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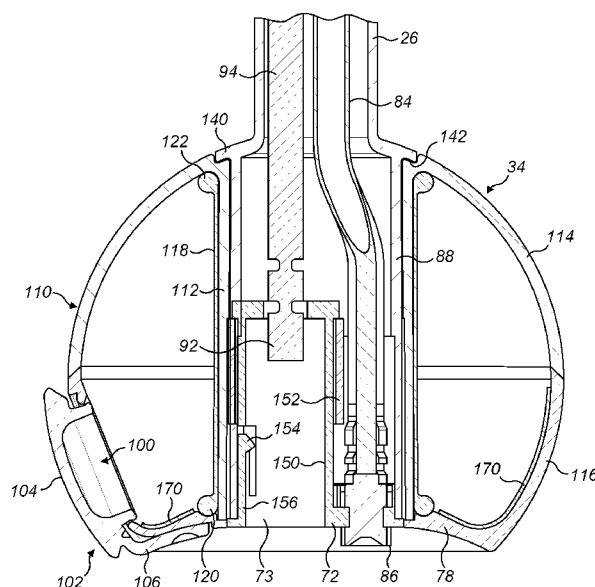


FIG. 10

(57) Abstract: A dental cleaning appliance includes a handle, and a cleaning tool detachably connected to the handle. The cleaning tool includes a nozzle for delivering a burst of working fluid to the teeth of a user, a stem extending between the handle and the nozzle, and a fluid reservoir for storing working fluid. The fluid reservoir is detachably connected to, and extends around, the stem. The fluid reservoir contains a coating or beads comprising a material, such as a phosphate glass, which is dissolvable in the working liquid.



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CLEANING APPLIANCE

FIELD OF THE INVENTION

The present invention relates to a cleaning appliance. The cleaning appliance is preferably a handheld cleaning appliance, and is preferably a surface treating appliance. In preferred embodiments of the invention, the appliance is a dental cleaning appliance. In a preferred embodiment, the appliance is an electric toothbrush having a fluid delivery system for delivering a fluid to the teeth of the user. This fluid may be toothpaste, or a fluid for improved interproximal cleaning. Alternatively, the appliance may not include any bristles or other elements for brushing teeth, and may be in the form of a dedicated interproximal cleaning appliance. The invention also relates to a cleaning tool for use with a dental cleaning appliance.

BACKGROUND OF THE INVENTION

Electric toothbrushes generally comprise a cleaning tool which is connected to a handle. The cleaning tool comprises a stem and a brush head bearing bristles for brushing teeth. The brush head comprises a static section which is connected to the stem, and at least one moveable section which is moveable relative to the static section, for example with one of a reciprocating, oscillating, vibrating, pivoting or rotating motion, to impart a brushing movement to bristles mounted thereon. The stem houses a drive shaft which couples with a transmission unit within the handle. The transmission unit is in turn connected to a motor, which may be driven by a battery housed within the handle. The drive shaft and the transmission unit convert rotary or vibratory motion of the motor into the desired movement of the moveable section of the brush head relative to the static section of the brush head.

It is known to incorporate into an electric toothbrush an assembly for generating a jet of fluid for interproximal cleaning. For example, US 8,522,384 describes an electric toothbrush in which the handle of the toothbrush defines a fluid chamber for storing a liquid such as water, and a slidable cover for enabling the fluid chamber to be accessed for replenishment by a user. A fluid path connects the fluid chamber to a nozzle located

on a static portion of the brush head. A pump located within the fluid path is actuated upon user operation of an actuator on the handle to pump fluid from the fluid chamber to the nozzle for release under pressure from the nozzle.

SUMMARY OF THE INVENTION

In a first aspect, the present invention provides a dental cleaning appliance comprising a handle; a nozzle for delivering a burst of working liquid to the teeth of a user, a stem extending between the handle and the nozzle, and a fluid reservoir for storing working liquid, wherein the fluid reservoir contains a material which is dissolvable in the working liquid.

The dissolvable material may be provided in the form of a layer of material applied to a surface of the fluid reservoir which is exposed to the stored working liquid. For example, the fluid reservoir may comprise a wall which defines, at least in part, the capacity of the fluid reservoir, and the dissolvable material may be applied to at least part of a surface of the wall which is exposed to the stored working liquid. The wall may be an external wall of the fluid reservoir, or an inner wall of the fluid reservoir. The dissolvable material may be in the form of a coating which is applied to at least part of an inner wall or an external wall of the fluid reservoir.

Alternatively, the dissolvable material may be in the form of a solid pellet, bead or tablet which is insertable into the fluid reservoir by a user. The pellet, for example, may be insertable into the fluid reservoir through a fluid port through which the fluid reservoir is replenished with working liquid.

The dissolvable material may comprise a water-soluble phosphate. The phosphate material may be in the form of a phosphate glass, for example a calcium sodium phosphate or a calcium sodium silicon phosphate, which will slowly dissolve in the water stored in the fluid reservoir to release minerals such as calcium phosphate, sodium phosphate and silica. The calcium ions within the released materials can be

beneficial for remineralization of voids or lesions formed in the enamel of the teeth of the user, whereas silica is widely used in toothpaste for stain removal.

5 The dissolvable material may comprise a dissolvable matrix impregnated with solid particles which become dispersed within the stored working liquid as the matrix dissolves into the working liquid. The solid particles may comprise, for example, mica or glycine particles which are delivered to the teeth of the user within a burst of working liquid, for example, to assist with the removal of matter located within the interproximal gap of the user, or with the disruption of plaque layers formed on the user's teeth. The
10 solid particles may comprise calcium sodium phosphate glass particles, which may fill channels present in sensitive teeth, or titanium dioxide particles.

The dissolvable matrix may comprise an inorganic or an organic material, such as an acrylate or a vinyl polymer. Such a material may also be provided without solid
15 particles, and may be a surface active material which can assist with the teeth cleaning process. The organic polymer material may be functionalized, for example with lauryl sulphate groups, to improve the cleaning process, or to deliver fluoride or a chelator such as EDTA (ethylenediaminetetraacetic acid). The dissolvable material may also comprise an organic polymer which inhibits the build-up of scale or microorganisms
20 within the fluid reservoir.

The dissolvable material may also comprise other materials, such as a fluoride for improved teeth cleaning, or an antibacterial material. For example, the dissolvable material may comprise silver particles having antibacterial properties.

