapters. The base 104 can include an interface, such as a USB connection, that allows an external power supply to be coupled to the power source.

[038] In an embodiment, the tail cap 110 and switch 112 are removably coupled to the base 104. The tail cap 110 and/or switch 112 can be threadably connected to a connector 302 coupled to the base 104. Alternatively, the tail cap 110 and/or switch 112 can be connected to the base 104 or mouthpiece 102 by any attachment means, including, but not limited to, a push- or snap-on mechanism.

[039] In yet another embodiment, the switch 112 can be illuminated, and can serve as an indicator. For example, upon depression, the switch 112 can be illuminated to indicate that the laser diode is active.

[040] FIG. 4 is an exploded view of a modular laser-based smoking device having a magnetic coupling interface. In this embodiment, the base 102 includes a sensor 402 responsive to a magnetic field, such Hall effect sensor or a magnetic reed switch. The mouthpiece 102 includes a high strength magnet 404. Upon screwing, or otherwise securing, the mouthpiece 102 to the base 104, the sensor 402 physically contacts the magnet 404, and the sensor 402 is exposed to a magnetic field produced by magnet 404. Upon exposure to the magnetic field, the sensor 402 emits a voltage or signal to a microprocessor that indicates that the mouthpiece 102 and the base 104 are secured together. The microprocessor can then enable or supply power to the laser diode and/or smoking device.

[041] In an embodiment, the sensor 402 emits a signal to the microprocessor only when the sensor 402 is in physical contact with the magnet 404. In another embodiment, the sensor 402 can emit a signal to the microprocessor when the sensor 402 is in proximal contact with the magnet 404. While the magnet 404 and the sensor 402 are not in physical or proximal contact, the laser diode is inactive and not supplied power, thus preventing accidental activation while the laser diode is exposed to the environment. The sensor 402 and the magnet 404 can be mounted within the mouthpiece 102 and the base 104, respectively, or the sensor 402 and the magnet 404 can be face mounted to their respective housings. In another embodiment, the sensor 402 can be coupled to the mouthpiece 102, and the magnet 404 can be coupled to the base 104.

[042] FIG. 5 is a view of a coupling interface with a recessed switch. The coupling interface 106 includes a switch 502 recessed within the base 104. The switch 502 can be a microswitch, relay switch, or other suitable mechanism that is compact enough to fit within the base 104. The switch 502 is activated when a male prong 506 on the mouthpiece 102 enters a female recess 508 on the base 104. The female recess 508 includes a spring-loaded pin 504. When the male prong 506 contacts the pin 504, the pin 504 is depressed and activates the switch 502. Upon activation by the pin 504, the switch 502 emits a voltage or signal to a microprocessor that indicates that the mouthpiece 102 and the base 104 are secured together. The microprocessor can then enable or supply power to the laser diode 308 and/or smoking device. In an embodiment, the pin 504 can be coupled to the male prong 506, instead of being coupled within the female recess 508.

[043] In an embodiment, the male prongs 506 and 510 can be insulated, thereby causing electrical shorting when the male prongs 506 and 510 are fully seated within the female recesses 508 and 512, respectively.

[044] In the embodiment depicted in FIG. 5, only one switch 502 and pin 504 combination is shown. However, another switch and pin combination (not shown) can be placed adjacent to female recess 512. The microprocessor can require that both switches are activated prior to the laser diode and/or the smoking device becoming enabled. This ensures that both the male prongs 506 and 510 are fully seated within their respective female recesses 508 and 512 prior to activation of the laser diode.

[045] FIG. 6 is a view of a coupling interface with a 1-Wire mechanism. 1-Wire is a device communications bus system designed by Dallas Semiconductor Corporation that provides low-speed data, signaling, and power over a single signal. In an embodiment, the mouthpiece 102 consists of two separate metallic portions, a first side 602, and a second side 604. The mouthpiece 102 can be made of any electrically conductive material, such as aluminum or steel. The first side 602 and the second side 604 are electrically isolated from each other via an insulating material 600. The insulating material 600 can be made of ceramic or any other non-conductive material capable of withstanding high-temperatures. A 1-Wire integrated circuit 614 is coupled to both the first side 602 and the second side 604.

[046] When the male prongs 606 and 608 of the mouthpiece 102 are fully seated in their respective female recesses 610 and 612 in the base 104 (also made from a metallic or conductive material), an electrical loop is created, whereby an electrical connection is made between the first

side 602 and the second side 604 of the mouthpiece 102. Upon completion of the electrical loop, the 1-Wire integrated circuit 614 transmits a signal to a microprocessor in the base 104. The signal can be a unique serial or other value that identifies a particular user or a particular mouthpiece. The microprocessor can then enable or supply power to the laser diode 308 and/or smoking device.

