

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
14 July 2005 (14.07.2005)

PCT

(10) International Publication Number  
**WO 2005/063144 A1**

(51) International Patent Classification<sup>7</sup>: **A61C 17/34**

A. [US/US]; 14591 Mill Hollow Lane, Strongsville, Ohio 44136 (US). **CHAN, John Geoffrey** [US/US]; 3574 Spring Lake Circle, Loveland, Ohio 45140 (US).

(21) International Application Number:  
PCT/US2004/042977

(74) Common Representative: **REED, T., David**; The Procter & Gamble Company, 6110 Center Hill Road, Cincinnati, Ohio 45224 (US).

(22) International Filing Date:  
17 December 2004 (17.12.2004)

(25) Filing Language: English

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AI., AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(26) Publication Language: English

(30) Priority Data:  
60/531,071 19 December 2003 (19.12.2003) US

(71) Applicant (for all designated States except US): **THE PROCTER & GAMBLE COMPANY** [US/US]; One Procter & Gamble Plaza, Cincinnati, Ohio 45202 (US).

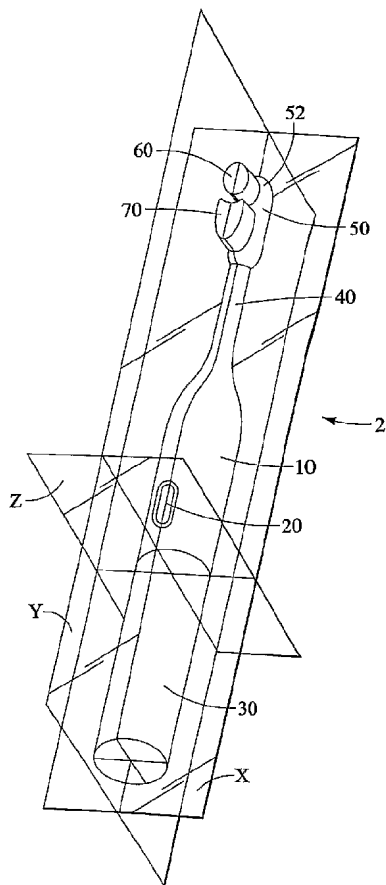
(72) Inventors; and

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

(75) Inventors/Applicants (for US only): **GALL, Douglas**

[Continued on next page]

(54) Title: ELECTRIC TOOTHBRUSH



(57) Abstract: An electric toothbrush is disclosed. The electric toothbrush includes a body having an interior hollow region for retaining one or more motors, batteries, and drive mechanisms. The toothbrush includes one or more bristle carriers. Each of the bristle carriers undergoes some type of movement and is driven by the one or more motors and drive mechanisms. Various combinations of movement of the bristle carriers are described. And, numerous drive train mechanisms are disclosed for achieving the noted motions.

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GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**ELECTRIC TOOTHBRUSH**

Douglas A. Gall

John Geoffrey Chan

**Cross Reference to Related Application**

This application claims priority of U.S. provisional application Serial No. 60/531,071 filed December 19, 2003 is herein incorporated by reference.

**Field of the Invention**

The present invention relates to the field of toothbrushes, and more particularly, the invention relates to the field of electrically powered toothbrushes.

**Background of the Invention**

Most known electric toothbrushes utilize a single bristle carrier that is powered or otherwise driven by an electric motor incorporated in the toothbrush. The bristle carriers in these toothbrushes undergo a wide array of motions. For example, bristle carriers that undergo rotary motion are well known. Bristle carriers that move back and forth in a linear fashion within the plane of the brush are also known. And, bristle carriers that move in a linear fashion perpendicular to the plane of the brush are also known such as in U.S. Patent 5,974,615. Although satisfactory in certain respects, a need still exists for an improved powered toothbrush design.

Numerous attempts have been made to improve the design, efficiency, cleaning efficacy, simplicity, and/or commercial viability of electric toothbrushes. One approach has been the provision of multiple powered bristle carriers. Most artisans have grouped multiple sets of bristles along an end of a brush and incorporated a drive mechanism for simultaneously rotating each of the bristle sets, together. Exemplary designs include those disclosed in U.S. Patents 3,242,516; 4,156,620; 4,845,795; 5,088,145; 5,020,179; 4,827,550; and 4,545,087, all of which are hereby incorporated by reference.

Although bristle carriers that undergo various combinations of movement have been disclosed in the prior art, there remains a need to provide an electric toothbrush with one or more bristle carriers that provides additional combinations of motion.

### Summary of the Invention

The present invention provides, in a first aspect, an electric toothbrush comprising an elongate handle having a motor disposed therein, and a head having a longitudinal axis and a movable bristle carrier, wherein the head is stationary during use. That is, the head is stationary with respect to the handle or main body portion of the toothbrush. The electric toothbrush also comprises a neck extending between the handle and the head. The toothbrush further comprises a shaft directly coupled to the moveable bristle carrier and operatively connected to the motor. Movement of the shaft causes the movable bristle carrier to oscillate about an axis generally perpendicular to the longitudinal axis of the head and to additionally reciprocate along the axis generally perpendicular to the longitudinal axis of the head. The movable bristle carrier further comprises a ramp disposed on an underside surface of the carrier. Additionally, a post is provided within the interior portion of the head. The post is positioned and configured such that the ramp and the post slidingly engage each other during operation of the toothbrush to thereby result in reciprocation of the bristle carrier.

In yet another aspect, the present invention provides an electric toothbrush comprising an elongate handle having a longitudinal axis and a motor disposed therein. The electric toothbrush also comprises a moveable head having a second longitudinal axis and a movable bristle carrier. The movable head is movable relative to the handle. The electric toothbrush further comprises a movable neck extending between the handle and the head. And, the electric toothbrush comprises a shaft operatively coupled to the motor and to the movable bristle carrier. The shaft operatively engages the movable neck such that movement of the shaft causes the movable bristle carrier to oscillate about an axis generally perpendicular to the second longitudinal axis of the head. Movement of the shaft also causes the moveable neck and the moveable head to move in a direction generally transverse to the longitudinal axis of the handle.

In yet another aspect, the present invention provides an electric toothbrush comprising an elongate handle having a longitudinal axis and a motor disposed therein. The electric toothbrush further comprises a movable head having a second longitudinal axis and a movable bristle carrier wherein the movable head is movable relative to the handle. The electric toothbrush further comprises a movable neck extending between the handle and the head. And, the electric toothbrush comprises a shaft operatively coupled to the motor and to the movable bristle carrier. The shaft operatively engages the movable neck such that the motor imparts only a single motion to the shaft and wherein movement of the shaft causes the movable bristle carrier to oscillate about an axis generally perpendicular to the second longitudinal axis of the head.

Furthermore, movement of the shaft causes the movable neck and the movable head to move in a direction generally transverse to the longitudinal axis of the handle.

In yet another aspect, the present invention provides an electric toothbrush comprising an elongate handle having a longitudinal axis and a motor disposed therein. The toothbrush further comprises a movable head having a second longitudinal axis and a movable bristle carrier. The movable head is movable relative to the handle. The toothbrush further comprises a movable neck extending between the handle and the head. And, the electric toothbrush comprises a shaft operatively coupled to the motor and to the movable bristle carrier wherein the shaft operatively engages the movable neck. Movement of the shaft causes the movable bristle carrier to oscillate about an axis generally perpendicular to the second longitudinal axis of the head. Additionally, movement of the shaft causes the moveable neck and the movable head to move in a direction generally transverse to the longitudinal axis of the handle about a pivot point at an end of the neck proximate the handle.

In yet another aspect, the present invention provides an electric toothbrush comprising an elongate handle having a longitudinal axis and a motor disposed therein. The electric toothbrush further comprises a movable head having a second longitudinal axis and a movable bristle carrier, wherein the movable head is movable relative to the handle. The electric toothbrush further comprises a movable neck extending between the handle and the head. And, the electric toothbrush comprises a shaft operatively coupled to the motor and to the movable bristle carrier such that the shaft repetitively engages and disengages the movable neck. Movement of the shaft causes the movable bristle carrier to oscillate about an axis generally perpendicular to the second longitudinal axis of the head and wherein the repetitive engagement and disengagement of the shaft causes the movable neck and the movable head to move in a direction generally transverse to the longitudinal axis of the handle.

#### **Brief Description of the Drawings**

The present invention may take form in various components and arrangements of components, and in various techniques, methods, or procedures and arrangements of steps. The referenced drawings are only for purposes of illustrating preferred embodiments, they are not necessarily to scale, and are not to be construed as limiting the present invention.

It is believed that the present invention will be better understood from the following description taken in conjunction with the accompanying drawings in which:

**Fig. 1** is a perspective view of a preferred embodiment toothbrush in accordance with the present invention illustrating various planes and their orientation with respect to the toothbrush.

**Fig. 2** is a partial exploded view of a head portion of a preferred embodiment toothbrush in accordance with the present invention.