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The stem of the appliance is preferably detachably connected to the handle. This allows the stem to be replaced, for example, when the nozzle has become worn, to allow a replacement stem having a different size or shape to be connected to the handle, or to allow a different user to attach a personal stem to the handle. The stem preferably forms
30 an interference fit with the handle.

The fluid reservoir is preferably detachably connected to the stem. The fluid reservoir may be detached from the stem when the dissolvable material has become depleted. The fluid reservoir preferably extends around, or surrounds, the stem. The fluid reservoir preferably forms an interference fit with the stem.

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Each of the connections between the stem and the fluid reservoir, and between the stem and the handle, is preferably in the form of an interference fit. This allows the stem to be pulled from the handle by the user separately from, or together with, the fluid reservoir. When the stem is pulled from the handle with the fluid reservoir, the fluid reservoir may be subsequently pulled from the stem. The fluid reservoir is preferably detachably connected to a base section of the stem, from which it may be pulled by the user in a direction extending away from the nozzle. The fluid reservoir preferably also forms an interference fit with the handle.

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15 The appliance preferably comprises a cleaning tool detachably connected to the handle. The cleaning tool preferably comprises the nozzle, the stem and the fluid reservoir of the appliance. This enables a user to either detach the stem and the fluid reservoir simultaneously from the handle, for example as part of the cleaning tool to enable the entire cleaning tool to be replaced, or detach the stem from the handle separately from
20 the fluid reservoir, to enable only the stem of the cleaning tool to be replaced.

The dissolvable material may be provided with a pigment or coloring agent which allows a user to identify when the dissolvable material has become depleted. At least part of the external wall of the fluid reservoir is preferably transparent, and is preferably
25 formed from transparent plastics material to allow a user to see the volume of working fluid within the fluid reservoir, and the amount of dissolvable material remaining in the fluid reservoir.

In a preferred embodiment, the external wall preferably has one of a curved shape, a convex shape, and a faceted shape. The external wall may have a curvature which is one
30 of ellipsoidal, spheroidal and spherical.

The fluid reservoir may comprise an inner wall which is connected to the external wall. The inner wall may be annular or tubular in shape, and located around the stem so as to provide a sleeve which forms a connection with the stem when the fluid reservoir is mounted on the stem. Both ends of the inner wall may be joined, for example using a welding technique or using an adhesive, to the external wall. Alternatively, the inner wall may be integral with at least part of the external wall. In a preferred embodiment, the external wall comprises an upper section and a lower section. The inner wall is preferably integral with the upper section of the external wall, and is joined to the lower section of the external wall. The fluid port is preferably formed in the lower section of the external wall, which is preferably integral with the bottom wall of the fluid reservoir. The upper section of the external wall is preferably formed from relatively transparent material. The lower section of the external wall may be formed from relatively opaque material, or from the same relatively transparent material as the upper section of the external wall. The dissolvable material may be in the form of a layer of material coating at least part of the internal surface of the lower section of the external wall.

The inner wall preferably forms an interference fit with the stem to prevent the fluid reservoir from inadvertently sliding from the stem when the cleaning tool is detached from the handle. The inner wall preferably forms an interference fit with a cylindrical, external surface of the stem.

The nozzle preferably forms part of a fluid delivery system of the appliance. The fluid delivery system preferably comprises a pump and a control circuit for actuating the pump to draw working fluid from the fluid reservoir and eject a burst of working fluid towards the nozzle. As the nozzle is moved between adjacent teeth of the user, the user may depress a button of a user interface provided on the handle to actuate the pump to cause a burst of working fluid to be ejected from the nozzle. Alternatively, the appliance may be configured to actuate the delivery of working fluid to the teeth of the user automatically depending on the magnitude of an output from a sensor for detecting that

the nozzle is located within an interproximal gap. For example, the sensor may be in the form of a light detector, such a camera or a light sensor, for receiving light, such a visible light or infrared light, reflected from a user's teeth. As another alternative, the appliance may be configured to actuate the delivery of working fluid to the teeth of the user automatically at a fixed frequency, for example between 0.5 and 5 Hz.

The fluid delivery system preferably comprises a cleaning tool conduit system and a handle conduit system. The handle conduit system preferably comprises a fluid inlet port for receiving working fluid from a fluid outlet port of the fluid reservoir. The fluid outlet port of the fluid reservoir is preferably formed in the bottom wall of the fluid reservoir. The handle conduit system comprises a plurality of conduits for conveying working fluid between the fluid inlet port, the pump and a fluid outlet port of the handle. The cleaning tool conduit system preferably comprises a fluid inlet port for receiving a burst of working fluid from the handle fluid outlet port, and at least one conduit for conveying the burst of working fluid to the nozzle.

The handle preferably comprises a spigot to which the stem is detachably connected. The spigot is generally cylindrical in shape, and comprises an external cylindrical surface which preferably forms an interference fit with an inner surface of the stem. The fluid outlet port of the handle is preferably located on the spigot. The stem is preferably pushed on to the spigot by the user. The inner surface of the stem is preferably generally cylindrical or tubular in shape, and is preferably formed from resilient material so that radial forces generated as the stem is mounted on the spigot act to retain the stem on the spigot. A resilient member, such as a spring clip, may be provided about the inner surface of the stem for urging, or biasing, the inner surface radially inwardly.

The handle may comprise an annular seat extending about the spigot for receiving the fluid reservoir. The fluid inlet port of the handle is preferably located on the seat so that the fluid outlet port of the fluid reservoir connects to the fluid inlet port of the handle when the fluid reservoir is mounted on the seat.

The entire inner wall of the fluid reservoir, along with the external wall of the fluid reservoir, may be formed from relatively rigid plastics material, so that the capacity of the fluid reservoir is fixed and is defined by the internal surfaces of the external wall and the inner wall. Alternatively, a part of the inner wall of the reservoir, or a separate component which partially delimits the fluid reservoir, may be moveable relative to the external wall to vary the volume of the fluid reservoir. This moveable member may be moved by a piston or other device which is actuated by a control circuit to reduce the volume of the fluid reservoir as working fluid is drawn from the fluid reservoir, for example by a pump located in the handle. This can inhibit the formation of an air lock within the fluid reservoir as working fluid is drawn therefrom. The piston may be actuated by the control circuit simultaneously with the actuation of the pump to draw working fluid from the fluid reservoir so that the reduction in the volume of the fluid reservoir is equal to the volume of working fluid which is drawn from the fluid reservoir by the pump.

