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United States Patent	12392464
Kind Code	B2
Date of Patent	August 19, 2025
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Electronic candle and method of manufacturing the same

Abstract

An electronic candle includes: a wax tube, a battery compartment, a PCBA board, and a light string. The wax tube is cylindrical and made from paraffin wax. The wax tube defines a cavity therein and has a first end and a second end, the second end defines an opening communicated to the cavity. The battery compartment is inserted into the cavity from the second end, the battery compartment has a third end and a fourth end, the fourth end defines an opening facing towards the first end. The PCBA board is inserted to the fourth end. At least a portion of the PCBA board is exposed to the cavity. The light string is extending spirally and arranged on an outer surface of the wax tube. The light string extends through the wax tube to be electrically connected to the exposed portion of the PCBA board.

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Appl. No.:	18/790422
Filed:	July 31, 2024

Prior Publication Data

Document Identifier	Publication Date
US 20250043930 A1	Feb. 06, 2025

Foreign Application Priority Data

CN	202310978490.1	Aug. 04, 2023
CN	202322091015.0	Aug. 04, 2023

Publication Classification

Int. Cl.: **F21S10/00** (20060101); **F21S4/10** (20160101); **F21S6/00** (20060101); **F21S9/02** (20060101); **F21S10/04** (20060101); **F21V17/12** (20060101); **F21V23/04** (20060101); **F21Y107/30** (20160101); **F21Y113/00** (20160101); **F21Y115/10** (20160101)

U.S. Cl.:

CPC **F21S10/043** (20130101); **F21S4/10** (20160101); **F21S6/001** (20130101); **F21S9/02** (20130101); **F21V17/12** (20130101); **F21V23/04** (20130101); **F21Y2107/30** (20160801); **F21Y2113/00** (20130101); **F21Y2115/10** (20160801)

Field of Classification Search

CPC: F21S (10/043); F21S (6/001); F21Y (2107/30)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
8408951	12/2012	Chartrand	439/754	H01R 13/2421
9797584	12/2016	Andretta-Pulera	N/A	F21V 21/088
11209141	12/2020	Chiang	N/A	F21V 19/0025
2008/0129226	12/2007	DeWitt	315/307	H05B 47/155
2008/0169788	12/2007	Bobbin	320/135	H01M 50/591
2014/0286024	12/2013	Li	362/392	A61L 9/03
2018/0058648	12/2017	Fang	N/A	F21S 6/001
2018/0347771	12/2017	Ansems	N/A	H05B 45/00

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
2335401	12/2000	CA	F21S 10/04
202024102430	12/2023	DE	F21S 10/04
1914471	12/2007	EP	F21S 6/001

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS

(1) The present application claims priorities of the Chinese patent application No. 202322091015.0, filed on Aug. 4, 2023 and the Chinese patent application No. 202310978490.1, filed on Aug. 4, 2023 and the contents of which are incorporated herein by their entireties.

TECHNICAL FIELD

(2) The present disclosure relates to the field of electronic candles, and in particular to an electronic candle and a method of manufacturing the electronic candle.

BACKGROUND

(3) An electronic candle does not generate smoke and is safe and has a long service life, therefore, the electronic candle is used to replace traditional candles in various situations. In order to imitate texture of a real wax candle, paraffin wax is used to make a candle tube of the electronic candle. Since the wax candle tube is thin and long, the wax candle tube may not be easily molded independently and may not have sufficient strength to be assembled with a core assembly. Therefore, for the electronic candle in the art, the core assembly is directly placed into a waxing mold, and wax is poured for molding. A paraffin wax layer is solidified to and combined with a surface of the core assembly. In this case, a PCBA board in the core assembly is completely wrapped. When a string of lights needs to be arranged to wrap an outside surface of electronic candle, the string of lights cannot be electrically connected to the PCBA board, such that the string of lights cannot be arranged.

