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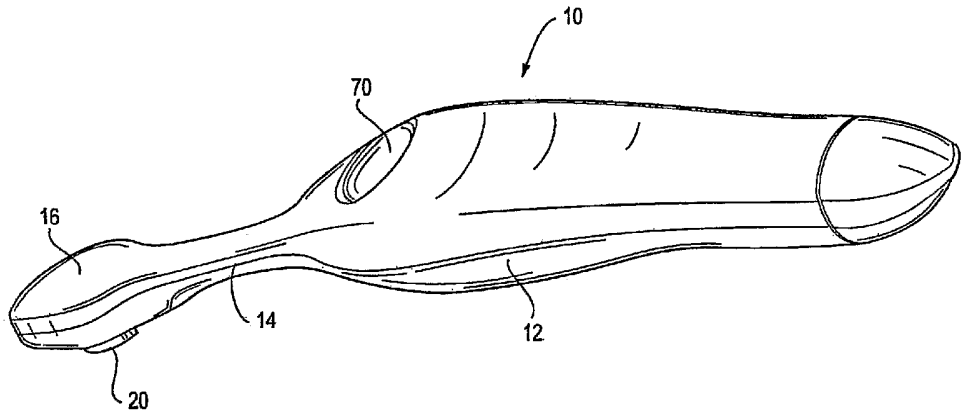
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(54) Title: ELECTRIC TOOTHBRUSH COMPRISING AN ELECTRICALLY POWERED ELEMENT



(57) Abstract: A toothbrush having an electrically powered element disposed on a head of an electric toothbrush. The electrically powered element can be a light emitting element such as a light emitting diode. Further the electrically powered element can serve as a pin and/or axis of motion for a movable bristle holder positioned along the face of the brush head.

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ELECTRIC TOOTHBRUSH COMPRISING AN ELECTRICALLY POWERED ELEMENT

Field of the Invention

The present invention relates to electric toothbrushes that utilize a moving bristle holder in conjunction with a light emitting element that illuminates the brushing area and provides a base for the moving bristle holder. In some versions of the toothbrush, a removable head is provided.

Background of the Invention

A toothbrush which emits light or generates other emissions from one or more electrically powered elements disposed on the head of the toothbrush can be provided in a variety of ways. A manual or electric toothbrush can have electrically powered elements disposed in the handle or other area remote from the head, and convey emissions from the electrically powered elements to the head of the toothbrush with transmitters such as fiber optics. However, emissions conveyed through a transmitter such as fiber optics are often diminished. For example, light emitting from a light emitting element that is conveyed via fiber optics can diminish in luminous intensity and/or flux density as it travels the length of the fiber optic transmitter. Alternatively, the electrically powered element can be disposed on the head of the toothbrush. However, an electrically powered element disposed on the head of an electric toothbrush must be of a size and placement such that space remains for bristles and the mechanics of the electric toothbrush. The mechanics of the toothbrush, especially the drive shaft, consume much of the space available within the head and neck of the toothbrush. Additionally, increasing the size of the head and/or handle of the toothbrush to increase space for including the electrically powered element can result in a toothbrush that is too large to effectively and comfortably clean the surfaces of the oral cavity. Therefore, it is desired to have an electric toothbrush wherein an electrically powered element is disposed on the head of the toothbrush such that the mechanics of the toothbrush are not interrupted or otherwise compromised. Further it is desired to have an electrically powered element disposed on the head of the toothbrush such that no fiber optics and/or other transmitters are necessary to convey the emissions from the electrically powered element to the head of the electric toothbrush.

Summary of the Invention

The present invention provides an electric toothbrush for use in the mouth comprising a handle, a head, and a neck extending between the handle and the head. The handle has a hollow interior region and the electric toothbrush has a longitudinal axis. The head

comprises at least one electrically powered element and at least one movable bristle holder. Additionally, a motor is disposed in the hollow interior region defined in the handle, and the motor is operatively connected to the movable bristle holder by a drive shaft.

The present invention also provides a head an electric toothbrush comprising an electrically powered element and a movable bristle holder, wherein the electrically powered element serves as the pin which is the axis of rotation for a movable bristle holder on the head of the toothbrush.

The present invention also provides a drive shaft for an electric toothbrush wherein the drive shaft extends between a motor and a movable bristle holder, and the drive shaft bends around an electrically powered element disposed on the toothbrush, and wherein the drive shaft does not contact the electrically powered element when the drive shaft is operated.

The present invention also provides a drive shaft comprising an electrically powered element, wherein the electrically powered element is disposed on the drive shaft.

The present invention also provides an electric toothbrush comprising a head with a movable bristle holder, a handle having a motor disposed therein, a light emitting element and a drive shaft operatively connecting the motor to the movable bristle holder wherein at least a portion of the drive shaft is transparent.

The present invention also provides an electric toothbrush comprising a handle, a head, a light emitting element, a drive shaft located between the light emitting element and the portion of the toothbrush from which the light emits, and reflecting elements which reflect the light from the light emitting elements around a drive shaft to the portion of the head from which the light emits.

The present invention also provides a head portion of an electric toothbrush for connecting to a handle portion, the head portion comprising an electrically powered element, at least one movable bristle holder, and at least one channel.

Brief Description of the Drawings

The invention may take physical form in certain parts and arrangements of parts, embodiments of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof, and wherein:

FIG. 1 is a perspective view of an electric toothbrush in accordance with the present invention.

FIG. 2 is a top planar view of the electric toothbrush of **FIG. 1**.

FIG. 2a is a top planar view of the electric toothbrush of **FIG. 1**.

FIG. 3 is a cross-sectional side elevational view of the electric toothbrush of

FIG. 1.

FIG. 3a is a cross-sectional side elevational view of the head portion of an embodiment of the present invention.

FIG. 3b is a partial front view elevational view of a head and neck of an embodiment of the present invention.

FIG. 3c is a partial front view of the lens of a light emitting element.

FIG. 4 is a detailed cross-sectional side elevational view of the head of the electric toothbrush according to the present invention.

FIG. 5 is a detailed cross-sectional side elevational view of the head of the electric toothbrush of **FIG. 1.**

FIG. 6 is a partial front elevational view of a head and neck of another embodiment of the present invention.

FIG. 6a is a partial front elevational view of a head and neck of another embodiment of the present invention.

FIG. 7 is a partial front elevational view of a head and neck of yet another embodiment of the present invention.

FIG. 7a is a partial front elevational view of a head and neck of yet another embodiment of the present invention.

FIG. 7c is a partial front elevational view of a head and neck of yet another embodiment of the present invention.

FIG. 8 is a partial front elevational view of a head and neck of still another embodiment of the present invention.

FIG. 8a is a partial front elevational view of a head and neck of still another embodiment of the present invention.

FIG. 9 is a perspective view of another embodiment of the electric toothbrush of the present invention in which the toothbrush includes a head and neck that can be separated from the handle.

FIG. 10 is a perspective view of a head and neck of yet another embodiment of the present invention.

FIG. 11 is a front elevational view of the head and neck of the embodiment illustrated in **FIG. 10.**

FIG. 11a is a back elevational view of the head and neck of the embodiment illustrated in **FIG. 10.**

FIG. 12 is a side elevational view of the head and neck of the embodiment shown in **FIG. 10.**

FIG. 13 is a cross-sectional side elevational view of the embodiment shown in **FIG. 10.**

FIG. 14 is a partial front elevational view of an embodiment of a drive shaft of a toothbrush made according to the present invention.

FIG. 15 is a partial front elevational view of an embodiment of a drive shaft of a toothbrush made according to the present invention.

FIG. 15a is a partial front elevational view of an embodiment of a drive shaft of a toothbrush made according to the present invention.

FIG. 15b is a partial side elevational view of the embodiment of the drive shaft shown in **FIG. 15a.**

FIG. 16 is a partial front elevational view of an embodiment of a drive shaft of a toothbrush made according to the present invention.

FIG. 17 is a partial back elevational view of an embodiment of a drive shaft of a toothbrush made according to the present invention.

FIG. 18 is a partial front elevational view of an embodiment of a drive shaft of a toothbrush made according to the present invention.

FIG. 19 is a cross sectional end view of a drive shaft, a light emitting element, and reflectors of a toothbrush made according to the present invention.

FIG. 20 is a cross sectional end view of a drive shaft and a light emitting element of a toothbrush made according to the present invention.

FIG. 21 is a cross sectional end view of a drive shaft and a light emitting element of a toothbrush made according to the present invention.

FIG. 22 is a cross-sectional side elevational view of an embodiment of the electric toothbrush of the present invention.

FIG. 23 is a cross-sectional side elevational view of an embodiment of the electric toothbrush of the present invention.

FIG. 24 is a front elevational view of an embodiment of the head and neck fo an electric toothbrush of the present invention.

FIG. 25 is a cross-sectional side elevational view of an embodiment of the head and neck of an electric toothbrush of the present invention.

FIG. 26 is a front elevational view of an embodiment of the head and neck of an electric toothbrush of the present invention.

FIG. 27 is a cross-sectional side elevational view of an embodiment of the head and neck of an electric toothbrush of the present invention.

FIG. 28 is a front elevational view of an embodiment of the head and neck of an

electric toothbrush of the present invention.

FIG. 29 is a front elevational view of an embodiment of the head and neck of an electric toothbrush of the present invention.

FIG. 30 is a front elevational view of an embodiment of the head and neck of an electric toothbrush of the present invention.

Detailed Description of the Embodiments

Generally, the present invention relates to an oral care implement for use in the mouth having one or more electrically powered elements disposed on the head including, but not limited to, light emitting diodes, light-emitting elements using incandescent elements, laser elements, halogen elements, neon elements, fluorescent elements, plasma elements, xenon elements, flossing elements, massaging elements, scraping elements, heat emitting elements, sonic wave emitting elements, ultra-sound emitting element, electric current emitting elements, composition emitting elements and/or any combination thereof. Such oral care implements can include, but are not limited to, electric toothbrushes, powered flossers, tooth polishers, gum massagers, etc. As used herein the term electrically powered element includes any electrically powered element that can convert electrical energy at the place where the element is disposed. For example, a light emitting element can convert electrical energy into light at the location where the element is disposed; such as on the head of an electric toothbrush. For simplicity's sake, hereinafter the present invention will be discussed as embodied in an electric toothbrush having a head, on which a light emitting element is disposed. Such electric toothbrushes can be used in personal hygiene to clean one's teeth and gums using a motorized movement, while the electrically powered element is activated. The present invention also relates to an electric toothbrush having a replaceable or removable head and/or neck. Furthermore, the present invention relates to kits including the toothbrush of the present invention.

As used herein, the term "light-emitting" element includes an element that converts electrical energy into light. In one embodiment the light-emitting element of the present invention is a light emitting diode ("LED"). As used herein, the term "light" is intended to encompass the spectrum of both visible and non-visible (e.g., ultraviolet and infra-red) light. The various embodiments of the toothbrushes described herein may utilize light emitting elements having a variety of characteristics. Concerning wave length, the light-emitting elements used in the toothbrushes described herein can emit light having a central wave length between about 10 nm and about 10^6 nm. In one embodiment of the toothbrush of the present invention the light emitted from the light emitting element can be greater than about 370, 390, 410, 430, 450, 470, 490, 510, 530, 550, 570, 590, 610, 630, 650, 670, 690, 710 nm and/or less than about 770, 750,

730, 710, 690, 670, 650, 630, 610 nm. In another embodiment the light emitted can have a wavelength of greater than about 420, 430, 440, 450, 460, 470, 480, and/or 490 nm and/or less than about 490, 480, 470, 460, 450, 440, 430, 420 nm. It will be appreciated that the particular range of wavelengths selected can depend upon the desired color of the light. In one embodiment the light emitted can be a blue color.

In one embodiment, the electric toothbrush includes an elongated body portion or handle, a head, and a neck extending between the head and the handle. One or more light-emitting elements can be provided on the head, adjacent to, on, or in one or more static or moving bristle holders having a plurality of bristles thereon. Incorporating a light emitting element into the head of an electric toothbrush can result in interference with the mechanics of the electric toothbrush, particularly the operative connection between the drive shaft and the movable bristle holder(s), depending on where the light emitting element is disposed. To prevent such interference the one or more light-emitting elements can be positioned such that the light emitting element is not disposed between the motor and the movable bristle holder. In certain embodiments, a light-emitting element can be positioned at the center or at the axis of movement of an oscillating bristle holder. Additionally, the light emitting element can act as the pin which serves as the contact surface and/or center or axis of rotation for a movable bristle holder. When the light emitting element is positioned within the movable bristle holder, particularly as the axis and/or center of rotation, the light emitting element is not disposed between the motor and the movable bristle holder, therefore the drive shaft can operatively connect with the movable bristle holder without interference from the light emitting element. Additionally, the light emitting element can refine the movement of the movable bristle holder, preventing the movable bristle holder from undergoing undesirable movement. For example, the light emitting element serving as a pin in the center of an oscillating movable bristle holder can prevent non-rotational or non-oscillating movement of the oscillating bristle holder. The light-emitting element can be stationary, or it can be secured to the movable bristle holder so that the element moves with the bristle holder. In other embodiments the light emitting element is disposed on the distal end of the toothbrush head, distal to the movable bristle holder. This embodiment also avoids interference with the operative connection between the movable bristle holder and the drive shaft.

In other embodiments wherein the light emitting element is disposed between the motor and the movable bristle holder, the operative connection between the drive shaft and the movable bristle holder can be achieved with a drive shaft that bypasses the light emitting element, a drive shaft that serves as a base or support for the light emitting element, a drive shaft that passes over the light emitting element wherein at least a portion of the drive shaft is transparent to the emitted light, a drive shaft that passes underneath a light emitting element, and/or modifying a

light emitting element such that the drive shaft becomes a part of the light emitting element. The bristle holder can, in certain embodiments, feature a region, typically provided at the center of the holder, which promotes the passage of light there through. That region may be formed from a transparent or translucent material, or alternatively, the region can be an aperture or other open area substantially free of bristles thereby permitting the passage of light. This region can be provided at any portion of the head of the toothbrush, including the center of a movable bristle holder. Alternatively, the electric toothbrush may have a light emitting element disposed on one portion of the head of the toothbrush, and a different electrically powered element, such as an ultra-sound emitting element, disposed on another portion of the head of the toothbrush.

The head includes a longitudinal axis, one or more moving bristle holders or carriers and, optionally, one or more static or fixed bristle holders. The moving bristle holders may rotate, swivel, gyrate, oscillate, linearly reciprocate, or undergo any combination of motions. The type of motion provided by the electric toothbrushes of the present invention can be widely varied. The static bristle holders and the arrangement of the static bristles disposed thereon can also be widely varied. For example, the static bristles might partially or wholly circumscribe the moving bristle holders or may be disposed in a gap between the moving bristle holders. Examples of some bristle holder motions and bristle arrangements suitable for use with the present invention are described in US 20030126699; US 20030084525; US 20030084524; US 20030084526; and WO 03/063723; and WO 03/063722. The bristles can be made from conventional non-elastomeric materials, such as polyethylene, or can be made from elastomeric materials such as natural or synthetic rubbers, polyolefins, polyetheramides, polyesters, styrenic polymers, polyurethanes, etc., or a combination of materials.

The handle has a hollow portion with a motor disposed therein that is operably connected to the moving bristle holders. A shaft extends from the motor through the neck and into at least a portion of the head. The shaft may rotate, oscillate, linearly reciprocate, gyrate, orbit, or move in a conical fashion when driven by the motor in order to impart one or more motions to the moving bristle holders. A gearing arrangement can be provided between the motor and the shaft or between the shaft and the moving bristle holders in order to impart motion thereto. Exemplary shaft and/or gearing arrangements are shown in U.S. Patent Nos. 6,360,395 and 5,617,601, and U.S. Patent Application Nos. 2003/0134567 and 2003/0163881 as well as in other patents and patent publications referenced herein. The handle also has a power source, such as one or more batteries, disposed therein for powering the motor and the light-emitting elements. Alternatively, the electric toothbrush may be connected to an external power source for powering the motor. A switch is disposed on the handle for activating the motor and/or light-emitting elements. The switch includes an actuator button and a metal contact. The switch is

manually depressed by pressing a molded actuator button down, which presses against a metal contact, completing the circuit, as in a conventional momentary switch. The switch allows continuous operation, through a ramp design, by depressing and sliding the actuator button forward as in a conventional continuous switch. By combining these two functions in one switch, the consumer can try the unit and see its operation prior to purchase, and still operate it continuously once out of the package. The switch can also activate one or more light emitting elements. The light emitting elements are energized whenever the motor is activated, however, the electric toothbrush can also have a switch designated to activate the light emitting element.