Alternatively, this moveable member may be moveable in response to a pressure difference established across the surfaces thereof as working fluid is drawn from the fluid reservoir. The appliance may comprise an expansion chamber located adjacent to the moveable member, preferably to one side of the moveable member, and which increases in volume as the volume of the fluid reservoir decreases as working fluid is drawn from the fluid reservoir.

The expansion chamber may contain a pressurized gas which exerts a force on the moveable member which causes the moveable member to move as working fluid is drawn from the fluid reservoir. However, the expansion chamber is preferably open to the atmosphere to receive ambient air as the volume of the expansion chamber increases.

The external wall is preferably formed from relatively rigid material, and the moveable member is preferably formed from relatively flexible material. In a preferred embodiment, the moveable member comprises a diaphragm or bladder which is

expandable in response to a pressure difference across the surfaces thereof. The dissolvable material may be in the form of a layer of material coating at least part of the surface of the diaphragm which delimits the fluid reservoir.

- 5 The external wall preferably surrounds the diaphragm. The diaphragm is preferably annular or tubular in shape, and preferably has opposite ends which are connected to the external wall, preferably at diametrically opposed locations on the external wall, or to the inner wall, preferably at opposite ends of the inner wall. The external wall, the inner wall and the diaphragm preferably extend about a common longitudinal axis so that as
10 water is drawn from the fluid reservoir the diaphragm expands outwardly away from the longitudinal axis.

The diaphragm preferably extends about the expansion chamber so that a relatively uniform force is applied over the surface of the diaphragm to pull the diaphragm
15 towards the external wall of the fluid reservoir as working fluid is drawn from the fluid reservoir. This can promote a uniform expansion of the diaphragm as working fluid is drawn from the fluid reservoir. To minimize the number of components of the appliance, preferably the diaphragm at least partially delimits the expansion chamber. For example, the diaphragm may be located between, and define a barrier between, the
20 expansion chamber and the fluid reservoir. The expansion chamber is preferably annular in shape. The expansion chamber may be delimited by the diaphragm and the stem. Alternatively, the expansion chamber may be delimited by the diaphragm and a wall which defines a port through which air enters the expansion chamber. The wall of the expansion chamber preferably extends around, and is coaxial with, the stem. The wall of the
25 the expansion chamber is preferably connected to the external wall and the diaphragm, and is preferably provided by the inner wall of the fluid reservoir.

As the diaphragm expands, the size and shape of the diaphragm approaches that of the external wall of the fluid reservoir. In other words, when the diaphragm is in a fully
30 expanded configuration, which occurs when the fluid reservoir is empty, the size and shape of the diaphragm are preferably substantially the same as the external wall of the

reservoir. When the diaphragm is in a fully contracted or deflated configuration, which occurs when the fluid reservoir has been filled to capacity, the size and shape of the diaphragm are preferably substantially the same as the inner wall of the fluid reservoir. Thus, the expansion chamber preferably has a maximum volume which is substantially the same as the maximum volume of the fluid reservoir.

As mentioned above, at least part of the external wall of the fluid reservoir is preferably transparent, which allows the user to see both the contents of the fluid reservoir and, when the working fluid is water, the diaphragm. At least part of the diaphragm is preferably formed from colored material, or otherwise bears an identifier which serves to distinguish the cleaning tool of the appliance from others. This can allow a cleaning tool to bear an identifier which can serve to distinguish that cleaning tool from those of other users of the appliance, or to distinguish the appliance from other similar appliances. For example, the cleaning tool may form one of a set of similar cleaning tools, where each cleaning tool within the set has a respective different such identifier.

The appliance may be in the form of a dedicated interproximal cleaning appliance for cleaning between the gaps in the user's teeth. Alternatively, the appliance may be in the form of a toothbrush which has the additional function of improved interproximal cleaning through the emission of a burst of working fluid into the interproximal gap. Where the appliance is in the form of a toothbrush, the cleaning tool, or stem, preferably comprises a plurality of bristles. The bristles are preferably arranged around the nozzle, and may be arranged circumferentially about the nozzle. A plurality of bristles may be attached to a static section of the cleaning tool, which section is not moveable relative to the handle. Alternatively, or additionally, a plurality of bristles may be attached to a moveable section of the cleaning tool, which section is moveable relative to the handle. In a preferred embodiment, the appliance comprises a brush unit comprising a bristle carrier and a plurality of bristles mounted on the bristle carrier, with the bristle carrier being moveable relative to the handle.

As mentioned above, the stem, or the entire cleaning tool, is preferably detachably connected to the handle. This can allow the appliance to be provided with a set of similar cleaning tools, each with a respective different identifier. This can also allow an appliance to be provided with a set of dissimilar stems or cleaning tools. For example, the set of cleaning tools may be selected from two or more of a first type of cleaning tool with a nozzle and a moveable brush unit, a second type of cleaning tool with a nozzle and a static brush unit, and a third type of cleaning tool with a nozzle and no bristles. A number of respective different cleaning tools of the same type may also be provided, for example, of the first type of cleaning tool, with bristles having a respective different stiffness, or with nozzles having respective different fluid outlet sizes.

The appliance is preferably a handheld appliance which includes all of the aforementioned components of the appliance.

The cleaning tools may be sold as stand-alone items, for example as spare parts or as alternative cleaning tools for use with an existing handle.

In a second aspect, the present invention provides a cleaning tool for a dental cleaning appliance comprising a handle to which the cleaning tool is detachably connectable, the cleaning tool comprising a stem; a nozzle for delivering the burst of working fluid to the teeth of a user; and a fluid reservoir for storing working liquid, wherein the fluid reservoir contains material which is dissolvable in the working liquid.