[047] FIG. 7 is a view of a unitary laser-based smoking device according to an embodiment of this invention. The smoking device 100 includes a base 702, a retractable chamber 704, a turning knob 706, an ignition switch 708, and a mouthpiece 710. The chamber 704 is configured to house any type of smokable material, such as tobacco. In an embodiment, the chamber 704 is replaceable and removable, so that it can be cleaned and sterilized after use. The turning knob 706 can be rotated to retract and detract the chamber 704, as described in more detail in FIG. 8. The base 702 can contain various electronic circuitry, such as a power source, laser diode, and a microcontroller. The smoking device 700 is portable. In an embodiment, the smoking device 700 is hand-held, and comparable in size to a traditional cigarette lighter. In another embodiment, the smoking device 700 is a table-top or vehicle-mountable device. The ignition switch 708 can be placed on any portion of the base 702, such as on a lateral side as shown in FIG. 7, or on a top portion as shown in FIG. 8.

[048] FIG. 8 is a view of a unitary laser-based smoking device with a retracted chamber. Upon rotation of the turning knob 706, the chamber 704 swivels or pivots outwards, exposing an internal cavity 804 in the chamber 704. After the internal cavity 804 is filled with a smokable material, the chamber 704 can be detracted into place, hiding the internal cavity 804 as seen in

FIG. 7. In an embodiment, the retraction/detraction mechanisms of the chamber 704 can be activated via a push button or switch. Alternatively, the chamber 704 can be displaced by simply exerting force on the chamber 704, such as with a finger. In another embodiment, the chamber 704 can be snapped or pulled out of the base 702, either in a swivel motion or so that the chamber 704 is completely removed from the base 702. In another embodiment, the chamber 704 is a drawer that can be slid in and out of a recess in the base 702. In yet another embodiment, the chamber 704 is a cartridge that can be loaded into the base 702.

[049] FIG. 9 is a view of an extended mouthpiece attached to a unitary laser-based smoking device. In an embodiment, an extended mouthpiece 902 can be coupled to the mouthpiece 710. The extended mouthpiece 902 includes an airflow tube 904. The airflow tube 904 is connected to the mouthpiece 710 at one end, and to the extended mouthpiece exit 906 at an opposite end. The airflow tube 904 can be in a coil, spiral, or zig-zag shape to increase the surface area that air must travel from the mouthpiece 710 to the mouthpiece exit 906. When air is released from the mouthpiece 710, it travels through the airflow tube 904 where it is cooled before exiting at the mouthpiece exit 906.

[050] In an embodiment, the airflow tube 904 is made of glass, ceramic, or a combination thereof. In another embodiment, the airflow tube 904 is made of a metal, thermoplastic or polymer material.

[051] In another embodiment, the extended mouthpiece 902 can include an air filter 908, similar to filters found in traditional cigarettes. The air filter 908 can reduce the amount of



smoke, tar, and fine particles that are inhaled by the user during combustion of the smokable material. The air filter 908 can also reduce the harshness of the smoke.

[052] In yet another embodiment, the extended mouthpiece 902 can include a pre-cooled liquid of gel surrounding the airflow tube 904 that assists in further cooling the smoke before it reaches the mouthpiece exit 906. Alternatively, the extended mouthpiece 902 can include a compressed air canister that provides cooled air around the airflow tube 904. The compressed air canister can be activated simultaneously with the laser diode upon engagement of the switch 708.

[053] While the principles of this invention have been illustrated in relation to the exemplary embodiments shown herein, the principles of this invention are not limited thereto and include any modification, variation or permutation thereof.

What is claimed is:

1. A portable smoking device, comprising:
  - a base;
  - a laser diode located within the base;
  - a power source coupled to the laser diode; and
  - a chamber configured to hold a smokable material.
2. The portable smoking device of Claim 1, further comprising a mouthpiece removably coupled to the base or to the chamber via a connection means.
3. The portable smoking device of Claim 1, further comprising a switch, the switch configured to activate the laser diode.
4. The portable smoking device of Claim 2, further comprising an airflow tube within the mouthpiece, the airflow tube having a spiral or zig-zag shape.
5. The portable smoking device of Claim 1, further comprising a safety switch mechanism configured to prevent activation of the laser diode.
6. The portable smoking device of Claim 1, further comprising at least one LED configured to illuminate upon activation of the laser diode.
7. The portable smoking device of Claim 2, wherein the connection means is a push-on connection, a screw-type connection, or a snap-on connection.
8. An ignition device for smokable material, comprising:
  - a base containing a laser diode and a power supply;

a connection means configured to connect to a mouthpiece;

