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(54) **FLUID-DISPENSING AND REFILLIG SYSTEM FOR A POWER TOOTHBRUSH**

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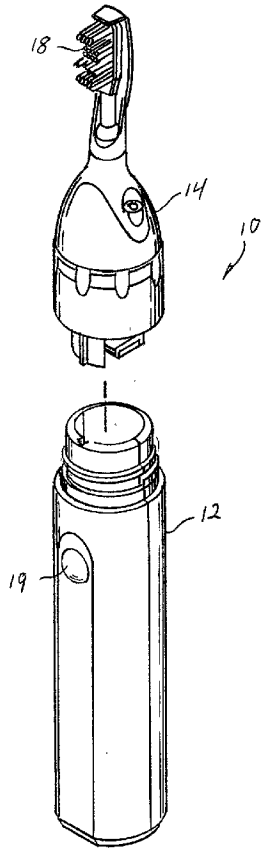
(57) **ABSTRACT**

The fluid delivery/refilling system includes a unit-of-use fluid reservoir for dentifrice or medication within a head portion of a power toothbrush, which is removable from the remainder thereof. A pump element is located in the brushhead and is configured so that the back and forth movement of the brushhead in operation results in fluid moving from the reservoir to a dispensing valve located in the brushhead. The dispensing valve has an end portion which is normally closed, opening under pressure of fluid from the pump. The refilling assembly is separate from the toothbrush and is configured to fit over the top of the toothbrush. Upward pressure exerted on the toothbrush when the toothbrush is within the refilling assembly results in movement of a core element in the refilling assembly, which in turn results in a hollow needle in the refilling assembly extending into a refiller valve in the head portion of the toothbrush. This results in a fluid path between the refilling assembly and the reservoir in the toothbrush. A selected sequence of movement of the toothbrush relative to the refilling results in fluid being moved from the external reservoir through the needle into the on-board unit-of-use reservoir in the toothbrush.



