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SCENTED IMITATION CANDLE DEVICE

Abstract

Methods, systems, and devices relating to an electronic scented candle that is convenient to use and enables rapid generation and dissipation of scented materials are described. One electronic candle device includes a shell that has a through hole, a flame element protruding through the through hole, an installation lid including a locking base to allow removable coupling of a fragrance container, a scent chamber including a locking clip, a first channel, a second channel, a third channel, and a fourth channel. The scent chamber is removably coupled to the locking base by the locking clip, and an air pump provided to supply pressurized air.

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Background/Summary

RELATED APPLICATIONS [0001] This patent document is a continuation of U.S. patent application Ser. No. 18/061,608, filed Dec. 5, 2022, which is a divisional of U.S. patent application Ser. No. 16/420,459, filed May 23, 2019, now U.S. Pat. No. 11,519,575, which is a continuation of U.S. patent application Ser. No. 15/886,781, filed Feb. 1, 2018, now U.S. Pat. No. 10,302,263, which claims priority to Chinese Patent Application No. 201710214532.9, filed Apr. 5, 2017. The entire contents of the before mentioned applications are incorporated by reference in this patent document.

TECHNICAL FIELD
[0002] The subject matter of this patent document relates to a candle device that use an imitation flame, and particularly, to features that produce an aromatic scent.
BACKGROUND
[0003] Traditional true flame candles, when lit, provide a pleasant ambience in many homes, hotels, churches, businesses, etc. Traditional candles, however, provide a variety of hazards including risk of fire, damage to surfaces caused by hot wax, and the possible emission of soot. Flameless candles have become increasingly popular alternatives to traditional candles. With no open flame or hot melted wax, flameless candles provide a longer-lasting, safe, and clean alternative. Such imitation candle devices often include light sources, such as LEDs, and include electronic circuits that control the operation the imitation candle device.
[0004] Along with the development of new technologies, scented candles that are electrically powered have appeared in the market. These electronic scented candles simulate a flickering flame, which plays a great role in creating the proper atmosphere for the above venues and household environments. In addition to their use as a decorative piece, these candles can provide additional practical functions such as releasing a scent by using a fan that forces the scent to a scent outlet for release into an external environment. However, such electronic scented candles often do not produce a satisfactory scent, and are not convenient to use
SUMMARY
[0005] The disclosed technology relates to an electronic scented candle that is convenient to use and enables rapid generation and dissipation of scented material.
[0006] In one exemplary aspect, an electronic candle device is disclosed. The device includes a shell including a through hole; a flame element protruding through the through hole; an installation lid including a locking base to allow removable coupling of a fragrance container; a scent chamber including a locking clip, a first channel, a second channel, a third channel, and a fourth channel, wherein the scent chamber is removably coupled to the locking base by the locking clip; and an air

pump configured to pump air, wherein the first channel of the scent chamber is removably coupled to a first section of a fragrance container to direct the pumped air into the fragrance container, wherein the second channel of the scent chamber is removably coupled to a second section of a fragrance container to draw, under air pressure of the pumped air, a fragrance material from the fragrance container into the scent chamber, wherein the third channel of the scent chamber is coupled to the air pump to allow pumped air to enter the scent chamber, and wherein the fourth channel of the scent chamber is coupled to the through hole to allow a fragrance material to reach an external environment of the electronic candle device.

[0007] In some embodiments, the device further includes the fragrance container that is removably coupled to the installation lid. In some embodiments, the device further includes a fifth channel coupled to the first channel of the scent chamber and a sixth channel coupled to the second channel of the scent chamber. In some implementations, the device further includes a suction tube coupled to the sixth channel to facilitate drawing of the fragrance material from the fragrance container to the scent chamber.

[0008] In some embodiments, the installation lid includes a mount support positioned removably on the installation lid to facilitate coupling of a fragrance container. In some embodiments, the installation lid includes a protrusion to facilitate correct alignment of the installation lid and the fragrance container.

[0009] In some embodiments, the device further includes an indicator positioned at an external surface of the electrical candle device to indicate a location of the protrusion. In some implementations, a first end of the second channel that is coupled to the scent chamber has a smaller dimension than a second end of the second channel. In some embodiments, the second channel has a tapered shape. In some embodiments, a bottom surface of the scent chamber has a funnel shape.

[0010] In some embodiments, the device further includes a central control circuit, a power supply, and one or more tilt sensors, wherein each of the one or more tilt sensors is configured to sense a tilt angle of the electronic candle device, the one or more tilt sensors further configured to transmit a signal to the central control circuit to shut down the power supply upon sensing that the tilt angle is greater than or equal to a predetermined threshold angle. In some implementations, the predetermined threshold angle is 45 degrees.

[0011] In some embodiments, the device includes a valve coupled to the fourth channel, wherein the valve is configured to, upon receiving a signal from the central control circuit indicative that the tilt angle is greater than or equal to the predetermined threshold angle, close the fourth channel to prevent the fragrance material from spilling outside of the electronic candle device. In some embodiments, the device includes a sound insulation layer around the air pump for reducing noise caused by the air pump to lower than or equal to 55 dB. In some implementations, the device includes an anti-vibration component positioned at an external side of the air pump for reducing vibration caused by the air pump.

[0012] In some embodiments, the shell includes an observation window corresponding to the fragrance container for allowing a user to observe a remaining quantity of the fragrance material in the fragrance container. In some implementations, the device includes a light source positioned within the shell, the light source configured to illuminate a fragrance container so that a remaining quantity of a fragrance material in the fragrance container can be observed via the observation window.

[0013] In some embodiments, the flame element is configured to retract into the shell when the electronic candle device is turned off. In some implementations, the device includes a dark-colored component protruding through the through hole, the dark-color part configured to have an appearance of a wick. In some embodiments, the device includes a light source positioned in proximity to the through hole, wherein the air pump is configured to pump air at a high pressure to allow the fragrance material in the fragrance container to reach the external environment in a