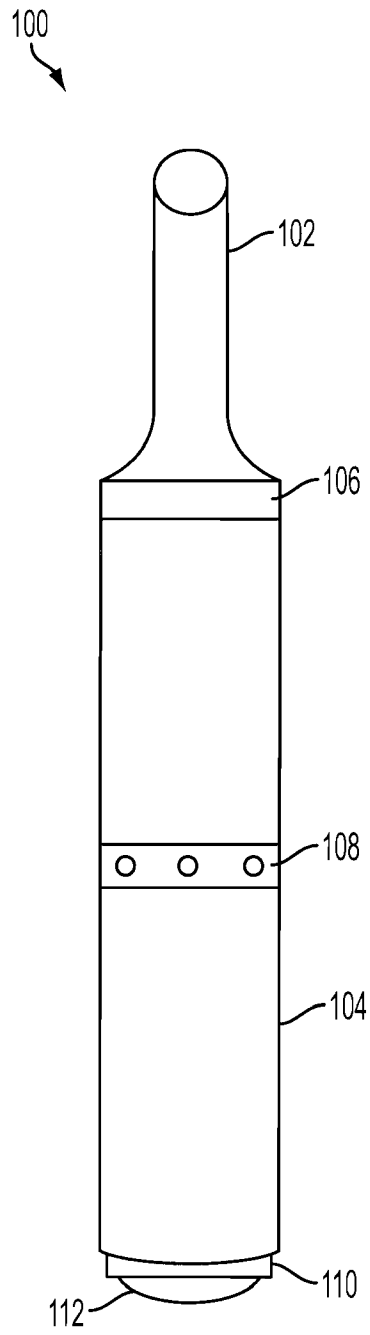
a chamber coupled to the base, the chamber configured to hold a smokable material; and