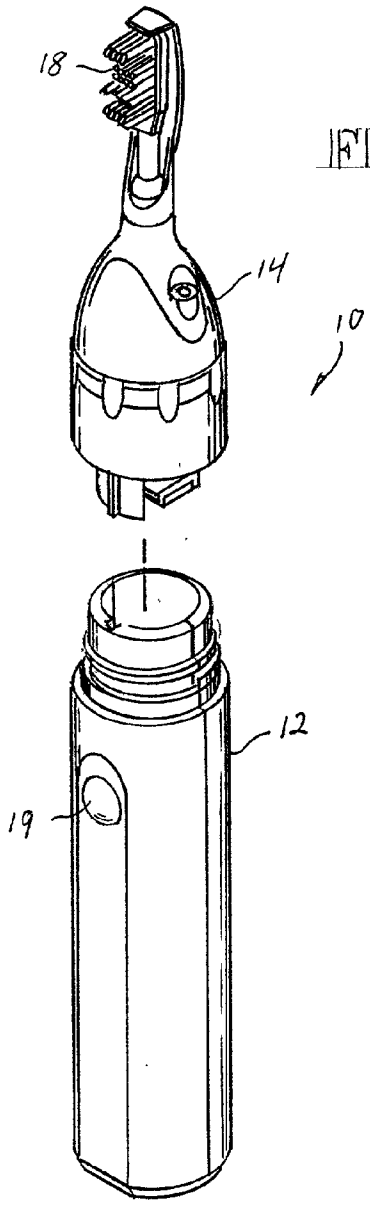


FIG. 1

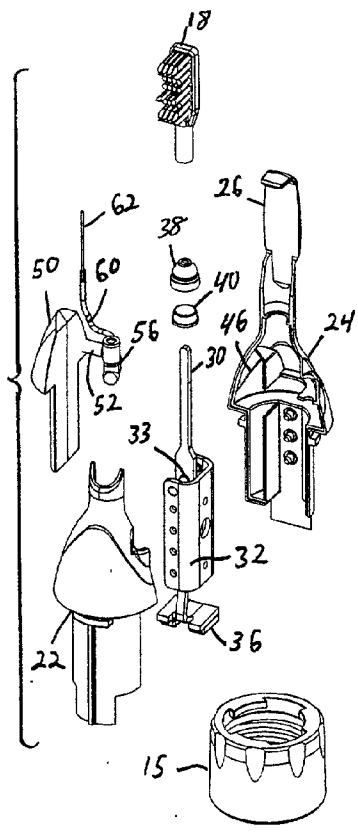


FIG. 2

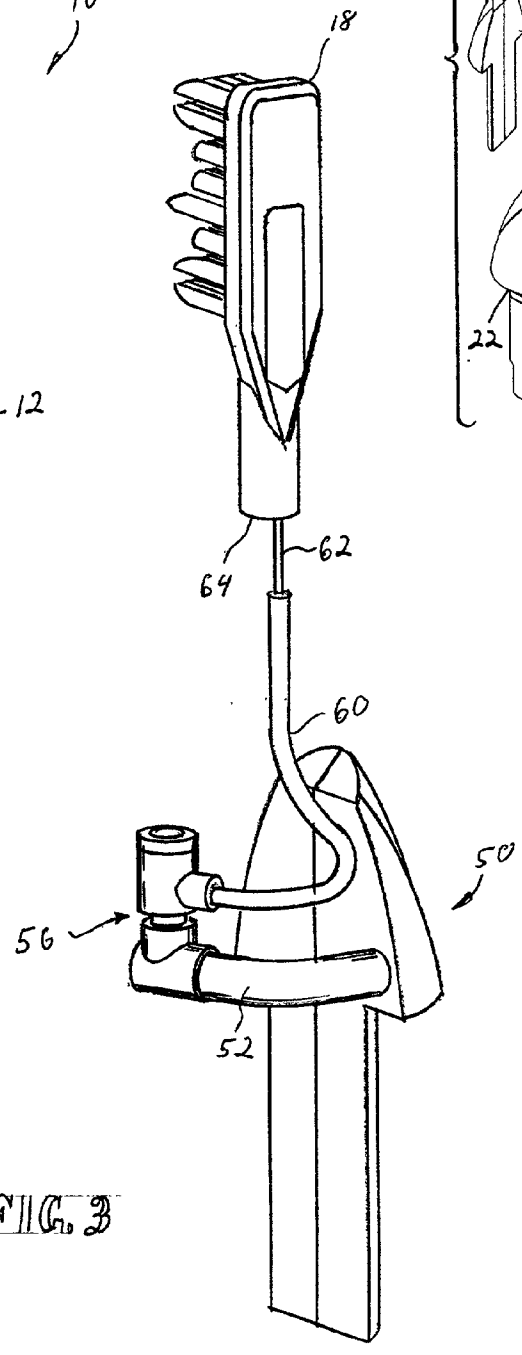


FIG. 3

FIG. 4A

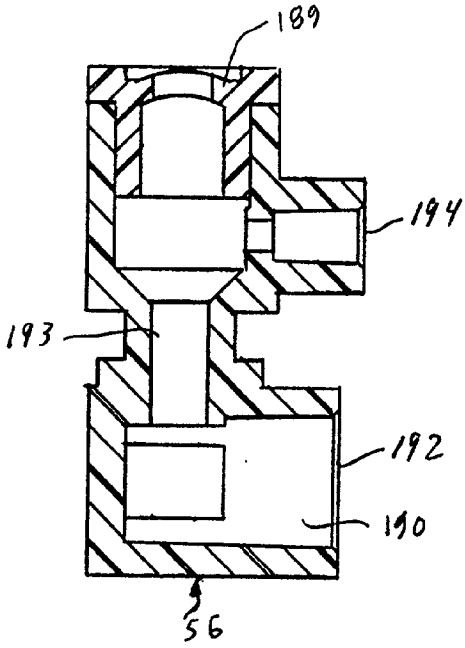
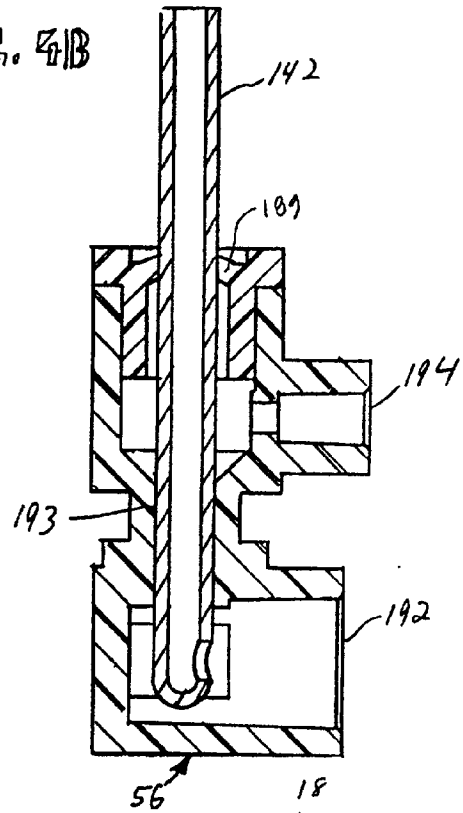