smoke form, and wherein the light source is configured to illuminate the flame element and the fragrance material in the smoke form to create an appearance of a real flame.
[0014] The details of one or more implementations are set forth in the accompanying attachments, the drawings, and the description below. Other features will be apparent from the description and drawings, and from the claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0015] FIG. **1** shows a scent producing imitation candle device in accordance with an exemplary embodiment.
[0016] FIG. **2**A shows certain components of a scent-producing mechanism within an imitation candle device including a scent chamber and an air pump in accordance with an exemplary embodiment.
[0017] FIG. **2**B shows an enlarged detailed view of some of the components illustrated in FIG. **2**A.
[0018] FIG. **2**C shows certain components of a scent-producing mechanism within an imitation candle device including a scent chamber in accordance with an exemplary embodiment.
[0019] FIG. **2**D shows certain components of a scent-producing mechanism within an imitation candle device including a scent chamber, an air pump, and a check valve in accordance with an exemplary embodiment.
[0020] FIG. **3**A shows certain components of a scent-producing mechanism within an imitation candle device including a scent chamber and a fan in accordance with an exemplary embodiment.
[0021] FIG. **3**B shows certain components of a scent-producing mechanism within an imitation candle device including a heating device and a fan in accordance with an exemplary embodiment.
[0022] FIG. **3**C shows certain components of a scent-producing mechanism within an imitation candle device including an atomizing device and a fan in accordance with an exemplary embodiment.
[0023] FIG. **3**D shows certain components of a scent-producing mechanism within an imitation candle device including an atomizing device in accordance with an exemplary embodiment.
[0024] FIG. **4** shows a central control circuit board of an imitation candle device in accordance with an exemplary embodiment.
[0025] FIG. **5**A shows an external side of an air pump in an imitation candle device in accordance with an exemplary embodiment.
[0026] FIG. **5**B shows an exploded view of certain components of an imitation candle device in accordance with an exemplary embodiment.
[0027] FIG. **5**C shows a side view of certain components around an air pump in an imitation candle device in accordance with an exemplary embodiment.
[0028] FIG. **6**A shows an installation lid of an imitation candle device in accordance with an exemplary embodiment.
[0029] FIG. **6**B shows an exploded view of components of an installation lid in accordance with an exemplary embodiment.
[0030] FIG. **7**A shows an installation lid and connection pipes of an imitation candle device in accordance with an exemplary embodiment.
[0031] FIG. **7**B shows an inverted installation lid and connection pipes of an imitation candle device in accordance with an exemplary embodiment.
[0032] FIG. **7**C shows another installation lid and connection pipes of an imitation candle device in accordance with an exemplary embodiment.
[0033] FIG. **8**A shows a locking clip and a locking base of an installation lid in accordance with an exemplary embodiment.

[0034] FIG. **8**B shows another locking clip and another locking base of an installation lid in accordance with an exemplary embodiment.
[0035] FIG. **9**A shows certain components of a scent-producing mechanism within an imitation candle device including a fragrance container, a scent chamber, and an air pump in accordance with an exemplary embodiment.
[0036] FIG. **9**B shows certain components of a scent-producing mechanism within an imitation candle device including a fragrance container and a scent chamber in accordance with an exemplary embodiment.
[0037] FIG. **10**A shows an electronic imitation candle including a flame element in accordance with an exemplary embodiment.
[0038] FIG. **10**B shows an electronic imitation candle with a retracted flame element and a dark-color component appearing as a wick in accordance with an exemplary embodiment.
[0039] FIG. **11**A shows certain components of an exemplary electronic imitation candle in accordance with an exemplary embodiment.
[0040] FIG. **11**B shows certain components of another electronic imitation candle in accordance with an exemplary embodiment.
[0041] FIG. **11**C shows an enlarged detailed view of some of the components in FIG. **11**B.
[0042] FIG. **12**A shows an arrangement of a light-emitting component and scent released in the form of smoke in accordance with an exemplary embodiment.
[0043] FIG. **12**B shows an arrangement of a light-emitting component and scent released in the form of smoke in accordance with an exemplary embodiment.
[0044] FIG. **12**C shows an arrangement of a light-emitting component and scent released in the form of smoke in accordance with an exemplary embodiment.
[0045] FIG. **13** shows a candle device that includes three fragrance containers in accordance with an exemplary embodiment.
[0046] FIG. **14**A shows a first step of installing a fragrance container in an imitation candle device in accordance with an exemplary embodiment.
[0047] FIG. **14**B shows a second step of installing a fragrance container in an imitation candle device in accordance with an exemplary embodiment.
[0048] FIG. **14**C shows a third step of installing a fragrance container in an imitation candle device in accordance with an exemplary embodiment.
[0049] FIG. **14**D shows an installed fragrance container in an imitation candle device in accordance with an exemplary embodiment.

DETAILED DESCRIPTION

[0050] In this patent document, the word “exemplary” is used to mean serving as an example, instance, or illustration. Any embodiment or design described herein as “exemplary” is not necessarily to be construed as preferred or advantageous over other embodiments or designs. Rather, use of the word exemplary is intended to present concepts in a concrete manner.
[0051] Imitation candle devices can simulate a real candle with a flame that resembles a real-life flame with flickering effects using optical, mechanical and electrical components. As technologies advance, there is a demand for imitation candle devices that can provide additional functions. This patent document describes imitation candle devices that are capable of releasing pleasant scents into an external environment.
[0052] FIG. **1** illustrates an exemplary scent producing imitation candle device **100** in accordance to technology disclosed herein. The device **100** includes a flame element **103** and a shell **101**. The device **100** also includes a scent-producing mechanism positioned within the shell **101** to produce scent and an observation window **126** for the user to see whether there is sufficient scent material.
[0053] FIGS. **2**A-**2**C show some exemplary components of a scent-producing mechanism within an imitation candle device **100**. In some embodiments, a scent producing mechanism includes a scent chamber **105**. The scent chamber **105** includes a first channel **108** (shown in FIG. **2**C) and a second

channel **109** (shown in FIGS. **2**A-**2**B). The first channel **108** is coupled to (or is in communication with) the air inside a fragrance container **107**, and the second channel **109** is coupled to (or in communication with) the fragrance inside the fragrance container **107**. As shown in FIG. **2**A, the scent chamber **105** further includes a third channel **110** and a fourth channel **111**. The third channel **110** is configured to allow outside air to enter the scent chamber **105**, and the fourth channel is configured to output a scent produced from the scent chamber **105** to the outside of the candle device **100**. In some implementations, the third channel **110** is coupled to an air pump **106** to allow air to enter the scent chamber **105**.

[0054] In some embodiments, the air pump **106** pumps air into the scent chamber **105** via the third channel **110** such that the air pressure of the scent chamber **105** keeps increasing. The air in the scent chamber **105** enters the fragrance container **107** via the first channel **108** under high air pressure such that the air pressure in the fragrance container **107** keeps increasing as well. The fragrance in the fragrance container **107** is then transported under pressure into the scent chamber **105** via the second channel **109**. The high pressure produced by the air pump **106** allows the fragrance to be fully atomized. Because the air pressure in the scent chamber **105** is higher than the air pressure of the external environment, the atomized fragrance leaves the scent chamber **105** via the fourth channel **111** dissipated outside of the candle device, thereby releasing a scent. In some embodiments, instead of having the air pump **106**, a fan may be used to supply the air to the third channel **110**, and the fan produces an air flow with a velocity that is directed into the scent chamber **105**.