Referring now to the drawings which illustrate the embodiments of the invention only and not for purposes of limiting same, **FIG. 1** shows an electric toothbrush **10** according to an embodiment of the present invention. The electric toothbrush can be used for personal hygiene such as brushing one's teeth and gums. As shown in **FIG. 1**, the electric toothbrush includes a handle **12** and a neck **14** attached to the handle **12**. A head **16** is attached to the neck **14**. Typically, the head is larger than the neck **14**, which is also typically smaller than the handle **12**.

Referring now to **FIG. 2**, the head **16** further is defined by a longitudinal axis **19**, and comprises a moving bristle holder **20** and one or more optional static bristle holders **22**. In this embodiment the static bristle holders **22** are located on opposite sides of the moving bristle holder **20**. The moving bristle holder **20** in this embodiment is located at the center of the head **16**. The moving bristle holder **20** includes a plurality of bristles **24** supported and retained on the holder **20**. The moving bristle holder can oscillate or rotate about an axis of motion approximately normal to the longitudinal axis **19** of the head **16**, although other motions may be provided as previously described. As described in greater detail herein, disposed along this axis of motion of the moving bristle holder, is an electrically powered element **74**. In a particular embodiment (as shown in **FIG. 2a**), the electrically powered element is a light-emitting element **75** such as a light emitting diode positioned on the head of the toothbrush and generally below or under where the surface of the light emitting element does not extend beyond the bristle bearing surface of the moving bristle holder (as shown in **FIG. 22**). In certain configurations, the moving bristle holder rotates on, pivots on, or otherwise undergoes motion with respect to the light-emitting element which can be stationary. Ideally in this configuration, the light-emitting element **75** can serve as a base, thereby serving as a supporting contact surface for the moving bristle holder **20**. The noted axis of motion can extend through, and depending upon the shape and orientation of the light-emitting element, be colinear therewith.

As shown in **FIG. 3**, the handle **12** further includes a hollow interior region **30** which houses a motor **32**. The hollow interior region **30** generally extends along an axis **34** and retains the motor **32** and one or more electrical power sources such as a battery **60**. Switching

elements or contacts **50** and **54** can be utilized in conjunction with the switch **52** to selectively operate the motor **32** and the light emitting element **75**. In this embodiment the motor **32** powers the moving bristle holder **20** through a rotatable shaft **44**. The shaft **44** rotates or oscillates about an axis **19**. A gearing arrangement is operatively interconnected between the shaft **44** and the motor **32**. The gearing arrangement includes a worm gear **40** and a pair of step gears **42, 43**. The motor **32** is operatively connected to the worm gear **40**. Step gear **42** is operatively connected to step gear **43** and the worm gear **40**. The light emitting element **75** is disposed in the interior of the toothbrush head. A switch **52** is provided to control operation of the electric toothbrush and is operatively connected to the motor **32**. The switch **52** is also configured to operate the one or more light emitting elements of the toothbrush. Such can be momentary or continuous. When the switch **52** is closed, a circuit is completed between the battery **60** provided within the hollow interior region **30** of the handle **12** and the motor **32** and light emitting element **75**.

FIG. 3a – 3b illustrate embodiments of the electric toothbrush wherein at least a portion of the light emitting element is the pin and/or contacting surface which serves as the axis or center of rotation for a movable bristle holder. To protect the light emitting element from damage resulting from contact with the movable bristle holder, the light emitting element can be disposed within a protective pillar, the outer surfaces of the light emitting element or the lens of the light emitting element can be coated with a protective material. The coating on the outer surfaces can be layered, and can comprise a variety of materials. These materials can include polymers, metals and/or any other material which reinforces and/or strengthens the surfaces of the light emitting element. Additionally, to facilitate smooth movement of the movable bristle holder around the light emitting element, the light emitting element can be coated with a friction reducing material. If the lens serves as the pin for the movable bristle holder, the lower portion of the lens **13** can be opaque and not transparent and/or translucent, and the upper portion of the lens **9** can be transparent and/or translucent, such that light emits from the upper portion of the lens as shown in **FIG. 3c**.

In one embodiment of the toothbrush head **1200** illustrated in **FIG. 3a** the drive shaft **1202** comprises an aperture **1204**, and the movable bristle holder **1206** comprises a protuberance **1208**. Protuberance **1208** fits into aperture **1204**, thereby operatively connecting the drive shaft **1202** to the movable bristle holder **1206**. The movable bristle holder **1206** also comprises an aperture **1210**. The light emitting element **1275** fits into aperture **1210** when the movable bristle holder is secured to the head **1212** of the toothbrush. Upon operation of the toothbrush, the motion of the drive shaft **1202** is translated to the movable bristle holder **1206**, which oscillates about the light emitting element **1275**. In this embodiment the drive shaft reciprocates.

In the embodiment of the toothbrush head **1300** illustrated in **FIG. 3b**, the movable bristle holder **1302** comprises an aperture **1304** and the drive shaft **1306** fits into aperture **1304**, thereby operatively connecting drive shaft **1306** and the movable bristle holder **1302**. When the electric toothbrush is operated the motion of the drive shaft **1306** is translated to the movable bristle holder **1302**, which oscillates about the light emitting element **1375**. In this embodiment of the toothbrush, the drive shaft has a conical driving motion.

FIG. 4 illustrates an embodiment of the toothbrush having a stationary light emitting element **75** that is connected to and/or disposed within a pillar **91** that is stationary and fixed to the head **95** at point **93** of the toothbrush. In this embodiment the moving bristle holder **97** oscillates or rotates around the stationary light emitting element **75** disposed within pillar **91**. This light emitting element **75** disposed within the pillar **91** serves as the axis of rotation for the moving bristle holder **97** on the head **95** of the toothbrush. The positive lead **87** and the negative lead **89** can run from the light emitting element **75** through the pillar **91** and then down the length of the head **95** and neck (not shown) of the toothbrush to the power source (not shown).

Referring to **FIG. 5**, in this embodiment the electric power is provided to the light-emitting element **75** by the use of a pair of electrical contacts **76** and **77** that slidingly contact dedicated contact regions defined along the underside of the moving bristle holder **20**, as shown by way of example in **FIG. 4**. Electrical wires (not shown) may be provided from the switch and power source to the contacts **76** and **77** for conducting electricity from the power source to the light-emitting element. The wires may run from the handle through the neck **14** to the head **16**. The wires can be disposed adjacent the interior wall of the neck **14** so that they do not interfere with the movement of the shaft **44**. Alternatively, the wires may be embedded within the neck **14**.

It is contemplated that circular electrically conductive contact regions **80** and **82** could be provided along the exterior of the moving bristle holder **20**, which regions would be in electrical communication with the pair of fixed contacts **76** and **77** provided within the interior of the head. The electrically conductive contact regions **80** and **82** are insulated from each other by a non-conductive material. Electrical leads **84** and **86** can be provided from the electrically conductive contact regions to the light-emitting element. **FIG. 5** illustrates the light-emitting element **75** disposed in contact with or within the moving bristle holder **20**. In this embodiment the light-emitting element is fixedly attached to the moving bristle holder **20** and therefore moves with the bristle holder. As shown, the bristle holder **20** and light emitting element **75** oscillate about an axis **90**. In one embodiment the top surface such as lens **81** of the light-emitting element is flush with the top surface **92** of the moving bristle holder **20**, although the top surface may extend above the top surface **92** if desired. Bristles (not shown) can be disposed on the top

surface **92**. Additional light-emitting elements can be provided in or on the static bristle holders **22** (**FIG. 2**).

FIGS. 1-5 collectively illustrate other features of the toothbrush embodiment **10**. For example, the toothbrush may feature one or more gripping regions such as **70** and **72**; and, as previously noted, the switch **52** that may be selectively positioned within a switching region **56** defined along the handle **12**. Upon activation, the light emitting element illuminates the region and specifically, the brushing environment, to which a face surface **21** of the head **16** is directed.

In another, related embodiment **300**, the light-emitting element **375** is disposed within an aperture or hole **88** that extends through a moving bristle holder **320**, as best seen in **FIG. 6**, so that the light-emitting element is stationary and the moving bristle holder **320** oscillates or rotates about the stationary light-emitting element **375**. **FIG. 6** depicts a toothbrush embodiment **300** having a head **316** and a neck **314** with the movable bristle holder **320** disposed on the head. A plurality of bristles **332** are supported on the holder **320**. The head may include a region of static bristles **322**. In this embodiment, the light-emitting element **375** is fixedly secured to the head **316**. The light-emitting element **375** might extend partially through the hole **88** or it may be disposed below the lower surface of the moving bristle holder **320** so that it is completely contained within the head **316**. The centerline or axis of the light-emitting element **375** may also be the axis of rotation or oscillation for the moving bristle holder **320**. In some of the above-described embodiments, particularly where the light-emitting element is disposed below the movable bristle holder **320**, the moving bristle holder can be formed from a transparent or translucent material. This characteristic promotes the transmission of light from the one or more light-emitting elements to the brushing region. This configuration can protect the light-emitting element from saliva, water, and oral compositions used with the electric toothbrush. It is also contemplated that the bristle holder may be formed from a colored or tinted material.

A variety of materials may be used for forming a transparent or translucent bristle holder and/or head. Examples of such materials include, but are not limited to, polystyrene (PS), polycarbonate (PC), polymethyl methacrylate (PMMA), polyethylene terephthalate glycol (PETG) (commercially available under the designation Eastoman BR003), cellulose acetate propylate (CAP), and combinations thereof. It is contemplated that one or more thermal treatments may be employed to facilitate processing of these materials.

In each of the above-described embodiments, the light-emitting element is disposed in, on, below or directly adjacent the moving and/or static bristle holders so that the light is directed onto the brushing area as efficiently as possible. Further, the light-emitting elements can be arranged so that the principal direction of light emission is generally perpendicular to the top surface of the bristle holders i.e. generally parallel to the direction of the bristles of the bristle

holder. In one embodiment, the light-emitting element can be arranged so that the centerline or axis of movement **90** of the light-emitting element is generally perpendicular to the top surface of the head and/or bristle holder, as best seen in **FIG. 4**. The centerline **90** typically passes through the lens **81** or aperture of the light-emitting element **75**. When the light-emitting element is disposed within, on, or below a moving and/or static bristle holder, a cylindrical region comprising the light emitting element, or volume about the centerline **90** of the light-emitting element can be devoid of bristles so that light is transmitted to the brushing surface without interference from the bristles. The diameter of the cylindrical region that is devoid of bristles can be greater than about 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 mm and less than about 20, 18, 16, 15, 14, 12, 10, 8, 6, 4, 2 mm. The moving bristle holder still, however, can have at least one ring of bristles that encircle the light-emitting element, as shown by way of example in **Fig. 6**. Additional bristle tufts or an inner ring of bristle tufts can also be provided.

FIGS. 7a and **8** illustrate toothbrush heads, bristle holders and bristle configurations for embodiments of the electric toothbrush made according to the present invention, all of which contain one or more light emitting elements.

FIG. 7a depicts a toothbrush embodiment **600** having a head **616** and a neck **614** in accordance with the present invention. The head **616** comprises a single bristle holder **620** having light-emitting element **675** disposed therein. The bristle holder **620** includes one or more rings of concentric circles of bristles or bristle tufts **632**.

FIG. 8 depicts another toothbrush **800** having a head **816** and a neck **814**. The head **816** has a first bristle holder **820** that moves and a second bristle holder **822** that is fixed or stationary. Both bristle holders have light-emitting elements **875** disposed thereon. The first bristle holder **820** has a plurality of bristle tufts **832** that encircle the light-emitting element **875** disposed thereon, and the second bristle holder **834** has a plurality of bristle tufts **822** that surround the light-emitting element **875** disposed thereon. **FIG. 8a** depicts another embodiment of the present invention. The head and neck of toothbrush **900** comprises three bristle holders **902**, **906**, and **908**, and two light emitting elements **975** and **976**. Light emitting element **976** is disposed on bristle holder **902** located at the distal end of the head **904** of the toothbrush **900**. Light emitting element **975** is disposed on the movable bristle holder **906** disposed in the center of the head of the toothbrush **900**. Finally bristle holder **908** is disposed on the head of the toothbrush proximal to the handle **914**. Bristle holders **902** and/or **908** can be either movable or stationary.

As shown in **FIG. 9**, another electric toothbrush **1000** is depicted having a head **1016**, a neck **1014**, and a handle **1012**. Disposed on the head **1016** is a light-emitting element **1075**. The neck and handle are replaceable, and are releasably connected at **1015** and contain

corresponding structures for their physical engagement and for establishing electrical communication between the light-emitting element and the power source.

FIGS. 10 - 13 illustrate another embodiment of the present invention toothbrushes. Toothbrush **1100** comprises a head **1116** and a handle or body (not shown), and a neck **1114** extending between the head and handle. Although this particular embodiment is shown and described as having a removable head and neck, in no way is the present invention limited to this configuration. Disposed on the head **1116** is a first movable bristle holder **1120** and an optional second bristle holder **1122**. The second bristle holder **1122** can be movable. However, it is also contemplated that the second bristle holder is stationary. Each of the bristle holders defines a plurality of apertures or recessed regions adapted for retaining tufts of bristles. For example, the first bristle holder **1120** defines a plurality of recesses or apertures for receiving bristles **1124**. And, the optional second bristle holder **1122** defines a plurality of recesses or apertures adapted for retaining a plurality of bristles **1126**. It will be appreciated that the toothbrush **1100** may utilize one or more arrays of fixed or stationary bristles instead of, or in addition to, the first bristle holder **1120** and associated bristles **1124**, and the second bristle holder **1122** and associated bristles **1126**.

The toothbrush **1100** comprises one or more light emitting components disposed on or within the brush head **1116**. For example, as shown in **FIGS. 11** and **12**, the brush head includes a first light emitting element **1175** and a second light emitting element **1185**. In one embodiment the first light emitting element **1175** is disposed within the center of the first bristle holder **1120**, and particularly concentrically disposed therein. As shown in **FIG. 12**, the first light emitting element **1175** can also be disposed under the first bristle holder **1120**. This configuration is described in greater detail herein. Also disposed within the brush head **1116** is the second light emitting element **1185**. The second light emitting element **1185** can be disposed within the interior of the brush head **1116** as best shown in **FIG. 12**. However, as illustrated in **FIG. 11**, both light emitting elements **1175** and **1185** can be exposed or viewable along the outer face of the brush head **1116**. The light emitting element(s) can also be disposed between a first bristle holder **1120** and second bristle holder **1122** as shown in **FIG. 11**. The second bristle holder **1122** can comprise a cut-out **1127**. This cut-out area can allow the light emitting element **1185** to be exposed, and light shining from the light emitting element is not obstructed by the bristle holder **1122**. The bristle holder can also comprise a transparent and/or translucent material which allows light to pass through the bristle holder. Additionally, the areas above the light emitting element can be substantially free of bristles. This second bristle holder **1122**, can be stationary or can undergo motion, including, but not limited to, oscillation, rotation, reciprocation, and/or any combination thereof. Furthermore, if this second bristle holder undergoes motion, the cut-out

1127 area of the bristle holder can also move. This cut out **1127** can be arranged such that the light emitting element is partially, completely, or not at all covered by the bristle holder when the bristle holder undergoes motion. In another embodiment of the present invention as shown in **FIG. 6a** the light emitting element **475** is disposed partially underneath a first bristle holder **420** that is disposed in the center of the head **416** of the toothbrush, and partially underneath a second bristle holder **421** disposed on the portion of the head **416** that is proximal to the neck **414** of toothbrush **400**. The bristle holder(s) can comprise a translucent and/or transparent material thereby allowing light to pass through the bristle holders even if the light emitting element is completely or partially covered by the bristle holder. Additionally, a third bristle holder **422** can be disposed on the distal end of the head **416** of the toothbrush, and a light emitting element **475** can be disposed partially underneath the first bristle holder **420** and partially underneath the third bristle holder **422**.

In other embodiments, the light emitting element can be disposed on, in or under the second bristle holder located on a portion of the toothbrush head proximal to the neck, as shown in **FIGS. 7, 7b**, and **8**. **FIG. 7** illustrates a toothbrush embodiment **500** having a head **516** and a neck **514**. It will be appreciated that the neck **514** extends between the head **516** and a handle of the toothbrush (not shown). Disposed on the head **516** is a single moving bristle holder **520** having a plurality of bristle tufts **532** disposed thereon. Disposed on a second bristle holder **534** is a light-emitting element **575**. The toothbrush **500** can include a plurality of static bristles **522** disposed on the second bristle holder **534**. The light emitting element **575** extends through the second bristle holder **534**, and the area above the light emitting element **575** is substantially free of bristles. **FIG. 7b** illustrates an embodiment of the toothbrush **501** having a light emitting element **575** disposed underneath a second bristle holder **576** located on a portion of the head proximal to the neck **514**. This bristle holder **576** is translucent and/or transparent, thereby allowing light to shine through the bristle holder **576**.