SUMMARY OF THE DISCLOSURE

(4) In a first aspect, the present disclosure provides an electronic candle including: a wax tube, a battery compartment, a PCBA board, and a light string. The wax tube is cylindrical and made from paraffin wax. An axial length of the wax tube is 6-15 inches, a diameter of the wax tube is 19 mm-25 mm. The wax tube defines a cavity at an interior thereof, the wax tube has a first end and a second end, the second end defines an opening communicated to the cavity. The battery compartment is tubular. The battery compartment is inserted into the cavity from the second end, the battery compartment has a third end and a fourth end, the fourth end defines an opening facing towards the first end of the wax tube. The PCBA board is inserted to the fourth end of the battery compartment. At least a portion of the PCBA board is exposed to the cavity of the wax tube. The light string is extending spirally and arranged on an outer surface of the wax tube. The light string extends through the wax tube to be electrically connected to the exposed portion of the PCBA board.

(5) In a second aspect, the present disclosure provides a method of manufacturing an electronic candle. The method includes: manufacturing, by a wax filling mold, a wax tube. The wax filling mold includes an outer mold and an inner mold; the outer mold has a cylindrical groove; the inner mold is rod-shaped; the inner mold is vertically inserted in the groove; a gap 93 is defined between the inner mold and an inner wall of the groove; a wax solution is poured into the gap. When the wax solution is solidified and is unable to flow, the inner mold is removed. After the wax solution is completely molded and shaped, the wax tube is separated from the outer mold; and the wax tube is obtained. A core assembly is assembled in the wax tube, the light string is taken to wrap around an outer surface of the wax tube. The light string extends through the wax tube to be electrically connected to the core assembly.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

- (1) FIG. 1 is a structural schematic view I of an electronic candle according to an embodiment of the present disclosure.
- (2) FIG. 2 is an exploded view of a portion of the electronic candle according to an embodiment of the present disclosure.
- (3) FIG. 3 is an exploded view I of the electronic candle according to an embodiment of the present disclosure.
- (4) FIG. 4 is an exploded view II of the electronic candle according to an embodiment of the present disclosure.
- (5) FIG. 5 is a perspective view of a portion of the electronic candle according to an embodiment of the present disclosure.
- (6) FIG. 6 is a structural schematic view II of the electronic candle according to an embodiment of

the present disclosure.

(7) FIG. 7 is an enlarged view of a portion A shown in FIG. 3.

(8) FIG. 8 is an enlarged view of a portion B shown in FIG. 3.

(9) FIG. 9 is a cross-sectional view of a wax filling mold according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

(10) In order to make the purposes, features and advantages of the present disclosure more obvious and understandable, specific embodiments of the present disclosure will be described in detail by referring to the accompanying drawings.

(11) To be noted that the terms “first”, “second”, and so on, in the specification, claims, and drawings of the present disclosure are used to distinguish similar objects and shall not be interpreted as describing a particular order or sequence. It is understood that the used data may be interchanged, when appropriate, such that embodiments of the present application described herein can be practiced in an order other than those illustrated or described herein.

(12) Unless otherwise expressly specified and qualified, in the description of the present disclosure, the terms “arranged”, “mounted”, “connected”, “coupled” shall be understood in a broad sense. For example, connection may be fixed connection, removable connection; or connected to form a one-piece structure; mechanical connection; direct connection, indirect connection through an intermediate medium; or connection internally between two elements. For any ordinary skilled person in the art, specific meanings of the above terms in the present disclosure shall be understood case by case.

(13) In the description of this specification, reference to the terms “embodiments”, “an embodiment”, and “one embodiment” means that the specific features, structures, materials, or properties described in the embodiment or implementation are included in at least one embodiment or implementation of the present disclosure. In the present specification, expressions of the above terms do not necessarily refer to a same embodiment or implementation. Moreover, the specific features, structures, materials, or properties described may be combined in any one or more of the embodiments or implementations in a suitable manner.

(14) The present disclosure is described in detail below by referring to the accompanying drawings.