[0055] The air pump provides several advantageous aspects as compared to a fan. First, the air pump **106** can effectively drive a fragrance to the second channel **109** inside the electronic candle **100** by producing a high air pressure. Meanwhile, the high air pressure can fully atomize a liquid fragrance, which improves the aromatic effect of the fragrance. Second, the atomized fragrance is more concentrated as compared to fragrance dispersed using other mechanisms, e.g., a fan. Furthermore, the air pressure produced by the air pump **106** is adjustable, thereby allowing the user to adjust the atomization rate of the fragrance. For example, when a fan is used to drive air flow to disperse the liquid fragrance, the magnitude and direction of its pressure on the fragrance may not be precisely controlled even though the wind speed and direction of the fan can be adjusted. The air pump, on the other hand, can apply air pressure of different magnitudes and directions in a relatively precise manner, thereby achieving more effective control by the user.

[0056] In some embodiments, an installation lid **113** can be used to connect the fragrance container **107** to the scent chamber **105**. In some implementations, the installation lid **113** includes a fifth channel **115** and a sixth channel **116** (shown in FIG. **2**C), which are coupled to the first channel **108** and the second channel **109** of the scent chamber **105**, respectively. In some embodiments, the installation lid **113** includes a mount support **117** for mounting the fragrance container **107** in the installation lid **113**. The mount support **117** is positioned on the installation lid **113** in a removable manner to facilitate easy disassembling of the mount support **117** from the installation lid **113** when the mount support **117** needs to be cleaned. The removable connection mechanism includes, but is not limited to, a snap connection. In some embodiments, the installation lid **113** further comprises a suction tube **118** disposed inside of the mount support **117**. The suction tube **118** may extend into the mount support **117** and may be coupled to the sixth channel **116** to guide the fragrance in the fragrance container **107** to rise into the scent chamber **105** via the suction tube **118**. In some embodiments, the suction tube **118** is fixed to the mount support **117** through an interference fit between the end of the suction tube **118** and the mount support **117**. In some embodiments, the mount support **117** includes a gasket that may be made of rubber or silica gel, such that an excellent seal can be achieved when the fragrance container **107** is mounted onto the mount support **117**. In some implementations, an elastic element **119** is further disposed between the installation lid **113** and the mount support **117**. The elastic element **119** can be used to improve the tightness between the installation lid **113** and the installation. The elastic material **119** can also reduce vibration of the

installation lid **113** and/or the mount support **117**, thereby reducing noise. The elastic material **119** may be rubber or silica gel. In some embodiments, the inner side of the mount support **117** is of a cylindrical structure and comprises threads to facilitate the fixation of the fragrance container **107** onto the mount support **117**. In some implementations, the fragrance container **107** has its own threads. The threads of the mount support **117** allow the use of various types of fragrance containers **107** so long as they have compatible threads, thereby improving the universality of the scent producing device. In some embodiments, the fragrance container **107** may also be fixed through a snap connection. In some implementations, moreover, the threads of the mount support **117** are generally used and therefore can fit most perfume bottles on the market, which also improves the universality of the scent producing device (i.e. a variety of general fragrance containers are compatible with the candle device).

[0057] In some embodiments, such as shown in FIGS. **7**A-B, the first channel is coupled to an air portion inside the fragrance container **107** via the connection pipe **130**B (shown in FIG. **7**B). In some implementations, the opening end of the connection pipe **130**B is above the surface of the fragrance in the fragrance container **107**, and the second channel extends into a fragrance portion inside the fragrance container **107** via the connection pipe **130**A (shown in FIG. **7**A). Usually, there is a small amount of the fragrance remaining at the bottom of the fragrance container **107** when the scent producing mechanism cannot produce scent because the fragrance is substantially consumed. When the fragrance container **107** is replaced by the user, the electronic candle **100** may be inverted so that the installation lid **113** and the fragrance container **107** can be disengaged together, as shown in FIG. **7**B. The remaining fragrance in the fragrance container **107** then gathers at the opening of the fragrance container **107**. Because the first channel **108** and the second channel **109** are coupled with the connection pipes **130**A and **130**B, whose openings are both higher than the opening of the fragrance container **107**, the perfume will not flow out via the first channel or the second channel.

[0058] In some implementations, the first channel and the second channel are coupled to a fragrance portion inside the fragrance container **107**, as shown in FIG. **7**C. The first channel and the second channel extend into a fragrance portion inside the fragrance container **107** via the connection pipe **130**A and the connection pipe **130**B. Usually there is a small amount of the fragrance remaining at the bottom of the fragrance container **107** when the scent producing device cannot produce a scent because the fragrance is substantially consumed. When the fragrance container **107** is replaced by the user, the electronic candle may be inverted so that the installation lid **113** and the fragrance container **107** can be disengaged together. The fragrance in the fragrance container **107** then gathers at the opening of the fragrance container **107**. Because the first channel and the second channel are connected with the connection pipe **130**A and the connection pipe **130**B, whose openings are both higher than the opening of the fragrance container **107**, the perfume will not flow out via the first channel or the second channel. Meanwhile, as shown in FIG. **7**C, the connection pipe **130**A and the connection pipe **130**B extend to the bottom of the fragrance container **107**. When the fragrance container **107** is inclined or inverted, the air inside of the fragrance container **107** moves to the bottom ends of the connection pipe **130**A and the connection pipe **130**B, which can effectively prevent the fragrance from flowing out of the first channel and the second channel in a large quantity.

[0059] It is noted that the length of the connection pipe **130**B may be set according to specific requirements, and any connection pipe **130**B higher than the bottle mouth of the fragrance container **107** shall be encompassed by the present document.

[0060] Referring back to FIGS. **2**A-**2**B, in some embodiments, the dimension of one end of the third channel **110** that is further away from the air pump **106** can be smaller than the dimension of the remaining portion. The shape of the third channel **110** includes, but is not limited to, an evenly tapered cone, or a tapered extension in a cylindrical manner from the opening, such that the air flow in the air pump **106** has a further increased velocity when it flows out of the opening into the

scent chamber along the third channel **110**. The high-speed air flow output from the third channel **110** allows the fragrance to be atomized and distributed more evenly. In some embodiments, the air pump **106** can continuously pump at a rate desired by a user. In some implementations, if a user wants the produced scent to be lighter, the scent producing mechanism may be set to spray the fragrance intermittently. For example, the device may spray for five minutes (or another time duration) at every half an hour/one hour/two hour intervals. In some embodiments, a user may set the time duration, turn-on time, and turn-off time of spraying. In some embodiments, the air pump **106** is controlled via a control circuitry (such as shown in FIG. **4**), e.g., through a hardware circuit such as a PCB board. In some embodiments, a control program for the air pump **106** may be written into a memory, and the control program can be executed by a processor to control operations of the air pump **106**. In some embodiments, the air flow rate by the air pump **106** into the scent chamber **105** is greater than or equal to 1.0 L/min. In some implementations, the air flow rate is greater than 1.2 L/min. The velocity of the air produced by the air pump **106** can be properly controlled to allow the liquid fragrance to be fully atomized while, at the same time, preventing the fragrance to be sprayed too far, such as directly onto the wall of the scent chamber **105**.