FIG. 8 depicts a portion of a toothbrush **800** having a head **816** and a neck **814**. The head **816** has a first bristle holder **820** that moves and a second bristle holder **822** that is fixed or stationary. Both bristle holders have light-emitting elements **875** disposed thereon. The first bristle holder **820** has a plurality of bristle tufts **832** that encircle the light-emitting element **875** disposed thereon, and the second bristle holder **834** has a plurality of bristle tufts **822** that encircle the light-emitting element **875** disposed thereon. The light emitting element **875** extends through the second bristle holder **834**, and the area above the light emitting element **875** is substantially free of bristles.

In another embodiment of the toothbrush **1100**, shown in **FIG. 11**, the first light emitting element **1175** is aligned with a region defined along the first bristle holder **1120** that is

substantially free of any bristles. Specifically, it can be seen that the first light emitting element **1175** is generally disposed underneath the first bristle holder **1120**, and accessible through an aperture **1121** defined in the bristle holder **1120**. Furthermore, the first light emitting element **1175** can also be positioned such that light emitted from that element is unobstructed as it passes through the first bristle holder **1120** and past the plurality of bristles **1124** extending from the first holder **1120**. Generally, the bristles **1124** are arranged about the perimeter of the first bristle holder **1120** so as to form a circular region of bristles, and particularly, to form a concentric ring about the first light emitting element **1175**. The remaining region above the outer face of the first bristle holder **1120** which is substantially free of any bristles is shown in **FIG. 13** as region **A**, which is generally cylindrical in shape. There it can be seen that the first light emitting element **1175** is concentrically disposed within region **A**.

FIG. 13 also illustrates the manner of mounting and/or engagement between the first light emitting element **1175** and the first bristle holder **1120**. The first bristle holder **1120**, can rotate or oscillate directly upon the light emitting element **1175**. That is, in certain embodiments, the light emitting element **1175** or a component of that element such as a lens, cap, cover, shield, or the light emitting element itself, can provide the contacting surface and/or pin upon which the bristle holder **1120** rotates or oscillates. The aperture **1121** defined in the holder **1120** can be sized and configured so as to promote the movement of the holder **1120** about the element **1175**. For example, the aperture can have a diameter slightly less than a maximum diameter of an element **1175** having a dome or cone-shaped tip such that the tip of the element partially extends within the aperture **1121**. Alternatively, the aperture **1121** can be sized and configured such that it has a diameter slightly greater than the diameter of the light emitting element **1175** so that the element **1175** extends well into the aperture **1121**, or entirely through the aperture **1121**. In this latter configuration, the light emitting element serves as an axis for the oscillating or rotating bristle holder **1120**.

Referring further to **FIG. 13**, the toothbrush **1100** also comprises a second, optional light emitting element **1185** generally disposed within the interior of the head **1116** of the toothbrush. The second element **1185** primarily serves to provide light for other transparent, translucent, or open regions of the toothbrush, and particularly in the region of the head **1116**. Either of the light emitting elements **1175** and/or **1185** can be incorporated within a receiving or mounting structure within the head **1116**, such as a pillar that defines a hollow region sized to accommodate the element.

A light emitting element, such as a light emitting diode, comprises a light emitting substrate, the location where the light is generated, and a lens, the location from which the light emits. In one embodiment of the present invention, as shown in **FIG. 22**, a light emitting

element is disposed on the head of the toothbrush such that the light emitting substrate **1902** is below and/or flush with the top surface **1915** of the head of the toothbrush. Top surface **1915** can be bristle bearing. However, the location from which the light emits, i.e. the lens **1904,** extends from the top surface **1915** of the toothbrush to the distal ends **1916** of the bristles **1910** extending from said top surface **1915**. The lens **1904** can comprise an elastomeric material. The elastomeric material can be transparent and/or translucent. During use, the lens comprising an elastomeric material can massage the gums and further assist with the cleaning of the oral cavity. The surface of the lens can comprise ridges, or the lens can be smooth. Alternatively, as shown in **FIG. 23**, the light emitting substrate **1903** can be disposed within or on the top of a pillar **1913** which extends above the top surface **1915** of the head of the toothbrush and the lens **1904** extends to the distal ends **1916** of the bristles **1910**. In both **FIGS. 22** and **23** leads **1906** and **1908** run from the light emitting element down the length of the pillar **1913** to the head **1914**, and then the leads run down the length of the neck **1912** and handle (not shown) to connect to the power source (not shown).

In another embodiment of the toothbrush, as shown in **FIG. 24** and **25** two electrically powered elements are disposed on the head **2012** of the toothbrush **2000**. One element is a light emitting element **2075** disposed in a pillar **2010** and serves as the center pin for oscillating bristle holder **2004**. The second electrically powered element is an ultra-sound emitting element **2008** disposed in a bristle holder **2006** proximal to the neck **2014** and/or handle (not shown) of the electric toothbrush. However, it is contemplated that the ultra-sound emitting element can also be disposed at the distal end of the toothbrush above the light emitting element, or the ultra-sound emitting element could be partially disposed on the neck of the electric toothbrush.

Another embodiment of the toothbrush **2001** comprising an ultra-sound emitting element is shown in **FIGS. 26** and **27**. The ultrasound emitting element comprises an ultrasonic transducer **2018** and an ultrasonic horn **2016**. The ultrasonic transducer **2018** is disposed on the head of the toothbrush **2012** and the ultrasonic horn **2016** extends from the ultrasonic transducer **2018** towards the surface of the toothbrush which contacts the teeth. In this embodiment the teeth are contacted by walls **2020**, and **2022**. These walls can be elastomeric and/or non-elastomeric and extend above and/or surround the ultrasonic horn **2016** thereby creating a space between the ultrasonic horn and the teeth. This space serves as a safety precaution, preventing the ultrasonic horn from contacting the teeth. These walls can be a static bristle plate **2028**, and bristles **2026** can be disposed thereon (as shown in **FIG. 30**). The walls can vibrate, and gel placed on top of the walls can transmit the vibration between the ultrasonic element and the surfaces of the teeth. Additionally, the bristles **2024** can surround the walls and/or the ultrasonic element. Bristles **2024**

and **2026** surrounding the ultrasonic horn **2016**, and disposed on the static plate **2028** disposed around the ultrasonic horn **2016** can vibrate as a result of the ultrasonic emissions from the ultrasonic element. The elastomeric walls **2020** and **2222,** including the static plate **2028**, serve to trap an oral care composition between the elastomeric walls and the ultrasonic horn. When this embodiment of the toothbrush is used to brush the teeth, this oral care composition comes into contact with the teeth, thereby aiding the transmission of ultrasonic waves from the ultrasonic horn to the teeth. This oral care composition can be a gel. The ultrasonic element can be used in combination with a light emitting element **2075**, which can also disposed on the head of the toothbrush.

In embodiment **2001** of the toothbrush the oscillating bristle holder **2004** surrounding the light emitting element **2075** can be the only movable surface of the head of the toothbrush comprising bristles **2024**. The ultrasonic element disposed on the head of the toothbrush proximal to the handle **2014** can serve to clean the teeth. An ultra-sonic element has superior teeth cleaning properties. Bristles **2024** can be disposed on the static non-moving portions of the head of the toothbrush (as shown in **FIG. 29**).

The drive shaft **2026** of the embodiments of the toothbrush **2000** and **2001** operatively connects the oscillating bristle holder **2004** to the motor (not shown) via the neck **2014** and can be designed to bypass the ultra-sonic element **2008** or the ultra-sonic horn **2016** and ultra-sonic transducer **2018** disposed on the head **2012** of the toothbrush as shown in **FIG. 28**. The drive shaft **2026** can have a lateral displacement portion **2028** which bypasses the ultra-sonic horn **2016** and ultra-sonic transducer **2018** and then extends along the head of the toothbrush to the oscillating bristle holder **2004**. This same design will also allow a drive shaft to bypass an ultrasonic element **2008**.

A toothbrush made according to the present invention can be used with a composition. However, if such a toothbrush is used in combination with a composition, including, but not limited to, a tooth whitening composition, the composition can build up in the areas around the light emitting element; such as the cut-out areas, the apertures through which the light shines and/or through which the light emitting element extends, and/or open spaces surrounding the light emitting element(s). This build up can reduce the quality and/or quantity of light emitting from the head of the toothbrush. To minimize the amount of composition build up in the areas surrounding and on the light emitting element(s), drains and/or channels can be provided on and/or within the head of the toothbrush. **FIG. 11** illustrates a toothbrush head provided with channels **1125** and **1123**, to facilitate drainage of the composition from the area around the light emitting elements **1175** and **1185**. Channel **1125** can be formed by the end surface of a first bristle holder **1120** and the end surface of a second bristle holder **1122**.

Alternatively the channels can be disposed on, within, and/or under the bristle holder. Generally, the channels begin at the light emitting element, such as **1185**, and extend to the side surfaces **1129** of the head **1116** of the toothbrush. Additionally, if the bristle holder **1122** reciprocates, the compositions within the channel **1125** can be agitated, which can increase the flow of the compositions away from the light emitting element. Channels can also be provided on the first movable bristle holder **1120**. These channels **1123** extend from the surfaces of the bristle holder closest to the light emitting element **1175** towards the ends surface **1131** of the movable bristle holder **1120**. These channels can be grooves in the bristle holder. If movable bristle holder **1120** oscillates, the centrifugal force resulting from the oscillation can increase the level of composition which is directed away from the light emitting element **1185** towards the end **1131** of the bristle holder **1120**. The channels can be any shape which allows compositions to flow away from the light emitting element. Additionally, channels **1130**, **1132**, **1133**, and **1134** can extend through the head **1116** of the toothbrush, allowing water to flow out the back of the toothbrush as shown in **FIG. 11a**. The channels can be greater than about 0.5, 1, 1.5, 2, 2.5, 3 mm and less than about 3, 2.5, 2, 1.5, 1 mm in width; and greater than about 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30 mm and less than about 30, 25, 20, 15, 10, 9, 8, 7, 6, 5, 4, 3, 2 mm in length; and a depth of greater than about 0.5, 1, 1.5, 2, 2.5, 3 mm and less than about 3, 2.5, 2, 1.5, 1 mm. The channels can also serve to dissipate heat generated by the electrically powered element disposed on the head of the toothbrush.

If a light emitting element is incorporated into or located distal to the movable bristle holder no modification of the drive shaft is necessary. However, disposing the light emitting element in a region between a movable bristle holder and the motor, may interfere with the operation of the drive shaft preventing an operative connection between the drive shaft and the movable bristle holder. Therefore, to impart motion to the movable bristle holder, modifications can be made to the drive shaft to facilitate the operative connection between the movable bristle holder and the drive shaft. The drive shafts shown are generally suitable to allow for placement of a light emitting element along the length of the toothbrush that corresponds to the position of the drive shaft. However, for simplicity's sake, the light emitting element will be described as placed on and/or in the head of the toothbrush. The operative connection between the drive shaft and the movable bristle holder can be achieved by a drive shaft that bypasses the light emitting element, a drive shaft that serves as a base or support for the light emitting element, a drive shaft that passes over the light emitting element wherein at least a portion of the drive shaft is transparent to the emitted light, a drive shaft that passes underneath a light emitting element, and/or modifying a light emitting element such that the drive shaft becomes a part of the light emitting element. **FIGS. 14-15** illustrate drive shafts which bypass the light emitting element,

and therefore allow the drive shaft to operatively connect to a movable bristle holder when a light emitting element is disposed between the drive shaft and the movable bristle holder (such as shown in **FIG. 7**). Furthermore, if the drive shaft rotates, oscillates, gyrates, orbits and/or moves in a conical fashion the drive shaft can be flexible, bending around the light emitting element when the drive shaft is operating. If the drive shaft reciprocates, the drive shaft can be flexible or inflexible so long as the drive shaft does not contact the light emitting element while operating.

FIG. 14 illustrates a drive shaft **1400** for use in an electric toothbrush, comprising a lateral displacement portion **1402** that bypasses the light emitting element **1475**. This embodiment of the drive shaft can operatively connect the motor (not shown) to the movable bristle holder (not shown) and bypass the light emitting element **1475** which can be disposed on any portion of the head of the toothbrush. The lateral displacement portion **1402** can be any shape or size necessary to bypass the light emitting element such that the drive shaft does not contact the light emitting element during operation. The shape and size of the lateral displacement portion **1402** can result in spaces **1401** and **1403** which are of sufficient size that the drive shaft does not contact the light emitting element while operating. The size of theses spaces can vary depending on the shaft motion, and the distance the shaft moves. In one embodiment, where the drive shaft reciprocates, the spaces **1401** and **1403** can be greater than about 0 and less than about 5 mm.

FIG. 15 illustrates a drive shaft that encircles the light emitting element that is disposed on the head of an electric toothbrush. Drive shaft **1407** splits into two lateral displacement portions **1405** and **1406**, the lateral displacement portions encircle the light emitting element **1475** and then the lateral displacement portions rejoin to form the single drive shaft **1409**. The drive shaft can operate without contacting the light emitting element. The spaces **1419** and **1421** should be sufficient such that the drive shaft does not contact the light emitting element while operating. Additionally, the spaces **1411** and **1413** should also be sufficient such that the drive shaft does not contact the light emitting element during operation. In an embodiment where the drive shaft reciprocates the spaces **1411** and **1413** can be greater than about 0, 0.5, 1, 1.5, 2, 3, 4, 6, 8, 10, 15, 20, 25, 30 mm and/or less than about 30, 25, 20, 15, 10, 8, 6, 5, 4, 3, 2, 1.5, 1, 0.5 mm, and the spaces **1419** and **1421** can be greater than about 0 and less than about 5 mm.

The embodiment shown in **FIG. 15** may result in a drive shaft having additional width. To minimize the increase of the width of the drive shaft resulting from the drive shaft splitting into two lateral displacement portions, the portions can be expanded in height rather than width as shown in **Figs. 15a** and **15b**. Drive shaft **1443** splits into two lateral displacement portions **1444** and **1445** and then rejoin to form drive shaft **1442**. The drive shaft can operate without contacting the light emitting element. The spaces **1446, 1447, 1448,** and **1449** should be sufficient such that the drive shaft does not contact the light emitting element while operating. In

an embodiment where the drive shaft reciprocates the spaces **1446, 1447, 1448,** and **1449** can be greater than about 0, 0.5, 1, 1.5, 2, 3, 4, 6, 8, 10, 15, 20, 25, 30 mm and/or less than about 30, 25, 20, 15, 10, 8, 6, 5, 4, 3, 2, 1.5, 1, 0.5 mm.. The height **1450** of the arms **1444** and **1445** generates additional strength without resulting in a drive shaft having additional width. The height **1450** can be greater than about 0.2, 0.5, 0.75, 1, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15 mm and/or less than about 15, 13, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 1.5, 1, 0.75, 0.5, 0.2 mm.

FIG. 16-17 illustrates an embodiment of the drive shaft wherein the drive shaft serves as a support for a light emitting element. This drive shaft has a portion which is hollowed out such that a light emitting element can be disposed thereon. Drive shaft **1410** has a portion **1408** carved out and light emitting element **1475** is disposed thereon. As shown in **FIG. 16**, the leads **1415** and **1416** for the light emitting element can be incorporated into the drive shaft **1410**, traveling the length of the drive shaft to the motor (not shown). Alternatively, as shown in **FIG. 17**, the leads **1417** and **1418** can exit the back of the drive shaft **1410** and travel along the head, neck and handle of the toothbrush to the motor (not shown).

As previously mentioned additional modifications can be made to drive shafts that rotate, oscillate, linearly reciprocate, gyrate, orbit, and/or move in a conical fashion to incorporate a light emitting element on and/or within the head of the toothbrush, including a transparent and/or translucent drive shaft, disposing the light emitting element underneath and/or above the drive shaft, and modifying the light emitting element such that the drive shaft becomes a part of the light emitting element.

FIG. 18-19 illustrates a drive shaft a drive shaft that passes underneath a light emitting element. Drive shaft **1500** has a transparent portion **1502** and portions **1504** and **1506** that can be either transparent and/or translucent or not transparent (i.e. opaque) and/or any combination thereof. The drive shaft is disposed between the light emitting element **1575** and the portion of the head of the toothbrush from which the light emits. At least a portion of the drive shaft **1502** can be transparent and/or translucent. This transparent and/or translucent portion of the drive shaft **1502** allows for light to pass from the light emitting element, through the drive shaft, and exit the head of the toothbrush. This transparent and/or translucent portion can be disposed above the light emitting element. The light emitting element can be disposed within the interior of the head of the toothbrush with the drive shaft traveling over top of the light emitting element such as light emitting element **1185** and drive shaft **1141** shown in **FIG. 13**. The portion of the head of the toothbrush from which light emits can be an aperture such as aperture **1121** as shown in **FIG. 10**. This aperture can be covered with a transparent and/or translucent material to prevent water from entering the head of the toothbrush while allowing light to emit from the head of the toothbrush.