FIG. 4B



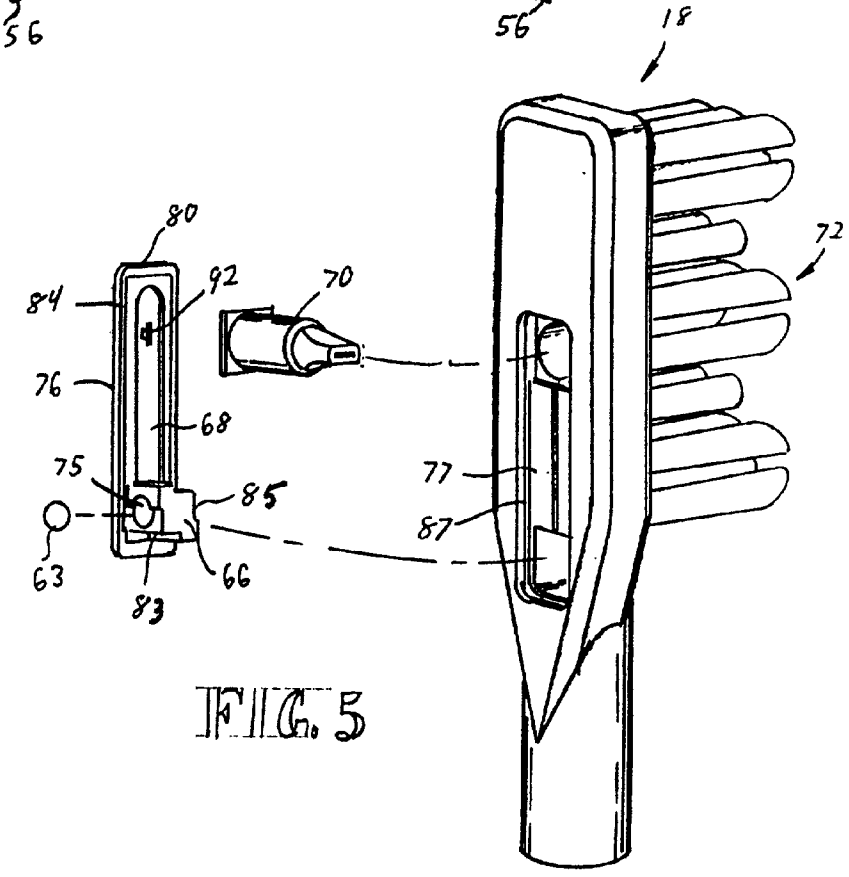


FIG. 5

FIG. 6

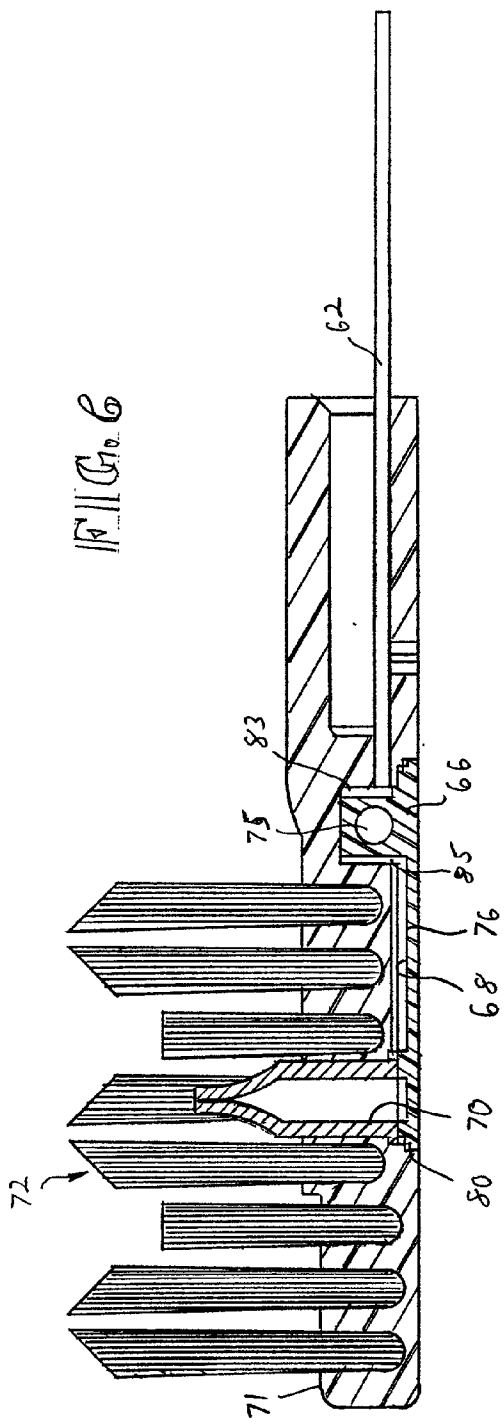


FIG. 7

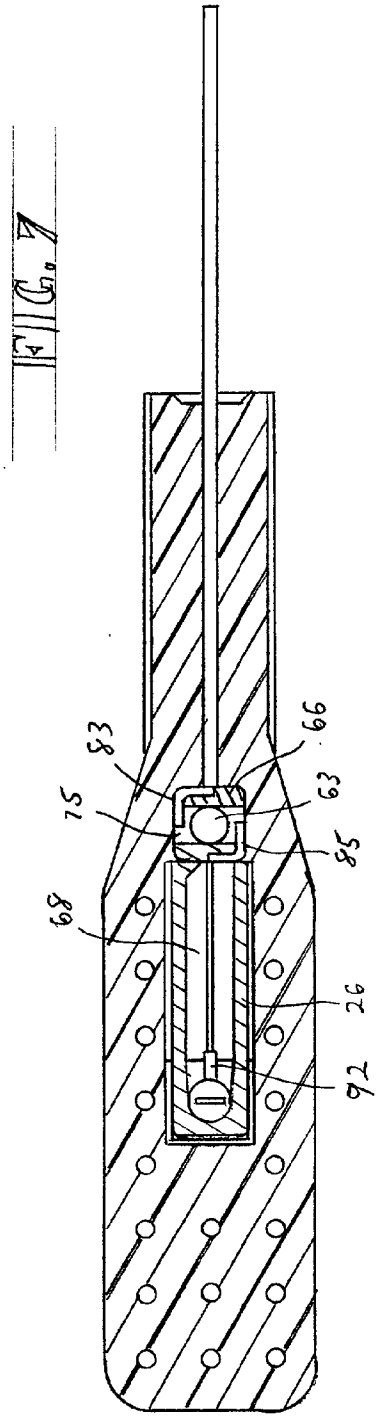


FIG. 8

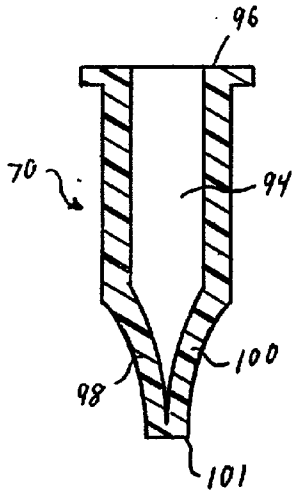
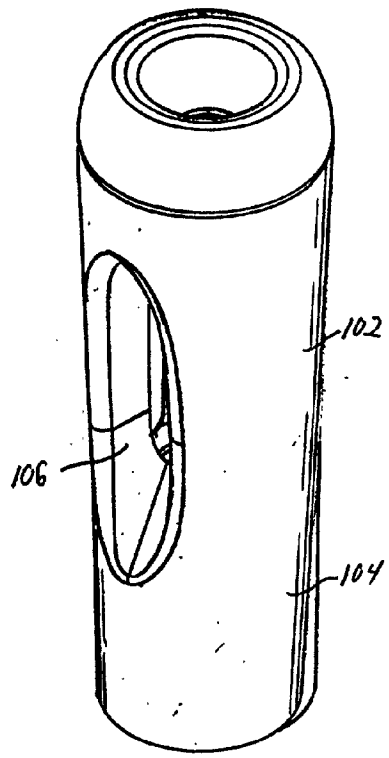