[0061] Referring to FIGS. **8**A-B, the installation lid **113** is provided with a locking clip **121**, such as a lock switch, with a corresponding locking base **120** (see also FIGS. **6**A-B). The locking base **120** and the locking clip **121** may be disposed on the top or one side of the installation lid **113**. As shown in FIGS. **8**A-B, the locking clip **121** can form a snap connection with the locking base **120**. In some embodiments, the locking clip **121** is fixed on the scent chamber **105** to form an integral part with the scent chamber **105**. In some embodiments, the locking base **120** has a structure that is wide at the top and narrow at the bottom, similar to a T-shaped structure.

[0062] Referring to FIG. **11**A, in some embodiments, an installation lid **113** is placed onto the fragrance container **107**. The installation lid **113** along with the fragrance container **107** may, for example, be pushed into an accommodating chamber **104** from the bottom of the electronic candle **100** and snapped into the locking clip **121**. If a user wants to take out the fragrance container **107**, the bottom of the fragrance container **107** may be pressed, then the installation lid **113** along with the fragrance container **107** are disengaged from the locking clip **121**, allowing convenient use. In some embodiments, the installation lid **113** may be placed onto the fragrance container **107** using other means. For example, it may be snapped into the locking clip **121** via the locking base **120**. When the fragrance container **107** needs to be replaced, the fragrance container **107** may be rotated by an angle such that the installation lid **113** along with the fragrance container **107** are disengaged from the locking clip **121**. In some embodiments, as shown in FIGS. **7**A-C, a limit protrusion **122** is formed on a side of the installation lid **113**, such that the installation lid **113** is installed at a fixed angle when being placed into the accommodating chamber **104**, thereby making the installation easier.

[0063] It is noted that the locking mechanism is not limited to the snap connection or the lock switch as described above. It is also noted that the installation lid **113** and the fragrance container **100** may be installed upward from the bottom.

[0064] In some embodiments, the top of the installation lid **113** includes a protective layer for covering the fifth channel **115** and the sixth channel **116** (such as shown in FIG. **2**C). The protective layer can be made of silica gel, rubber, or PVC film with a thickness in the range of 0.1-3.5 mm. The protective layer is mainly used to prevent the fragrance from flowing out of the fragrance container **107** when the fragrance container **107** is installed for the first time.

[0065] When the fragrance container **107** is installed for the first time, a user needs to unscrew the lid of the fragrance container **107**, and at the same time, screw on the installation lid **113** installed with the mount support **117** onto the fragrance container **107** in order to replace the original lid of the fragrance container **107**. One way of installation is to vertically place the fragrance container **107** with its opening facing upwardly, and then align the accommodating chamber **104** of the electronic candle **100** with the fragrance container **107**. However, sometimes it is relatively difficult

to align the accommodating chamber **104** with the fragrance container **107**.
[0066] Alternatively, the electronic candle device **100** can be inverted for the installation. As shown in FIGS. **14**A-**14**D, the electronic candle device **100** is inverted first, and the fragrance container **107** with the installation lid **113** (such as shown in FIGS. **7**A-B) is also inclined or inverted. Because the installation lid **113** includes a limit protrusion **122** (such as shown in FIGS. **7**A-B), the fragrance container **107** can be installed into the electronic candle **100** only when the limit protrusion **122** is aligned with the corresponding limit groove. The protrusion **122** of the installation lid **113** enables the fragrance container **107** to be smoothly and precisely installed into the electronic candle **100**, thereby preventing incorrect installation by the user. In addition, such as shown in FIGS. **14**C-D, a prompt point or indicator **134** can be positioned on the bottom of the electronic candle **100** for prompting a user to align the limit projection **122** at the prompt indicator **134**. The prompt indicator **134** further enables the user to install the fragrance container **107** easily and precisely. In some embodiments, the protective layer included in the top of the installation lid **113** prevents the fragrance from leaking through the suction tube **118**, the fifth channel **115**, and/or the sixth channel **116** on the fragrance container **107**. When the fragrance container **107** is almost installed, the protective layer will be in contact with the first channel **108** and/or the second channel **109**. The first channel **108** and/or the second channel **109** may push through and penetrate the protective layer, allowing the perfume to flow out. After the fragrance container **107** is installed, consequently, the first channel **108** is now coupled to the fifth channel **115**, and the second channel **109** is also coupled to the sixth channel **116**. This way, leakage of the fragrance container during installation can be avoided, and normal use of the fragrance container is not affected.
[0067] Furthermore, as shown in FIGS. **14**A-D, the bottom of the fragrance container **107** is exposed to the outside of the electronic candle **100**. Because the fragrance container **107** is typically made of a transparent material, a user can observe the remaining quantity of the perfume inside the fragrance container **107** from the bottom of the fragrance container **107**.
[0068] In some embodiments, any one of the first channel **108**, the second channel **109**, the third channel **110**, the fourth channel, the fifth channel **115**, and/or the sixth channel **116** described above may be made of a hard tube, a soft tube, or an elastic material **119**. In some embodiments, the first channel **108** and/or the second channel **109** may be positioned on the scent chamber **105**. In some implementations, they are formed as an integral part of the scent chamber **105**. The third channel **110** and/or the fourth channel may be a soft tube or a hard tube, and the specific material may be plastic, rubber, or PVC. In some embodiments, the third channel **110** and the fourth channel are fixedly disposed on the scent chamber **105**. They are connected to the air pump **106** and a scent-releasing opening respectively via soft tubes. The third channel **110** and/or the fourth channel may also be formed as an integral part of the scent chamber **105**. In some implementations, the fifth channel **115** and the sixth channel **116** are fixedly disposed on the installation lid **113**. In some implementations, the fifth channel **115** and the sixth channel **116** may be formed as an integral part of the installation lid **113**. They can be made of an elastic material **119**, such as rubber or silica gel.
[0069] In some embodiments, such as shown in FIGS. **5**A-C, the external side of the air pump **106** includes a sound insulation layer **128**. The sound insulation layer **128** may be made of sound insulation materials, such as sound insulation cotton, to minimize the noise caused by the air pump **106**. For example, the sound insulation material can be sound insulation cotton so that the noise produced by the electronic candle **100** is lower than or equal to 55 dB, or lower than or equal to 45 dB. Within such noise limits, the produced noise has a relatively small impact on the users. In some embodiments, the external side of the air pump **106**, including but not limited to the top and/or bottom, may include an anti-vibration component(s) **129** so as to minimize the vibration caused by the air pump **106** in the electronic candle **100**, thereby ensuring the stability of electrical contact and visual effect. The material for the anti-vibration component(s) **129** includes, but is not limited to, silica gel and/or rubber. In some implementations, with the anti-vibration component(s) **129**, the noise produced by the scent-producing electronic candle **100** is lower than or equal to 55 dB, or

lower than or equal to 45 dB. In some embodiments, simultaneous use of sound insulation cotton and an anti-vibration component(s) lowers the noise produced by the electronic candle **100**. In some embodiments, the air pump **106** and the fragrance container **107** are positioned in different chambers of the candle device **100** respectively to avoid severe vibration caused by resonance of the air pump **106** and the fragrance container **107**, thereby reducing the vibration and noise of the product and reducing disruption to the atmosphere.