(15) In order to solve the above technical problems, as shown in FIGS. 1, 2, 3 and 4, embodiments of the present disclosure provide an electronic candle, including following components.

(16) A wax tube **1** is a cylindrical structure made from paraffin wax material. An axial length **L1** of the wax tube **1** is 6-15 inches, and a diameter **D1** of the wax tube **1** is 19 mm-25 mm. The wax tube **1** defines a cavity **12** at an interior thereof. The wax tube **1** has a first end **13** and a second end **14**. The second end **14** has an opening communicated to the cavity **12**.

(17) A battery compartment **32** is arranged and is tubular. The battery compartment **32** is inserted into the cavity **12** from the second end **14**. The battery compartment **32** has a third end **322** and a fourth end **321**. The fourth end **321** has an opening facing towards the first end **13** of the wax tube **1**.

(18) A PCBA board **31** is inserted to the fourth end **321** of the battery compartment **32**, and at least a portion of the PCBA board **31** is exposed to the cavity **12** of the wax tube.

(19) A light string **2** is extending spirally to be arranged on an outer surface **11** of the wax tube **1**. The light string **2** extends through the wax tube **1** to be electrically connected to the exposed portion of the PCBA board **31**.

(20) To be noted that, the wax tube **1** is made from paraffin wax material, having the axial length **L1** of 6-15 inches and the diameter **D1** of 19 mm-25 mm. In this way, the wax tube **1** is thin and long, having a structure similar to a shape of a real candle. The wax tube **1** defines the cavity **12** at the interior thereof. In some embodiments, the cavity **12** is a cylindrical cavity coaxial with the wax tube **1**, such that the wax tube **1** is cylindrical having the closed first end **13** and the opened second end **14**. In this way, a space is provided to enable the PCBA board **31** to be electrically connected to

the light string **2**. The battery compartment **32** is tubular. In some embodiments, the battery compartment **32** is a circular tubular structure having openings at both the third end **322** and the fourth end **321**. The battery compartment **32** is inserted into the wax tube **1** from the second end **14** of the wax tube **1**, such that a space inside the wax tube **1** is saved as much space as possible, facilitating the diameter **D1** of the wax tube **1** to be reduced. The fourth end **321** of the battery compartment **32** faces towards the first end **12** of the wax tube **1**. The PCBA board **31** is inserted to the fourth end **321** of the battery compartment **32** to be disposed close to the first end **13** of the wax tube **1**. In this way, subsequent electrical connection with light beads **5** may be achieved easily. In addition, at least a portion of the PCBA board **31** is exposed to out of the battery compartment **32**, facilitating a connection end of the light string **2** to extend through the wax tube **1** to be electrically connected with the PCBA board **31**. In this way, the light string **2** can be arranged and lit up, such that the electronic candle may emit light more splendidly, meeting preferences of consumers.

(21) In an embodiment, as shown in FIGS. **2**, **3**, and **4**, the PCBA board **31** is elongated. A maximum width of the PCBA board **31** is in an interference fit with an inner diameter of the battery compartment **32**, enabling the PCBA board **31** to be snapped into the battery compartment **32**.

(22) To be noted that, in some embodiments, the PCBA board **31** is elongated in shape to fully utilize the internal space of the wax tube **1**. The elongated PCBA board **31** provides a larger surface area to allow electronic components to be arranged thereon. In some embodiments, the battery compartment **32** is circular cylindrical in shape. Each of two sides **312** of the PCBA board **31**, along a transverse direction, is arranged with a bump **311**, such that the maximum width is formed. The portion of the PCBA board **31** having the maximum width is in interference fit with the inner diameter of the battery compartment **32**. An end of the PCBA board **31** near the battery compartment **32** is a fifth end **313**. The fifth end **313** is inserted in the fourth end **321** of the battery compartment **32**, such that the PCBA board **31** is secured. It is understood that a depth that the PCBA board **31** is inserted into the battery compartment **32** may also be adjustable as required to ensure the light beads **5** to be located at a suitable position after passing through a through hole **132**.