FIG. 9



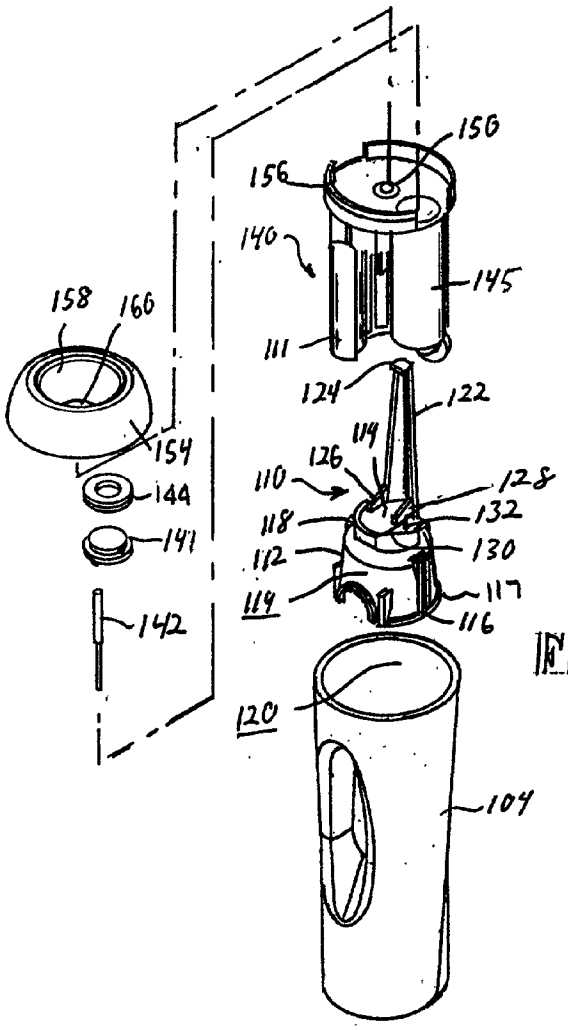


FIG. 10

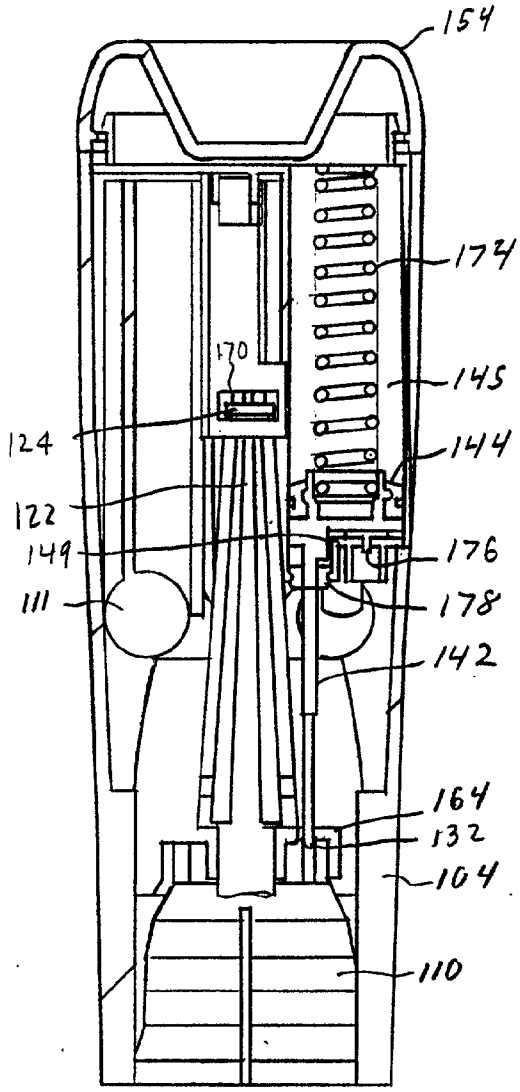

154
174
170
145
124
144
122
176
149
178
111
142
164
132
104
110

FIG. 11

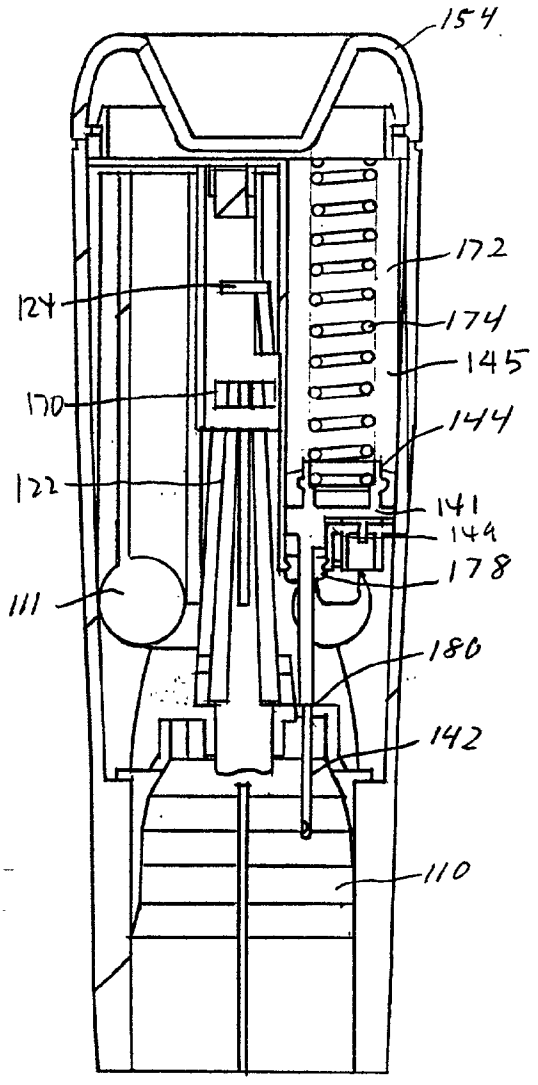

154
172
124
174
145
170
144
122
141
149
178
111
180
142
110

FIG. 12

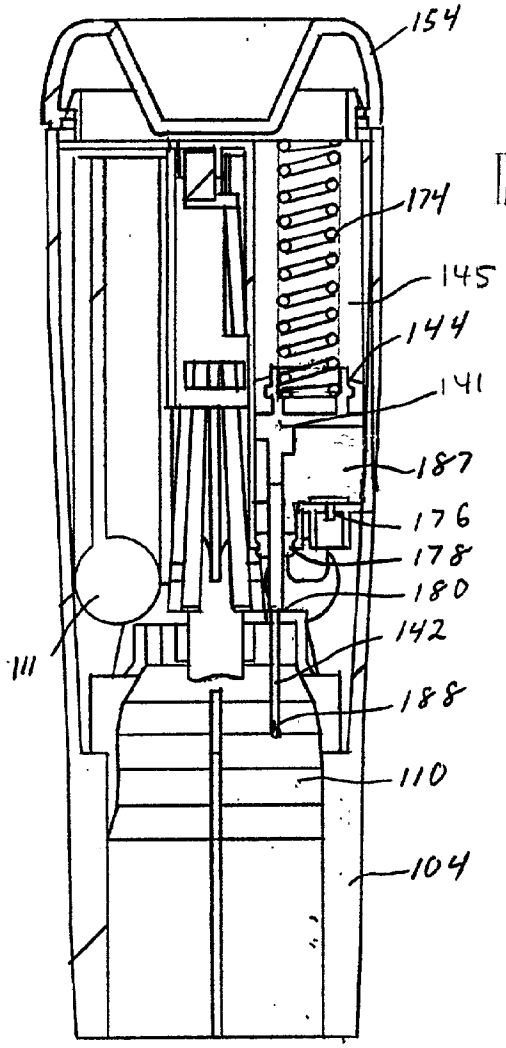

154
174
145
144
141
187
176
178
180
142
188
110
104
111

FIG. 13

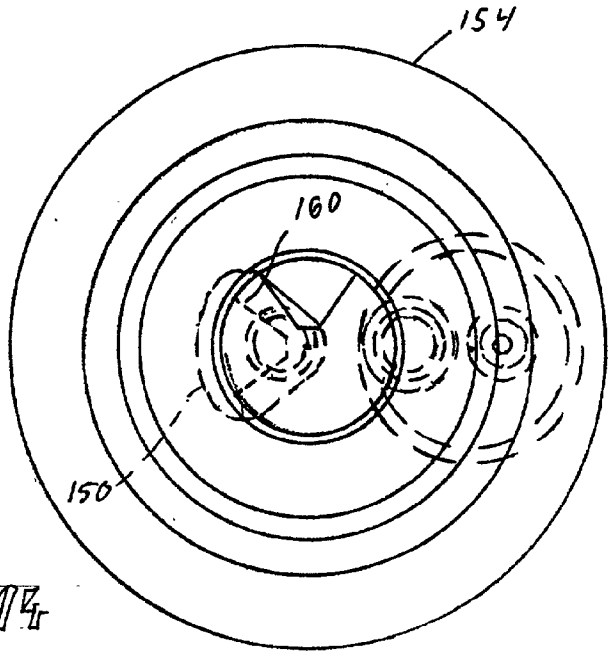

154
160
150

FIG. 14

FLUID-DISPENSING AND REFILLIG SYSTEM FOR A POWER TOOTHBRUSH

TECHNICAL FIELD

[0001] This invention relates generally to fluid-dispensing power toothbrushes, and more specifically concerns such a toothbrush which has an on-board reservoir and refilling arrangement and a fluid path arrangement which includes a pump element located in the brushhead portion of the toothbrush. The pump element uses the action of the moving brushhead to move fluid from the on-board reservoir to the bristles on the brushhead.

BACKGROUND OF THE INVENTION

[0002] The effective delivery of an oral dentifrice and/or medication capable of inhibiting or killing bacteria responsible for dental disease has long been desirable and has been the subject of a substantial amount of research effort. A wide variety of devices, both active and passive, have been developed to accomplish the delivery of dentifrice or medication to the bristles. Such devices have been developed for both manual and power toothbrushes. Manual toothbrushes typically use a hand-operated pump, such as shown in U.S. Pat. No. 4,221,492 to Boscardin et al and U.S. Pat. No. 4,413,370 to Gingras, while power toothbrushes use a variety of approaches, including on-board and external active pumping devices, which include various mechanical, pneumatic and hydraulic elements.

[0003] Some power toothbrush fluid-dispensing systems use the action of the toothbrush itself to draw a dentifrice from the reservoir to the bristles, such as shown in U.S. Pat. No. 5,309,590 to Giuliani et al. Some representative examples of fluid-dispensing systems for manual and power toothbrushes include U.S. Pat. No. 3,547,110 to Balamuth; U.S. Pat. No. 5,066,155 to English et al; U.S. Pat. No. 5,208,933 to Lustig and U.S. Pat. No. 5,062,728 to Kuo.

[0004] The reservoir for the dentifrice is typically located either in the handle portion of the toothbrush, such as shown in the '590 patent, or in a separate device, such as shown in the '110 patent. In some cases, the reservoir is disposable, so that when the fluid in the reservoir is depleted, the reservoir itself is discarded and a replacement reservoir is inserted. Such a system is shown in the '370 patent. In other systems, the reservoir is refillable. Typically, the reservoir contains sufficient fluid for a substantial number of individual uses of the fluid dentifrice or medication.