[0070] In some embodiments, as shown in FIGS. **2**A-B, the scent chamber **105** comprises an opening coupled to one end of the second channel **109**. In some embodiments, the dimension of the opening of the second channel **109** in the scent chamber **105** is smaller than the dimension of the second channel **109** outside of the scent chamber **105**. The shape of the opening includes, but is not limited to, an evenly tapered cone, or a tapered extension in a cylindrical shape, such that the liquid input from the second channel **109** into the scent chamber **105** has a further increased velocity when it leaves the end opening of the second channel **109**. In some implementations, the output end opening of the second channel **109** is close to the output end opening of the third channel **110**. As a result, the fragrance output via the second channel **109** is fully atomized by the air flow from the third channel **110**, and can be extensively distributed in the scent chamber **105**.

[0071] When the fragrance is a liquid with relatively high viscosity, such as an essential oil, the liquid tends to adhere to the wall of the channel. As time passes by, the path for the scent to flow may become increasingly narrow, which affects scent-producing efficiency. In some embodiments, as shown in FIG. **2**C, the internal bottom surface of the scent chamber **105** is not set to be a horizontal plane, but a surface inclined towards the inlet of the first channel **108** so as to form a funnel shape near the inlet of the first channel **108**. This way, the liquid fragrance suspended on the inner wall of the scent chamber **105** can return into the fragrance container **107**, thereby saving the fragrance. Therefore, the high-velocity air flow can fully atomize the fragrance in the embodiments in accordance with the techniques disclosed herein. Moreover, the fragrance that is not fully atomized may stay on the inner wall of the scent chamber **105** and ultimately flow back into the fragrance container.

[0072] In some embodiments, referring to FIG. **2**D, the path of the fourth channel **111** includes a check valve **125**. In some embodiments, the candle device further includes an inclination sensor **124**, as shown in FIG. **4**. When the candle device is tilted, the inclination sensor **124** can sense the tilt and then shut down the power supply to the air pump **106**. The air pressure in the scent chamber **105** then quickly decreases to shut down the check valve **125**.

[0073] When the candle device is tilted or inverted, it is possible for the liquid fragrance to flow into the scent chamber **105** through the first channel **108**, the second channel **109**, the fifth channel **115**, the sixth channel **116**, and the suction tube **118**. The scent chamber **105** acts as a buffer between other channels (e.g., the first channel **108**, etc.) and the fourth channel **111** such that the liquid fragrance needs to be accumulated to a certain amount in the scent chamber **105** before it can enter the fourth channel **111** and flow out, which requires the candle device to be tilted or inverted for a relatively long time. In some embodiments, the check valve **125**, such as the one shown in FIG. **2**D, can stop the fragrance that flows into the fourth channel **111** from leaking out. Furthermore, when the air pump **106** is turned off, the check valve **125** is in a closed state to form a sealed space inside of the fourth channel **111**. Therefore, even when the fragrance is in contact with an external channel, the check valve **125** ensures that the fragrance will not flow out of the device. In some embodiments, the inclination sensor **124** may include a rolling ball switch, which can be disposed on a circuit board of the candle device or any other places where it can be positioned. The switch of the inclination sensor **124** can turn on or off the power supply to the air pump **106**, either by hardware circuitry or software control. In some embodiments, an inclination angle threshold can be set at, for example, 45 degrees, 75 degrees, or another angle, as the threshold angle formed between the longitudinal axis of the candle device and the vertical axis with respect to the horizon. The threshold can be used to determine when the inclination sensor **124** should shut down the

power supply to the air pump **106**. For example, as shown in the embodiment in FIG. **4**, three inclination sensors **124** are disposed in a triangular manner with respective to each other on a circuit broad. An inclination angle threshold of 45 degrees or 75 degrees is used such that, when the longitudinal axis of the candle device forms an angle, relative to the vertical axis, that is larger than the threshold, the power supply to the air pump **106** is shut down.

[0074] In some embodiments, referring to FIG. **3**A, the candle device does not include a first channel. Instead, the fragrance goes through the suction tube **218** and a corresponding second channel **209** into the scent chamber **105** directly. In some embodiments, the scent chamber may include, or can be replaced by, a water-absorbing material **228** at the location where the suction tube **218**, the scent-releasing opening **229**, and the seventh channel **230** meet. The water-absorbing material **228** can be used for transporting the liquid fragrance in the fragrance container **207** to an external environment of the candle device. The water-absorbing material **228** includes, but is not limited to, cotton, sponge, etc. The water-absorbing material **228** absorbs the liquid fragrance and helps it evaporate into the air. In the embodiment shown in FIG. **3**A, a fan **227** is used to accelerate the evaporation of the fragrance. In some embodiments, the air pump **206** may also be used to accelerate the evaporation of the fragrance. Such embodiments as shown in FIG. **3**A require fewer components, thereby allowing the candle device to be smaller and more compact.

[0075] In some embodiments, referring to FIGS. **3**B-D, the candle device does not include a first channel. Instead, the fragrance goes through the suction tube **318** and/or a corresponding second channel **309** into the scent chamber directly. In some embodiments, the scent chamber may be replaced by a heating device **331** or an atomizing device **332** at the location where the suction tube **318**, the scent-releasing opening **328**, and the seventh channel **330** meet. The heating device **331** or the atomizing device **332** can be used for transporting the liquid fragrance in the fragrance container **307** to an external environment of the candle device. In the embodiments shown in FIGS. **3**B-**3**C, a fan **327** is used to accelerate the evaporation of the scent. In some embodiments, as shown in FIG. **3**B, the heating device **331** heats and helps the fragrance to evaporate. The heat facilitates the fragrance to evaporate more quickly and evenly. In some embodiments, the heating device **331** may also produce smoke during the process of heating, mimicking a visual effect of a real flame. The heating device **331** may include an electric heating wire, a Positive Temperature Coefficient (PTC) heating element, a semiconductor or electromagnetic heating module, and other electric heating elements.