(23) In an embodiment, as shown in FIGS. **4** and **5**, an end **314** of the PCBA board **31** away from the battery compartment **32** is connected with the light bead **5**. An end face **133** of the first end **13** of the wax tube **1** defines the through hole **132**. The light bead **5** passes through the through hole **132** to be exposed.

(24) To be noted that the end **314** of the PCBA board **31** away from the battery compartment **32** is a sixth end **315**. The light bead **5** is provided on the sixth end **315** of the PCBA board **31** by a lead wire **6**. The light bead **5** passes through the through hole **132** at the first end **13** of the wax tube **1**. The through hole **132** is defined in a center of the end face **133** of the first end **13**. The light bead **5** passes through the through hole and is exposed. The light bead **5**, when being lit up, can mimic a flame of the real candle.

(25) In an embodiment, as shown in FIG. **3**, the electronic candle further includes a battery **323**. The battery **323** is received in the battery compartment **32** and is coaxially arranged with the battery compartment **32**. The battery **323** and the light string **2** are electrically connected to the PCBA board **31**.

(26) To be noted that the battery **323** is received in the battery compartment **32**. In some embodiments, two batteries **323** are arranged and are distributed along an axial direction the battery compartment **32**, such that the two batteries **323** are coaxial with the battery compartment **32**. The batteries **323** are electrically connected to the PCBA board **31**. The PCBA board **31** is electrically connected to and supply power to the light string **2** and the light bead **5**. The PCBA board **31** may control switching, timing and a lighting mode of the light string **2** and the light bead **5**.

(27) In an embodiment, as shown in FIG. **5**, the electronic candle further includes a light bead sleeve **4**, which is light transmissive. The light bead sleeve **4** sleeves the light bead **5**. The light bead sleeve **4** is conical, having a shape similar to the flame.

(28) To be noted that, in some embodiments, the light bead sleeve **4** is made of white soft silicone, which allows light to pass through but is non-transparent, and the light bead sleeve **4** has the shape similar to the flame. The light bead sleeve **4** sleeves the light bead **5** and is configured to blur graininess of the light bead **5**, such that the passing through the light bead cover is softer and is similar to light of the flame when the real candle is burning. When the light from the light bead **5** lights up the light bead sleeve, the light bead sleeve imitates the shape of the flame when the real candle is burning. Therefore, simulation is achieved.

(29) In an embodiment, as shown in FIG. 5, the light emitted from the light bead **5** is warm white light, similar to the flame.

(30) To be noted that, in some embodiments, the light emitted from the light bead **5** is warm white light, similar to the flame, such that a color of the flame when the real candle is burning can be ideally simulated.

(31) In an embodiment, as shown in FIG. 3, an edge **131** of the opening of the first end **13** of the wax tube **1** is wavy, flat or inclined.

(32) To be noted that, the edge **131** of the opening of the first end **13** of the wax tube **1** may be arranged to simulate various states of the real candle. For example, the flat edge simulates the real candle that is not burning. Alternatively, the irregular wavy edge simulates the real candle that has been burned for a period of time. Alternatively, the inclined edge simulates the real candle that has been burned for a period of time forming a higher side and a lower side. It is understood that the shape of the edge **131** at the first end of the wax tube **1** may be arranged in other shapes to simulate other shapes of the real candle that is burning, such that simulation is ideal, and the electronic candle is more design-oriented.

(33) In an embodiment, as shown in FIGS. 3 and 6, the light string **2** is extending to form a crossing pattern and winds along the axial direction of the wax tube **1**, and is disposed on the outer surface **11** of the wax tube **1**.

(34) To be noted that the light string **2** includes a light wire **21** and LEDs **22**, and the light wire **21** is configured to space the LEDs **22** to be apart from each other. The light string **2** has two ends. One of the two ends is the connection end, and the other end of the two ends is a winding end. In an embodiment, the connection end of the light string **2** extends through the wax tube **1** to be electrically connected to the PCBA board **31**, such that the light string **2** is electrically illuminated. The other end of the light string **2** is arranged crosswise along the axial direction of the wax tube **1** until the light string **2** completely wraps around the wax tube **1**.