[0005] Various systems for dispensing the fluid from the brushhead are also known. In some cases, the fluid is dispensed from a plurality of openings in the brushhead itself, such as shown in the '492 patent, while in other cases, the fluid is dispensed through the bristles themselves, such as shown in U.S. Pat. No. 4,039,261 to Evans.

[0006] Fluid-dispensing systems in general, however, have often been difficult to operate, unreliable and expensive. Many such systems are too complex for reliable operation and/or are incapable of working properly, while other systems fail due to clogging of the fluid lines or exit openings, or poor pumping action, among other reasons. Also, it is difficult to design a system with a pump small enough to fit within a typical toothbrush structure. External pumps are often used, which are bulky and expensive. The pump element, whether on-board or external, is typically too complex for sustained, reliable operation, or too expensive to be practical. For all of these reasons, fluid-dispensing systems for both manual and power toothbrushes have not been particularly successful.

[0007] Because of the potential benefits, it is desirable to have a fluid-dispensing system in a power toothbrush which is reliable and yet sufficiently simple in design that it is practical to manufacture and maintain.

DISCLOSURE OF THE INVENTION

[0008] Accordingly, the present invention includes a fluid delivery system for a power toothbrush, comprising: a reservoir which is located within a toothbrush head portion of a power toothbrush, wherein the head portion is removable from the handle portion of the toothbrush; a pump member and associated fluid line for moving fluid from the reservoir to a brushhead part of the head portion of the toothbrush; and a dispensing member located in the brushhead, connected to the fluid line, for receiving fluid from the pump member and permitting exit of fluid therefrom to the vicinity of the bristles, under pressure provided by the pump member.

[0009] The invention also includes a pump for use in the fluid delivery system for a power toothbrush, comprising: a pump member for moving fluid from a reservoir to a dispensing member located in a brushhead portion of a toothbrush, wherein the pump member includes a chamber and a ball which moves within the chamber in response to movement of the brushhead during operation of the toothbrush, wherein movement of the ball in the chamber results in fluid moving from the reservoir into the pump member and then out of the pump member with sufficient pressure to move the fluid to the dispensing member and then outwardly therefrom.

[0010] The invention also includes a refilling system for a power toothbrush for use with a power toothbrush having an internal reservoir located therein from which fluid in operation is moved to the bristles in the brushhead, the internal reservoir having a small volume, at least one unit of use, the refilling system comprising: an external refilling assembly which is separate from the power toothbrush, the refilling assembly having a fluid reservoir which contains a substantial volume of fluid, at least a plurality of unit-of-use volumes of fluid; means associated with the refilling assembly and the power toothbrush for producing a fluid path from the refilling assembly to the power toothbrush; and means for moving fluid from the refilling assembly to the internal reservoir in the power toothbrush.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is a schematic view showing a toothbrush which incorporates the fluid-dispensing system of the present invention.

[0012] **FIG. 2** is a partially exploded view of the head portion of the toothbrush of **FIG. 1**.

[0013] **FIG. 3** is a schematic view showing a portion of the fluid-dispensing system of the present invention.

[0014] **FIGS. 4A and 4B** are cross-sectional views of a refill valve of the fluid-dispensing system of the present invention, with and without a refilling needle therein.

[0015] **FIG. 5** is a partially exploded view showing the pump member and the brushhead.

[0016] **FIGS. 6 and 7** are cross-sectional views showing the movement of fluid between the reservoir and the brushhead, including the pump element which moves the fluid.

[0017] **FIG. 8** is a cross-sectional view showing the dispensing valve of the fluid delivery system.

[0018] **FIGS. 9 through 13** are diagrams showing the refilling assembly of the present invention and the process of refilling the on-board reservoir of the toothbrush of **FIG. 1**.

[0019] **FIG. 14** is a top plan view of the refilling assembly.

BEST MODE FOR CARRYING OUT THE INVENTION

[0020] **FIG. 1** shows a typical power toothbrush in which the fluid-dispensing and refilling system of the present invention is used. It should be emphasized, however, that the present invention is not limited to the particular power toothbrush shown and described or a particular brushhead movement. Rather, the principles of the present invention can be used with a variety of power toothbrush configurations and structural arrangements, with some aspects of the invention even being usable in a manual toothbrush.

[0021] The power toothbrush of **FIG. 1**, shown generally at **10**, comprises a handle portion **12** and a removable head portion **14**. In the handle portion is a power unit, including an electromagnetic driver and a battery for moving a brushhead **18**, which is mounted on a pivoting arm, in a side-to-side manner, as discussed in more detail below. Toothbrush **10** is controlled by a pushbutton on/off switch **19**.

[0022] **FIG. 2** is an exploded view showing the principal parts of the head portion **14** of the toothbrush of **FIG. 1**. The head portion includes two mating body parts **22** and **24**, which are fitted together about a support member **32**. Body part **24** includes an extended shield **26** for brushhead **18**. Brushhead **18** is mounted on a pivot arm **30**, which in turn is mounted for pivoting action about a torsion pin pivot member **33**, which extends between opposing sides of support member **32**. Pivot arm **30** is driven by a electromagnetic driver (not shown) in handle portion **12** of the toothbrush, operating on magnetic elements **36** at the end of pivot arm **30**. The structure and operation of such a toothbrush is described in more detail in U.S. Pat. No. 5,378,153 to Giuliani et al, owned by the same assignee as the present invention.

[0023] Rubber seal **38** and plastic ring **40** seal arm **30** to the body parts **22** and **24**, preventing moisture from moving back into head portion **14**. A nut portion **15** connects head portion **14** to handle portion **12** through a threaded connection. Positioned in an internal cavity **46** formed by the two mated body portions **22** and **24** is an on-board reservoir **50**. On-board reservoir **50** is generally arrow-shaped in configuration, approximately 2 inches long, having front and rear similar flexible plastic panels joined together along the peripheral edges thereof. On-board reservoir **50** in the embodiment shown typically holds sufficient fluid for one brushing use, i.e. one "unit of use". This relatively small on-board reservoir volume is significant, in that it permits a fluid reservoir to be positioned in the removable head portion **14** of the toothbrush structure of **FIG. 1**. This arrangement has a number of advantages, including a relatively short fluid travel path and an overall simplicity of structure. Accordingly, when head portion **14** is replaced, such as when the bristles of brushhead **18** are worn, reservoir **50** as well as the associated fluid delivery system is part of the replacement unit.

[0024] Referring to **FIGS. 2 and 3**, extending from reservoir **50** is a short tube section **52** which fits into a lower end of a refilling valve **56**, which is explained in more detail below. Extending from the side of refilling valve **56**, above the entry point of tube section **52**, is a flexible fluid line **60** which in the embodiment shown is flexible plastic material approximately 0.10 inches in diameter and approximately 1 inch long. Fluid line **60** connects to a fluid inlet tube **62**, which has a diameter of approximately 0.05 inches, and extends into brushhead **18** at a proximal end **64** thereof.

[0025] FIGS. **5-8** show the fluid delivery structure within brushhead **18**, including a fluid pump **66**, a fluid-delivery cavity **68** which extends from pump **66** in a base element **76**, and a fluid-dispensing valve **70** which extends upwardly from delivery cavity **68**, through brushhead **18** above surface **71** of the brushhead, into the bristle region **72** of the toothbrush.