In the embodiment illustrated in **FIG. 19** the light emitting element **1675** is disposed underneath a drive shaft **1602** for an electric toothbrush. The drive shaft **1602** can be either transparent and/or translucent or not transparent and/or translucent (i.e. opaque). Reflectors **1600** and **1604** reflect the light emitting from the light emitting element around the drive shaft **1602**, thereby allowing the light to emit from the head of the toothbrush. The drive shaft can comprise a reflective material, such as a reflective coating, which can serve to enhance the quality and/or quantity of light emitting from the head of the toothbrush.

FIG. 20 illustrates a light emitting element **1775** disposed between a drive shaft **1706** and the portion of the head of a toothbrush from which the light emits. Therefore, the drive shaft does not interfere with the light emitting from the light emitting element. Additionally, the leads **1704** and **1702** can be disposed in the walls of the head of the toothbrush and travel the length of the head and handle of the toothbrush to reach the motor (not shown). The light emitting element can be disposed on a support and/or a pillar through which the drive shaft passes to reach the movable bristle holder. Alternatively the light emitting element can be disposed on the head of the toothbrush such that no support and/or pillar is needed, and the drive shaft can pass underneath the light emitting element.

The light emitting element can also be modified, such that the drive shaft becomes part of the light emitting element. In **FIG. 21** the light emitting element has a lens **1802** shaped to allow the drive shaft to sit within the light emitting element **1875**. The drive shaft **1800** can be transparent and/or translucent, thereby allowing light to pass through the drive shaft to reach the portion of the head of the toothbrush from which light emits. Additionally, the drive shaft can include a design, material and/or shape that enhances the light emitting from the light emitting element. The light emitting element can be disposed on the interior of the head of the toothbrush such as light emitting element **1185** shown in **FIG. 13**.

A wide variety of light-emitting elements may be used with the present invention. The light emitting element can be a small, low power consumption, light emitting diode (LED) such as those commercially available under the designation Luxeon™ manufactured by Lumileds Lighting, LLC of San Jose CA. Other commercially available light emitting units include those from American Opto Plus LED Corporation. The LED can operate from a relatively low voltage DC power supply, such as greater than about 0.5, 1, 2, 2.5, 3, 4, 5 volts and/or less than about 5, 4, 3, 2.5, 1.5, 1 volts. The light emitting element can have a diameter of greater than about 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 10, 15, 20 mm and less than about 20, 15, 10, 8, 7, 6, 5, 4, 3, 2, 1 mm.

A voltage or current driver suitable for use with the present invention is the ZXSC310 Single or Multi Cell LED Driver manufactured by Zetex Semiconductors, Oldham, UK. Separate switches might be provided to separately active the light-emitting element and the

motor. More than one light-emitting element might be provided. Light-emitting elements having different spectral, photometric, radiometric, and colormeteric characteristics (e.g., different dominant wavelengths, peak wavelengths, radiometric power, etc.) might be provided to accommodate multiple uses in a single electric toothbrush (i.e., the first light-emitting element might be adapted for use with a first light activated composition and the second light-emitting element might be adapted for use with a second light-activated composition).

As noted, it may be desirable in certain embodiments that the one or more movable bristle holders rotate, oscillate, or undergo motion; directly upon and contact a surface or region of the light emitting element. In these configurations, the present invention includes the use of a friction reducing layer or coating on the surface of the light emitting element which the bristle holder contacts. This layer or coating may also serve to reduce wear that might otherwise occur due to the contacting surfaces. A wide array of coating materials can be used including those known in the art and which are suitable for consumer healthcare appliances. Generally, such coatings are non-toxic and inert, durable, and depending upon the application, can be transparent or translucent. Examples of coatings suitable for use in the present invention include, but are not limited to Teflon, and silicone grease such as RT910T manufactured by Refrigeration Technologies, Nevastane 5 manufactured by Keystone Lubricants, and Nevastane SFG manufactured by Keystone Lubricants.

The present invention may be used in conjunction with nearly any tooth whitening composition, such as, but not limited to, the compositions described in USPNs 6,488,914; 5,851,514; 4,980,152; 3,657,413; 4,983,380; 5,084,268; 5,171,564; 5,376,006; 5,645,428; 5,713,738; RE 34,196; 5,122,365; 6,558,654; 6,555,020; 6,536,628; 6,533,582; 6,521,215; 6,514,543; 6,479,037; 6,447,757; 5,891,453; and 6,419,905. It is not necessary that the composition exhibit an enhanced whitening function upon exposure to light. Benefits may result simply from exposure of the tooth surface to light from the electrical toothbrush prior to application of the whitening composition. Furthermore, additional benefits may stem from greater brushing or cleaning efficacy resulting from illuminating the brushing area. In one aspect, the present invention relates to the use of the toothbrushes described herein during a whitening procedure wherein the whitening effect of the composition is enhanced or accelerated as a result of light and heat emitted from the light-emitting element of the electric toothbrush.

In some embodiments, it may be desirable that the toothbrush and whitening composition be "matched." That is, it is desirable that if the whitening composition exhibits enhanced or accelerated whitening function upon exposure to light of a certain wavelength or range of wavelengths, i.e. a band, then the wavelength of light emitted from the light emitting unit of the toothbrushes described herein is the same, or substantially so, as that certain wavelength.

For example, if a particular whitening composition is identified for use with the toothbrushes described herein, and if that composition exhibits enhanced effects upon exposure to light of a peak wavelength of 430 nm to 470 nm, then the toothbrush to be used in conjunction with that composition emit light having a wavelength within the range of 430 nm to 470 nm.

The electric toothbrush can be packaged as a kit comprising one or more replaceable heads containing a light-emitting element. The heads can thus be replacements or individually assigned to different members of a family. Color distinction is thus often a part of the different heads in a kit. Although the handle is discussed as battery powered, the invention also includes other well known power supplies such as corded for outlet connection or rechargeable batteries and an associated brush holder/charger (not shown). The kit may further include one or more packaged, light-activated oral compositions, such as a packaged tooth whitening composition. Additionally, the kit can include other non-light activated oral care products and toothbrush heads that do not comprise a light emitting element.

Typical time periods for a brushing operation are generally greater than about 10, 20, 30, 45, 60, 90, 120, 150, 300, 360, 480 seconds and/or less than about 600, 480, 360, 300, 150, 120, 90, 60, 45 seconds.

All documents cited herein are, in relevant part, incorporated herein by reference; the citation of any document is not to be construed as an admission that it is prior art with respect to the present invention.

While particular embodiment of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

CLAIMS:

1. A head portion (16, 1200, 1212, 1300, 95, 316, 616, 816, 904, 1016, 1116, 416, 516, 816, 1116, 1914, 2012) of an electric toothbrush for connecting to a handle (12, 914, 1012, 2014) portion, said head portion comprising:
(a) at least one electrically powered element (74); and
(b) at least one movable bristle holder (320, 906, 1120, 1206, 1302) disposed on said head.

2. An electric toothbrush (10, 400, 500, 501, 600, 800, 900, 1000, 1100, 2000, 2001, 2012) comprising said head according to any one of the preceding claims, said electric toothbrush further comprising:
(a) a handle, and a neck (14, 314, 414, 514, 614, 814, 1014, 1114, 1912, 2014) extending between said head and said handle, said handle defining a hollow interior region (30), said electric toothbrush having a longitudinal axis (19);
(b) at least one movable bristle holder (320, 906, 1120, 1206, 1302) disposed on said head; and
(c) a motor (32) disposed in said hollow interior region defined in said handle, wherein said motor is operatively connected to said movable bristle holder by a drive shaft (1141, 1202, 1306, 1400, 1407, 1409, 1410, 1442, 1443, 1500, 1602, 1706, 1800, 2026).

3. The electric toothbrush comprising a head according to any one of Claims 1 or 2, wherein said at least one electrically powered element is a light emitting element (75, 475, 575, 975, 976, 1175, 1185, 1275, 1375, 1475, 1575, 1675, 1775, 1875, 2075), preferably wherein said light emitting element is a light emitting diode.

4. The electric toothbrush according to any one of Claims 2 or 3, wherein at least a portion of said drive shaft is transparent.

5. The electric toothbrush comprising a head according to any one of Claims 1-4, wherein said movable bristle holder comprises an aperture (88, 1121, 1210, 1304) into which said electrically powered element is disposed.

6. The electric toothbrush according to any one of Claims 2-5, wherein said movable bristle holder oscillates, and wherein said electrically powered element is disposed within said movable bristle holder, preferably wherein said electrically powered element is encircled by

one or more rings of bristles (332, 632, 1124, 1910).

7. The electric toothbrush according to one of Claims 2-7, wherein said electrically powered element is a pin which is the axis of rotation for the movable bristle holder.

8. The electric toothbrush according to any one of Claims 2-7, wherein said electrically powered element is disposed between two movable bristle holders.

9. The electric toothbrush according to any one of Claims 2-9, wherein said electric toothbrush further comprises one or more channels (1123, 1125, 1130, 1132, 1133, 1134), preferably wherein said electric toothbrush further comprises a second bristle holder, more preferably wherein said channel is formed by a surface of said movable bristle holder and a surface of said second bristle holder (421, 534, 576, 822, 834, 1122).

10. The electric toothbrush according to any one of Claims 2-9, wherein at least one of said electrically powered elements is an ultra-sound emitting element (2008).

11. An electric toothbrush according to any one of Claims 2-10, wherein the placement of said electrically powered element is selected from the group consisting of: disposed on said drive shaft, disposed underneath said drive shaft, and disposed above said drive shaft.

12. An electric toothbrush according to any one of Claims 2-11, wherein said drive shaft further comprises at least one lateral displacement portion (1402, 1405, 1406, 2028) which bypasses said electrically powered element disposed on said toothbrush, and wherein said electrically powered element does not interfere with the motion of said drive shaft.