Features described above in connection with the first aspect of the invention are equally applicable to the second aspect of the invention, and vice versa.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred features of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1(a) is a right side view of a dental cleaning appliance, Figure 1(b) is a front view of the appliance, and Figure 1(c) is a left side view of the appliance;

Figure 2 illustrates schematically components of a fluid delivery system for delivering a burst of a working fluid to the teeth of a user;

Figure 3 is a right side perspective view, from above, of a cleaning tool of the appliance;

Figure 4 is a right side perspective view, from above, of a handle of the appliance;

Figure 5 is a side sectional view of part of the cleaning tool;

Figure 6(a) is a sectional schematic view of a fluid reservoir of the cleaning tool, and with a diaphragm of the fluid reservoir in a fully contracted configuration, Figure 6(b) is a similar view to Figure 6(a) but with the diaphragm in a partially expanded configuration, and Figure 6(c) is a similar view to Figure 6(a) but with the diaphragm in an almost fully expanded configuration;

Figure 7 is a perspective view of the appliance, with the cleaning tool detached from the handle;

Figure 8 is a perspective view of the appliance, with a stem of the cleaning tool detached from the handle;

Figure 9 is a perspective view of a disassembled appliance, with the fluid reservoir detached from the stem;

Figure 10 is a side sectional view of part of a cleaning tool having a dissolvable material formed on an internal surface of an external wall of the fluid reservoir;

Figure 11 is a side sectional view of part of a cleaning tool having a dissolvable material formed on a surface of the diaphragm of the fluid reservoir; and

5 Figure 12 is a side sectional view of part of a cleaning tool having a dissolvable bead of material housed within the fluid reservoir.

DETAILED DESCRIPTION OF THE INVENTION

10 Figures 1(a) to 1(c) illustrate external views of an embodiment of a dental cleaning appliance 10. In this embodiment, the appliance is in the form of a handheld appliance, which is in the form of an electric toothbrush having an integrated assembly for dispensing a working fluid for improved interproximal cleaning.

15 The appliance 10 comprises a handle 12 and a cleaning tool 14. The handle 12 comprises an external body 16 which is gripped by a user during use of the appliance 10. The body 16 is preferably formed from plastics material, and is preferably generally cylindrical in shape. The handle 12 comprises a plurality of user operable buttons 18, 20, 22 which are located within respective apertures formed in the body 16 so as to be accessible to the user. The handle 12 may comprise a display which is positioned so as to be visible to a user during use of the appliance.

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The cleaning tool 14 comprises a stem 26 and a head 28. The stem 26 is elongate in shape, which serves to space the head 28 from the handle 12 to facilitate user operability of the appliance 10. In this embodiment, the head 28 of the cleaning tool 14 comprises a brush unit 29, which comprises a bristle carrier 30 and a plurality of bristles 32 mounted on the bristle carrier 30. However, in other embodiments the cleaning tool 14 may be provided without a brush unit 29 so that the appliance is in the form of a dedicated interproximal cleaning appliance for cleaning between the gaps in the user's teeth.

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30 The cleaning tool 14 also comprises a fluid reservoir 34 for storing a working fluid, and a nozzle 36 for delivering one or more bursts of working fluid to the teeth of the user during use of the appliance 10. The fluid reservoir 34 is connected to the stem 26. The

fluid reservoir 34 extends at least partially around the stem 26. In this embodiment which includes a brush unit 29, the brush unit 29 extends at least partially around the nozzle 36.

- 5 The nozzle 36 forms part of a fluid delivery system 40 for receiving working fluid from the fluid reservoir 34 and for delivering bursts of working fluid to the teeth of a user during use of the appliance 10. The tip of the nozzle 36 comprises a fluid outlet 42 through which a burst of working fluid is delivered to the teeth of the user. The fluid delivery system 40 is illustrated schematically in Figure 2. In overview, the fluid
- 10 delivery system 40 comprises a fluid inlet 44 for receiving working fluid from the fluid reservoir 34. In this embodiment, the working fluid is a liquid working fluid, which is preferably water. The fluid delivery system 40 comprises a pump assembly 46 for drawing working fluid from the fluid reservoir 34 through the fluid inlet 44, and for delivering a burst of working fluid to the nozzle 36. The pump assembly 46 is located
- 15 within the handle 12, and comprises a positive displacement pump 48 and a drive for driving the pump 48. The drive preferably comprises a motor 50. A battery 52 for supplying power to the motor 50 is also located in the handle 12. The battery 52 is preferably a rechargeable battery.
- 20 A first conduit 54 connects the fluid inlet 44 of the fluid delivery system 40 to a fluid inlet 56 of the pump 48. A first one-way valve 58 is located between the fluid inlet 44 and the pump 48 to prevent water from returning to the fluid reservoir 34 from the pump 48. A second conduit 60 connects a fluid outlet 62 of the pump 48 to the nozzle 36. A second one-way valve 64 is located between the pump 48 and the nozzle 34 to
- 25 prevent water from returning to the pump 48. A control circuit 66 controls the actuation of the motor 50, and so the motor 50 and the control circuit 66 provide a drive for driving the pump 48. The battery 52 supplies power to the control circuit 66. The control circuit 66 includes a motor controller, which supplies power to the motor 50.
- 30 In this embodiment, the control circuit 66 receives signals generated when the user depresses the buttons 18, 20, 22 located on the handle 12 of the appliance 10.

Alternatively, or additionally, the control circuit 66 may receive signals which are generated by a sensor located within the appliance, or which are received from a remote device, such as a display or a personal device. For brevity, in the following description the control circuit 66 receives signals which are generated when the user operates one of the buttons 18, 20, 22.

The cleaning tool 14 is detachably connected to the handle 12. With reference to Figures 3 to 5, the handle 12 comprises a male connector, preferably in the form of a spigot 70, which is received by a complementary female connector, preferably in the form of a recessed connector 72, of the cleaning tool 14. The recessed connector 72 defines a generally cylindrical recess 73 for receiving the spigot 70. The spigot 70 preferably protrudes outwardly from an end surface 74 of the body 16, and preferably in a direction which is parallel to a longitudinal axis of the handle 12. The end surface 74 defines an annular seat 76 for receiving an annular bottom wall 78 of the fluid reservoir 34 when the cleaning tool 14 is mounted on the handle 12. The annular seat 76 comprises the fluid inlet 44 of the fluid delivery system 40. The fluid inlet 44 receives fluid from a reservoir fluid outlet port 80 of the fluid reservoir 34 when the cleaning tool 14 is mounted on the handle 12.

The second conduit 60, which connects the fluid outlet 62 of the pump 48 to the nozzle 36, comprises a handle conduit section located within the handle 12, and a cleaning tool conduit section located within the cleaning tool 14. The handle conduit section extends from the fluid outlet 62 of the pump 48 to a handle fluid outlet port 82 located adjacent to the spigot 70. The cleaning tool conduit section 84 extends from a cleaning tool fluid inlet port 86 to the nozzle 36. The cleaning tool fluid inlet port 86 protrudes from the base of the recessed connector 72. The recessed connector 72 is housed within, and connected to, a relatively wide base section 88 of the stem 26.