[0076] In some embodiments, as shown in FIG. **4**, the electronic candle **100** further comprises a smoke generator **131**. The smoke generator **131** is used to further atomize the fragrance and/or additional liquid scent to a smoke. For example, the smoke generator **131** can be the atomizing device **332** as shown in FIGS. **3**C-**3**D. The smoke generator **131** works with a control circuit **133**, and the control circuit **133** can be used to detect actions of a user, such as “blowing off,” “turning off fan,” or “turning off device.” In some implementations, when the electronic candle **100** is turned on, the smoke generator **131** does not produce smoke. When the control circuit **133** detects an action of “blowing off,” “turning off fan,” or “turning off device,” the control circuit **133** sends a signal to the control circuitry **132**, which controls, according to the signal, the smoke generator **131** to produce smoke when the electronic candle **100** is “extinguished” to simulate the smoke produced when a real candle is extinguished. In some implementations, the smoke generator **131** may also continuously produce smoke when the electronic candle **100** is turned on so that, when the electronic candle **100** is lit, a scent is released and accompanied by a smoke to simulate the smoke produced when a real candle is burning. In some embodiments, the smoke (e.g. a thin smoke) produced by the smoke generator **131** is released from the through hole **102**. In some implementations, the shell **101** includes a plurality of holes to allow the smoke to be released.

[0077] In some embodiments, the smoke generator **131** is electrically coupled to the control circuitry **132** to control the smoke generator **131**. In some embodiments, the smoke generator **131** is an ultrasonic atomizer. After being activated by an electric signal, the ultrasonic atomizer

produces high-frequency harmonic oscillations, which cause a porous metal membrane adhered to the ultrasonic atomization piece to produce ultrasonic vibration through energy transfer, causing the liquid adsorbed to the metal membrane to be atomized. Such smoke generator **131** does not require heating or adding a chemical reagent, and thus can be more energy-efficient than atomization techniques that use heat. Such smoke generator **131** also has characteristics such as low noise, long service life, and low power consumption. The smoke produced by the smoke generator **131** may appear like real smoke from a real candle. It is noted that the smoke generator **131** can be implemented using other compatible smoke generation structures and techniques that operate based pressurized atomization, static atomization, ultrasonic atomization, bubble atomization, rotary atomization, annular hole atomization, etc.

[0078] In some embodiments, the light-emitting element **112** of the electronic candle **100** may be an LED lamp. FIGS. **12**A-**12**C show some embodiments in which the light emitted by at least one LED lamp illuminates the smoke produced during the heating process through a through hole. In some embodiments, the smoke can be blown out of the candle device through the through hole by the air pump or the fan. The illumination of the LED light cast on changing shapes of the smoke can make the flames look like real flames of a burning candle. In some embodiments, the LED light may be installed on one side of the flame element **103**, such as shown in FIG. **12**A. In some embodiments, the LED light may be installed on two sides of the flame element **103**, such as shown in FIG. **12**B. In some embodiments, the LED light may be installed on the bottom of a support structure that supports the flame element **103**, such as shown in FIG. **12**C. The light-emitting element **112** may also be a halogen lamp, which can facilitate the evaporation of the fragrance by the heat of the lamp itself. The warm color of the halogen lamp and the heated smoke give the candle device a more appealing appearance of a real burning candle. In some embodiments, such as shown in FIG. **3**C, the atomizing device **332** atomizes the fragrance, which is blown out by the air pump or the fan **337** such that the fragrance can evaporate more evenly. In another embodiment, as shown in FIG. **3**C, the atomizing device **332** directly atomizes the fragrance, which is released into the external environment by the scent-releasing opening. Embodiments such as the one shown in FIG. **3**C require fewer components so that the candle device can be made smaller and more compact.

[0079] In some embodiments, referring to FIGS. **9**A-**9**B, the scent-producing candle device includes a fragrance container **107**, a first channel **108** coupled to an air inside the fragrance container **107**, and a second channel **109** coupled to a fragrance inside the fragrance container **107**. The fragrance container **107** can be a bottle containing a liquid fragrance, such as perfume or essential oil. In some embodiments, the air pump **106** pumps air into the scent chamber **105** via the third channel **110**.

[0080] It should be noted the examples described herein include one fragrance container **107** in the scent-producing electronic candle. However, a plurality of fragrance containers **107**, for example two, three or more fragrance containers **107**, can be used if desired. FIG. **13** shows an example of a candle device that includes three fragrance containers **107**. In some implementations, a plurality of scent chambers can be used so that each scent chamber is connected to each of the plurality of fragrance containers **107**. A plurality of fourth channels can be connected to the plurality of scent chambers to allow the scent to be transported to an external environment. In some implementations, one scent chamber is connected to the plurality of fragrance containers **107**. Another channel is connected to the scent chamber to allow the fragrance to be transported to the outside. A user may choose his or her favorite customized scent by mixing and matching various fragrance stored in the plurality of fragrance containers. Different scents can either be mixed before being sent to an external environment, or be sent to an external environment and then mixed in the air, both of which can further improve the diversity and the effect of scents.

[0081] In some embodiments, referring to FIGS. **10**A-**10**B and FIGS. **11**A-**11**B, an electronic candle **100** includes a shell **101**, a through hole **102** on the top of the shell **101**, a flame element **103**

running through the through hole **102** and extending outwardly from the inside of the through hole **102**. The inside of the shell **101** is constructed to accommodate a fragrance container **107**, a first channel **108** coupled to the air inside the fragrance container **107**, and a second channel **109** coupled to a fragrance inside the fragrance container **107**. The shell **101** may be used for installation and fixation of various components inside the electronic candle **100**. For example, the shell **101** may be used to support a bracket to hold a light-emitting element and a coil for driving a flame piece to sway.

[0082] In the specific embodiment shown in FIGS. **11**A-**11**B, the candle device **100** includes an accommodating chamber **104** within the shell **101**. The scent-producing mechanism includes a scent chamber **105**. The scent chamber **105** further includes a first channel (not shown) and a second channel **109**. The first channel is constructed to be coupled to the air inside a fragrance container **107**, and the second channel **109** is constructed to be coupled to a fragrance inside the fragrance container **107**. The scent chamber **105** may also include a third channel **110** and a fourth channel **111**. The third channel **110** is constructed to input the air to the scent chamber **105**, and the fourth channel is constructed to output a scent produced in the scent chamber **105** to the outside of the electronic candle **100**. The fragrance container **107** located within the accommodating chamber **104** can be a bottle containing a liquid fragrance, such as perfume or essential oil. In some embodiments, the accommodating chamber **104** may also be used to accommodate a container holding a solid fragrance, such as a scent block. In some embodiments, the air pump **106** pumps air into the scent chamber **105** via the third channel **110**. The air pump **106** can be disposed inside the shell **101**. Alternatively, the air pump **106** may also be disposed outside the shell.