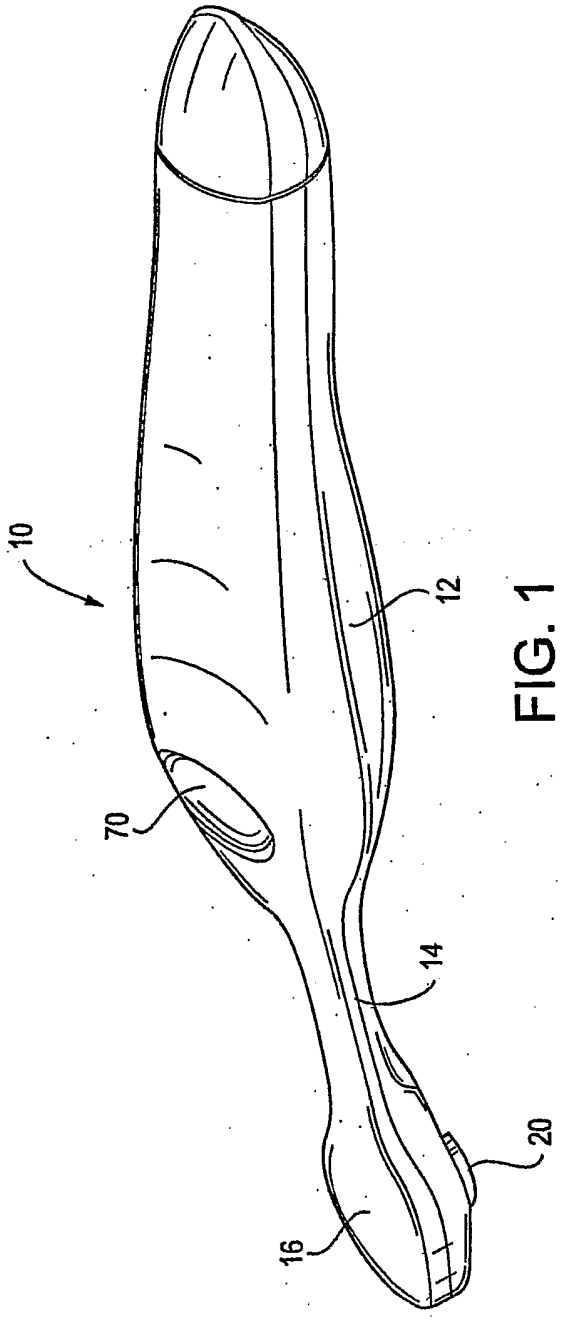


FIG. 1

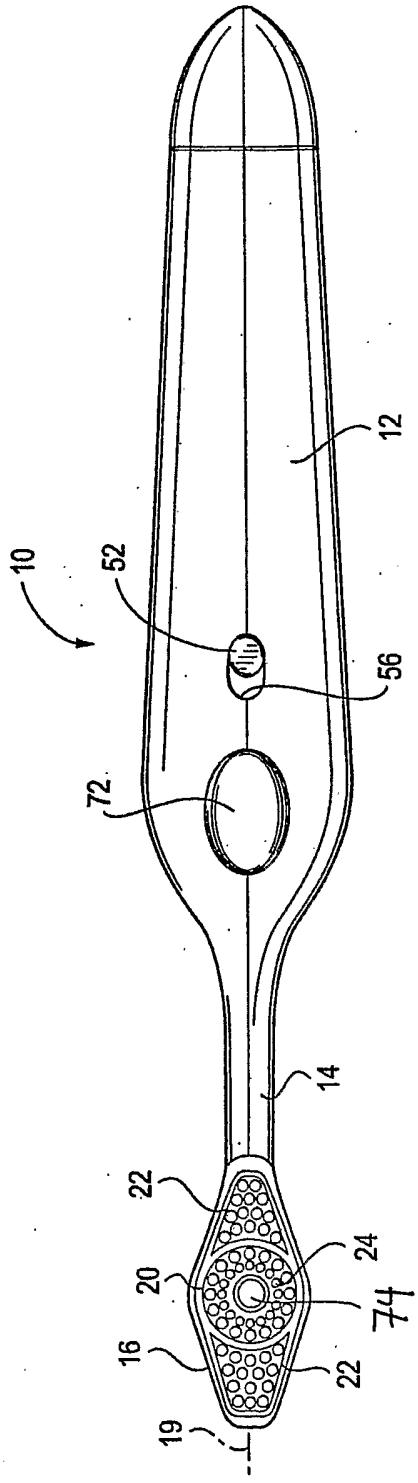


FIG. 2

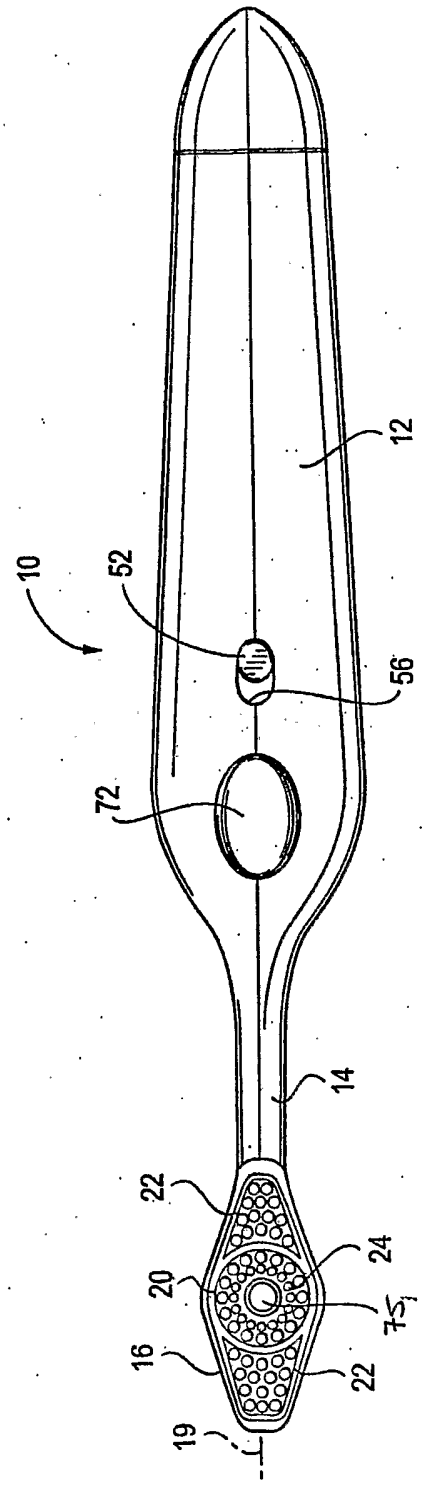


FIG. 2a

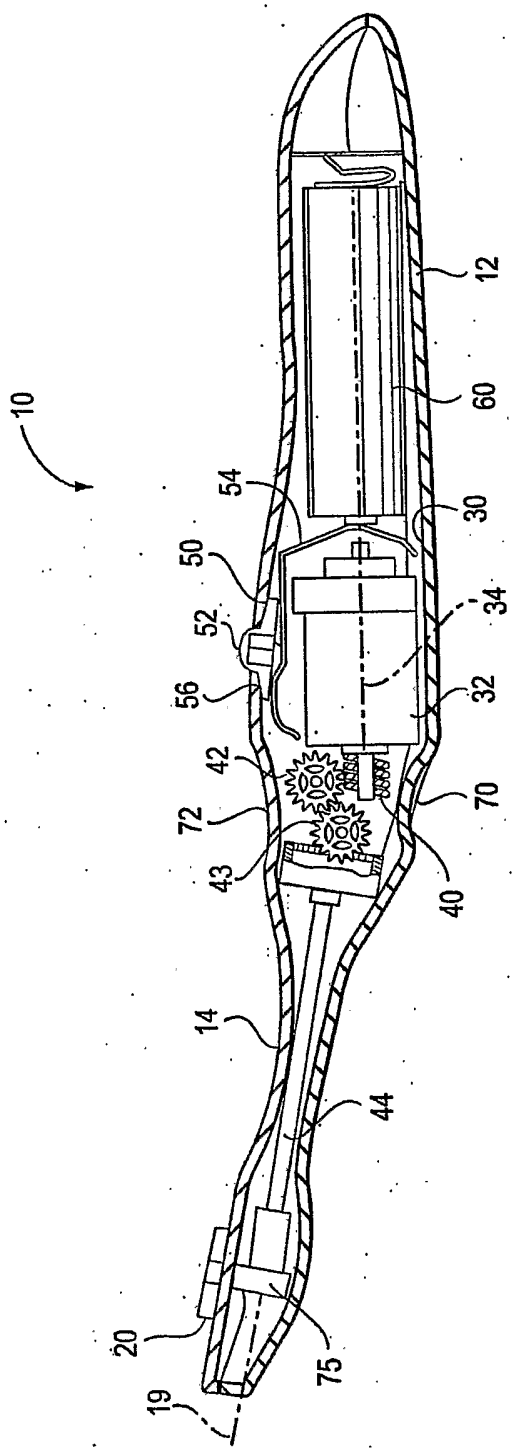


FIG. 3

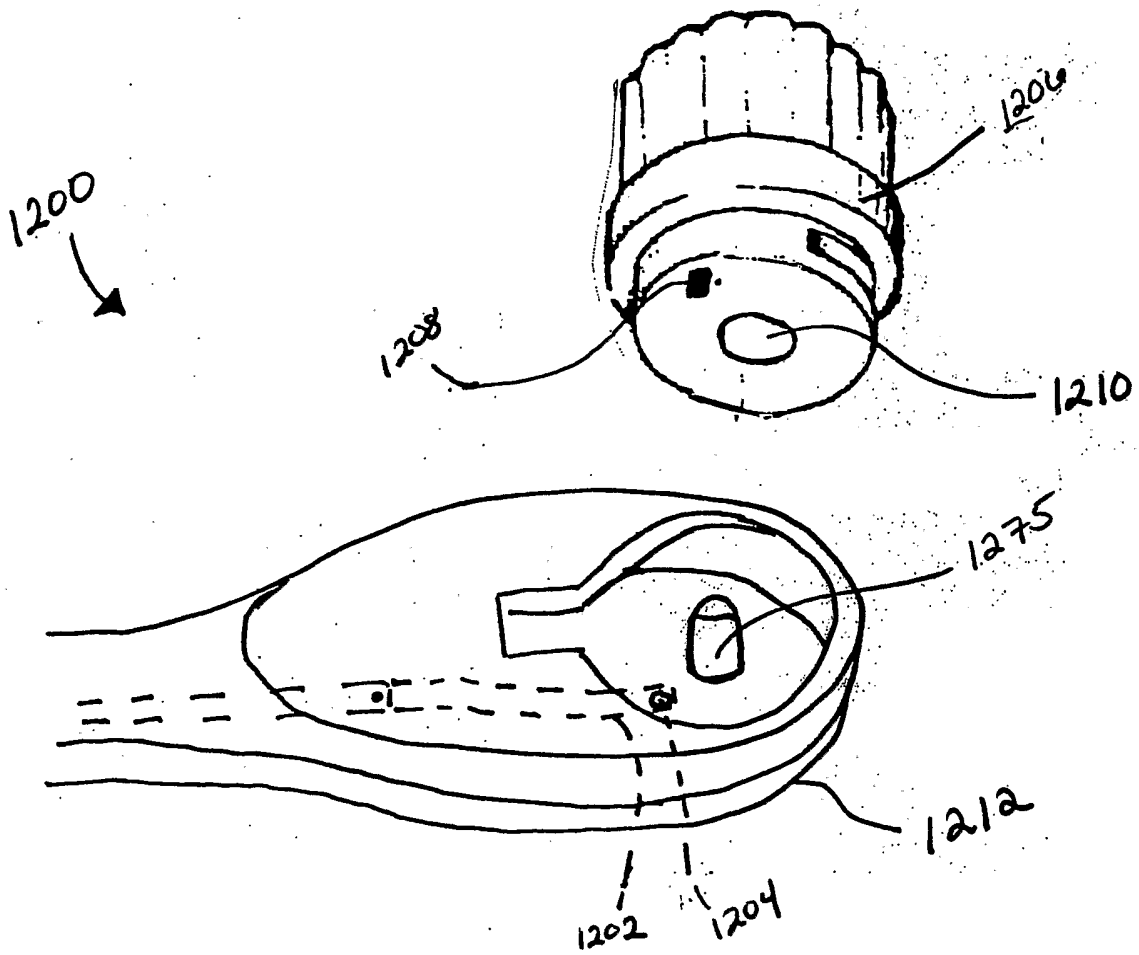


FIG. 3a

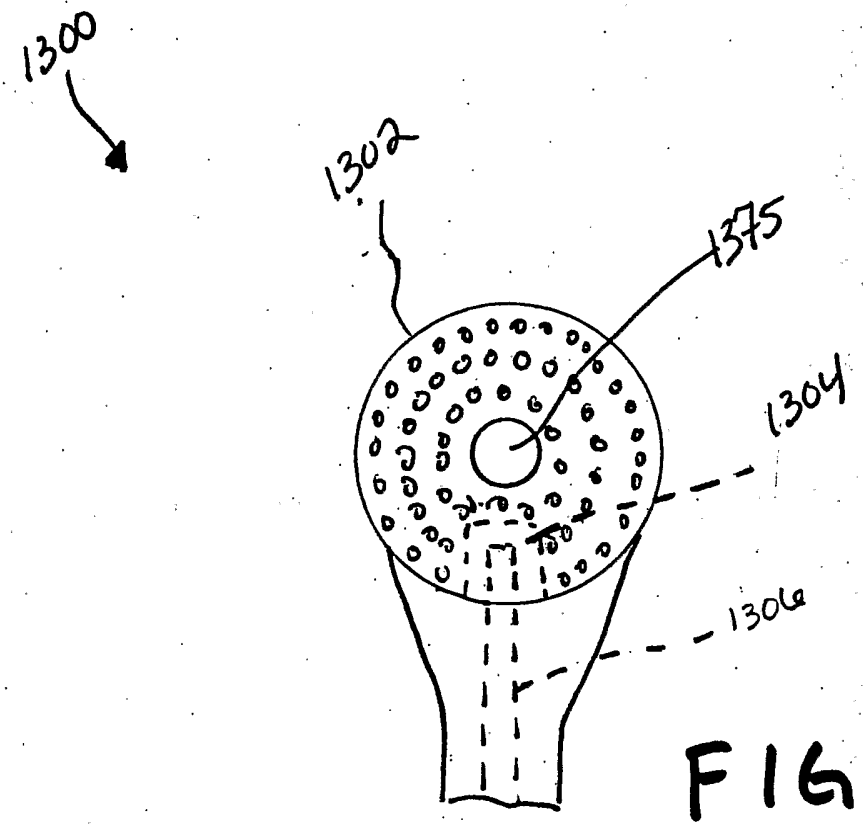


FIG. 3b

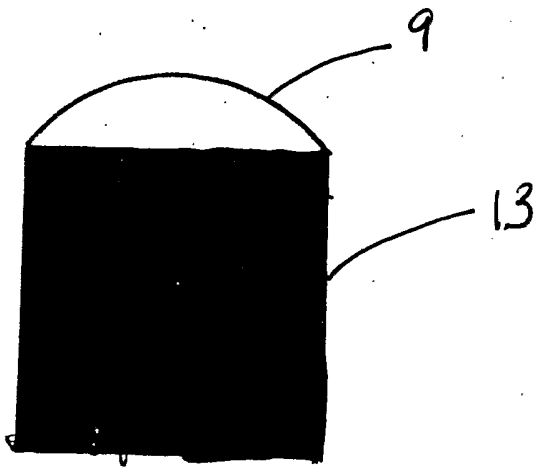


FIG. 3c

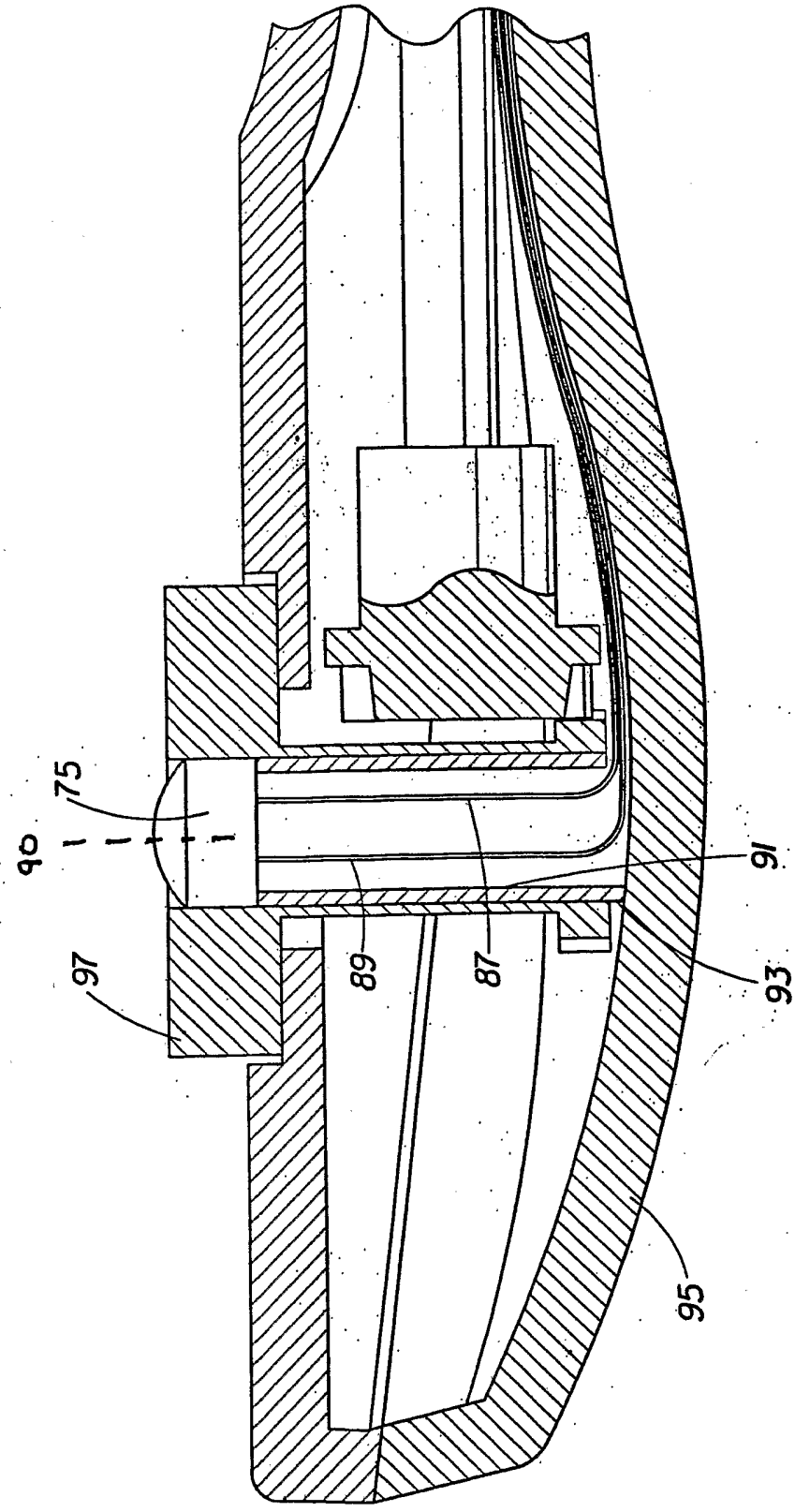


Fig. 4

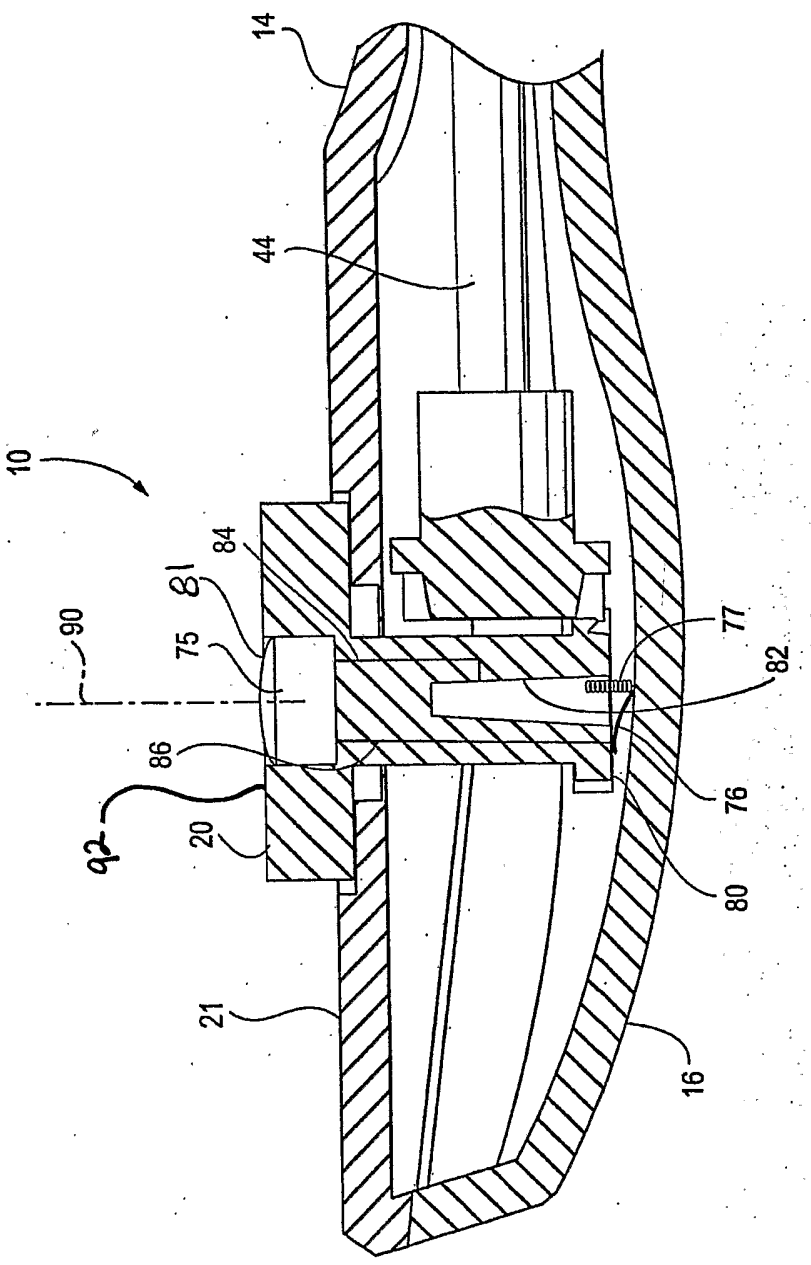


FIG. 5

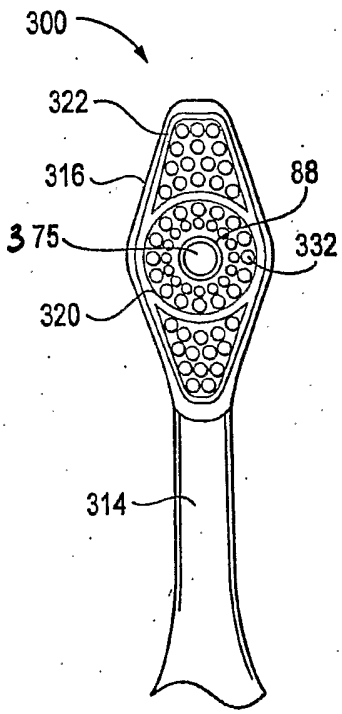


FIG. 6

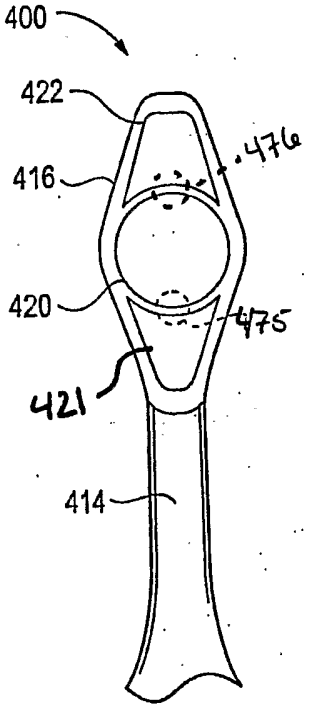


FIG. 6a

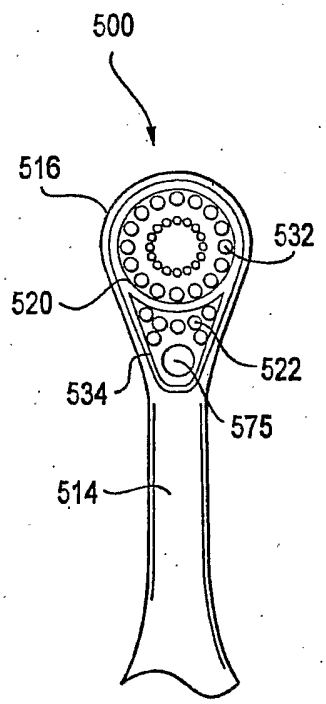