(35) In an embodiment, as shown in FIG. 7, the light string **2** is arranged spirally, winding along the axial direction of the wax tube **1** on the outer surface **11** of the wax tube **1**.

(36) To be noted that, in another embodiment, the connection end of the light string **2** extends through the wax tube **1** to be electrically connected to the PCBA board **31** to be electrically illuminated. The other end of the light string **2** is extending spirally along the axial direction of the wax tube **1**, such that a parallel pattern is formed, until the light string **2** completely wraps around the wax tube **1**. It is understood that the light string **2** may be extending in other manners according to preferences of the user to achieve a desired lighting effect.

(37) In an embodiment, as shown in FIG. 7, the wax tube **1** defines a receiving groove **21**. An extending shape of the receiving groove **21** matches with an extending path of the light string **2** to receive the light string **2**.

(38) To be noted that, in some embodiments, the wax tube **1** defines the receiving groove **21**. The receiving groove **21** is an elongated shallow groove defined in the outer surface **11** of the wax tube **1**. The receiving groove **21** is configured to receive the light string **2**. In this way, the light string **2** is prevented from shifting, and the light string **2** and the outer surface **11** of the wax tube **1** cooperatively form a plane. Therefore, the electronic candle is overall beautiful. In addition, the receiving groove **21** covers a trace that the light string **2** extends through the wax tube **1**, such that a seamless appearance is achieved.

(39) In an embodiment, as shown in FIGS. 4 and 8, the electronic candle further includes an end cap 8. The third end 322 of the battery compartment 32 is convex to form a connection structure 7. The connection structure 7 includes an abutting surface 71. The abutting surface 71 abuts against the end surface 141 of the second end 14 of the wax tube 1, enabling the connection structure 7 to be exposed out of the wax tube 1. The end cap 8 is connected to the connection structure 7.

(40) To be noted that the connection structure 7 and the battery compartment 32 are configured as a one-piece and integral structure, or the connection structure 7 and the battery compartment 32 are separated structures. A diameter of the connection structure 7 is larger than the inner diameter of the cavity 12 of the wax tube 1. In this way, the abutting surface 71 is formed. The abutting surface 71 abuts against the end surface 141 of the second end 14 of the wax tube 1, such that the connection structure 7 is exposed. An outer surface of the connection structure 7 is arranged external threads 72. An inner surface of the end cap 8 is arranged internal threads 82. Therefore, the end cap 8 and the connection structure 7 are threadedly connected to each other.

(41) In an embodiment, as shown in FIG. 4, the end cap 8 is arranged with a press switch 81 for controlling the light bead 5 and the light string 2 to be switched on and off.

(42) To be noted that the end cap 8 is arranged with the press switch 81, the push switch 81 is electrically connected to the PCBA board 31, such that the PCBA board 31 controls the light bead 5 and the light string 2 to be switched on and off. In some embodiments, the press switch 81 is disposed on a bottom end of the end cap 8. An outer surface of the end cap 8 is arranged with a vertical stripe 83, such that the electronic candle can be inserted into a candlestick (not shown in the drawing).

(43) In an embodiment, as shown in FIG. 2, the battery compartment 32 is a plastic member. The battery compartment 32 is assembled to the wax tube 1 by an adhesive.

(44) To be noted that the battery compartment 32 is made from plastic, such that the battery compartment 32 may be easily shaped and have a certain tensile strength. Therefore, the PCBA board 31 can be easily inserted to the battery compartment 32 to be fixed. The adhesive may be glue, and the battery compartment 32 is attached and inserted in the wax tube 1. In order to prevent the battery compartment 32 from loosening, the glue may be applied between the battery compartment 32 and the wax tube 1, adhesive and fixation is achieved by the glue.