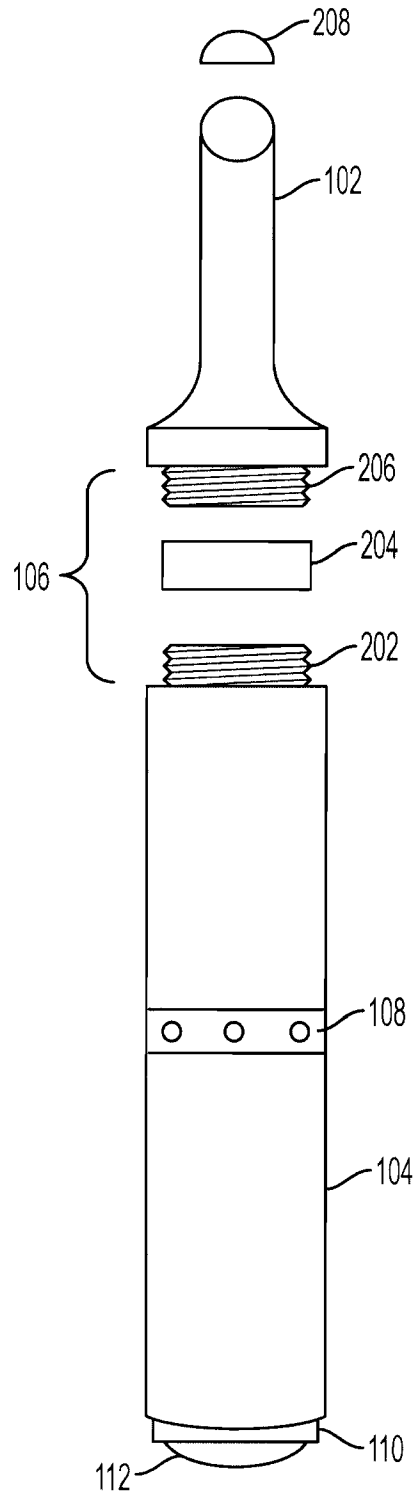
an ignition switch,

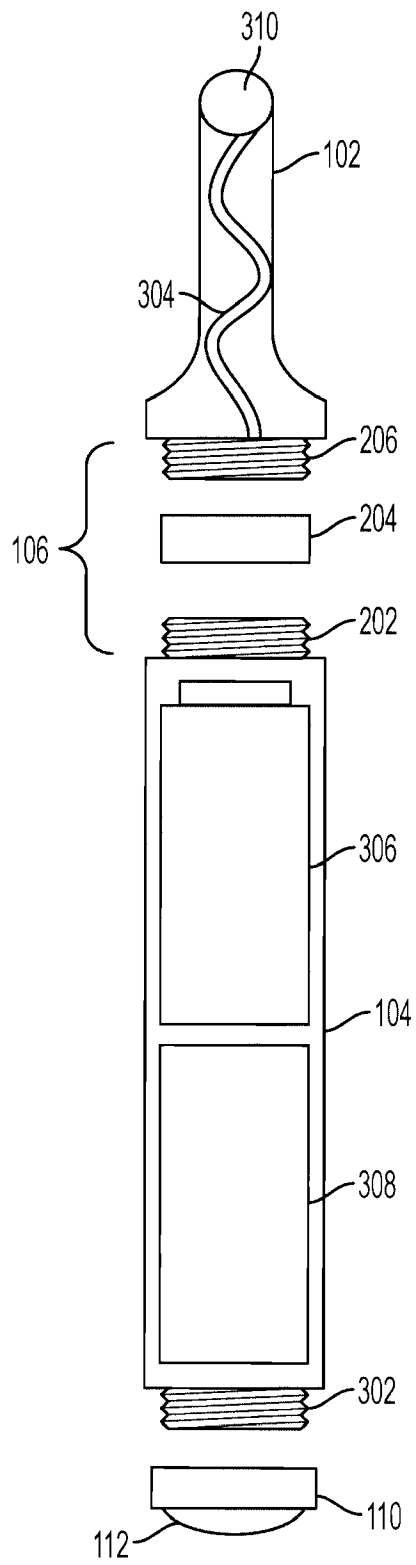
wherein the laser diode is configured to emit a laser beam towards the chamber upon activation of the ignition switch.

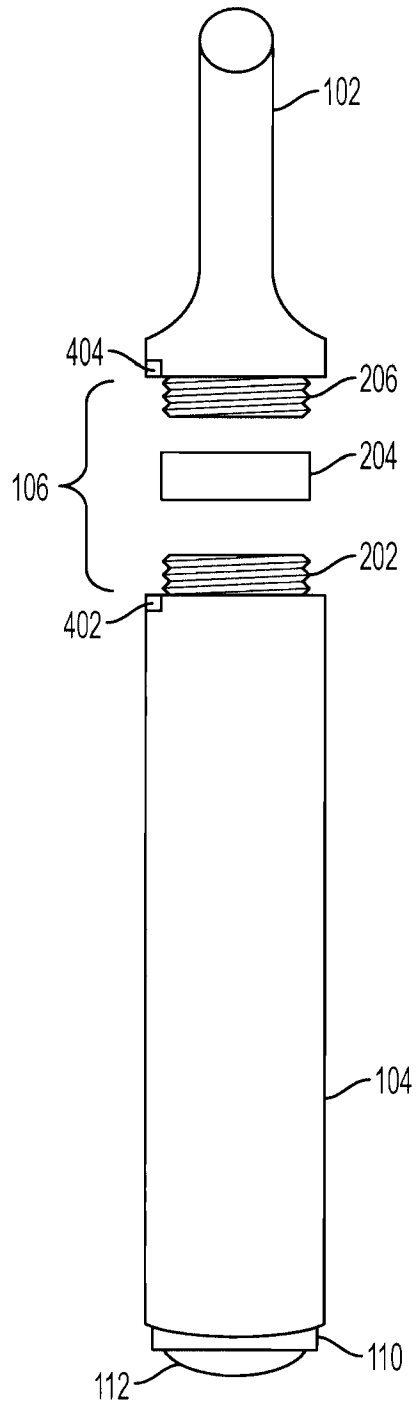
9. The ignition device of Claim 8, wherein a circular LED array circumscribes the base.
10. The ignition device of Claim 8, wherein the ignition switch includes an illumination means.
11. The ignition device of Claim 8, wherein the power supply is removable from the base.
12. The ignition device of Claim 8, wherein chamber is pivotally attached to the base.
13. The ignition device of Claim 8, wherein the chamber is removably attached to the base.
14. The ignition device of Claim 8, wherein the mouthpiece is removably coupled to the base or to the chamber.
15. A modular smoking device, comprising:
  - a base;
  - a mouthpiece;
  - a chamber configured to be positioned between the base and the mouthpiece, the chamber further configured to hold a smokable material; and
  - an ignition source located adjacent to the chamber.