FIG. 7

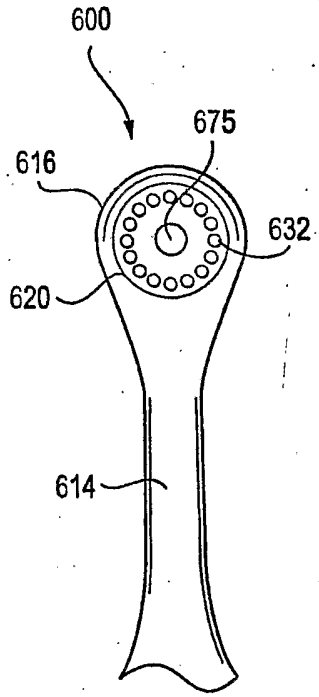


FIG. 7a

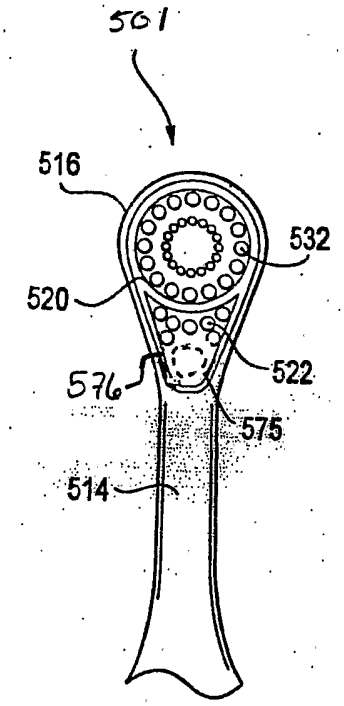


FIG. 7b

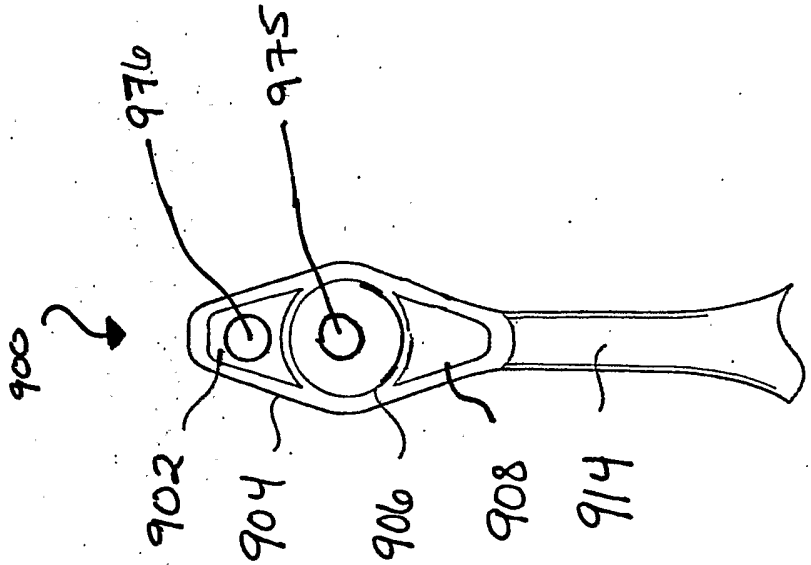

900
976
975
902
904
906
908
914

FIG. 8a

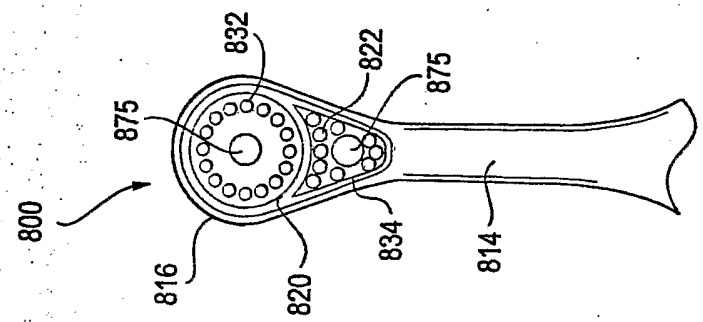

800
832
822
875
875
816
820
834
814

FIG. 8

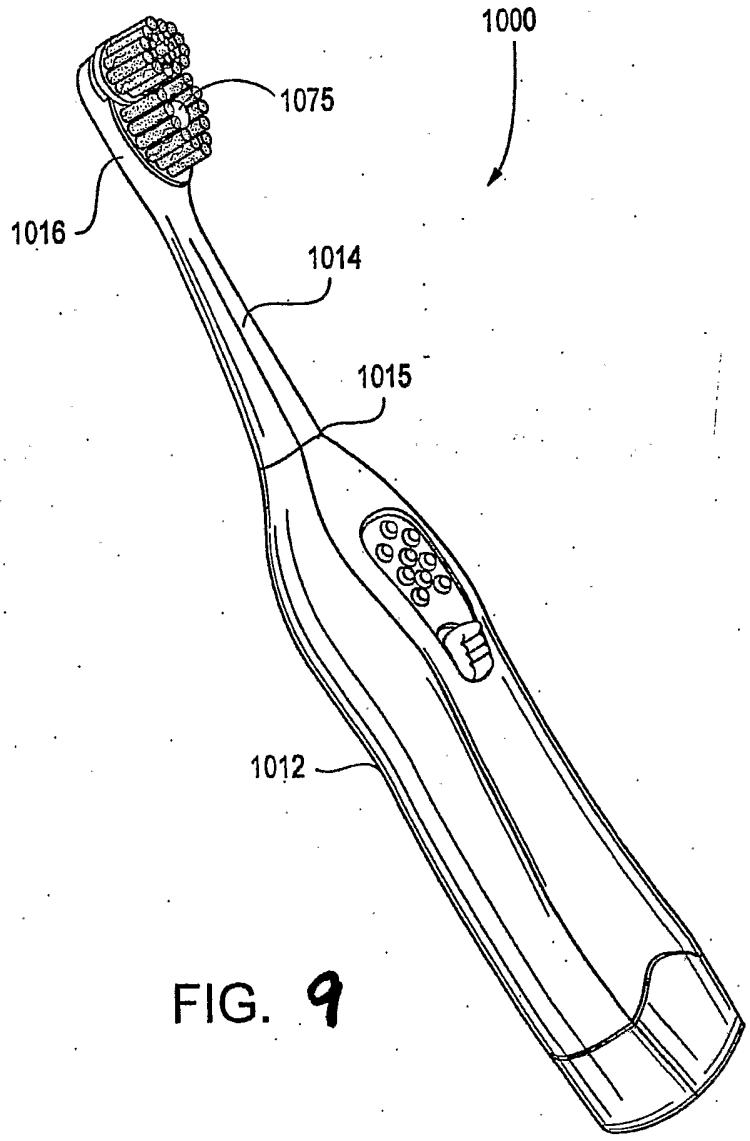


FIG. 9

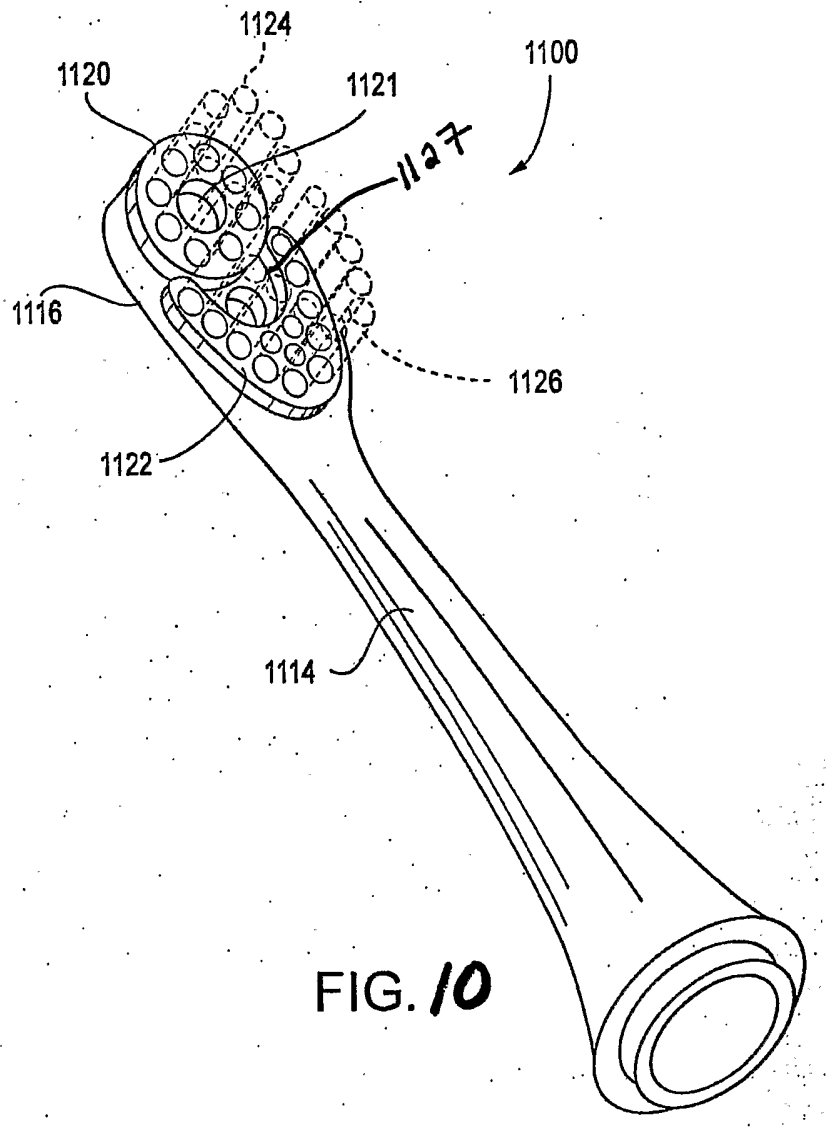


FIG. 10

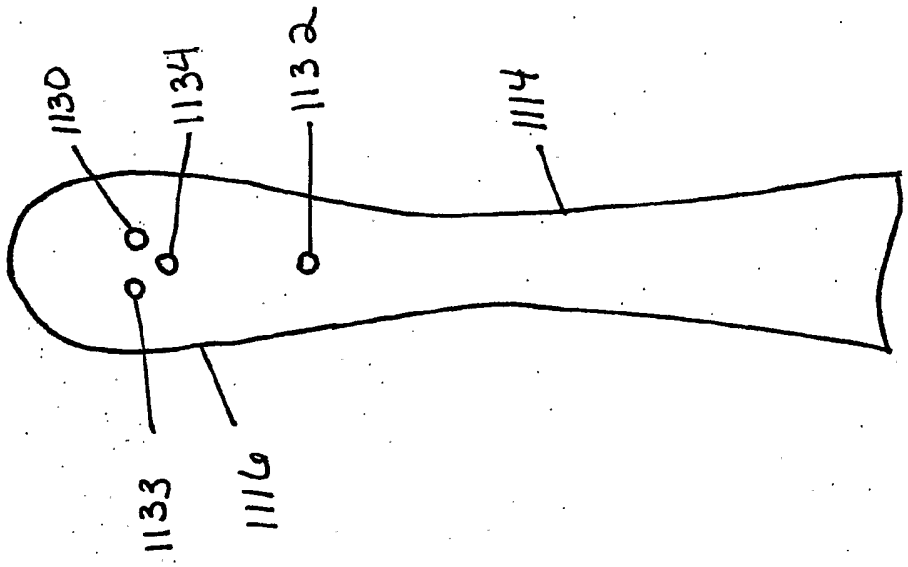


FIG. 11a

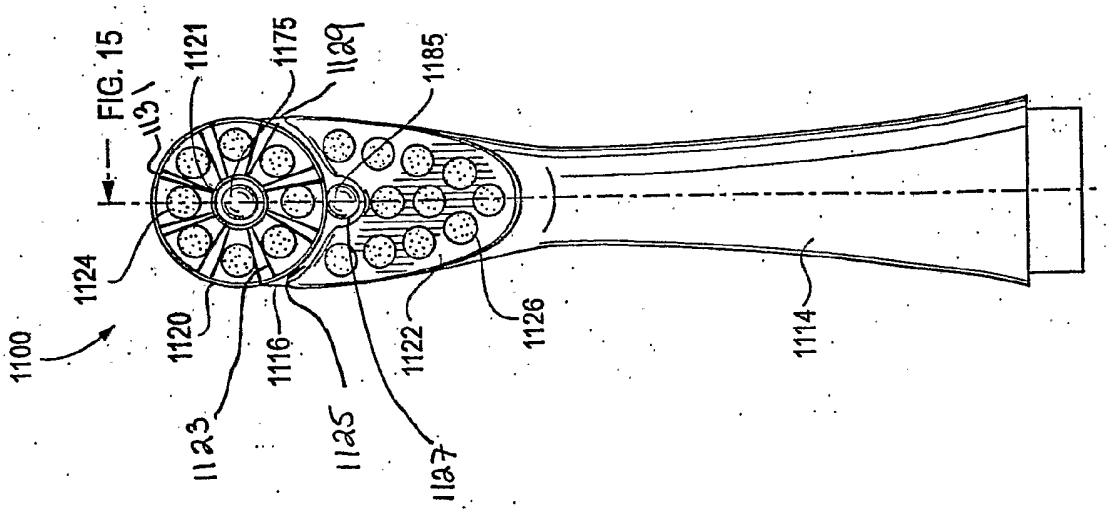


FIG. 11

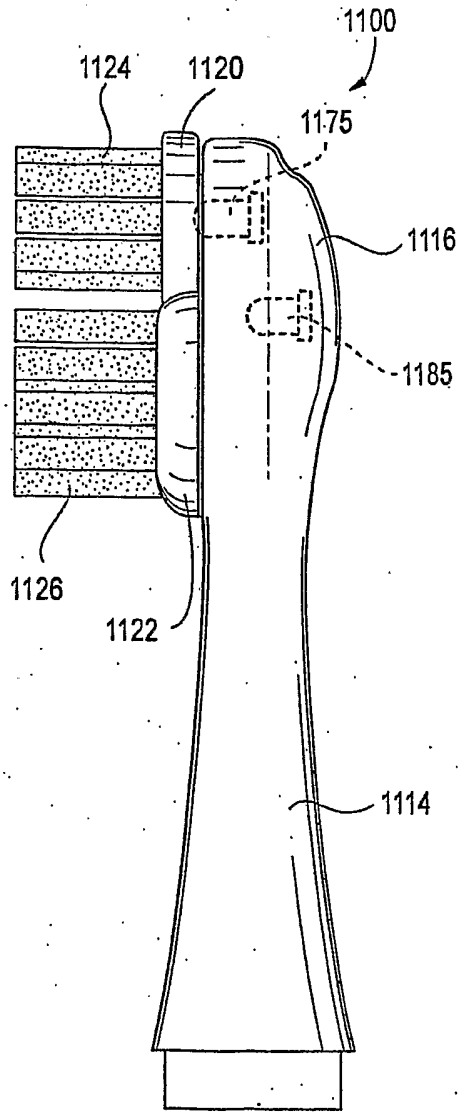


FIG. 12

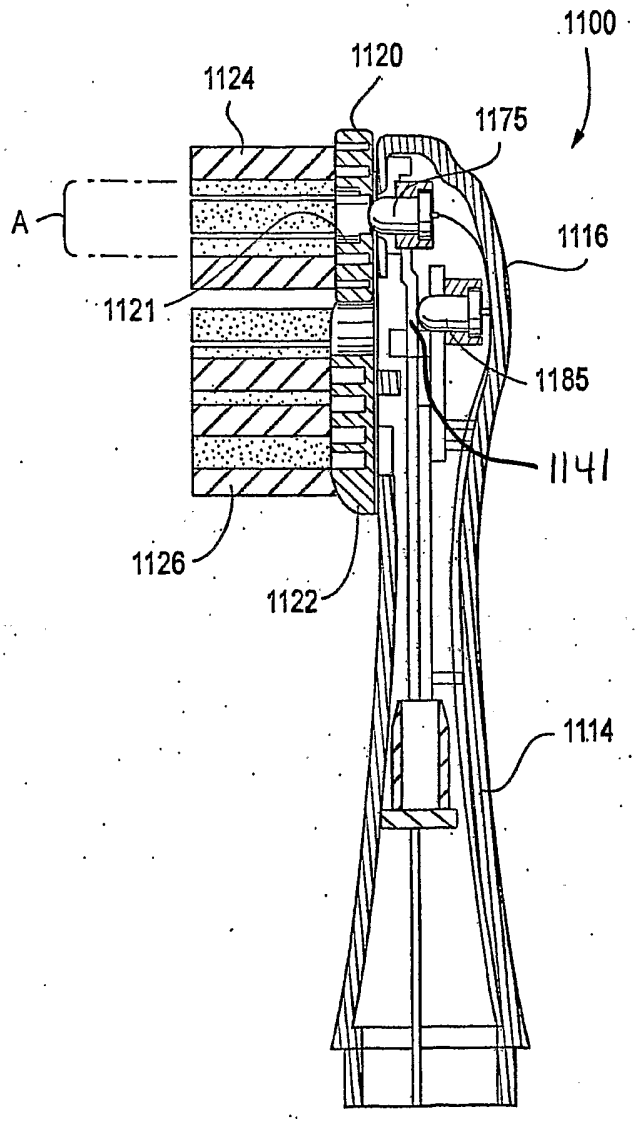


FIG. 13