**Fig. 3** is a side elevation view of a first bristle carrier utilized in the preferred embodiment toothbrush illustrated in **Fig. 2**.

**Fig. 4** is a view of the underside of the first bristle carrier shown in **Fig. 3**.

**Fig. 5** is a perspective view of a partially assembled head portion of the preferred embodiment toothbrush.

**Fig. 6** is a collection of views of the head portion of the preferred embodiment toothbrush illustrating the displacement of the first bristle carrier during operation of the brush.

**Fig. 7** is a front view of a head portion of another preferred embodiment toothbrush in accordance with the present invention.

**Fig. 8** is a front view of yet another preferred embodiment toothbrush in accordance with the present invention.

**Fig. 9** is a front view of still another preferred embodiment toothbrush in accordance with the present invention.

**Fig. 10** is a partial fragmentary side view of a head portion of another preferred embodiment toothbrush during a first direction of travel of a reciprocating drive shaft in accordance with present invention.

**Fig. 11** is a partial fragmentary side view of the toothbrush depicted in **Fig. 10** during a second direction of travel of the drive shaft.

**Fig. 12** is a detailed partial cross-sectional view illustrating the engagement between the drive shaft and a guide member utilized in the toothbrush depicted in **Fig. 10**.

**Fig. 13** is a partial fragmentary side view of the toothbrush shown in **Figs. 10 & 11** having a secondary stabilizing member provided.

**Fig. 14** is a partial fragmentary side view of yet another preferred embodiment toothbrush utilizing an orbital motion drive shaft in accordance with the present invention.

**Fig. 15** is a view of the underside of the neck and head portion of the toothbrush depicted in **Fig. 14**.

**Fig. 16** is a view of the underside of the head and neck portion of a variant version of the toothbrush depicted in **Fig. 14**.

#### **Detailed Description of the Preferred Embodiments**

As will be appreciated, the present invention is directed to electric toothbrushes, including electric toothbrushes having replaceable brush head ends, replaceable bristle carriers and electric toothbrushes having one or more bristle carriers. In particular, the present invention

is directed to an electric toothbrush with two bristle carriers, each of which is driven by an electric motor incorporated within the toothbrush body.

Specifically, the present invention can be used in conjunction with electric toothbrushes, brush heads, and bristle carriers that include shafts that rotate, oscillate, orbit, or reciprocate (as well as combinations thereof) to impart motion to the first and second bristle carriers. In addition, the present invention can be used in combination with electric toothbrushes, brush heads, and bristle carriers where the shaft is operatively connected to both the first and second bristle carriers or only one of the bristle carriers. In the latter instance, the bristle carriers are themselves interconnected so that a motion is imparted to the bristle carrier that is not directly coupled to the shaft.

Before describing the various preferred embodiment toothbrushes, it is instructive to define the various types of motions referenced herein. As used herein, the term “angular motion” refers to any angular displacement. “Linear motion” is movement along a straight or substantially straight, line or direction. “Primarily linear motion” is described below. “Curvilinear motion” is movement that is neither completely linear nor completely angular but is a combination of the two (e.g., curvilinear). These motions can be constant or periodic. Constant motion refers to motion that does not change direction or path (i.e., is unidirectional). Periodic motion refers to motion that reverses direction or path. Constant angular motion (i.e., motion that extends through 360 degrees or more) that is substantially in the form of a circle is referred to as rotary motion. Periodic angular motion is motion that extends through less than 360 degrees and is referred to as oscillating motion. Curvilinear motions can also be either constant (i.e., unidirectional) or periodic (i.e., reverses direction). Periodic linear motion is referred to as “reciprocation”. Orbital motion is generally rotary motion of a body about a point that is different than the center point of the body.

The above-described motions can also occur along one or more axes of a bristle carrier. Accordingly, motion is described herein as being either one, two, or three dimensional motion depending upon the number of axial coordinates required to describe the position of a bristle carrier during its movement. The axes, **X**, **Y**, and **Z**, are shown in **Fig. 1**. One dimensional motion is motion that can be described by a single coordinate (e.g., **X**, **Y**, or **Z** coordinates). Typically, only linear motion can be one dimensional. For example, periodic linear motion substantially along only the **Y** axis is one dimensional motion (referred to herein as a “pulsing motion”). Two dimensional motion is movement by a bristle carrier that requires two coordinates (e.g., **X** and **Y** coordinates) to describe the path of travel of the bristle carrier. Angular motion that occurs in a single plane is two dimensional motion. Three dimensional motion is movement by a bristle carrier that requires three coordinates (e.g., **X**, **Y**, and **Z** coordinates) to describe the

path of travel of the bristle carrier. An example of three dimensional motion is movement by a bristle carrier in the path of a helix.

**Fig. 1** is a perspective view of a preferred embodiment toothbrush **2** in accordance with the present invention. The toothbrush **2** comprises an elongated body **10** having a handle **30**, a head **50**, and a neck **40** extending between the handle **30** and the head **50**. A switch **20** is provided or made accessible along the outer region of the body **10**. As will be appreciated, the switch **20** actuates an electrical motor contained within the body **10** of toothbrush **2**. The motor (not shown) and a drive mechanism as described herein (not shown) provide a powered drive for one or more bristle carriers disposed near a distal end of the toothbrush. Specifically, the toothbrush **2** further includes a first bristle carrier **60** and a second bristle carrier **70**. The first carrier **60** is located adjacent a distal-most end **52** of the head **50**. As described in greater detail herein, upon activation of the drive mechanism, the first and second bristle carriers undergo a particular combination of motions. The motions are best described in terms of the axes **X**, **Y**, and **Z** and the planes which contain these axes. As referenced herein, these planes are referred to as the **X** plane, **Y** plane, or **Z** plane.

The **X** axis is generally referred to herein as the longitudinal axis and generally extends along a longitudinal or lengthwise dimension (as seen from the top planar view of the toothbrush) of the toothbrush head or the bristle carrier. The longitudinal axis of the toothbrush head or bristle carrier may coincide with the longitudinal axes of the toothbrush neck and/or handle, although it need not do so as for example where the toothbrush head is angled with respect to either the toothbrush neck or handle. In certain embodiments described herein, the head and/or neck component may have a different longitudinal axis than the longitudinal axis of the handle. In this instance, the longitudinal axis of the handle can be referred to as a first longitudinal axis and that of the head and/or neck, referred to as a second longitudinal axis. The **Y** axis is transverse to the **X** axis and generally bisects the toothbrush head into its left and right halves. The **Z** axis is orthogonal or perpendicular to the **X** and **Y** axes.

Plane **X** contains the **X** axis and is generally referred to herein as the plane of the toothbrush or the plane of the toothbrush head. This plane generally extends along the longitudinal dimension of the toothbrush or the toothbrush head. The **Y** plane contains the **Y** axis and extends through the toothbrush and is perpendicular to the **X** plane. The **Y** plane either bisects the toothbrush or is parallel to a plane that does. The **Z** plane is perpendicular to both the **X** plane and the **Y** plane.

Furthermore, it is useful to address the terminology used in describing the preferred embodiment toothbrushes and bristle carriers. As used herein, the term "forward" refers to the direction from the handle to the head while the term "rearward" refers to the direction from

the head to the handle. A longitudinal direction is a direction that generally corresponds to a longitudinal or X axis but which may not lie in the same plane as the axis. For example, the longitudinal axes of a shaft and a bristle carrier may not extend in the same plane but generally extend in the same direction from a top planar view. Similarly, a neck and head that are angled with respect to each other may not have longitudinal axes that extend in the same plane, but do have axes which extend in the same general longitudinal direction from a top planar view. Many of the preferred embodiment electric toothbrushes typically have an elongated head with a longitudinal axis passing through the longest dimension thereof. This axis typically extends in the same general direction as the longitudinal axes of the toothbrush neck and/or shaft. This axis is generally referred to as the longitudinal axis of the toothbrush. By the phrase "same general direction," some angular deviation is contemplated between the axes. Various references are also made herein to the "plane of the toothbrush." As will be understood, this is generally the plane within which extends the longitudinal axis of the toothbrush head.

And, as described herein, the first bristle carrier is the bristle carrier that is located at the distal-most end of the toothbrush. The second bristle carrier is the next bristle carrier positioned alongside or proximate to the first bristle carrier and rearward therefrom. A third bristle carrier is proximate the second bristle carrier and is positioned rearward of the second bristle carrier. A fourth bristle carrier is rearward of the third and so on.

Generally, the preferred embodiment toothbrushes according to the present invention comprise an elongated hollow body that retains an electrically powered motor and drive mechanism that is used to drive one, two or more moveable bristle carriers. The elongated hollow body also includes an interior chamber for containing one or more batteries for powering the motor. And, one or more switches are provided along the outer region of the body for activating the motor and drive mechanism. As will be appreciated, a removable end cap is provided to enclose the interior chamber and provide a seal against external agents for the components inside the toothbrush body. As described in detail herein, the preferred embodiment toothbrushes comprise one, two or more movable bristle carriers. Each of the bristle carriers undergoes particular types of motion and the resulting combinations of movements provide unique cleaning efficacy.