16. The modular smoking device of Claim 15, further comprising means for preventing activation of the ignition source when the chamber is not coupled to both the base and the mouthpiece.
17. The modular smoking device of Claim 15, further comprising a 1-Wire coupling means between the mouthpiece and the top connector.
18. The modular smoking device of Claim 15, further comprising a recessed switch coupling means between the mouthpiece and the top connector.
19. The modular smoking device of Claim 15, further comprising a magnetic switch coupling means between the mouthpiece and the top connector.
19. The modular smoking device of Claim 15, further comprising an airflow tube positioned within the mouthpiece, the airflow tube having a spiral or zig-zag shape.
20. The modular smoking device of Claim 15, further comprising a molded ring configured to secure the chamber between the base and the mouthpiece.

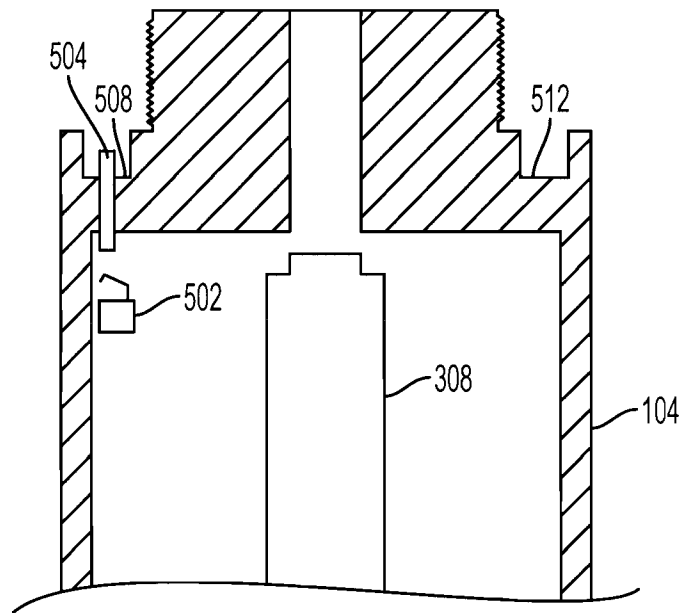
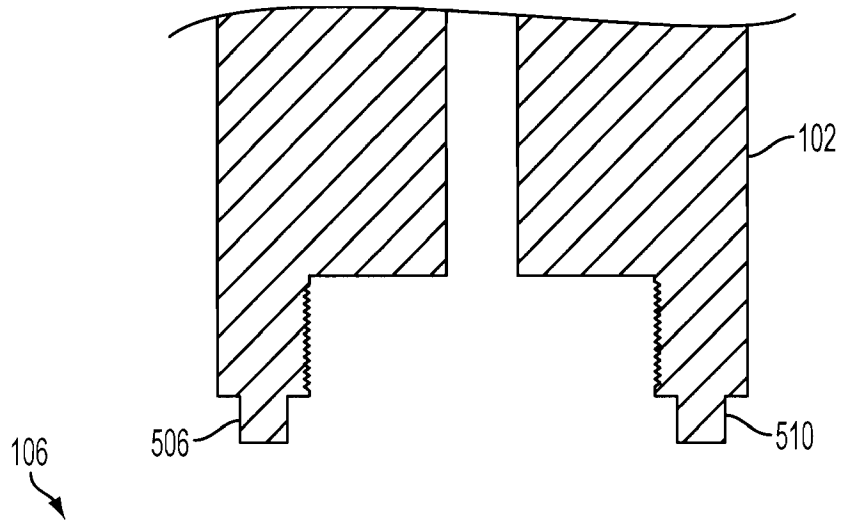