[0083] Referring to FIG. **11**A, in some embodiments, the air enters the scent chamber **105** via the third channel **110**. In some implementations, the air pump **106** pumps the air into the third channel **110** such that the air pressure of the scent chamber **105** keeps on increasing. Under the higher air pressure, the air in the scent chamber **105** then enters the fragrance container **107** via the first channel **108**, causing the air pressure in the fragrance container **107** to increase as well. The fragrance in the fragrance container **107** is then transported under pressure into the scent chamber **105** via the second channel **109** to be fully atomized. Because the air pressure in the scent chamber **105** is also higher than the air pressure of the external environment of the electronic candle **100**, the atomized fragrance is released via the fourth channel to the outside of the electronic candle **100**. Compared to those embodiments that include a fan to drive the air to produce a scent, the embodiments that use an air pump have the following advantages. First, the electronic candle **100** in accordance with the techniques disclosed herein can effectively drive a fragrance to the second channel **109** inside the electronic candle **100** by the air pressure produced by the air pump **106**. Meanwhile, the air pressure of the air pump **106** itself can fully atomize a liquid fragrance, which improves the aromatic effect of the fragrance. The atomized fragrance can also appear as smoke produced when the candle device **100** is “burning.” Second, the atomized fragrance is more concentrated as compared to fragrance dispersed using other mechanisms, e.g., a fan. Furthermore, the air pressure produced by the air pump **106** is adjustable, thereby allowing the user to adjust the atomization rate of the fragrance. For example, when a fan is used to drive air flow to disperse the liquid fragrance, the magnitude and direction of its pressure acting on the fragrance may not be precisely controlled even though the wind speed and direction of the fan can be adjusted. The air pump, on the other hand, can apply air pressure of different magnitudes and directions in a relatively precise manner, thereby achieving more effective control by the user. Using the air pump, the atomized fragrance can appear like a smoke that is produced by a real burning candle, achieving a more realist look and feel. In some embodiments, the air pump can pump the fragrance at a higher speed to produce a burst of smoke so that the candle device appears to be extinguished like a real candle.

[0084] In some embodiments, referring to FIGS. **10**A-**10**B, the shell **101** has an appearance similar to a conventional candle. The cross section of the shell **101** may have a triangular, square, oval, or

irregular shape. The shell **101** may be made of any one of the materials such as wax, paraffin, plastics, glass, metal, ceramic, crystal, and polymers, or any combination thereof. The top of the shell **101** may be a substantially flat surface, or have a recess, to simulate a brand-new unused candle. The shell **101** may also include additional shapes, such as solidified flows of melted wax, formed on its surface so as to simulate a used candle. The top of the electronic candle **100** includes a through hole **102**, and the flame element **103** extends outwardly from inside the shell **101** via the through hole **102**.

[0085] In some embodiments, the candle device **100** comprises an accommodating chamber **104** and a fragrance container **10** positioned in the accommodating chamber **104**. In some embodiments, the fragrance container **107** may pre-installed in the electronic candle **100** during manufacturing or packaging. In some other embodiments, the electronic candle **100** may not carry the fragrance container **107**. Instead, a user may install it on his/her own into the accommodating chamber **104** according to his/her preferences of fragrances.

[0086] In some embodiments, the accommodating chamber **104** may have a shape of a cuboid or a cube to accommodate a plurality of fragrance containers **107**, such as shown in FIG. **13**. In some implementations, the accommodating chamber **104** may have a shape of a ring such that the plurality of fragrance containers **107** are evenly or unevenly distributed along the ring-shaped space in the chamber **104**.

[0087] In some embodiments, one end of the third channel **110** is connected to the scent chamber **105**, and the other end of the third channel **110** extends to the through hole **102** to release the scent out of the electronic candle **100**. The shell **101** may include a plurality of scent-releasing openings disposed at different positions of the shell. In some embodiments, the other end of the third channel **110** may extend to other places of the electronic candle **100**. For example, the electronic candle **100** can be suspended using a support mechanism. The other end of the third channel **100** may extend to the bottom of an electronic candle **100** to release scent from the bottom of the candle. In some embodiments, the support mechanism can be a magnetic levitation mechanism. In some embodiments, one or more additional through hole(s) can be formed at the bottom of the electronic candle to allow convection of the air and the fragrance in the electronic candle **100** to enable a smoother spray of the scent from the electronic candle **100**.

[0088] In some embodiments, as shown in FIG. **10**A, the upper portion of the flame element **103** has a flame shape and can make irregular movements. When a light is projected onto the flame element **103**, the flame element **103** randomly sways to simulate of the movements of a real flame. In addition, as shown in FIGS. **10**A-**10**B, the flame element **103** includes a dark-colored section **123** to simulate a real candle wick after burning. As shown in FIG. **4**, when the control circuit **133** detects one of the following actions of “blowing off,” or “turning off the fan,” or “turning off the device”, the control circuit **133** sends a signal to the control circuitry **132**, which controls the smoke generator **131** according to the signal to produce smoke when the electronic candle is extinguished to simulate the smoke produced when a real candle is extinguished. At the same time, the flame element **103** may retract, as shown in FIGS. **10**A-**10**B, and the dark-colored section **123** of the flame element **103** extends outside of the through hole **102** to simulate a real candle wick after burning. The dark-colored section **123** may still remain outside of the through hole **102**, and/or may slightly rise outside of the through hole **102**. The flame shape on the upper portion of the flame element **103** can be a sheet-like flame, or may be combined by two or more sheet-like flames, or may have a 3D shape. In some embodiments, the flame element **103** may be made of plastic or an organic synthetic material. In some embodiments, the flame element **103** is made of a translucent material, such that the flame can be seen from both sides of the flame piece. In some implementations, the flame piece on the upper portion of the flame element **103** has an uneven thickness to simulate lighting effects of a flame at different heights. For example, the flame piece is thin at the top and thick at the bottom. For another example, the flame piece is thin at the top, thick in the middle, and thin at the bottom. In some embodiments, the flame element **103** includes a pivot

hole (not shown). A support element, e.g., a rigid V-shaped rod, goes through the pivot hole to support the flame element **103**. In some implementations, the distances between the lowest point of the support element and two ends are not equal. The light source **112** can be positioned at the end that has a shorter distance to allow better illumination of the flame-shaped portion. The support element may be a soft wire, and two ends of the support element can be fixed to the shell **101** such that the flame element **103** can pivot about the support element. In some embodiments, the lower portion of the flame element **103** may have a magnet or a magnetic material, such that the flame element can make nonlinear movements varying with time under the action of the magnetic field. In some embodiments, the flame element **103** is driven by other mechanisms such as air flow (e.g., from a fan) or gas flow from the outside.

[0089] Moreover, as shown in FIG. **4**, the electronic candle **100** further comprises a remote control module **136**. A user can send an electric signal to the remote control module **136** using a remote control device. The remote control module **136** receives the electric signal and sends a signal to the control circuitry **132**, and the control circuitry **132** controls, according to the signal, the electronic candle **100** to turn the electronic candle **100** on or off and to perform other controls of the device.