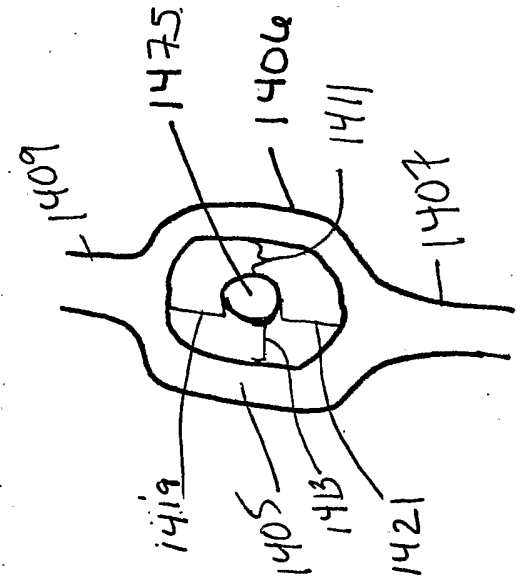

1409
1475
1404
1411
1407
1419
1405
1413
1421

FIG. 15

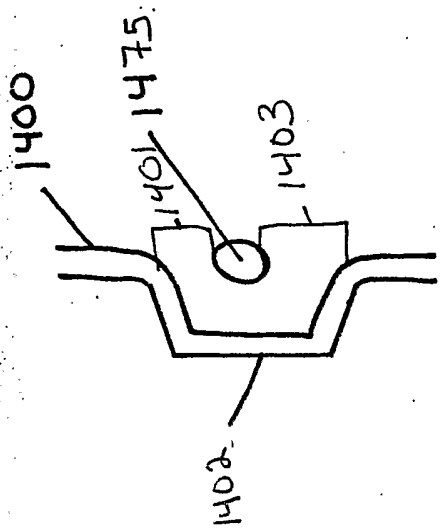

1400
1401
1475
1403
1402

FIG. 14

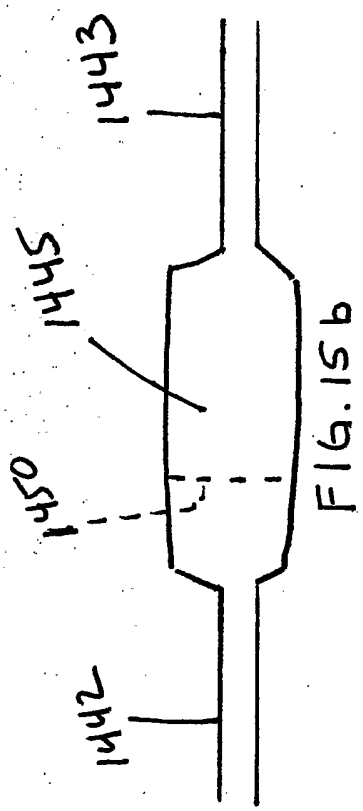


FIG. 15b

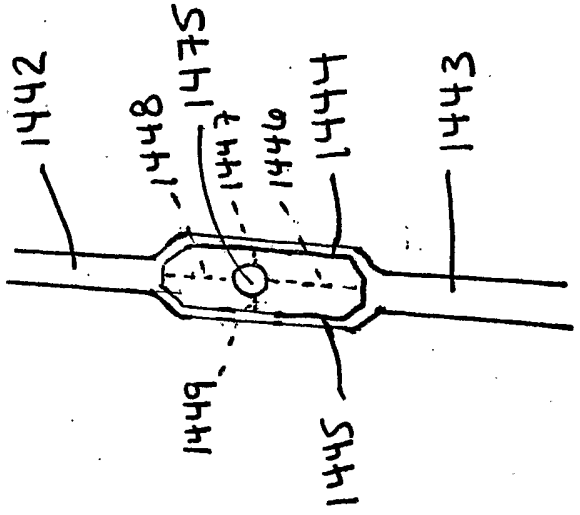


FIG. 15a

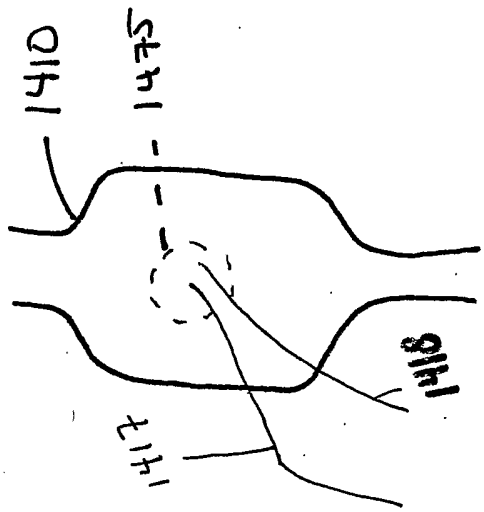


FIG. 17

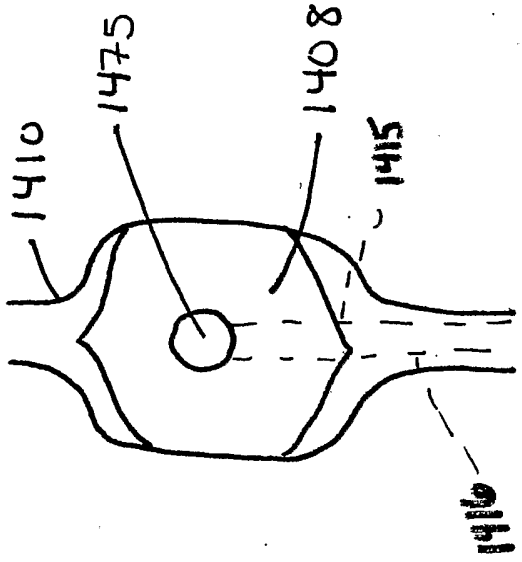


FIG. 16

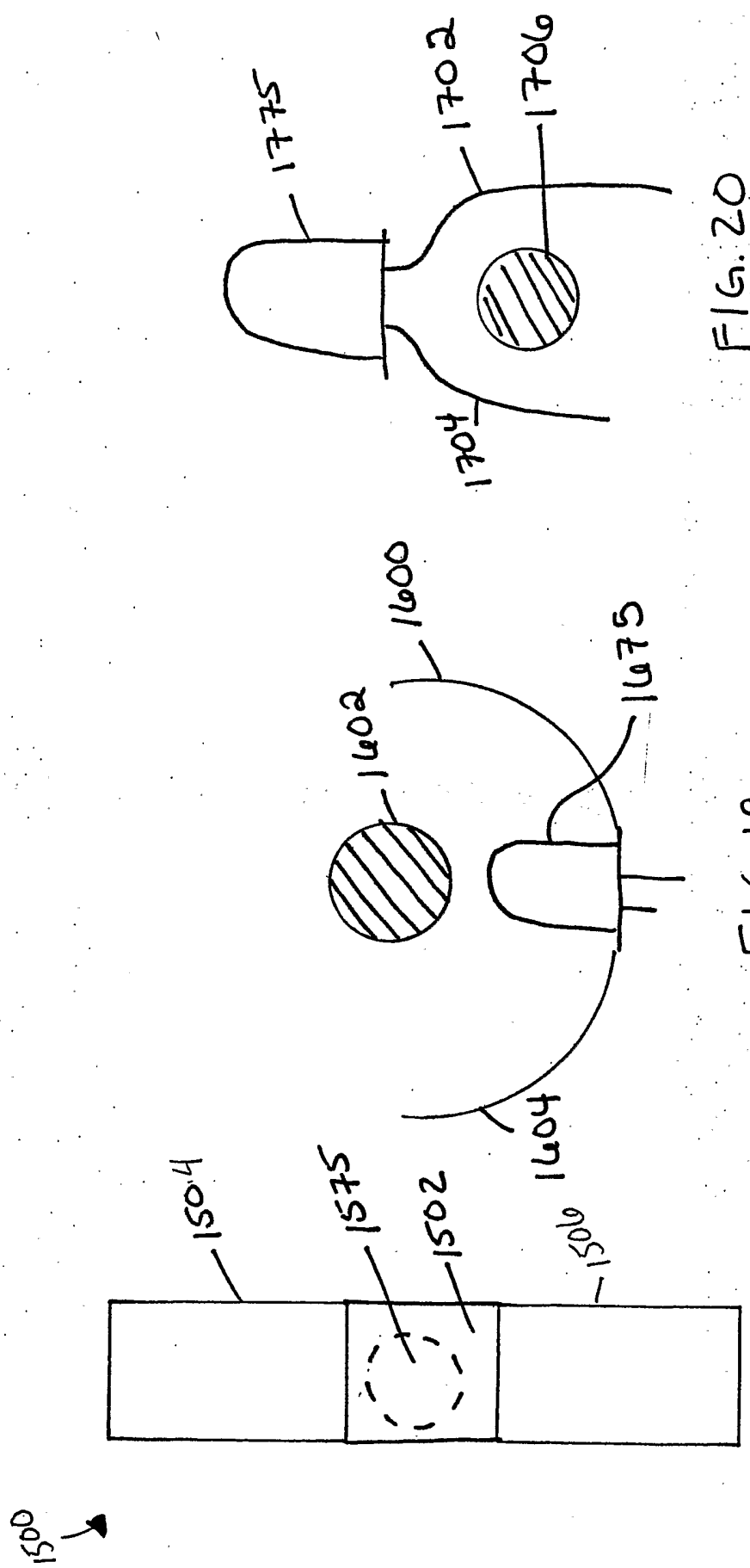


FIG. 18

FIG. 19

FIG. 20

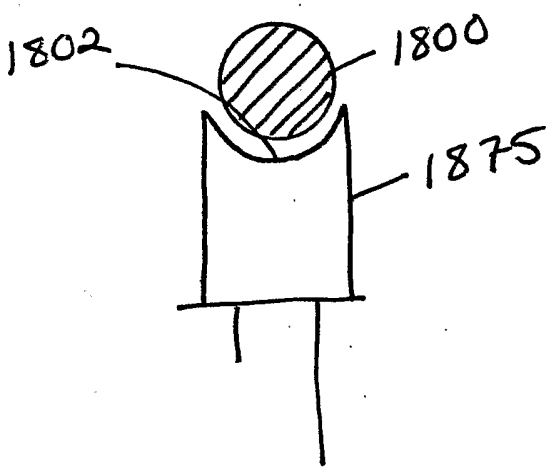


FIG. 21

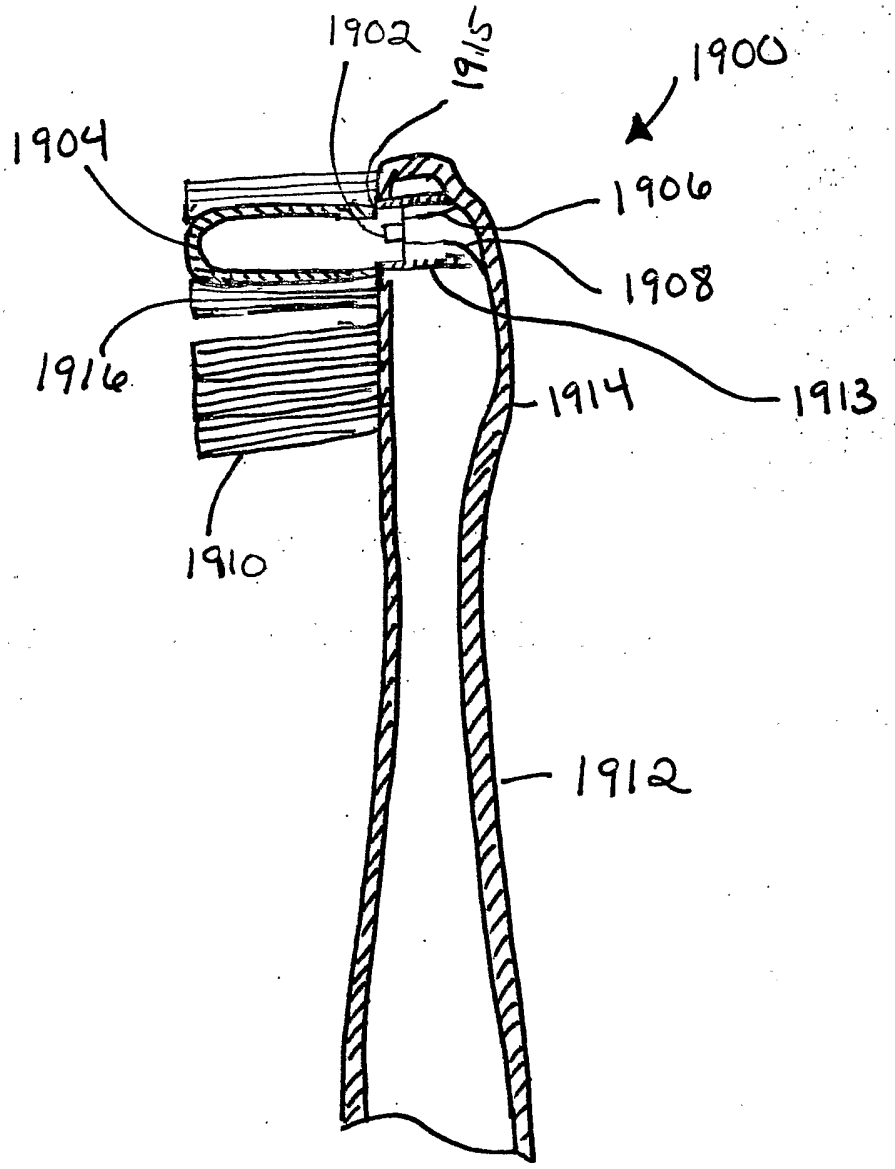


FIG. 22

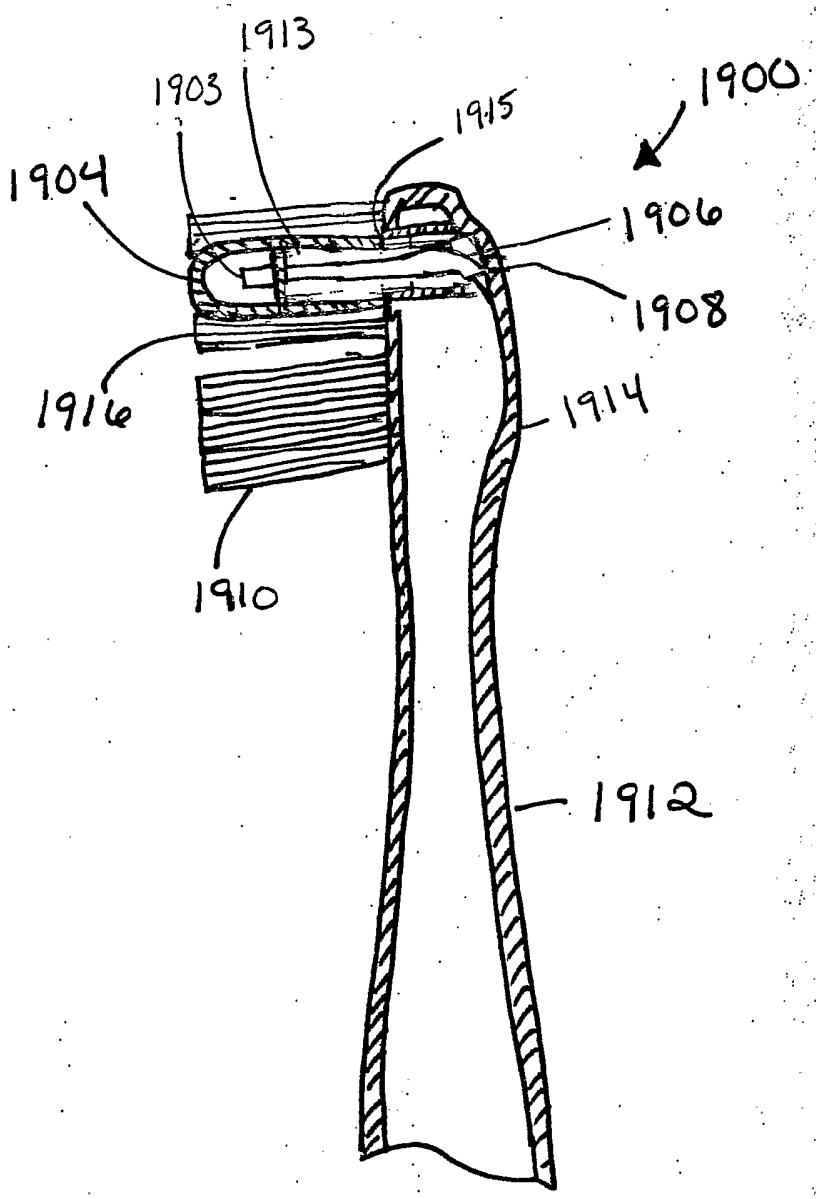


FIG. 23