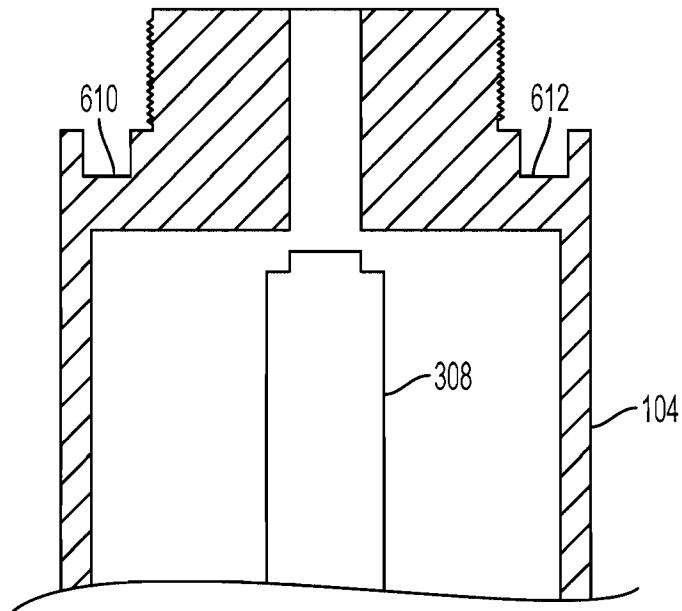
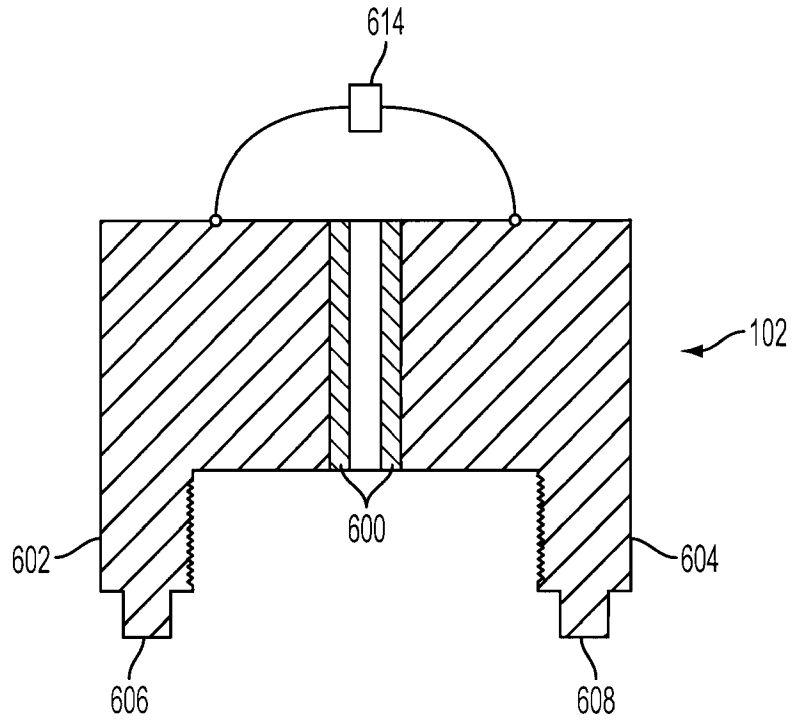