As noted, the preferred embodiment electric toothbrushes comprise one or more bristle carriers that are driven by an electric motor and drive mechanism incorporated in the toothbrush. Preferably, these toothbrushes utilize two bristle carriers, each undergoing motion different than the motion of the other bristle carrier.

Fig. 2 illustrates a preferred assembly configuration between a first bristle carrier 60 and the head and neck, i.e., 50 & 40 respectively, portions of the preferred embodiment

toothbrush 2. The first bristle carrier 60 includes a base 110 having a plurality of bristles 114 extending outwardly therefrom. Defined within the interior portion of the head 50 is a sleeve receptacle 126. The sleeve receptacle 126 is preferably in the form of a cylindrical projection defining an interior mating surface 128. The mating surface 128 is adapted to receive a sleeve 122. The sleeve 122 in turn is sized to accommodate an axle 118 disposed within the interior of the sleeve 122. Extending between the sleeve receptacle 126 and the distal-most end 52 of the head portion 50 is preferably, a guide member or post 140. The guide member 140 defines a guide surface 142 described in greater detail herein.

Fig. 3 is a detailed side view of the first bristle carrier 60. Extending along the underside of the first bristle carrier base 110 is a first bristle carrier cam member 150. The cam member 150 defines a cammed surface or ramp 152 generally extending between a first location 152a and a second location 152b on the cam surface 152. Also extending from the underside of the first bristle carrier base 110 is an engagement member 156. The engagement member is adapted to attach to, or otherwise engage with, a drive shaft described in greater detail herein. The engagement member 156 may be in a variety of forms other than the cylindrical projection depicted in the figures. It is preferred that the drive shaft be directly coupled to the carrier, and most preferably by direct coupling to the engagement member. By "direct" coupling, it is meant that the shaft is coupled to the carrier during all phases or occurrences of motion of the drive shaft. The engagement member 156 may also serve as a stop member, also described in greater detail herein.

Fig. 4 illustrates the underside of the base 110 of the first bristle carrier 60. The cam member 150 is preferably in the form of an arcuate member extending about the center of the base 110 at which is located the axle 118. The first and second locations 152a and 152b, respectively, of the ramp surface 152 are shown in Fig. 4. Similarly it will be appreciated that the engagement member 156 is located adjacent the first location 152a.

Fig. 5 is a detailed perspective view of a partially exploded view of the head portion 50 and neck portion 40 of the preferred embodiment toothbrush 2. In this view, the first bristle carrier 60 is shown attached to and/or rotatably supported on the head 50 by axle 118 received within the receptacle 126. Furthermore, it will be noted that the cam member 150 is in engagement with the guide surface 142 of the guide member 140. Specifically, the cammed surface 152 (not shown) is in contact with the guide surface 142.

Fig. 6 illustrates the respective motions that the first bristle carrier 60 undergoes during operation of the preferred embodiment toothbrush 2. It will be appreciated that the top elevation side views correspond to the lower planar views of the brush head. It will be understood that the lower views of the brush head are schematic views and depict the underside of the carrier

base **110**, the cam member **150**, and the guide member or post **140**, as if the underside of the head **50** were transparent. The left-most views illustrate the toothbrush during a first phase during its operation, while the right-most views illustrate the position of the brush components during a second phase of operation of the toothbrush. Specifically, the preferred embodiment toothbrush **2** includes a drive shaft **90**. The distal end of the drive shaft **90** is coupled to the engagement member **156**. For clarity purposes, this coupling is not shown. Preferably, the drive shaft **90** undergoes a reciprocating motion during operation of the toothbrush **2**. Upon movement of the drive shaft **90** in the direction of the arrow shown in the lower left diagram, i.e. in the direction of arrow **J**, the first bristle carrier base **110** is rotated in the direction of arrow **K**. This rotation about the center or axle **118** allows movement of the base **110** in the direction of arrow **L** shown in the upper left diagram. Upon movement of the drive shaft **90** in the direction of arrow **M**, shown in the lower right diagram, the base **110** is rotated in the direction of arrow **N** about the axle **118**. This rotational motion urges the carrier **60** and specifically its base **110** outward from the head **50** in the direction of arrow **O** shown in the upper right diagram. The engagement member **156** may serve as a stop member to prevent over-rotation or excessive oscillation of the base **110** during operation. That is, the engagement member **156** can serve to ensure that the guide surface **142** remains in contact with the cam surface **152**. Generally, after the carrier **60** has been displaced outward a distance **D** in the direction of arrow **O**, application of force to the brush head by the user during a brushing operation causes displacement and return of the carrier **60** in the direction of arrow **L**. The present invention encompasses embodiments in which a spring or other biasing member is utilized to return, or assist in returning, the carrier **60** to the brush head in the direction of arrow **L**.

Referring further to **Figs. 3 and 4**, it will be appreciated that the configuration, shape, and size of the cam member **150** may vary depending upon the extent of pulsating motion desired, the frequency and stroke length of reciprocation of the drive shaft **90**, and other factors. For example, the angle of inclination of the ramp surface **152**, particularly between locations **152a** and **152b** may be a constant angle, or may be a varying angle with respect to plane **X** of the brush. It will be understood that if a varying angle or other nonlinear configuration is used for the ramp surface **152**, the pulsating characteristics of the carrier **60** may readily be changed. Additionally, the difference in height between locations **152a** and **152b**, such as shown by dimension **H** depicted in **Fig. 3**, primarily determines the dimension **D** depicted in **Fig. 6**. Generally, this dimension may range from, as a lower limit, about 0.1 mm, more preferably about 0.5 mm, more preferably about 0.75 mm, more preferably about 1.0 mm, more preferably about 1.5 mm, to, as an upper limit, about 5.0 mm, more preferably about 4.0 mm, more preferably about 3.0 mm, and more preferably about 2.5 mm.

The preferred embodiment toothbrush may utilize any number of a combination of bristle carriers in further combination with collections or arrays of static bristles. For example, **Fig. 7** illustrates an embodiment of another preferred embodiment toothbrush **2a** having a head **50a** and a neck **40a**. Disposed on the distal-most end of the head **50a** is a first bristle carrier **60a**. Disposed elsewhere on the head **50a** are a plurality of static bristles **80a**.

**Fig. 8** illustrates another preferred embodiment toothbrush **2b** according to the present invention. Toothbrush **2b** comprises a head **50b** and a neck **40b**. Disposed on the head **50b** is a first bristle carrier **60b** and a second bristle carrier **70b**.

**Fig. 9** depicts another preferred embodiment toothbrush **2c**. The toothbrush **2c** includes a head **50c** and a neck **40c**. Disposed on the distal-most end of the head **50c** is a first bristle carrier **60c**. A second bristle carrier **70c** is disposed alongside or proximate the first bristle carrier **60c**. An array of static bristles **80c** are located between the second bristle carrier **70c** and the neck **40c**.

In each of the embodiments depicted in **Figs. 7, 8, and 9**, the first bristle carrier **60a, 60b, and 60c** preferably undergoes the same combination of movements as described herein for the bristle carrier **60** of the toothbrush **2**. That is, upon operation of the toothbrush **2a, 2b, or 2c**, the carrier **60a, 60b, or 60c** undergoes both an oscillating motion and a pulsating motion.

It will be appreciated that the second bristle carriers, such as for instance carriers **70b and 70c**, or any of additional carriers such as a third or a fourth carrier, may undergo any type of motion. Preferably, it is contemplated that the second bristle carrier undergo a side-to-side motion, i.e. within plane **X**, and preferably that this motion be reciprocating motion. Alternatively, it is also preferred that the second bristle carrier undergo a reciprocating motion that is generally parallel with the longitudinal axis of the head and/or that of the handle of the toothbrush. The present invention also includes embodiments in which the second bristle carrier pulsates in a similar fashion as the first carrier. Furthermore, the present invention include embodiments in which the second carrier undergoes an oscillating and pulsating motion, while the first carrier and/or another carrier undergoes some type of motion. As previously noted, any of the carriers may undergo any type of motion such as angular motion, linear motion, curvilinear motion and variations of these motion types.