(45) Embodiments of the present disclosure further provide a method of manufacturing the electronic candle as shown in FIGS. 2 and 9. The method includes following operations.

(46) The wax tube 1 is manufactured by a wax filling mold 9. The wax filling mold 9 includes an outer mold 91 and an inner mold 92. The outer mold 91 has a cylindrical groove 911, and the inner mold 92 is rod-shaped. The inner mold 92 is vertically inserted in the groove 911. A gap 93 is defined between the inner mold 92 and an inner wall of the groove 911. A wax solution is poured into the gap 93. When the wax solution is solidified and is unable to flow, the inner mold 92 is removed. After the wax solution is completely shaped, the wax tube 1 is separated from the outer mold 91, and the wax tube 1 is obtained.

(47) A core assembly 3 is assembled in the wax tube 1, and the light string 2 wraps around the outer surface 11 of the wax tube 1. The light string 2 extends through the wax tube 1 to be electrically connected to the core assembly 3.

(48) To be noted that, the inner mold 92 is disposed above a bottom wall of the outer mold 91. The inner mold 92 is rod-shaped to be in conformity with the shape of the cavity 12 of the wax tube 1. The outer mold 91 has the cylindrical groove 911. The cylindrical groove 911 is configured to form the outer surface 11 of the wax tube 1 and the end surface 141 of the first end 13. The inner mold 92 is inserted vertically to an axial center of the groove 911 and leaves the gap 93 away from the wall of the groove 911. In this way, the wax tube 1 can be formed after pouring wax solution. When the wax solution starts to be solidified, the inner mold 92 is taken out. At this moment, the wax solution has certain plasticity, the wax tube 1 is prevented from being cracked due to shaking or being squeezed when the inner mold 92 is taken out. The wax tube 1 is molded individually firstly,

and subsequently, assembled inside the wax the core assembly 3 is assembled to the inside of the wax tube 1. The technical solution in the art, in which the wax solution is poured for molding after the core assembly 3 is directly inserted into the wax filling mold 9, is changed. For the method in the art, the paraffin wax layer is solidified to and combined with the surface of the core assembly 3. By contrast, in the present method, the light string 2 can be arranged easily, and the core assembly 3 may not be damaged due to the wax solution being poured improperly, such that the overall cost is reduced significantly.

(49) In an embodiment, as shown in FIGS. 2, 3 and 4, the wax tube 1 defines the cavity 12 therein and includes the first end 13 and the second end 14. The first end 13 is closed, and the second end 14 has the opening. The core assembly 3 includes the battery compartment 32, the elongated PCBA board 31, and the light bead 5. The battery compartment 32 is tubular. The battery compartment 32 includes the third end 322 and the fourth end 321, and each of the third end 322 and the fourth end 321 defines the opening.

(50) The light bead 5 is soldered to the PCBA board 31, and then the PCBA board 31 is vertically inserted in the battery compartment 32. The light bead 5 is disposed at the end of the PCBA board 31 away from the battery compartment 32.

(51) The battery compartment 32 is inserted into the wax tube 1 from the second end 14 of the wax tube 1 until the light bead 5 passes through and is exposed out of the wax tube 1 from the first end 13. At least a portion of the PCBA board 31 is exposed in the cavity 12.

(52) The light string 2 extends through the wax tube 1 and is soldered to the exposed portion 311 of the PCBA board 31 to be electrically connected to the PCBA board 31.

(53) To be noted that the battery compartment 32 is tubular. The PCBA board 31 is elongated. The PCBA board 31 is vertically inserted to the battery compartment 32, the end 314 of the PCBA board 31 away from the battery compartment 32 is soldered with the light bead 5. In this way, the battery compartment 32, the PCBA board 31 and the light bead 5 can be assembled to form an integral structure along the axial direction, and the integral structure is arranged into the wax tube 1 from the second end 14. In this way, the core assembly 3 is assembled in an open-ended manner, an assembling efficiency is greatly improved. After the assembling, at least a portion of the PCBA board 31 is exposed in the cavity 12, facilitating the light string 2 to be soldered.