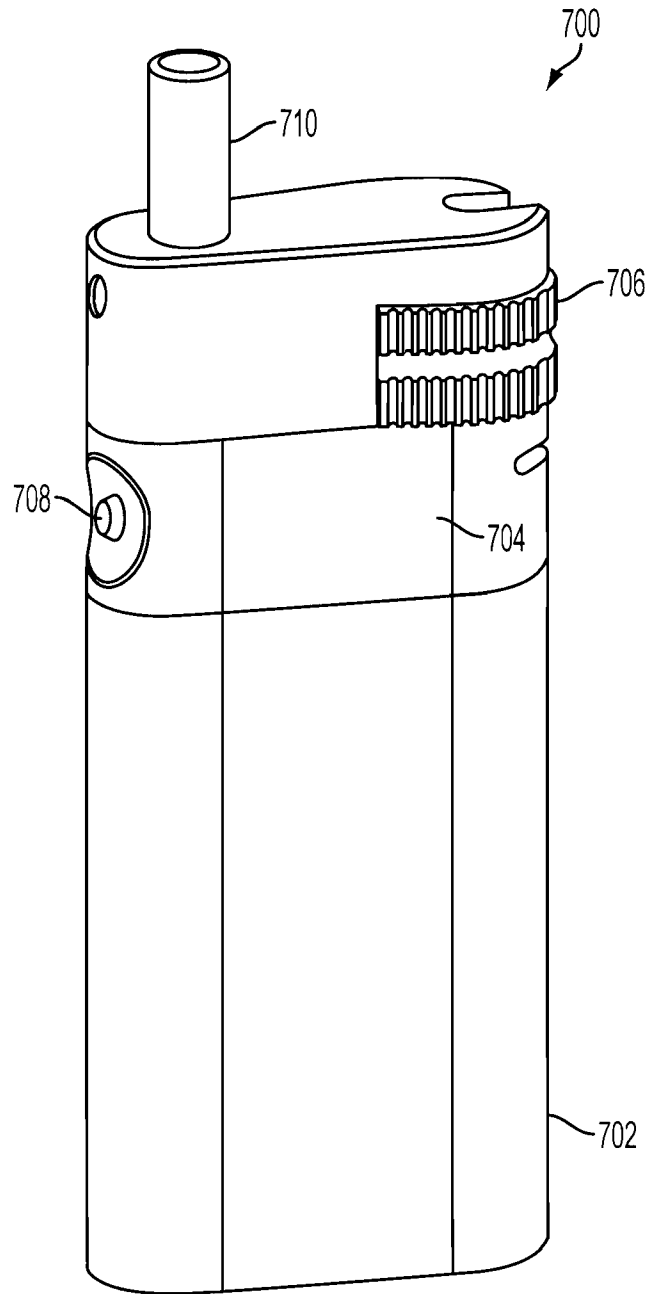


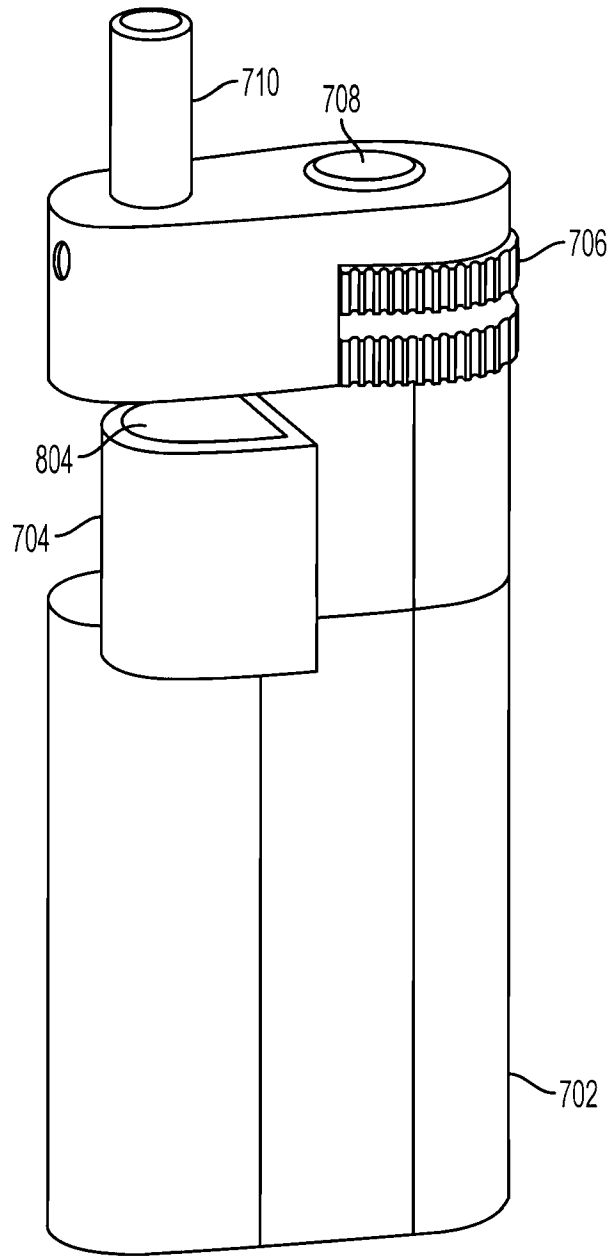


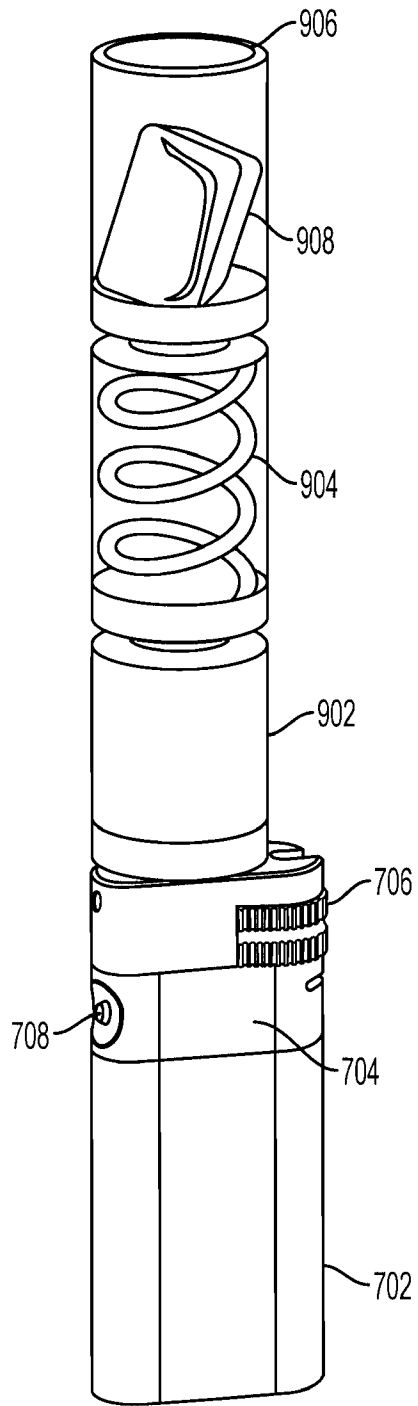












INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2010/057657

<p><b>A. CLASSIFICATION OF SUBJECT MATTER</b>                  IPC(8) - A24F 3/00 (2011.01)                  USPC - 131/185                  According to International Patent Classification (IPC) or to both national classification and IPC</p>																																									
<p><b>B. FIELDS SEARCHED</b></p> <p>Minimum documentation searched (classification system followed by classification symbols)                  IPC(8) - A24F 1/00, 3/00, 9/00, 13/00, 47/00; F23Q 7/00 (2011.01)                  USPC - 128/202.21; 131/185, 328, 329, 330, 351; 219/121.6; 431/253, 254, 350</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                  PatBase and Google Patents</p>																																									
<p><b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b></p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 2009/0217933 A1 (CHEN) 03 September 2009 (03.09.2009) entire document</td> <td>15</td> </tr> <tr> <td>--</td> <td></td> <td>-----</td> </tr> <tr> <td>Y</td> <td></td> <td>1-14, 16, 18-20</td> </tr> <tr> <td>Y</td> <td>US 5,268,553 A (SHIMOJI) 07 December 1993 (07.12.1993) entire document</td> <td>1-14,</td> </tr> <tr> <td>Y</td> <td>CN 201328361 Y (JUHE) 21 October 2009 (21.10.2009) entire document</td> <td>4, 19b</td> </tr> <tr> <td>Y</td> <td>US 5,934,289 A (WATKINS et al) 10 August 1999 (10.08.1999) entire document</td> <td>8-14, 18</td> </tr> <tr> <td>Y</td> <td>US 2007/0121786 A1 (OKAWA et al) 31 May 2007 (31.05.2007) entire document</td> <td>9</td> </tr> <tr> <td>Y</td> <td>US 7,145,103 B2 (SHEEN) 05 December 2006 (05.12.2006) entire document</td> <td>10</td> </tr> <tr> <td>Y</td> <td>US 1,302,047 A (HURST) 29 