The present invention toothbrush also includes embodiments in which motion is imparted to the entire head and/or at least a part of the neck portion of the toothbrush. This is in distinction to the previously described embodiments in which only one or more bristle carriers located on the head undergo motion during operation of the toothbrush. **Fig. 10** illustrates such a preferred embodiment toothbrush **202** having a head **250**, a handle **230**, and a neck **240** extending therebetween. As described in greater detail herein, a flexible member **300** is preferably provided

between the end or base of the neck **240** and the handle **230**. Disposed on the head **250** is a first bristle carrier **260**, and a second bristle carrier **270**. A drive shaft **290** extends within the neck **240** and preferably undergoes a reciprocating motion during operation of the brush. Disposed along the exterior periphery of the drive shaft **290** is an engagement collar **292**. The engagement collar **292** is located at a position on the drive shaft **290** such that during operation of the toothbrush and reciprocation of the drive shaft **290**, the collar **292** periodically contacts, and preferably engages, a guide member **242**. The guide member **242** is preferably formed such that it extends inwardly from the interior surface of the neck **240**. **Fig. 10** illustrates that during movement of the drive shaft **290** in the direction of arrow S, the collar **292** periodically contacts and engages the guide member **242**. Due to the configuration of the guide member **242**, described in greater detail herein, the neck **240** and head **250** are displaced in the direction of arrow T. More specifically, the displacement generally occurs in an angular or pivoting motion about point F.

**Fig. 11** illustrates movement of the head **250** and the neck **240** during continued operation of the brush and movement of the drive shaft **290** in the direction of arrow U. This disengagement between the collar **292** and the guide member **242** results in the head moving in an opposite direction such as shown in the direction of arrow V in **Fig. 11**.

**Fig. 12** is a detailed partial cross-sectional view of the relationship between the collar **292** of the drive shaft **290** and the guide member **242** extending from the interior surface of the neck **240**. Preferably, the guide member **242** defines a guide surface **244**. It is this guide surface **244** that contacts a portion of the collar **292** and causes displacement of the neck **240** during movement of the drive shaft **290** along the longitudinal axis L. The guide surface **244** preferably extends at some angle with respect to the longitudinal axis L of the drive shaft **290**. This angle is designated as angle A as shown in **Fig. 12**. Angle A may be any angle of the guide surface **244** that, as a result of periodic engagement with the collar **292** during reciprocation of the drive shaft **290**, imparts movement to the head of the toothbrush. Generally, as a lower limit, angle A is from about 5°, more preferably about 10°, more preferably about 20°, more preferably about 30°, and more preferably about 40°. As an upper limit, angle A is to about 85°, more preferably to about 80°, more preferably to about 70°, more preferably to about 60°, and more preferably to about 50°.

It will be appreciated that instead of the collar **292** being a separate component from the drive shaft **290** and so, must be assembled or affixed thereon, the collar **292** could be integrally formed with the drive shaft **290**.

**Fig. 13** illustrates a variant configuration of the preferred embodiment toothbrush **202**. In this alternate version, a second member **246** is provided within the interior of the neck

portion 240. This secondary member 246 provides assistance and promotes alignment of the drive shaft 290 during reciprocation of the drive shaft 290.

The preferred embodiment toothbrushes may also utilize a drive mechanism in which the drive shaft 290 undergoes an orbital type motion rather than reciprocation. For example, as shown in Fig. 14 & 15, the drive shaft 290, while undergoing orbital motion, rotates about a center point C shown in Fig. 15 generally along path P. Referring to Fig. 14, it will be seen that as the drive shaft 290 rotates in this matter it periodically contacts and preferably engages a first orbital guide member 245 extending from the interior of the neck 240. This contact and engagement displaces the neck portion and head portion as previously described. As the drive shaft 290 continues along its path P and disengages from the member 245, the head portion and the neck portion return to their previous positions. In a preferred aspect, the drive shaft 290 undergoes a single motion. That is, as the drive shaft 290 undergoes orbital motion about the center point C, the shaft 290 is not undergoing any other motion such as a linear displacement of either or both of its ends, or any deviation from the circular paths resulting from orbital motion.

Yet another alternate version is depicted in Fig. 16. In this alternate version, a plurality of guide members are provided such as the first orbital guide member 245 and a second orbital guide member 247.

Referring further to Figs. 10 and 11, it will be appreciated that a first direction of travel of the brush head 250 is primarily due to engagement between the drive shaft 290 or rather its collar 292, and the guide member 242. The second direction of travel, i.e. generally in the opposite direction as that of the first direction, is primarily due to release of prior loading of the flexible member 300. This characteristic is referred to herein as a bias return. During the first direction of travel of the head 250 and neck 240, such as in the direction of arrow T shown in Fig. 10, the region 300b of the member 300 is compressed and the opposite region 300a of the member 300 is placed under tension. During the second direction of travel of the brush head 250 and neck 240, such as in the direction of arrow V shown in Fig. 11, the head 250 and neck 240 move as the flexible member 300 returns to its previous configuration. The stiffness, resilience, and degree and ease (or resistance) of deformation of the flexible member 300 may be selected as desired. Furthermore, it is contemplated that one or more regions of the member 300 such as regions 300a and/or 300b, may be provided with different physical characteristics to provide desired aspects of motion during operation of the toothbrush.

The previous description is generally for a neck configuration utilizing a single interior guide member 242. Preferably, the guide member 242 is provided within the desired plane of motion within which the head 250 and neck 240 move. For example, if it is desired for

the head and neck to pivot or move generally within the Y plane of the brush then the guide member 242 should be located along an interior region of the neck 240 as shown in Figs. 10 and 11, at a region of the neck which is either located nearest the user or farthest from the user during operation of the toothbrush.

The toothbrush embodiment depicted in Fig. 16 which utilizes two guide members 245 and 247, can eliminate the need for a flexible member that provides a bias return for the head and neck.

Moreover, a bias return can be provided in a toothbrush without the presence of a flexible member 300. Instead, the bias return can be provided by the materials of construction of the neck 240 and/or head 250.

As with the alternate embodiments shown in Figs. 7-9 utilizing various combinations and numbers of bristle carriers and optionally in conjunction with bristles extending from the head and/or neck regions (referred to as static bristles), the toothbrushes depicted in Figs. 10-16 may also utilize various combinations and various numbers of bristle carriers. Moreover, the toothbrushes of Figs. 10-16 may also utilize bristles that extend directly from the head and/or neck regions. Such bristles would not be "static" as that term is used herein since upon operation of the toothbrush and movement of the head and neck, the bristles are placed in motion. However, the bristles could still be considered as "static" relative to the head and neck.

While the embodiments of the present invention have been illustrated for simplicity with bristles which extend in a direction substantially perpendicular to the longitudinal axis and the surface of the bristle carriers, it is contemplated that the bristles might be arranged differently to complement or further enhance the motions of the first and/or second bristle carriers. That is, some or all of the bristles might extend in a direction which forms an acute angle to a surface of the bristle carrier and extend in a direction toward or away from the handle. In another embodiment, some of the bristles might extend outwardly away from the head, in another direction, again forming an acute angle with respect to the surface of the bristle carrier. Massaging bristles or bristles of varying height might also be used, such as described in U.S. Patent Nos. Des. 330,286, Des. 434,563, the substances of which are incorporated herein by reference. Other preferred bristle arrangements suitable for use include those arrangements described in whole or part in U.S. Patents Nos. 6,006,394; 4,081,876; 5,046,213; 5,335,389; 5,392,483; 5,446,940; 4,894,880; and international publication no. WO 99/23910; the substances of which are incorporated herein by reference.

A variety of drive mechanisms may be utilized in the preferred embodiment toothbrushes described herein. As noted, drive mechanisms that provide a powered reciprocating or orbiting output are preferred. For example, U.S. Patent Nos. 5,617,603; 5,850,603; 5,974,615;

6,032,313; 5,504,959; 5,524,312; 5,625,916; 5,732,432; 5,070,567; 5,170,525; 5,416,942; 3,588,936; 5,867,856; and 4,397,055, the substances of which are incorporated herein by reference, disclose other motor and rotating or oscillating shaft arrangements that might be suitable. Furthermore, the drive mechanisms disclosed in U.S. Serial No. 10/027,594, filed December 21, 2001; and U.S. Serial No. 09/993,167, filed November 6, 2001, both of which are incorporated herein by reference, may be used. Additionally, any or all of the aspects of U.S. Patent Nos. 5,617,601 and 5,435,032, both of which are hereby incorporated herein, may be utilized in the toothbrushes described herein.

Another preferred mechanism for imparting motion to one or more bristle carriers is described in provisional application Serial No. 60/361,625, filed March 4, 2002, herein incorporated by reference. That mechanism imparts a "side-to-side" motion to a bristle carrier. Referring to **Fig. 1**, such motion causes either of both of the bristle carriers **60** and **70** to reciprocate within the plane of the toothbrush head, e.g. within the X plane, or within a plane parallel thereto, and in a direction generally perpendicular to the longitudinal axis of the toothbrush.

A variety of different mechanisms may be used to provide the noted motions described herein. These mechanisms may utilize either a rotating or oscillating shaft or a linearly reciprocating shaft as a power source. Generally, the various repeating periodic motions are achieved by arrangements of pivoting members and linkage assemblies that have certain predetermined regions of freedom. Accordingly, rotating or reciprocating motion from a powered shaft may be translated to a linear, primarily linear, curvilinear, or a three dimensional motion by particular selection and configuration of components forming the drive mechanism. Furthermore, guide channels may be provided along or within the head or region of the toothbrush body near the bristle carrier(s) for assisting or guiding the movement of the bristle carrier(s).