(54) In an embodiment, as shown in FIGS. 4 and 5, the core assembly 3 further includes the battery 323, the end cap 8, and the light bead sleeve 4 that is light transmissive.

(55) The light bead sleeve 4 is taken to sleeve the light bead 5. The battery 323 is mounted from the third end 322 of the battery compartment 32. After mounting the battery 323, the end cap 8 is mounted to the third end 322. The end cap 8 is arranged with the press switch 81 to control the light bead 5 and the light string 2 to be switched on and off.

(56) To be noted that, in some embodiments, the light bead sleeve 4 is made of white soft silicone, which is light transmissive but is non-transparent. The light bead sleeve is conical shaped, similar to the flame. By arranging the light bead sleeve 4, the shape of the flame when the real candle is burning can be simulated. The battery 323 is disposed along the axial direction of the battery compartment 32 to fully utilize the space inside the battery compartment 32. After mounting the battery 323 into the battery compartment 32, the end cap 8 is arranged. In this way, the battery 323 is secured, and the end cap 8 is arranged with the press switch 81 to facilitate control from the user.

(57) To be noted that the above technical features can further continue to be combined with each other to form various embodiments that are not listed in the above, all of which shall be considered to be within the scope of the present disclosure. Any ordinary skilled person in the art may perform improvement or transformation according to the above description, and all of which shall fall within the scope of the appended claims of the present disclosure.

Claims

1. An electronic candle, comprising: a wax tube, being cylindrical and made from paraffin wax, wherein, an axial length of the wax tube is 6-15 inches, a diameter of the wax tube is 19 mm-25 mm, the wax tube defines a cavity at an interior thereof, the wax tube has a first end and a second end, the second end defines an opening communicated to the cavity; a battery compartment, wherein, the battery compartment is inserted into the cavity from the second end, the battery compartment has a third end and a fourth end, the fourth end defines an opening facing towards the first end of the wax tube; a PCBA board, inserted to the fourth end of the battery compartment, wherein, at least a portion of the PCBA board is exposed to the cavity of the wax tube; a light string, extending spirally and arranged on an outer surface of the wax tube, wherein, the light string extends through the wax tube to be electrically connected to the exposed portion of the PCBA board; wherein, the PCBA board is elongated; a maximum width of the PCBA board is in an interference fit with an inner diameter of the battery compartment, enabling the PCBA board to be snapped with the battery compartment.
2. The electronic candle according to claim 1, wherein, each of two sides of the PCBA board is arranged with a bump to form the maximum width.
3. The electronic candle according to claim 1, wherein, an end of the PCBA board away from the battery compartment is connected with a light bead; an end face of the first end of the wax tube defines a through hole; the light bead passes through the through hole to be exposed out of the wax tube.
4. The electronic candle according to claim 1, further comprising a battery, received in the battery compartment and coaxially arranged with the battery compartment; wherein, the battery and the light string are electrically connected to the PCBA board.
5. The electronic candle according to claim 1, further comprising a light bead sleeve, wherein, the light bead sleeve is light transmissive and sleeves the light bead; the light bead sleeve is conical, having a shape to simulate a flame.
6. The electronic candle according to claim 5, wherein, light emitted from the light bead is warm white light to simulate the flame.
7. The electronic candle according to claim 1, wherein, an edge of an opening of the first end of the wax tube is wavy, flat or inclined.
8. The electronic candle according to claim 1, wherein, the light string is extending to form a crossing pattern and winds along an axial direction of the wax tube, and the light string is disposed on the outer surface of the wax tube.
9. The electronic candle according to claim 1, wherein, the light string is extending spirally, winding along an axial direction of the wax tube, to be arranged on the outer surface of the wax tube.
10. The electronic candle according to claim 1, wherein, the wax tube defines a receiving groove, an extending shape of the receiving groove matches with an extending path of the light string, the receiving groove receives the light string.
11. The electronic candle according to claim 10, wherein, an outer surface of the light string flushed with the outer surface of the wax tube.
12. An electronic candle, comprising: a wax tube, being cylindrical and made from paraffin wax, wherein, an axial length of the wax tube is 6-15 inches, a diameter of the wax tube is 19 mm-25 mm, the wax tube defines a cavity at an interior thereof, the wax tube has a first end and a second end, the second end defines an opening communicated to the cavity; a battery compartment, wherein, the battery compartment is inserted into the cavity from the second end, the battery compartment has a third end and a fourth end, the fourth end defines an opening facing towards the first end of the wax tube; a PCBA board, inserted to the fourth end of the battery compartment, wherein, at least a portion of the PCBA board is exposed to the cavity of the wax tube; a light string, extending spirally and arranged on an outer surface of the wax tube, wherein, the light string