April 1919 (29.04.1919) entire document</td> <td>12</td> </tr> <tr> <td>Y</td> <td>US 4,216,786 A (WRIGHT) 12 August 1980 (12.08.1980) entire document</td> <td>16</td> </tr> <tr> <td>Y</td> <td>US 4,669,465 A (MOORE et al) 02 June 1987 (02.06.1987) entire document</td> <td>19a</td> </tr> <tr> <td>Y</td> <td>US 4,258,730 A (TSUKAMOTO) 31 March 1981 (31.03.1981) entire document</td> <td>20</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 2009/0217933 A1 (CHEN) 03 September 2009 (03.09.2009) entire document	15	--		-----	Y		1-14, 16, 18-20	Y	US 5,268,553 A (SHIMOJI) 07 December 1993 (07.12.1993) entire document	1-14,	Y	CN 201328361 Y (JUHE) 21 October 2009 (21.10.2009) entire document	4, 19b	Y	US 5,934,289 A (WATKINS et al) 10 August 1999 (10.08.1999) entire document	8-14, 18	Y	US 2007/0121786 A1 (OKAWA et al) 31 May 2007 (31.05.2007) entire document	9	Y	US 7,145,103 B2 (SHEEN) 05 December 2006 (05.12.2006) entire document	10	Y	US 1,302,047 A (HURST) 29 April 1919 (29.04.1919) entire document	12	Y	US 4,216,786 A (WRIGHT) 12 August 1980 (12.08.1980) entire document	16	Y	US 4,669,465 A (MOORE et al) 02 June 1987 (02.06.1987) entire document	19a	Y	US 4,258,730 A (TSUKAMOTO) 31 March 1981 (31.03.1981) entire document	20
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<p>Date of the actual completion of the international search</p> <p>14 January 2011</p>		<p>Date of mailing of the international search report</p> <p><b>27 JAN 2011</b></p>																																							
<p>Name and mailing address of the ISA/US</p> <p>Mail Stop PCT, Attn: ISA/US, Commissioner for Patents                  P.O. Box 1450, Alexandria, Virginia 22313-1450                  Facsimile No. 571-273-3201</p>		<p>Authorized officer:</p> <p>Blaine R. Copenheaver</p> <p>PCT Helpdesk: 571-272-4300                  PCT OSP: 571-272-7774</p>																																							