Additionally, it will be appreciated that any of the mechanisms or drive trains described or illustrated herein may be combined with any of the other mechanisms or drive trains noted herein. And, portions of any of these mechanisms may be combined with portions of any other mechanism noted herein. It is also contemplated that a toothbrush as described herein may employ two of the drive trains noted herein, such that each drive train powers a particular bristle carrier. Accordingly, two electrical motors could also be utilized, one for each drive train.

Furthermore, it is contemplated that a toothbrush embodiment can utilize both the features of the toothbrush depicted in **Figs 1-9** and also the features of the toothbrush depicted in **Figs. 10-16**. For example, a toothbrush can be provided with a flexible member **300**, a guide member **242**, and a reciprocating drive shaft **290** that induces motion to the entire head and neck

assembly, in conjunction with a bristle carrier **60** having a cam member **150** and post **140** that induces pulsating motion and/or an oscillating motion of the carrier **60** with respect to the head.

Selection of materials for the various components in the toothbrushes of the present invention is an important consideration. The toothbrushes employ various inclined ramps or cam surfaces to impart particular motions to one or more bristle carriers. Accordingly, the durability and wear resistance of those components and their respective surfaces are desirably promoted by the proper selection of materials. These components may be formed from a wide array of materials. Generally, it is preferred that these components exhibit low friction characteristics. Other components utilized in the toothbrushes described herein serve as bearings or points for supporting a rotating element. These components are preferably formed from low friction materials, or even materials having an internal lubricity.

It is further contemplated in certain applications to provide access openings or apertures in the head or neck region so that water in the environment from a typical brushing operation, may enter the interior of the brush head and serve to lubricate the various external surfaces of the various components.

Additionally, in the toothbrushes described in **Figs. 10-16**, the flexible member **300** may be made from a variety of materials. Generally, these materials are flexible and exhibit a limited degree or resistance to deformation. Upon being deformed, i.e. a load being placed thereon, and then the load being removed, the material should readily return to its previous shape and configuration. An indication as to the desired compressive, stiffness, and/or resilience characteristics of the material used for the flexible member is as follows. For an electric toothbrush of typical dimensions, it is preferred that the flexible material have a thickness and characteristics such that a brushing load of from about 1 to about 3 pounds can be placed upon the brush head without fully compressing the flexible member. That is, it is desired that upon such a load being placed upon the brush head, the flexible member retain an adequate amount of reserve or capacity for further additional loading, and that such loading, i.e. from about 1 to 3 pounds, not cause permanent deformation of the flexible member upon release of the load.

It is contemplated that a wide array of materials and/or combinations of materials could be utilized for the flexible member. For example, various foamed materials or other cellular matrix could be employed. A viscoelastic foam or matrix could be used having time-dependent properties. A bonded foam could be used in which two or more different foams are adhered together. Moreover, instead of or in addition to foams, viscoelastic fluids which are generally incompressible could be used. A flexible member formed from an incompressible material would therefore not compress, but instead undergo some type of displacement. Additionally, the flexible member could utilize one or more regions of segmentation, each region having separate and

distinct properties. It is further contemplated that the flexible member utilize one or more covering materials that may serve to protect the underlying material, or to assist in stiffness, resilience, or deformation characteristics of the flexible member.

The head and neck portions of the preferred embodiment toothbrushes described herein can be formed from an array of polymeric materials. In the following description of the preferred polymer materials for use herein, the abbreviations that are commonly used by those of skill in the art to refer to certain polymers appear in parentheses following the full names of the polymers. An example of a preferred polymer is polypropylene ("PP"), or may be selected from the group consisting of other conventional toothbrush materials, such as polystyrene ("PS"), polyethylene ("PE"), acrylonitrile-styrene copolymer ("SAN"), and cellulose acetate propionate ("CAP"). Another exemplary polymer is preferably a thermoplastic elastomer ("TPE"), a thermoplastic olefin ("TPO"), a soft thermoplastic polyolefin (e.g., polybutylene), or may be selected from other elastomeric materials, such as ethylene-vinylacetate copolymer ("EVA"), and ethylene propylene rubber ("EPR"). Examples of suitable thermoplastic elastomers herein include styrene-ethylene-butadiene-styrene ("SEBS"), styrene-butadiene-styrene ("SBS"), and styrene-isoprene-styrene ("SIS"). Examples of suitable thermoplastic olefins herein include polybutylene ("PB"), and polyethylene ("PE"). A particularly preferred polymeric material for use in forming the head and/or neck, is a commercially available material under the designation Celcon®.

In addition, color can be provided to give the neck and head portions of the toothbrush an aesthetically pleasing appearance. Opaque or translucent colors can be provided. For translucent brushes an insert can further be provided in the neck and/or head. Such inserts can be any color and are typically made from a polypropylene material.

Techniques known to those of skill in the art, such as injection molding, can be used to manufacture the head and neck components. Any design, shape, or configuration for the handle and/or the bristles is suitable herein.

The flexible neck can also act to buffer excessive force on the teeth and gums that may be exerted by a user. Application of excessive force during brushing is deleterious to the gums. Accordingly, by appropriate selection of the materials forming the neck of the preferred embodiment toothbrush described herein, application of excessive force can be prevented.

Additional aspects and details of preferred toothbrush components, manufacture, and use are described in U.S. application Serial No.s 60/410,864; 60/410,556; 60/410,865; 60/387,841; 10/128,018; 60/419,672; 60/410,902; 60/410,903; 60/410,853; 60/464,787; 60/487,670; all of which are hereby incorporated by reference.

The present invention has been described with reference to particular embodiments. Modifications and alternative forms will occur to others upon reading and understanding this specification. Furthermore, it is contemplated that any of the features or aspects of any of the toothbrushes described herein may be combined with or utilized in conjunction with any of the other features or aspects of any of the toothbrushes described herein. It is intended that all such modifications and alternations are included insofar as they come within the scope of the appended claims or equivalents thereof.

All documents cited in the Detailed Description of the Invention 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 embodiments 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.

What is claimed is:

1. An electric toothbrush, comprising:  
an elongate handle having a motor disposed therein;  
a head having a longitudinal axis and a movable bristle carrier disposed thereon, wherein said head is stationary during use;  
a neck extending between said handle and said head;  
a shaft directly coupled to said movable bristle carrier and operatively connected to said motor; and  
wherein movement of said shaft causes said movable bristle carrier to oscillate about an axis generally perpendicular to said longitudinal axis of said head and to reciprocate along said axis generally perpendicular to said longitudinal axis of said head and wherein said movable bristle carrier further comprises a ramp disposed on an underside surface thereof and said head further comprises a post, wherein said ramp and said post are slidingly engaged.
2. The electric toothbrush according to claim 1, wherein a second movable bristle carrier is disposed between said movable bristle carrier and said handle.
3. The electric toothbrush according to claim 2, wherein said second movable bristle carrier reciprocates along said longitudinal axis of said head.
4. The electric toothbrush according to any of the preceding claims, wherein said shaft reciprocates.

5. The electric toothbrush according to any of the preceding claims, wherein said movable bristle carrier further comprises a stop member at one end of said second ramp.

6. The electric toothbrush according to claim 5, wherein said stop member is in the form of a pin extending from an underside of said movable bristle carrier.