[0026] Fluid inlet tube **62** extends into brushhead **18** to where it contacts the entry region **83** (**FIG. 7**) of fluid pump **66**. Fluid pump **66** is an irregular block of material having a cylindrical opening **75** which extends laterally thereof. Fluid pump **66** is positioned at one end of the elongated base element **76**. Elongated base element **76** is approximately 0.03 inches thick and has a cutout or cavity portion **68** which extends from pump **66** to approximately the other end **80** of base element **76**. Cavity portion **68** in the embodiment shown is approximately 0.015 inches deep.

[0027] As shown in **FIG. 5**, fluid pump **66** and base element **76** in the embodiment shown form a unitary member, which fits into a matching cavity **77** in the lower surface of the brushhead. Cavity **77** is configured to provide a solid seal for the ends of cylindrical opening **75** in pump **66** when the unitary member is correctly positioned in cavity **77**. Fluid delivery cavity **68** connects exit portion **85** of pump **66** and the lower end of dispensing valve **70**. A lip **84** surrounding cavity **68** in base element **76** contacts a mating surface **87** in the brushhead when the unitary pump and base element are in place, providing a fluid-tight seal around cavity **68**. Cavity **68** thus serves as a fluid-delivery means connecting pump **66** with dispensing valve **70**.

[0028] Pump **66** is configured with opposing corners being relieved, the relieved portions extending, respectively, from the opposing open ends of cylindrical opening **75**, around adjacent corners of the block, to a point approximately half-way along the adjacent side of the pump **66**. This configuration is shown most clearly in **FIGS. 6 and 7**. A spherical ball **63**, which functions as a piston, rides in cylindrical opening **75**. Entry region **83** overlaps one end of opening **75**, while exit region **85** overlaps the other end of opening **75**. Exit region **85** connects to fluid delivery cavity **68** in the base element. Hence, there is a complete fluid path from tube **62** to cavity **68**. The ball **63** moves within cylindrical opening **75**, producing a pumping action for the fluid which enters opening **75**, as the brushhead moves from side to side in operation.

[0029] Proper clearance between ball **63** and the interior surface of cylindrical opening **75** is important for correct

pumping operation, with adequate fluid pressure to valve **70**. In the embodiment shown, the clearance is approximately 0.0015 inches.

[**0030**] In operation, during the outlet stroke, as the ball moves toward the exit or outlet region **85** for opening **75**, fluid is moved both toward the outlet region and also around the piston toward the inlet region **83** for opening **75**. On the return stroke of the piston (toward the inlet region **83**), the closed dispensing valve forces fluid to pass around the ball toward the outlet region, in preparation for the next outlet stroke. The flow rate is partially dependent on the amplitude of the brushhead movement and hence is a function of the loading of the toothbrush. When the brushhead system is a resonant system, such as described in the '153 patent, the flow rate increases when the bristles are in contact with the teeth. The pumping action will occur with or without a dispensing valve at the end of the fluid path and is self-priming in operation, i.e. it can pump air.

[**0031**] The action of the piston ball **63** moving back and forth in the opening due to the back and forth action of the brushhead forces fluid out of the outlet region **85** of the pump and allows fluid to enter inlet region **83** from fluid tube **62**. In the outlet region **85**, fluid moves around the corner of the pump block and along the adjacent side, bound by the walls of the brushhead cavity into which the pump and base element fits. The fluid moves into cavity **68** in base element **76**, around a small diverting member **92** near the end of cavity **68** into internal opening **94** of base portion **96** of the dispensing valve **70**.

[**0032**] The dispensing valve **70** is shown in **FIG. 8**. Internal opening **94** is approximately 0.07 inches in diameter. Valve **70** in the embodiment shown is 0.34 inches high. Valve **70** is known as a "duck bill" valve because it has two converging lip portions **98** and **100** at the free end **101** thereof. The two lip portions **98** and **100** are normally closed, i.e. pressed together, to prevent leakage and/or backflow of fluid. Fluid is moved by the back and forth action of the brushhead and the action of the pump, into valve **70**, with sufficient pressure to force apart the two lips **98** and **100**, dispensing the fluid into the area of the bristles in spurts on each "outlet" stroke of the piston. The valve shown not only prevents backflow of fluid, which is a potential source of contamination, but also assists in making the pump self-priming as well as determining the output flow speed and velocity.

[**0033**] The "duck bill" valve **70** is conventional, made out of a flexible plastic material to facilitate opening and closure of the lip portions **98** and **100**. In the embodiment shown, the free end of valve **70** extends above the base of the brushhead approximately 0.18 inches. It is located approximately in the middle of the bristles both longitudinally and laterally, although this is not necessary to proper operation of the system.

[**0034**] In operation, as brushhead **18** moves from side to side, such that piston ball **63** moves back and forth between the inlet and outlet ends of the cylindrical opening **75**, small volumes (approximately 0.00013 cc) of fluid will be successively moved from the reservoir through the pump **66** and then to the dispensing valve **70**. The lips **98**, **100** of valve **70** part slightly with each small surge of fluid, but close again after the surge has passed. The successive amounts of fluid are forced out into the bristle area and are delivered to the desired region of the teeth by the action of the moving bristles.

[**0035**] Hence, there is a continuous (in small successive spurts) delivery of fluid to the area of the bristles during bristle action. This system has several advantages over existing systems. First, the continuous (in the form of successive spurts or pulses) nature of the fluid delivery prevents the effect of the fluid from becoming diluted over the brushing time, which is the case when the fluid, be it conventional dentifrice or oral medication, is administered at the start of brushing. Second, the effect of the fluid is enhanced with the present invention because the fluid can be provided directly to the area of bristle action.

[**0036**] In the case of the particular action of the toothbrush shown, in the manner and with the operating characteristics, including frequency and amplitude, set forth in the '590 patent, the effect of the fluid, dentifrice or medication, is frequently enhanced due to the cavitation and other action of the fluid created by the bristle action. This is in addition to the precise delivery of the fluid to specific regions of interest in the mouth, including the gingival areas in the gum line and between the teeth.

[**0037**] Hence, the fluid-dispensing system of the present invention is not only practical and reliable, but it has a significant therapeutic effect when used under selected operating conditions, such as those produced by the action of the toothbrush in the '590 patent.

[**0038**] As indicated above, reservoir **50** in the embodiment shown has a unit-of-use volume, i.e. the volume is sufficient for one brushing of typical length, i.e. two minutes or so. The system of the present invention also includes a refilling system for the unit-of-use reservoir. The refilling system is shown in FIGS. **9-14**.

[**0039**] **FIG. 9** shows the refiller apparatus **102** in general, for use with the toothbrush of **FIG. 1**. To refill the unit-of-use reservoir **50** in the head portion of the toothbrush, the refiller apparatus **102** fits down over the top of the toothbrush, with the head portion and the brushhead portion of the toothbrush extending up into the interior of the refiller apparatus **102**. The refiller apparatus includes a housing **104**, with a viewing window **106** which shows a portion of the interior of the refiller apparatus so that the user can ascertain proper insertion of the toothbrush.