As mentioned above, the cleaning tool 14 includes a bristle carrier 30 which is moveable relative to the stem 26. The appliance 10 comprises a drive mechanism for driving the movement of the bristle carrier 30 relative to the stem 26. The drive

mechanism comprises a transmission unit connected to the bristle carrier 30, and a drive unit for driving the transmission unit to move the bristle carrier 30 relative to the stem 26.

- 5 The handle 12 comprises the drive unit of the drive mechanism. The drive unit comprises a motor, preferably in the form of a dc motor, which is actuated by the control circuit 66 in response to the user depression of one or more of the buttons of the handle 12. The motor of the drive unit is connected via a gear train to a rotatable drive unit coupling member 90 which protrudes outwardly from the spigot 70, and which
10 rotates relative to the body 16 upon actuation of the motor of the drive unit.

- The cleaning tool 14 comprises the transmission unit of the drive mechanism. The transmission unit comprises a transmission unit coupling member 92 which couples with, and preferably receives, the drive unit coupling member 90 when the cleaning tool
15 14 is connected to the handle 12. The transmission unit coupling member 92 is connected to, and is preferably integral with, one end of a connecting rod 94 housed within the stem 26. The other end of the connecting rod 94 is connected to the side surface of the bristle carrier 30 so that periodic rotation of the connecting rod 94 about a 15° angle results in a 15° sweeping movement of the bristle carrier 30 relative to the
20 stem 26.

- The fluid reservoir 34 is mounted on, and extends at least partially around, the stem 26 of the cleaning tool 14. In this embodiment, the fluid reservoir 34 is annular in shape, and so surrounds the stem 26. The fluid reservoir 34 is preferably located at or towards
25 the end of the stem 26 which is remote from the head 28, and so in this embodiment extends around the base section 88 of the stem 26. The fluid reservoir 34 preferably has a capacity in the range from 5 to 50 ml, and in this embodiment has a capacity of 25 ml.

- The fluid reservoir 34 is filled through a reservoir fluid inlet port 100 formed in the
30 external wall of the fluid reservoir 34. The fluid inlet port 100 is preferably formed in an annular external side wall 110 of the fluid reservoir 34. The reservoir fluid inlet port

100 is sealed by a closure member 102. The closure member 102 is moveable relative to the fluid reservoir 34 between a closed position, as shown in Figure 3, in which the closure member 102 inhibits the leakage of working fluid from the reservoir fluid inlet port 100, and an open position. In this embodiment, the closure member 102 is pivotably connected to the fluid reservoir 34. The closure member 102 is locatable within, and forms a fluid-tight seal against, the reservoir fluid inlet port 100. The closure member 102 comprises a head 104 which may be gripped by the user to move the closure member 102 from the closed position to the open position, and which may be pushed by the user towards the reservoir fluid inlet port 100 to return the closure member 102 to the closed position.

The closure member 102 is connected to the fluid reservoir 34 by a pair of arms 106. One end of each arm 106 is connected to the closure member 102, and the other end of each arm 106 is connected to the fluid reservoir 34. In this embodiment, the arms 106 are integral with the closure member 102, with a portion of each arm 106 which is remote from the closure member 102 being connected to the bottom wall 78 of the fluid reservoir 34, for example using an adhesive or by welding. Each arm 106 comprises a hinge 108, which may be formed from a part of the arm 106 which has a locally reduced thickness, to enable the part of the arm 106 which is connected to the closure member 102 to pivot relative to the other part of the arm 106 which is connected to the fluid reservoir 34.

To fill the fluid reservoir 34, the user detaches the cleaning tool 14 from the handle 12, as explained in more detail below, grips the head 104 of the closure member 102 between finger and thumb and pulls it out from the reservoir fluid inlet port 100. The fluid reservoir 34 may then be filled by the user, for example by locating the reservoir fluid inlet port 100 beneath a running tap. Once the fluid reservoir 34 has been filled, the user pushes the head 104 of the closure member 102 back into the reservoir fluid inlet port 100, and reconnects the cleaning tool 14 to the handle 12. The pivoting connection between the closure member 102 and the bottom wall 78 of the fluid reservoir 34 inhibits accidental loss of the closure member 102 while the reservoir fluid

inlet port 100 is exposed, and enables the joint between the closure member 102 and the fluid reservoir 34 to be located between the handle 12 and the fluid reservoir 34 when the cleaning tool 14 is mounted on the handle 12. As shown in Figure 3, the lower parts of the arms 106 of the closure member 102 are located within a recessed section of the bottom wall 78 of the fluid reservoir 34 when the closure member 102 is in its closed position so that the bottom surfaces of the lower parts of the arms 106 are substantially flush with the bottom wall 78 of the fluid reservoir 34.

At least part of the external wall 110 of the fluid reservoir 34 is preferably transparent to allow a user to observe the contents of the fluid reservoir 34, and so assess whether the fluid reservoir 34 requires replenishment prior to the desired use of the appliance 10. The external wall 110 preferably has a shape which is symmetrical about the longitudinal axis of the cleaning tool 14. The external wall 110 preferably has a curved shape, more preferably a convex curved shape, but alternatively the external wall 110 may have a polygonal or faceted shape. In this embodiment, the external wall 110 has a spherical curvature. As described below, the fluid reservoir 34 is mounted on the relatively wide base section 88 of the stem 26, and so the external wall 110 has opposed circular apertures which are centred on the longitudinal axis of the cleaning tool 14 to allow the base section 88 of the stem 26 to pass therethrough.

The fluid reservoir 34 further comprises an inner wall 112 which is connected to the external wall 110. The inner wall 112 is tubular in shape. The ends of the inner wall 112 are preferably circular in shape, and are connected to the external wall 110 so as to form a fluid-tight seal between the external wall 110 and the inner wall 112. In this embodiment, the fluid reservoir 34 is formed from two housing parts. A first housing part 114 comprises an upper section of the external wall 110 and the inner wall 112, and so the upper end of the inner wall 112 is integral with an upper section of the external wall 110. A second housing part 116 comprises a lower section of the external wall 110 and the bottom wall 78 of the fluid reservoir 34.