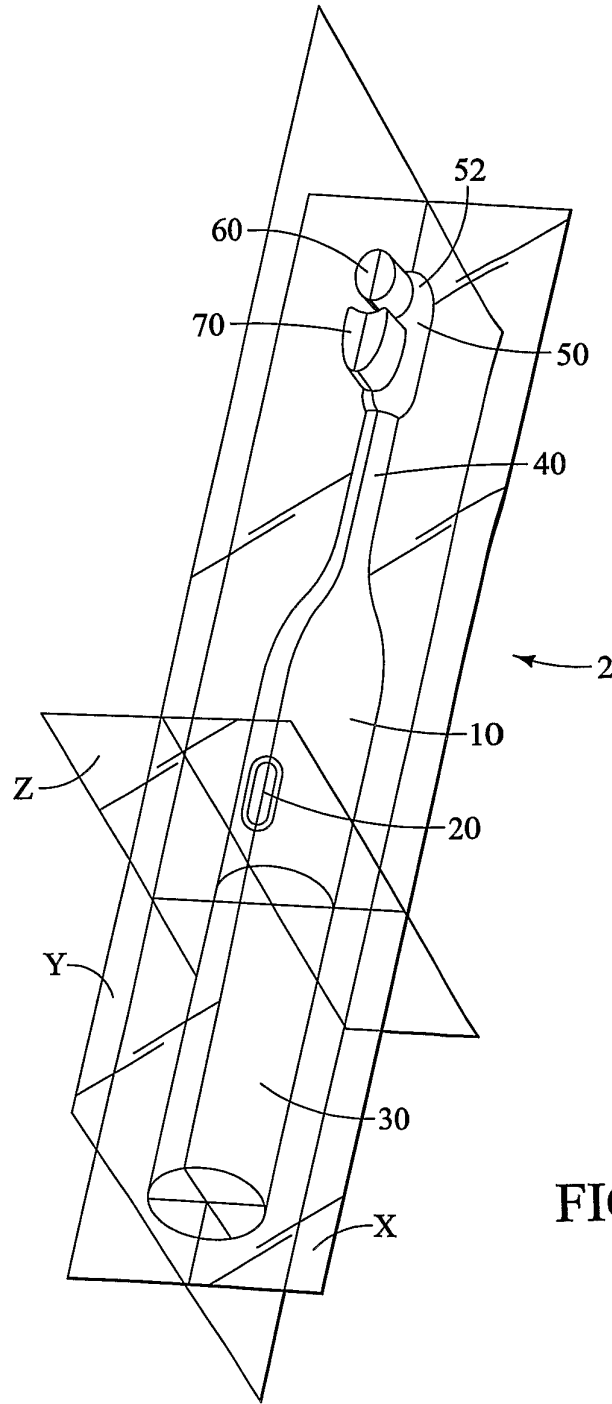
7. The electric toothbrush according to claim 1, wherein each of said head and said neck are moveable, and wherein said handle comprises a second longitudinal axis, wherein said head is movable relative to said handle;

wherein movement of said shaft causes said neck and said head to move in a direction generally transverse to said longitudinal axis of said handle.

8. The electric toothbrush according to claim 7, wherein said electric toothbrush further comprises a second movable bristle carrier disposed on said head.

9. The electric toothbrush according to claim 8 wherein movement of said shaft causes said second movable bristle carrier to reciprocate along an axis generally parallel with said longitudinal axis of said head.

10. The electric toothbrush according to any one of claims 7-9 wherein said shaft reciprocates.



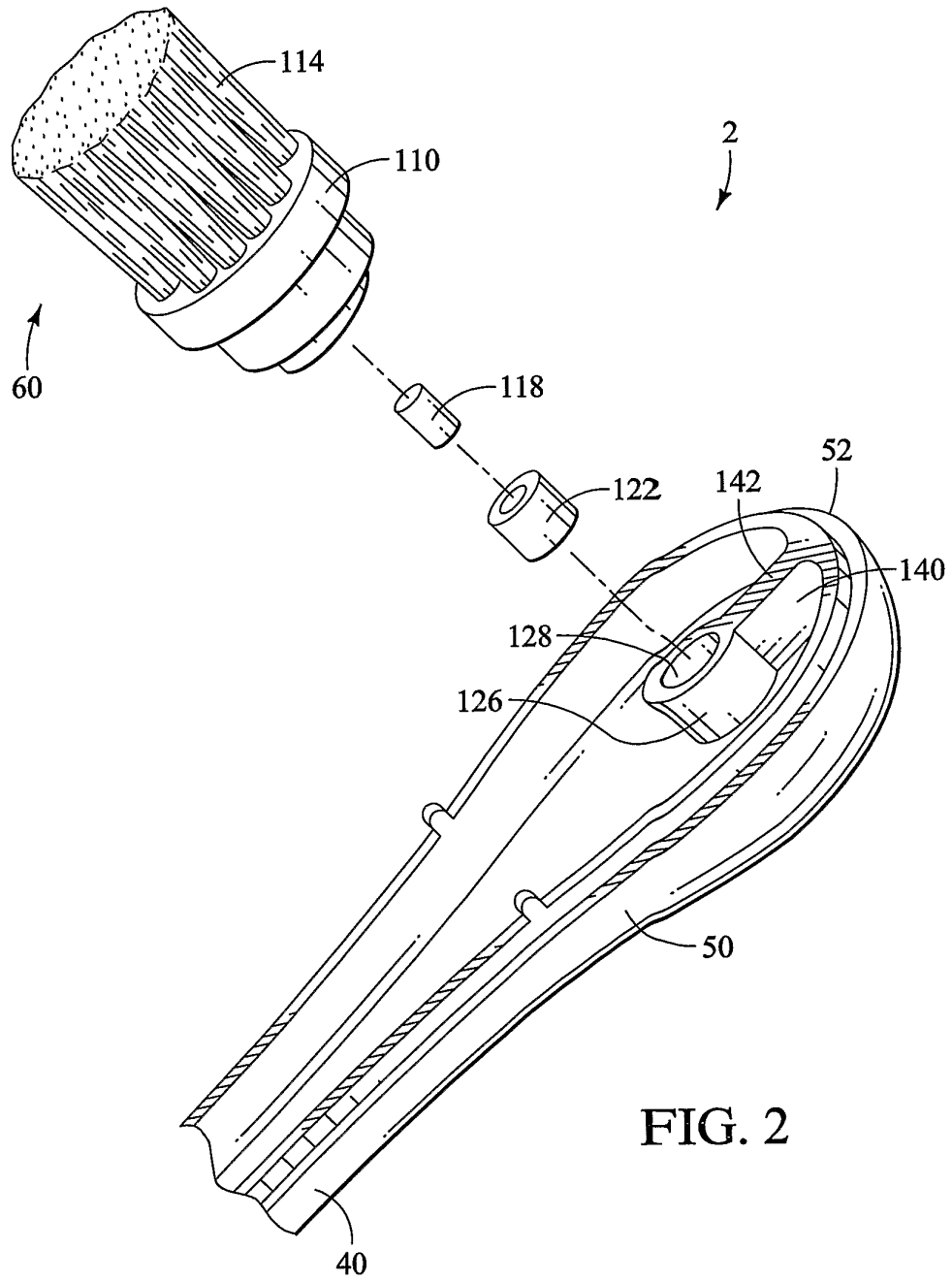


FIG. 2

FIG. 3

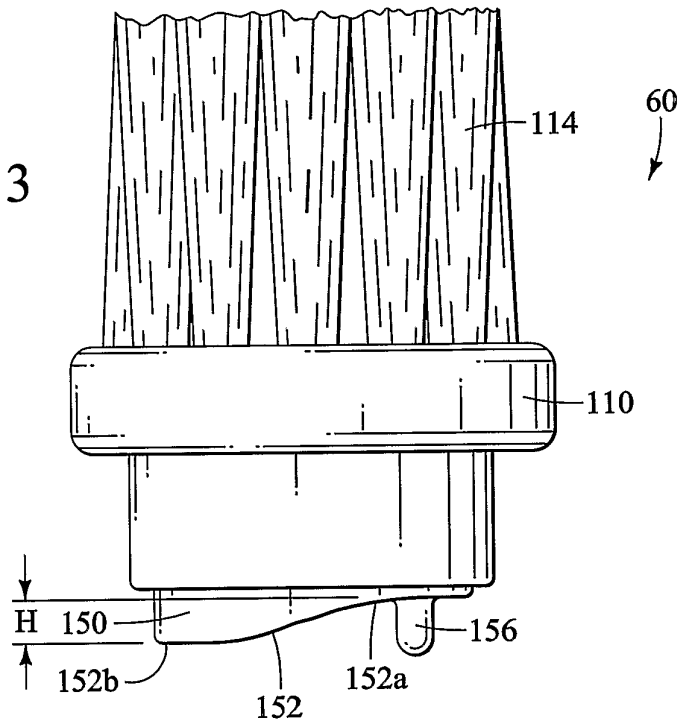
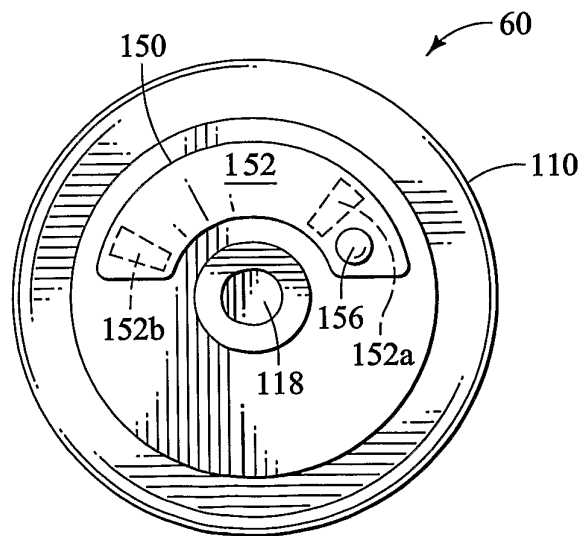