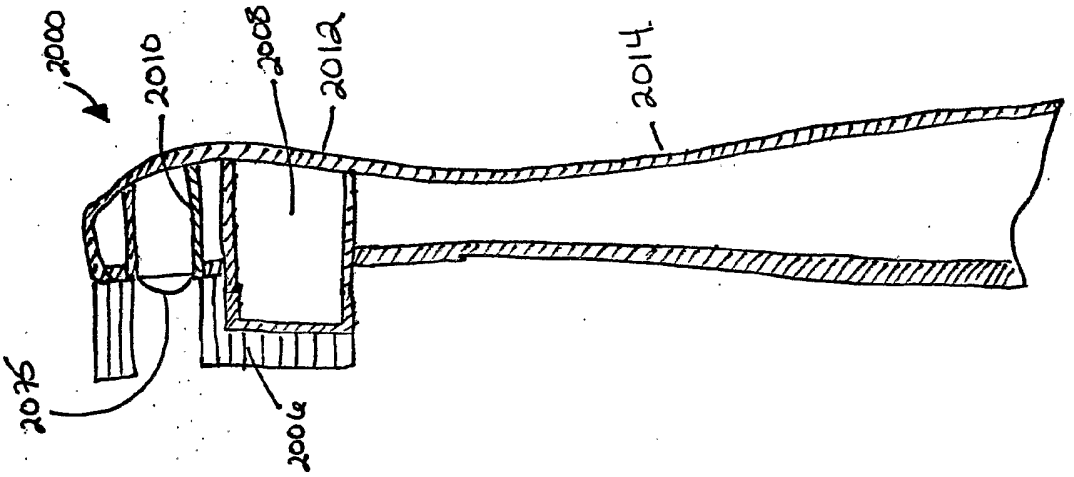

2000
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2008
2012
2014
2075
2004

FIG. 25

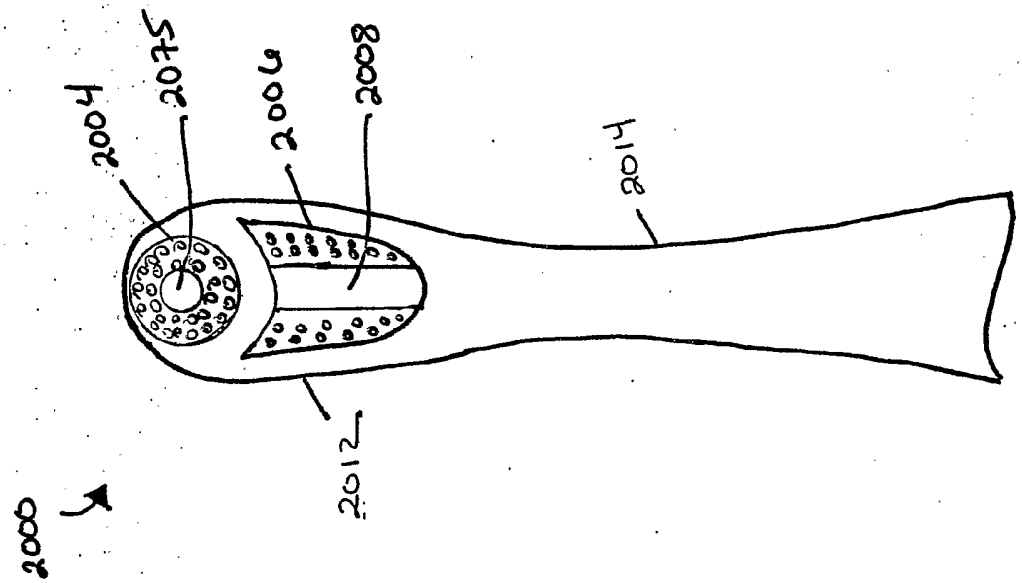

2004
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FIG. 24

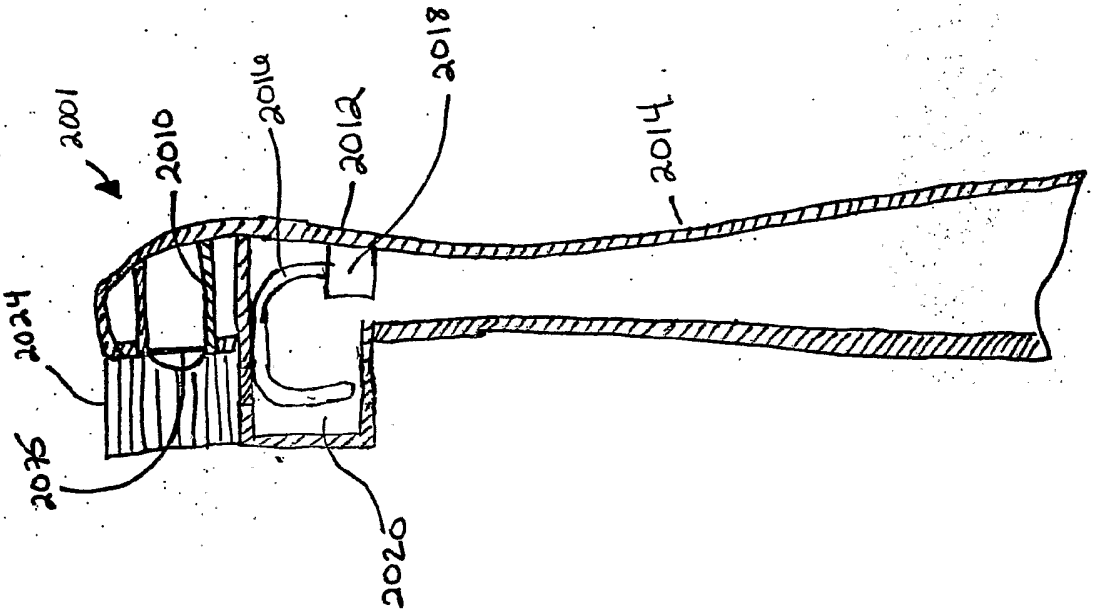

2001
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FIG. 27

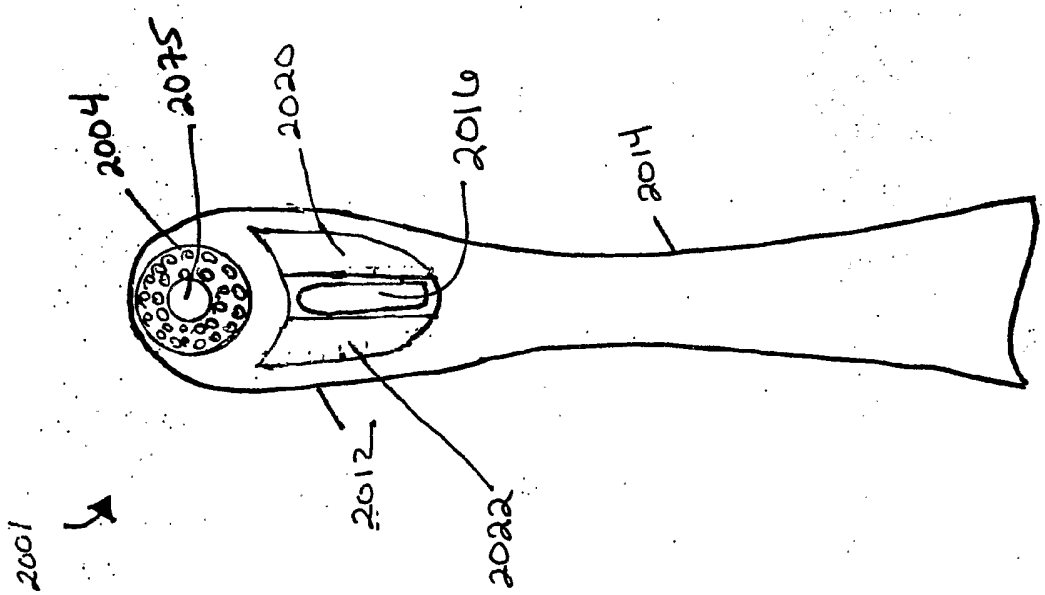

2001
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FIG. 26

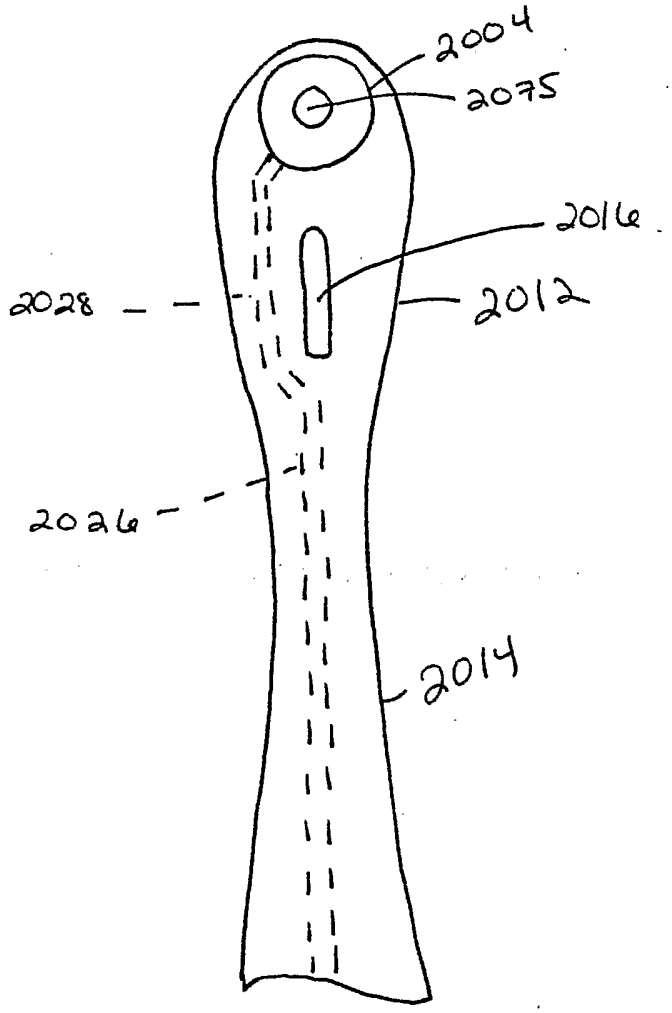


FIG. 28

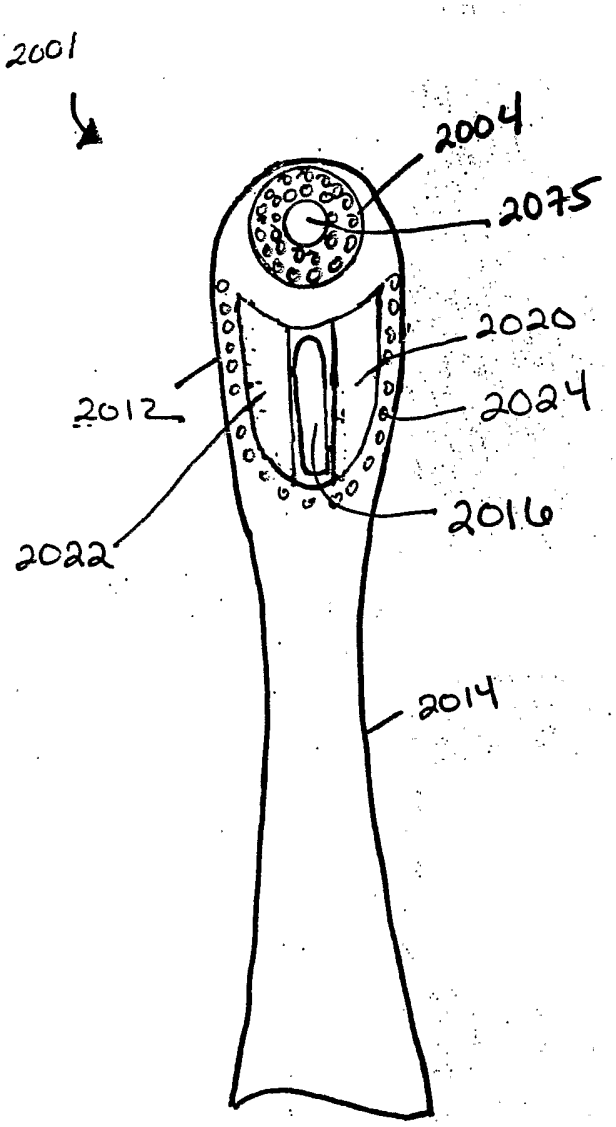


FIG. 29

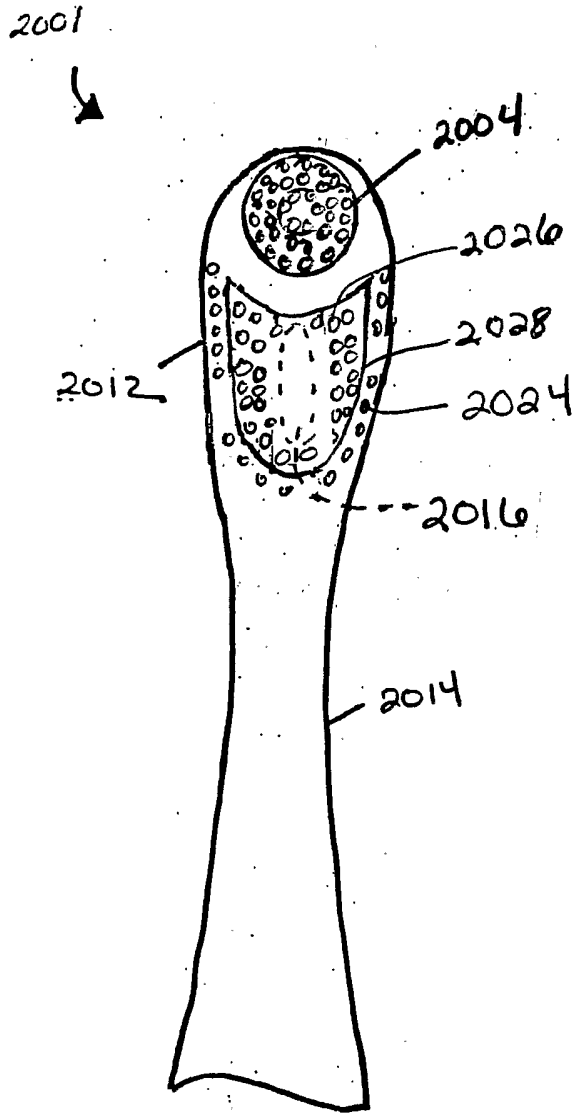


FIG. 30