[**0040**] **FIG. 10** shows the various portions of the refiller apparatus. It includes housing **104** and an interior core element **110**. Core element **110** includes a lower portion **112** which is configured to receive and mate with an upper part of the head portion of the toothbrush. Brushhead **18** extends upwardly through an opening **114** in core element **110**. Core element **110** has opposing side tracks **116** and **118** which extend from a lower edge **117** of the core element upwardly thereof, on the exterior surface **119** thereof. Tracks **116** and **118** mate with corresponding mating channels (not shown) on interior surface **120** of housing **104**.

[**0041**] This arrangement permits the core element **110** to move up and down a selected distance within housing **104** in a reliable fashion, without rotation or side-to-side movement. Extending upwardly from the top of lower portion **112** of core element **110** is a narrow extending member **122**, with a horizontal lip **124** at the upper end thereof and two spaced

wing elements **126** and **128** at the base thereof, adjacent the top of the lower portion. Lower portion **112** of core element **110** also includes a flat surface portion **130** at the upper end thereof, adjacent wing element **128**. Extending through this flat surface portion **130** is a small opening **132**. Opening **132** conveniently and readily accommodates a refilling needle from the refilling apparatus.

[**0042**] Positioned above core element **110** is a pump assembly **140**, which includes therein a refilling reservoir **111**. Positioned within pump assembly **140** is a fill needle **142**, which is oriented vertically with a base portion **141** of the needle mounted to a seal assembly **144**, which fits into a pump chamber portion **145** of the pump assembly **140** in a sealing relationship to the interior peripheral surface of the pump chamber. In the top of the pump assembly **140** is an opening **150** which connects with refilling reservoir **111** within the pump assembly. A top element **154** snaps onto an upper lip **156** of pump assembly **140**. At the center of top element **154** is a cavity-like portion **158**, at the bottom of which is an opening **160** (shown partially in **FIG. 10**), which can be either in or out of registry with opening **150** in the pump assembly, depending upon the rotational position of the top element. The refiller reservoir **111** may be filled through these two openings **160** and **150** when the top element is in the correct position such that the two openings are in registry.

[**0043**] FIGS. **11-13** are cross-sectional diagrams showing the sequence of steps in the refilling process for the unit-of-use reservoir **50** in the toothbrush. In **FIG. 11**, the toothbrush has been just positioned within the refiller apparatus, with the core element **110** being at its lowermost position. In this position, lip **124** of extending member **122** remains in a receiving slot **170** within the refiller apparatus, as is the case when there is no toothbrush within the refiller. In this position, the lower end **164** of fill needle **142** just penetrates through opening **132** in surface **130** of the core element. The needle base **141** and seal assembly **144** are in their lowermost position within pump chamber **145**. A spring **174** within pump chamber **145** tends to maintain the needle base and seal assembly in their lowermost position. Chamber inlet valve **176** at the lower end of pump chamber **144** is in its closed (lowered) position, as shown. The body of needle **142** is sealed to the lower edge member **149** of chamber **145** by seal **178**.

[**0044**] As the toothbrush is inserted further into core element **110** by a user, the particularly configured curved shoulders of the head portion of the toothbrush push against the wing elements **126**, **128** at the base of extending member **122** (**FIG. 10**). This action forces the extending member **122** backwardly sufficiently that lip **124** at the top of the extending member moves out of receiving slot **170**, allowing the core member to move further up within the refiller apparatus. Further upward pressure on the toothbrush by the user results in further upward movement of the core element **110**, with fill needle **142** penetrating further through opening **132** in the core element and into refiller valve **56** of the head portion **14** of the toothbrush (shown in **FIG. 2**).

[**0045**] **FIG. 12** shows a mid-position of the movement of the core element where the upper surface of the core element **110** abuts a shoulder portion **180** of fill needle **142**. To achieve this mid-position, the core element has moved upwardly within the refilling apparatus, but neither the needle itself nor the seal assembly **144** to which base **141** of fill needle **142** is attached has moved within pump chamber **145**. Inlet valve **176** remains closed.

[**0046**] Referring now to **FIG. 13**, further upward movement of the toothbrush will result in further upward movement of core element **110** within the refilling assembly, the core element pushing upwardly against the shoulder portion **180** of fill needle **142**. The needle **142**, its base section **141** and the seal assembly **144** move upwardly within pump chamber **145**, against the action of spring **174**, producing a volume **187** between the needle base **141** and the lower end of pump chamber **145**. Fluid from the refilling reservoir is drawn into volume **187** by vacuum action through inlet valve **176**, which moves upwardly. Volume **187** fills with fluid as needle base **141** and seal assembly **144** move upwardly against the action of spring **174** in pump chamber **145**.

[**0047**] Fill needle **142** has spaced openings around its periphery where it joins base portion **141**. More particularly, needle **142** joins base portion **141** through a "cross-hair" structure, with the space between the adjacent portions of the cross-hair structure being open to the hollow interior of the needle. When the core element reaches its highest position within the refiller assembly, volume **187** has a capacity of approximately **4** ml, and is completely filled with fluid from the refilling reservoir **111**.

[**0048**] At this point, the brushhead is withdrawn slightly. When the brush is withdrawn, the action of spring **174** forces the seal assembly **144**, the base portion **141** of the needle and the fill needle **142** itself downwardly with pump chamber **145**, decreasing the volume **187**. The fluid in volume **187** is forced through the cross-hair openings at the base of the fill needle down into and through the hollow interior of fill needle **142** and out opening **188** at the lower end of the needle.

[**0049**] Opening **188** in needle **142** at this point is within the refilling valve in the toothbrush, as explained above. Referring to **FIGS. 4A and 4B**, needle **142** extends down through a top seal element **189** in the valve **56** to approximately the lower end **190** thereof. The valve **56** seals around the needle **142** in region **193**, preventing any backflow of fluid from the needle through outlet port **194**, which connects with fluid line **60**. Fluid coming out opening **188** in the needle moves through port **192** into fluid line **52** (**FIG. 3**), which leads to the on-board reservoir **50**.

[**0050**] The amount of fluid moved from the refilling apparatus into reservoir **50** is approximately 4 milliliters in the embodiment shown, which is the amount of fluid appropriate for one unit-of-use. Other amounts, however, could be dispensed to the on-board reservoir, if desired, depending on the capacity of the reservoir. When the toothbrush is sufficiently withdrawn from the refilling assembly, the needle, its base portion and the seal assembly are back to their original position in the refilling apparatus, as shown in **FIG. 12**. The toothbrush is then removed from the refiller apparatus, ready for a single use of fluid, i.e. a single brushing event. The refilling of the on-board reservoir **50** occurs prior to each brushing.

[**0051**] While the embodiment shown includes a single unit-of-use reservoir, with the reservoir being filled for each brushing, it is possible to modify the reservoir so as to have

fluid for more than one use. The external refilling assembly, however, will still be useful for convenient refilling of the reservoir, permitting use of a relatively small fluid reservoir on board the toothbrush, thus saving space and pumping requirements.