FIG. 4



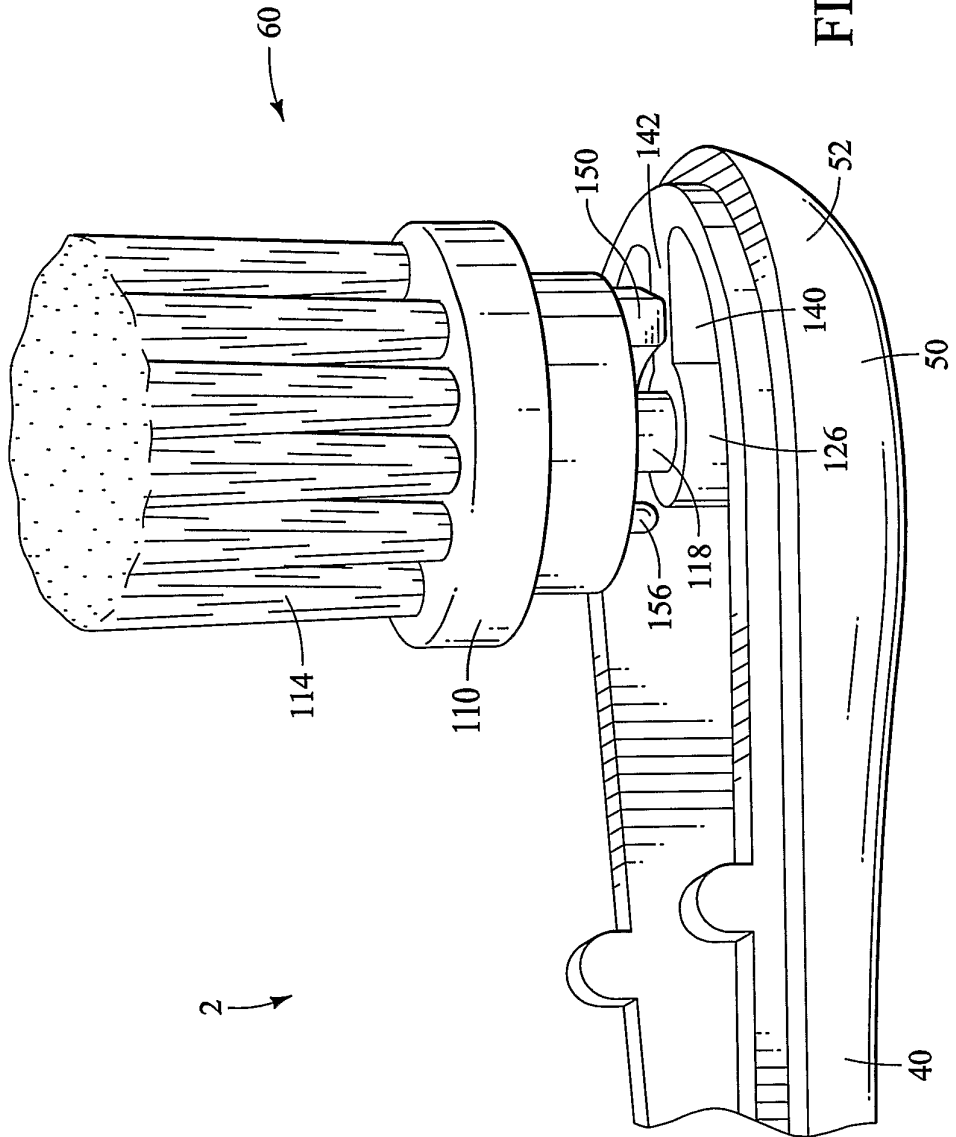


FIG. 5

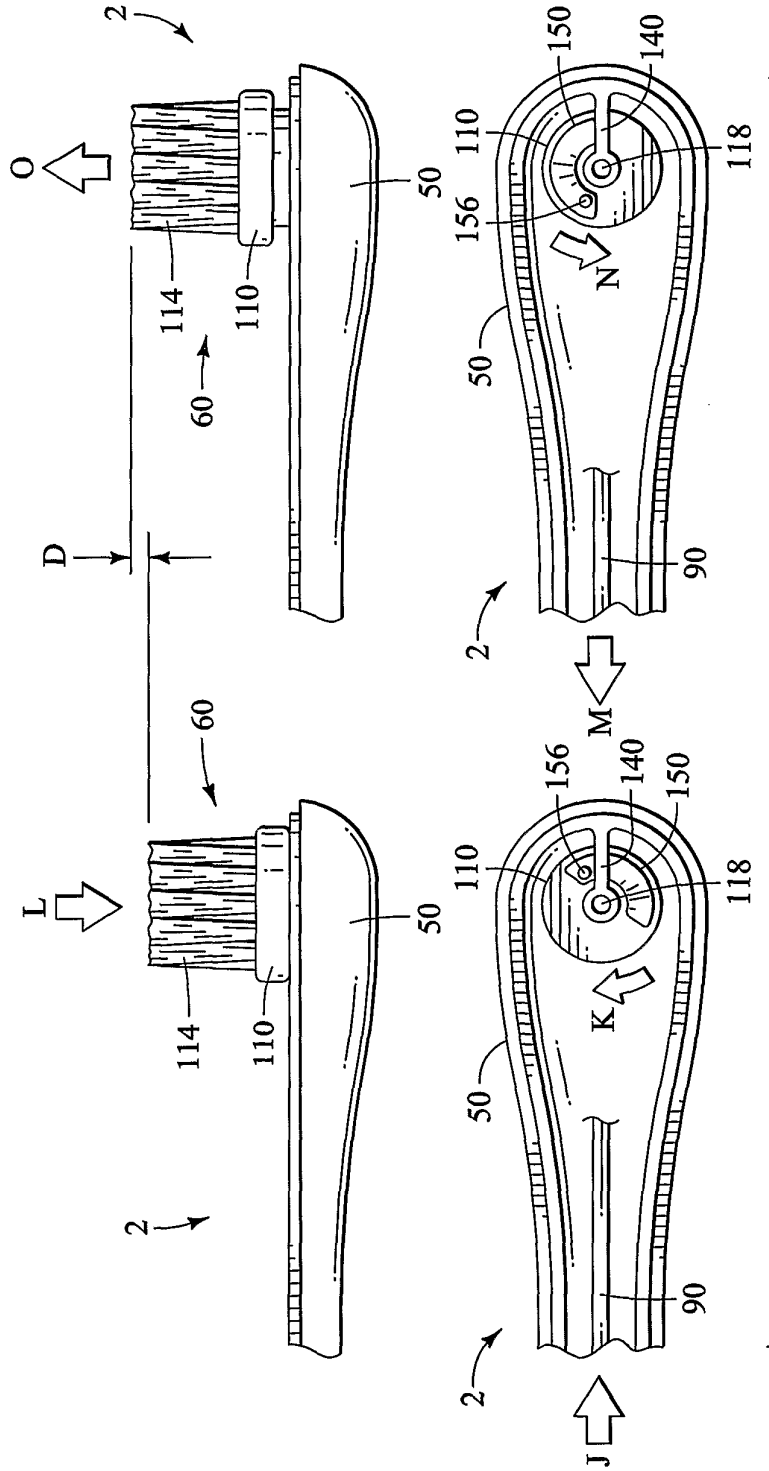


FIG. 6

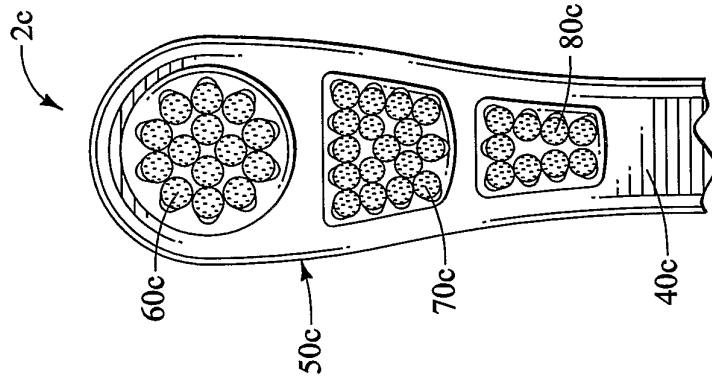


FIG. 9

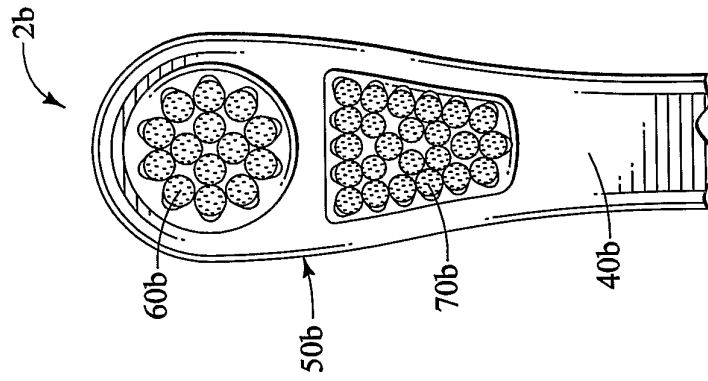


FIG. 8

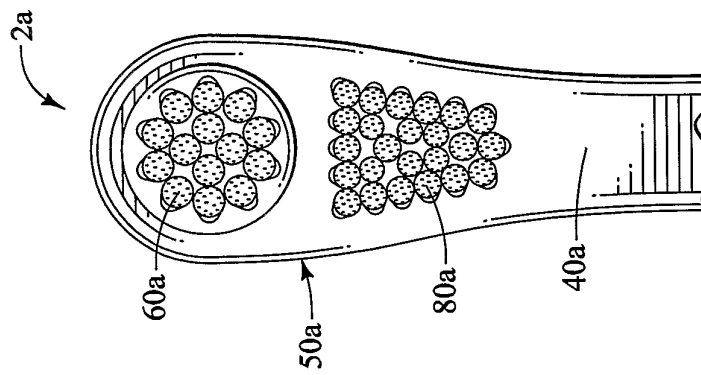


FIG. 7

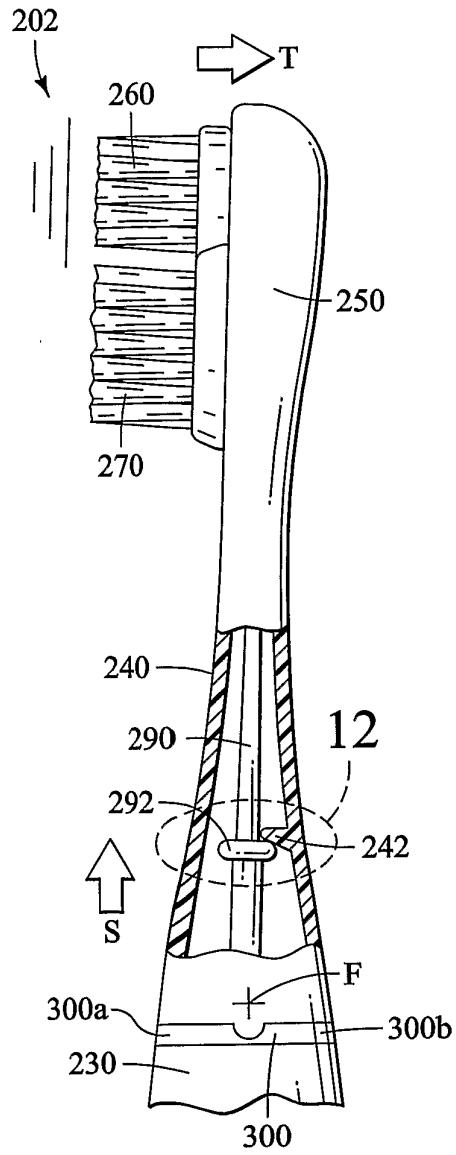


FIG. 10