The fluid reservoir 34 also comprises a diaphragm 118. The diaphragm 118 is tubular in shape, and surrounds the inner wall 112 of the fluid reservoir 34. The ends 120, 122 of the diaphragm 118 may be connected to the external wall 110, or to the inner wall 112. The diaphragm 118 thus has an external surface 124 which faces the external wall 110 of the fluid reservoir 34, and which defines with the external wall 110 the capacity of the fluid reservoir 34. As the diaphragm 118 is visible to the user through at least part of the external wall 110, the external surface 124 of the diaphragm 118 may bear an identifier for user identification of the cleaning tool 14. For example, the identifier may be a coloured portion of the external surface 124 of the diaphragm 118, or one or more alphanumeric characters moulded or otherwise formed on the external surface 124 of the diaphragm 118.

Figures 5 and 6(a) illustrates the fluid reservoir 34 when it has been filled with working fluid. The thickness of the diaphragm 118, and the material from which the diaphragm 118 is formed, are selected so that at least part of the diaphragm 118 is moveable relative to the external wall 110 in response to a pressure differential which is established across the diaphragm 118 as working fluid is drawn from the fluid reservoir 34 by the pump 48. In this embodiment, the diaphragm 118 is expandable in response to a pressure differential which is generated across the surfaces 124, 126 of diaphragm 118 as working fluid is drawn from the fluid reservoir 34. Figure 6(a) illustrates the diaphragm 118 in a fully contracted configuration, or state, in which the capacity of the fluid reservoir 34 is maximised.

In this embodiment, the cleaning tool 14 comprises an expansion chamber 128 which is located adjacent to the inner wall 112. The expansion chamber 128 has a volume which increases as the volume of the fluid reservoir 34 decreases. In this embodiment, the expansion chamber 128 is open to the atmosphere to allow atmospheric air to enter the expansion chamber 128 as the inner wall 112 moves towards the external wall 110 as working fluid is supplied to the fluid delivery system 100. The expansion chamber 128 is shown in Figures 6(b) and 6(c), which illustrate the diaphragm 118 in a partially expanded configuration, and in an almost fully expanded configuration, respectively.

The expansion chamber 128 is delimited by the internal surface 126 of diaphragm 118, and the external surface 130 of the inner wall 112. One or more apertures or ports 132 are formed in the inner wall 112 to allow atmospheric air to enter the expansion chamber 128, for example, from an air flow path which extends between the stem 26 and the inner wall 112, with expansion of the diaphragm 118.

As the diaphragm 118 expands towards its fully expanded configuration, the size and shape of the diaphragm 118 approaches that of the external wall 110. In other words, when the diaphragm 118 is in a fully expanded configuration, which occurs when the fluid reservoir 34 is substantially empty, the size and the shape of the diaphragm 118 are substantially the same as the size and the shape of the external wall 110 of the fluid reservoir 34. Thus, the maximum volume of the expansion chamber 128 is preferably substantially the same as the maximum volume of the fluid reservoir 34.

As mentioned above, the fluid reservoir 34 is mounted on the relatively wide base section 88 of the stem 26. To mount the fluid reservoir 34 on the stem 26, the circular aperture formed in the first housing part 114 of the fluid reservoir 34 is aligned with the free end of the base section 88 of the stem 26, and the fluid reservoir 34 is pushed on to the stem 26. The internal surface of the inner wall 112 of the fluid reservoir 34 bears against the base section 88 of the stem 26 so that frictional forces therebetween prevent the fluid reservoir 34 from falling from the stem 26. The movement of the fluid reservoir 34 along the stem 26 is restricted by a flange 140 which extends radially outwardly from the stem 26, and is located at the upper end of the base section 88 of the stem 26. The flange 140 is annular in shape, and is arranged to engage an annular planar end portion or recess 142 of the first housing part 114 of the fluid reservoir 34. When the recess 142 of the fluid reservoir 34 engages the flange 140 of the stem 26, the fluid reservoir 34 is in the correct axial position along the stem 26 for the subsequent connection of the reservoir fluid outlet port 80 to the fluid inlet 44 of the fluid delivery system 40. To facilitate angular alignment of the fluid reservoir 34 relative to the stem 26, the flange 140 and the recess 142 may be provided a non-annular shape, for example a C- shape. Otherwise, the fluid reservoir 34 may be visually angularly aligned by the

user relative to the head 28, for example so that the head 104 of the closure member 102 is aligned with the nozzle 36.

To mount the cleaning tool 14 on the handle 12, as shown in Figure 7 the spigot 70 of the handle 12 is aligned with the recess 73 formed in the connector 72 of the cleaning tool 14, and the handle fluid outlet port 82 located adjacent to the spigot 70 is aligned with the cleaning tool fluid inlet port 86 of the cleaning tool 14. The cleaning tool 14 is then pushed on to the spigot 70 so that the handle fluid outlet port 82 connects to the cleaning tool fluid inlet port 86, and so that the fluid reservoir 34 engages the annular seat 76 to connect the reservoir fluid outlet port 80 to the fluid inlet 44 of the fluid delivery system 40. The internal surface 150 of the connector 72 of the stem 26 bears against the external surface of the spigot 70 so that frictional forces therebetween retain the stem 26 on the handle 12. The connector 72 is preferably formed from resilient plastics material which flexes as the connector 72 is pushed on to the spigot 70 to increase the frictional forces therebetween. A spring clip 152 may be provided at least partially about the connector 72 for urging the internal surface 150 of the connector 72 against the spigot 70. To prevent the cleaning tool 14 from becoming accidentally dislodged from the handle 12, the connector 73 may comprise a detent 154 mounted on an arm 156 which is hingedly connected to the connector 72. For example, the arm 156 may be integral with the connector 72, and connected to the remainder of the connector 72 by an elastic hinge. As the cleaning tool 14 is pushed on to the spigot 70, the detent 154 enters a recess (not shown) formed on the external surface of the spigot 70. With reference to Figures 3 and 4, to inhibit accidental rotation of the fluid reservoir 34 relative to the handle 12, the bottom wall 78 of the fluid reservoir 34 may be provided with a male connector 160 which engages with a female connector 162 disposed on the annular seat 76 of the handle 12. In this embodiment, the male connector 160 at least partially surrounds the cleaning tool fluid inlet port 86, and the female connector 162 surrounds the handle fluid outlet port 82. Alternatively, the fluid reservoir 34 may be provided with a female connector which receives a male connector located on the handle 12 as the cleaning tool 14 is connected to the handle 12.