[0052] Hence, a new fluid-dispensing and refilling system for power toothbrushes has been described. The system includes a small unit-of-use reservoir in a removable head portion of the toothbrush. A fluid line extends from the reservoir to a small pump element located in the brushhead. The pump element, with the back and forth action of the brushhead, provides movement of the fluid from the reservoir to a dispensing valve in the head of the toothbrush, through which fluid moves to the bristles.

[0053] The on-board reservoir is refilled before each use by a separate refilling apparatus, into which the toothbrush is inserted. Movement of the brushhead relative to the refilling apparatus in a particular sequence results in fluid in the refiller reservoir moving through a fill needle and refiller valve in the head portion of the toothbrush into the on-board unit-of-use reservoir.

[0054] Although a preferred embodiment of the invention has been disclosed herein for illustration, it should be understood that various changes, modifications and substitutions may be incorporated in such embodiment without departing from the spirit of the invention, which is defined by the claims as follows.

What is claimed is:

1. A fluid delivery system for a power toothbrush, comprising:

reservoir means located within a toothbrush head portion of a power toothbrush, the head portion being removable from a handle portion thereof;

a pump member and associated fluid line for moving fluid from said reservoir means to a brushhead part of the head portion of the toothbrush; and

a dispensing member located in the brushhead, connected to said fluid line, permitting exit of fluid to the vicinity of the bristles, under pressure provided by the pump member.

2. A system of claim 1, including a refilling valve member located externally to said reservoir means, wherein the fluid line connects the reservoir means, the refilling valve, the pump member and the dispensing member.

3. A system of claim 1, wherein the pump member is located in the brushhead part.

4. A system of claim 3, wherein the pump member includes a chamber and a ball which moves within the chamber in response to the movement of the brushhead in operation of the toothbrush, wherein movement of the ball results in fluid moving from the reservoir means into the pump member and then from the pump member to the dispensing member in the brushhead.

5. A system of claim 4, wherein the chamber is cylindrical and extends laterally of the brushhead, and wherein the movement of the brushhead is from side to side.

6. A system of claim 1, wherein the dispensing member is a valve which is positioned in the brushhead such that a free end portion of said valve extends to a point which is above a base surface of the brushhead, in the midst of bristle portions of the brushhead.

7. A system of claim 6, wherein the free end portion of the valve includes a pair of flexible, normally closed lips which open to permit exit of fluid therefrom when fluid pressure is applied thereto by action of the pump member.

8. A system of claim 1, wherein the pump member is positioned on a base element which includes a channel therein which connects an outlet of the pump member to the dispensing member.

9. A system of claim 1, wherein the reservoir means has a capacity of approximately one unit-of-use of fluid.

10. A system of claim 1, wherein the fluid is a dentifrice.

11. A system of claim 1, wherein the fluid is a selected medication for treatment of an oral medical condition.

12. A system of claim 2, wherein the refilling valve member includes means for receiving a needle from a refilling apparatus and a port connecting to the reservoir means, wherein fluid is moved into the reservoir means from an external source thereof through the needle.

13. A system of claim 12, wherein the refilling valve includes a sealing portion which prevents backflow of fluid from the needle through the refilling valve.

14. A fluid delivery system for a power toothbrush, comprising:

reservoir means located within a toothbrush, the reservoir having a capacity of approximately one unit-of-use of fluid;

a pump member and associated fluid line for moving fluid from said reservoir means to a brushhead part of the toothbrush; and

a dispensing member located in the brushhead, connected to said fluid line, permitting exit of fluid to the vicinity of the bristles, under pressure provided by the pump means.

15. A system of claim 14, wherein the pump member is located in the brushhead.

16. A system of claim 14, wherein the pump member includes a chamber and a ball which moves within the chamber in response to the movement of the brushhead in operation of the toothbrush, wherein movement of the ball results in fluid moving from the reservoir means into the pump member and then from the pump member to the dispensing member in the brushhead.

17. A system of claim 14, wherein the dispensing member is a valve which is positioned in the brushhead such that a free end portion of said valve extends to a point which is above a base surface of the brushhead, in the midst of bristle portions of the brushhead.

18. A pump for use in a fluid delivery system for a power toothbrush, comprising:

a pump member for moving fluid from a reservoir of fluid to a dispensing member located in a brushhead portion of the toothbrush, wherein the pump member includes a chamber and a ball which moves within the chamber in response to movement of the brushhead during operation of the toothbrush, wherein movement of the ball in the chamber results in fluid moving from the reservoir into the pump member and then out of the pump member with sufficient pressure to move the fluid to the dispensing member and then out of the dispensing member.

19. A system of claim 18, wherein the chamber is cylindrical and extends laterally of the brushhead, and wherein the movement of the brushhead is from side to side.

20. A refilling system for a power toothbrush for use with a power toothbrush having an internal reservoir located therein from which fluid in operation is moved to the bristles in the brushhead, the internal reservoir having a small volume, at least one unit-of-use, the refilling system comprising:

an external refilling assembly separate from the power toothbrush, having a fluid reservoir which contains a substantial volume of fluid, at least a plurality of unit-of-use volumes;

means associated with the refilling assembly and the power toothbrush for establishing a fluid path from the refilling assembly to the power toothbrush; and

means for moving fluid through the fluid path from the refilling assembly to the internal reservoir in the power toothbrush.

21. A system of claim 20, including a refilling valve member in the power toothbrush, the valve member including a first connection leading to the reservoir in the toothbrush and a second connection leading to a pump member in the toothbrush.

22. A system of claim 20, wherein the refilling assembly is configured to permit insertion of the toothbrush thereinto in a cooperating relationship, such that when the toothbrush is in a selected relationship within the refilling assembly, said fluid path is established from the refilling assembly to the power toothbrush.

23. A system of claim 21, wherein the refilling assembly includes a refilling needle having an opening at one end thereof for exit of fluid through the refilling valve to the internal reservoir in the power toothbrush and an opening at the other end for receiving fluid from the reservoir in the refilling assembly, and wherein the toothbrush is adapted to fit into the refilling assembly such that the needle penetrates into the refilling valve when the refilling valve and the toothbrush are in a particular physical relationship.

24. A system of claim 20, wherein the refilling system includes a top member which is movable between two positions, wherein in one position an opening in the top member comes into approximate registry with an opening in a top surface of the remainder of the refilling system, leading to the reservoir therein, so that the reservoir in the refilling system can be conveniently refilled, and wherein in the other position, the opening in the top member is completely out of registry with the opening in the top surface of the remainder of the refilling system.

25. A system of claim 21, wherein the refilling assembly includes a core member which is movable within the refilling assembly, the core member being configured to receive an upper portion of the toothbrush, including the brushhead, such that when pressure is applied to the toothbrush against the core element, the core element moves, resulting first in a hollow needle element in the refilling assembly penetrating into the refilling valve in the toothbrush, and wherein further movement of the brushhead against the core element results in a further movement of the needle within the refilling assembly, the needle having a base portion and a sealing member positioned in a pump chamber portion of the refilling apparatus, wherein fluid moves into the pump chamber and then into the hollow needle as the toothbrush is moved to its highest point into the refilling assembly and then down again, the fluid moving through the needle, the refilling valve and into the toothbrush reservoir.

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