[0090] To enable the air pump **106** and the light-emitting element **112** to operate normally, the electronic candle **100** further comprises a power supply. The power supply may be formed by providing a battery chamber to accommodate one or more dry cells or re-chargeable batteries. In the case of a rechargeable battery, the battery can be charged in a wired charging mode. In some embodiments, the power supply may also be charged in a wireless charging mode. In some implementations, the power supply may be charged with solar energy; such solar energy is converted into electrical energy for storage when the product is not in use, and the electrical energy can be supplied to the electronic candle **100** during use. In some embodiments, the power supply may include a plug that is directly connected to an AC outlet so as to supply power to the electronic candle **100**.

[0091] Furthermore, as shown in FIGS. **14**A-**14**D, the bottom of the electronic candle **100** includes a plurality of support components **128** (e.g., legs). The plurality of support components **128** are separated from one another by corresponding gaps. As shown in FIG. **14**D, a power supply connection **129** is formed in the center bottom of the electronic candle **100**, where a can be connected to the power supply connection **129**. The spacing between the support components **128** allows the power cord to reach the electronic candle while the electronic candle is placed on a flat surface. The user may select, according to the desired position and direction of the electronic candle **100**, the appropriate gap for routing the power cord.

[0092] In some embodiments, referring to FIG. **13** and FIGS. **14**A-**14**D, the shell **101** of the electronic candle **100** includes at least one observation window **126** to observe the remaining quantity of fragrance in the fragrance container **107**. When there is a plurality of fragrance containers **107**, the shell **101** includes a plurality of observation windows **126**, each corresponding to one of the plurality of fragrance containers **107**. In some embodiments, the observation window **126** is made of a clear plastic. In some implementations, the observation window **126** may have a specific shape such as, but not limited to, a rectangle, a rhombus, an ellipse, and the like. To allow the user to observe the fragrance under poor lighting situations, in some embodiments such as shown in FIGS. **11**B-**11**C, a light source **127** may be provided in the electronic candle **100**. The light source **127** can illuminate the body of the fragrance container **107** such that the quantity of remaining fragrance can be observed.

[0093] It is noted that the fragrance container **107** may hold a liquid fragrance. In some embodiments, the fragrant container may also hold a scented bead, a scented block, etc. In some implementations, the fragrance container **107** may simply contain water. When the water is atomized, it can humidify the air and achieve an effect similar to that of a humidifier.

[0094] While this patent document contains many specifics, these should not be construed as limitations on the scope of any invention or of what may be claimed, but rather as descriptions of

features that may be specific to particular embodiments of particular inventions. Certain features that are described in this patent document in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable sub-combination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a sub-combination or variation of a sub-combination.

[0095] Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. Moreover, the separation of various system components in the embodiments described in this patent document should not be understood as requiring such separation in all embodiments.

[0096] Only a few implementations and examples are described and other implementations, enhancements and variations can be made based on what is described and illustrated in this patent document.

Claims

1. An electronic candle device, comprising: a shell; a flame element protruding through a hole on the shell; a light source positioned in proximity to the hole and configured to illuminate the flame element to mimic a real flame; a central control circuit; a power supply; an installation lid including a locking base; a fragrance container removably connectable to the installation lid; a scent chamber including a locking clip, a first channel, a second channel, a third channel, and a fourth channel, wherein a bottom surface of the scent chamber has a funnel shape, and wherein the locking clip is configured to allow the scent chamber to be secured to the locking base; and an air pump configured to accelerate a speed of air through the scent chamber, wherein the first channel of the scent chamber is positioned to direct the air to exit the scent chamber into the fragrance container, wherein the second channel of the scent chamber is positioned to draw a fragrance material in a liquid form from the fragrance container into the scent chamber, wherein the third channel of the scent chamber is coupled to the air pump to allow the air to enter the scent chamber, and wherein the fourth channel of the scent chamber is configured to direct the fragrance material to reach an external environment of the electronic candle device.

2. The electronic candle device of claim 1, wherein the shell includes an observation window corresponding to the fragrance container for allowing a user to observe a remaining quantity of the fragrance material in the fragrance container.

3. The electronic candle device of claim 1, wherein the installation lid includes a protrusion to facilitate alignment of the installation lid and the fragrance container.

4. The electronic candle device of claim 3, comprising an indicator positioned at an external surface of the electronic candle device to indicate a location of the protrusion.

5. The electronic candle device of claim 1, wherein the installation lid includes a mount support positioned removably on the installation lid to facilitate coupling of the fragrance container.

6. The electronic candle device of claim 1, wherein a first end of the second channel that is coupled to the scenter chamber has a smaller dimension than a second end of the second channel.

7. The electronic candle device of claim 1, wherein the second channel has a tapered shape.

8. The electronic candle device of claim 1, wherein the air pump is configured to generate a first pressure that is higher than a second pressure associated with the external environment to drive the fragrance material into the scent chamber.

9. The electronic candle device of claim 8, wherein the first pressure is adjustable according to a desired rate at which the fragrance material is dissipated.

10. The electronic candle device of claim 1, wherein the installation lid includes a fifth channel and a sixth channel, wherein the fifth channel is coupled to the first channel of the scent chamber and the sixth channel is coupled to the second channel of the scent chamber.
11. The electronic candle device of claim 10, wherein the installation lid comprises a protective layer that covers at least parts of the fifth channel and the sixth channel to prevent the fragrance material from leaking through the installation lid.
12. The electronic candle device of claim 1, comprising an anti-vibration component positioned at an external side of the air pump for reducing vibration caused by the air pump.
13. The electronic candle device of claim 1, comprising one or more tilt sensors configured to sense a tilt angle of the electronic candle device.
14. The electronic candle device of claim 13, wherein the one or more tilt sensors are configured to transmit a signal to the central control circuit to shut down the power supply upon sensing that the tilt angle is greater than or equal to a predetermined threshold angle.
15. The electronic candle device of claim 14, wherein the predetermined threshold angle is 45 degrees.
16. The electronic candle device of claim 1, comprising a smoke generator configured to produce a smoke to simulate an appearance of a real candle.
17. The electronic candle device of claim 16, wherein the smoke generator comprises an ultrasonic atomizer.
18. The electronic candle device of claim 1, comprising a valve coupled to the fourth channel, wherein the valve is configured to, upon receiving a signal from the central control circuit indicative that a tilt angle is greater than or equal to a predetermined threshold angle, close the fourth channel to prevent the fragrance material from spilling outside of the electronic candle device.
19. The electronic candle device of claim 1, comprising a sound insulation layer around the air pump for reducing noise.
20. The electronic candle device of claim 1, wherein the air pump comprises a fan.