To operate the appliance 10, the user presses buttons 18, 20, 22 located on the handle 12. The user switches on the appliance 10 by depressing button 18, the action of which is detected by the control circuit 66. The user may select a mode of operation of the appliance 10 by depressing button 20. For example, through pressing button 20 once, the control circuit 66 may activate the motor to move the brush unit 29 relative to the handle 12. Pressing that button 20 again may switch off the motor. When the button 22 is pressed, a burst of water is emitted from the nozzle 36. The control circuit 66 activates the pump 48 to urge a volume of water from a fluid chamber of the pump 48 to the nozzle 36, and to replenish the fluid chamber through drawing a volume of water from the fluid reservoir 34.

The various connections between the handle 12, the stem 26 and the fluid reservoir 34 enable the appliance 10 to be readily dismantled by the user, for example to allow components of the appliance 10 to be replaced, for example due to wear. To replace the cleaning tool 14, the user grasps the stem 26 or the fluid reservoir 34 with one hand, and the handle 12 with the other hand, and pulls the cleaning tool 14 away from the handle 12. Under the force applied by the user, the detent 154 moves away from the recess located on the external surface of the spigot 70 to enable the cleaning tool 14 to be detached from the handle 12. If required, the user may then detach the fluid reservoir 34 from the stem 26, as shown in Figure 9, by pulling the fluid reservoir 34 from the handle 12.

Alternatively, as shown in Figure 8 the stem 26 may be separately detached from the handle 12 for replacement. To replace the stem 26, the user grasps the stem 26 with one hand, and the fluid reservoir 34 and the handle 12 with the other, and pulls the stem 26 away from the handle 12, leaving the fluid reservoir 34 connected to the handle 12. While the stem 26 is detached from the handle 12, friction forces between the male connector 160 on the fluid reservoir 34 and the female connector 162 on the handle 12 can retain the fluid reservoir 34 on the handle 12. If required, the fluid reservoir 34 may be subsequently detached from the handle 12 by pulling the fluid reservoir 34 from the annular seat 76, thereby fully dismantling the appliance 10, as shown in Figure 9.

With reference to Figures 10 to 12, the fluid reservoir 34 may contain a material which is dissolvable in the working liquid. As shown in Figure 10, part of the internal surface of the external wall of the fluid reservoir may be coated with a layer 170 of such dissolvable material. In this embodiment, the internal surface of the second housing part 116 of the fluid reservoir 34 is coated with a layer of dissolvable material.

The dissolvable material may comprise a water-soluble phosphate. The phosphate material may be in the form of a phosphate glass, for example a calcium sodium phosphate or a calcium sodium silicon phosphate, which will slowly dissolve in the water stored in the fluid reservoir to release minerals such as calcium phosphate, sodium phosphate and silica. The calcium ions within the released materials can be beneficial for remineralization of voids or lesions formed in the enamel of the teeth of the user, whereas silica is widely used in toothpaste for stain removal.

The dissolvable material may comprise a dissolvable matrix impregnated with solid particles which become dispersed within the stored working liquid as the matrix dissolves into the working liquid. The solid particles may comprise, for example, mica or glycine particles which are delivered to the teeth of the user within a burst of working liquid, for example, to assist with the removal of matter located within the interproximal gap of the user, or with the disruption of plaque layers formed on the user's teeth. The solid particles may comprise calcium sodium phosphate glass particles, which may fill channels present in sensitive teeth, or titanium dioxide particles.

The dissolvable matrix may comprise an inorganic or an organic material, such as an acrylate or a vinyl polymer. Such a material may also be provided without solid particles, and may be a surface active material which can assist with the teeth cleaning process. The organic polymer material may be functionalized, for example with lauryl sulphate groups, to improve the cleaning process, or to deliver fluoride or a chelator such as EDTA (ethylenediaminetetraacetic acid). The dissolvable material may also comprise an organic polymer which inhibits the build-up of scale or microorganisms

within the fluid reservoir 34. Providing a dissolvable material comprising an organic polymer matrix can allow the dissolvable material to have a degree of elasticity. This can enable a layer 172 of such dissolvable material to be provided on the diaphragm 118, as shown in Figure 11, where it is more easily visible to the user through the transparent first housing part 114 of the fluid reservoir. The dissolvable material may be provided with a pigment or coloring agent which allows a user to identify when the dissolvable material has become depleted. The dissolvable material may also comprise other materials, such as a fluoride for improved teeth cleaning, or an antibacterial material. For example, the dissolvable material may comprise silver particles having antibacterial properties.

As a further alternative, the dissolvable material may be in the form of beads 174 of dissolvable material, as shown in Figure 12, which are insertable into the fluid reservoir 34 by the user through the fluid inlet port 100. The beads 174 may take any desired shape, and may be in the form of pellets or tablets. As discussed above, the beads 174 may be formed from a water-soluble phosphate, for example a phosphate glass.

CLAIMS

1. A dental cleaning appliance comprising:
 - a handle;
 - 5 a nozzle for delivering a burst of working liquid to the teeth of a user;
 - a stem extending between the handle and the nozzle; and
 - a fluid reservoir for storing working liquid, wherein the fluid reservoir comprises material which is dissolvable in the working liquid.
- 10 2. An appliance according to claim 1, wherein the dissolvable material is in the form of a layer of material applied to a surface of the fluid reservoir which is exposed to the stored working liquid.
3. An appliance according to claim 2, wherein the fluid reservoir comprises a wall
15 which defines, at least in part, the capacity of the fluid reservoir, and the dissolvable material is applied to at least part of a surface of the wall which is exposed to the stored working liquid.
4. An appliance according to claim 3, wherein the dissolvable material is applied to
20 an external wall of the fluid reservoir.
5. An appliance according to claim 3 or claim 4, wherein the dissolvable material is applied to an inner wall of the fluid reservoir.
- 25 6. An appliance according to any of claims 3 to 5, wherein the dissolvable material is the form of a coating which is applied to said at least part of a surface of the wall which is exposed to the stored working liquid.
7. An appliance according to any preceding claim, wherein the dissolvable material
30 is insertable into the fluid reservoir by a user.

8. An appliance according to claim 7, wherein the dissolvable material is insertable into the fluid reservoir through a fluid port through which the fluid reservoir is replenished with working liquid.

5 9. An appliance according to any preceding claim, wherein the dissolvable material may be in the form of a solid pellet, bead or tablet.

10. An appliance according to any preceding claim, wherein the dissolvable material comprises a phosphate material.

10

11. An appliance according to claim 10, wherein the phosphate material is a phosphate glass.

12. An appliance according to claim 10 or claim 11, wherein the phosphate material
15 is one of a calcium sodium phosphate or a calcium sodium silicon phosphate.