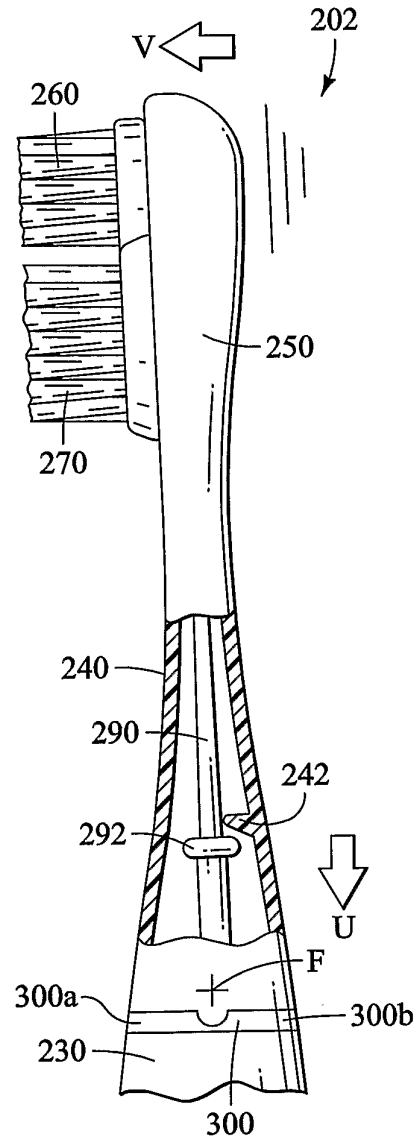


FIG. 11

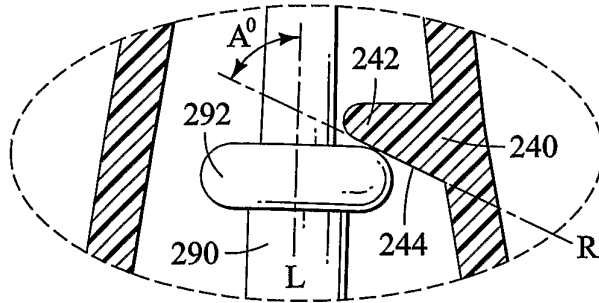


FIG. 12

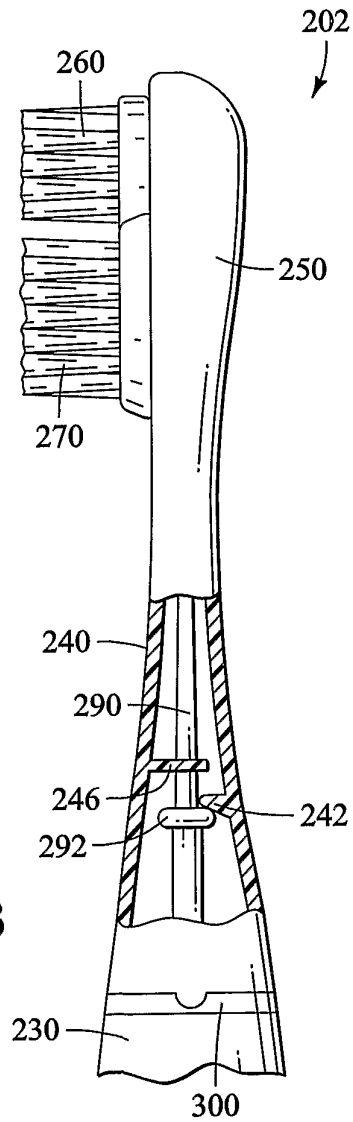


FIG. 13

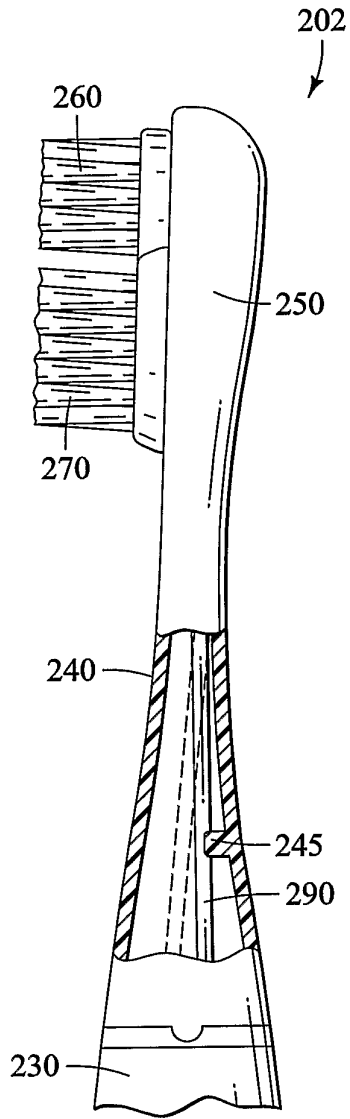


FIG. 14

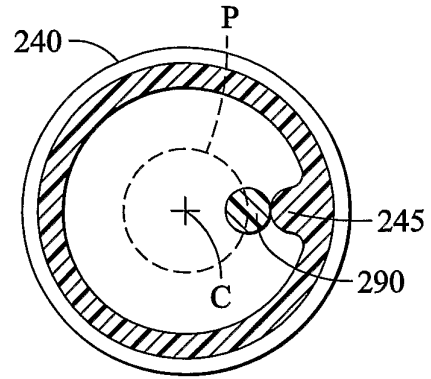


FIG. 15

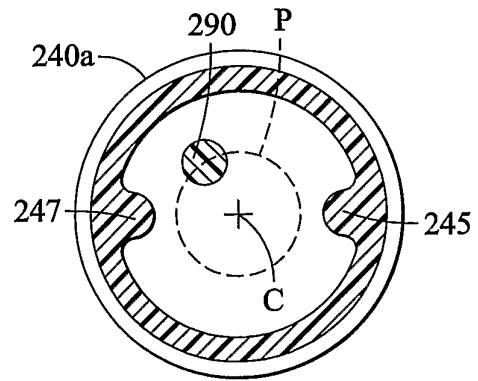


FIG. 16