extends through the wax tube to be electrically connected to the exposed portion of the PCBA board; a light bead sleeve, wherein, the light bead sleeve is light transmissive and sleeves the light bead; the light bead sleeve is conical, having a shape to simulate a flame; and an end cap, wherein the third end of the battery compartment is convex to form a connection structure; the connection structure comprises an abutting surface; the abutting surface abuts against an end surface of the second end of the wax tube; the connection structure is exposed out of the wax tube; the end cap is connected to the connection structure.

13. The electronic candle according to claim 12, wherein, the end cap is arranged with a press switch to control the light bead and the light string to be switched on and off.

14. The electronic candle according to claim 12, wherein, the end cap and the connection structure are connected to each other by threading.

15. The electronic candle according to claim 1, wherein, the battery compartment is a plastic member; and the battery compartment is assembled to the wax tube by an adhesive.

16. The electronic candle according to claim 1, wherein, the light string comprises a wire and a plurality of LED lights arranged on the wire, and the plurality of LED lights are spaced apart from each other.

17. A method of manufacturing the electronic candle according to claim 1, the method comprising: manufacturing, by a wax filling mold, a wax tube; wherein, the wax filling mold comprises an outer mold and an inner mold; the outer mold has a cylindrical groove; the inner mold is rod-shaped; the inner mold is vertically inserted in the groove; a gap **93** is defined between the inner mold and an inner wall of the groove; a wax solution is poured into the gap; when the wax solution is solidified and is unable to flow, the inner mold is removed; and after the wax solution is completely molded and shaped, the wax tube is separated from the outer mold; and the wax tube is obtained; and assembling a core assembly in the wax tube, taking the light string to wrap around an outer surface of the wax tube; wherein, the light string extends through the wax tube to be electrically connected to the core assembly.

18. The method according to claim 17, further comprising: forming a cavity in the wax tube, wherein, the wax tube comprises a first end and a second end; the first end is closed, and the second end has an opening; the core assembly comprises a battery compartment, an elongated PCBA board, and a light bead; the battery compartment is tubular; the battery compartment comprises a third end and the fourth end, and each of the third end and the fourth end defines an opening; soldering the light bead to the PCBA board, inserting the PCBA board vertically in the battery compartment; wherein, the light bead is disposed at an end of the PCBA board away from the battery compartment; inserting the battery compartment into the wax tube from the second end of the wax tube until the light bead passes through and is exposed out of the wax tube from the first end; wherein, at least a portion of the PCBA board is exposed in the cavity; and taking the light string to extend through the wax tube and to be soldered to the exposed portion of the PCBA board to be electrically connected to the PCBA board.

19. The method according to claim 18, wherein, the core assembly further comprises a battery, an end cap, and a light bead sleeve that is light transmissive; and the light bead sleeve is taken to sleeve the light bead; the battery is mounted from the third end of the battery compartment; after mounting the battery, the end cap is mounted to the third end; the end cap is arranged with a press switch to control the light bead and the light string to be switched on and off.