13. An appliance according to any preceding claim, wherein the dissolvable material comprises a dissolvable matrix impregnated with solid particles which become dispersed within the stored working liquid as the matrix dissolves into the working
20 liquid.

14. An appliance according to claim 13, wherein the solid particles comprise at least one of mica particles, glycine particles, titanium dioxide particles, and sodium phosphate glass particles.

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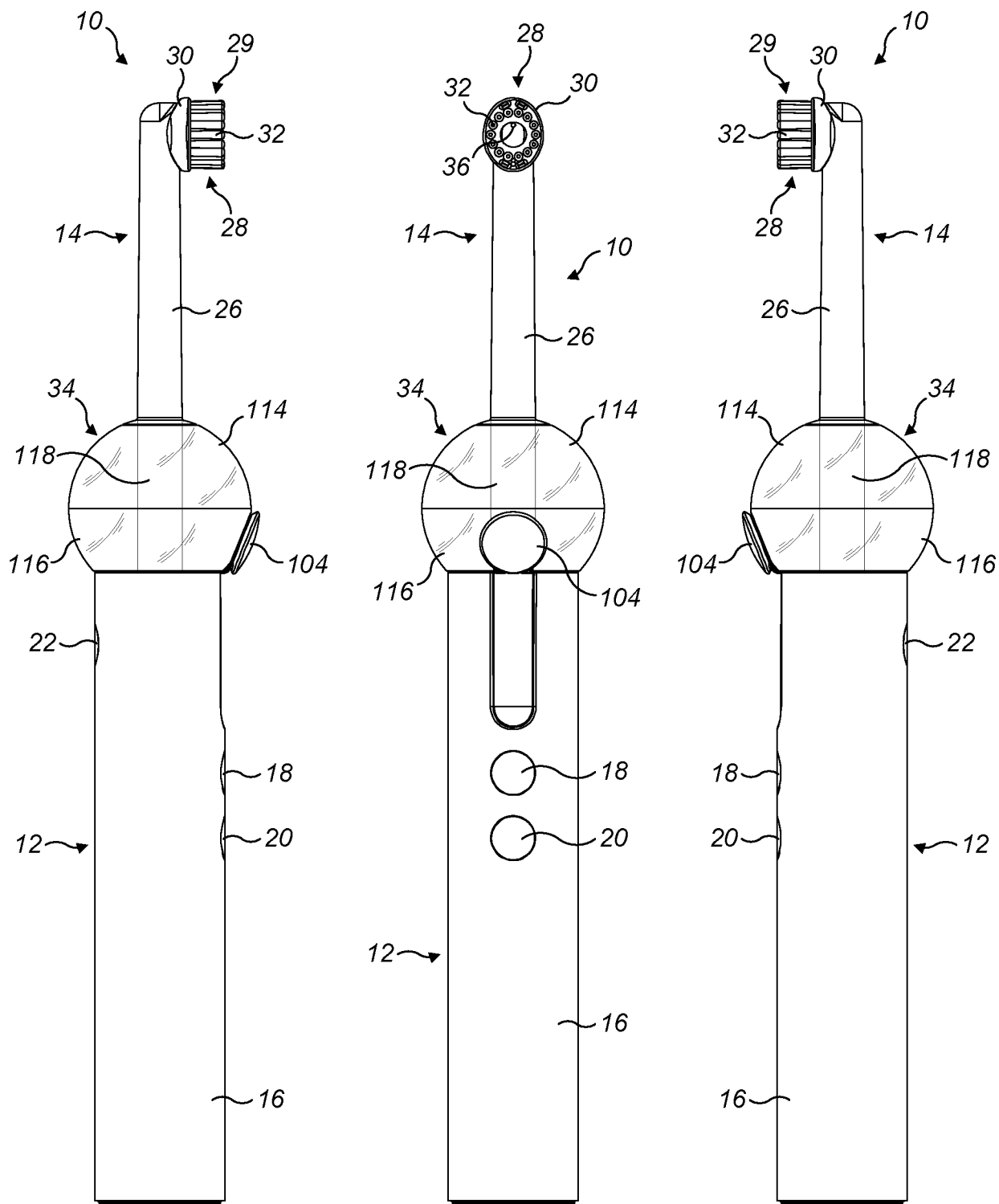


FIG. 1(a)

FIG. 1(b)

FIG. 1(c)

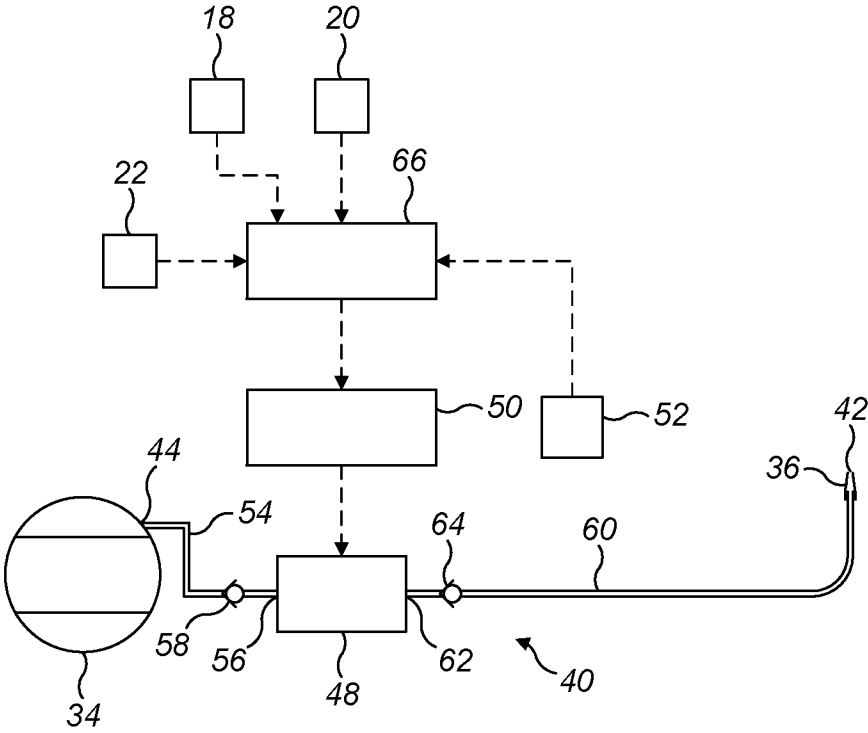


FIG. 2

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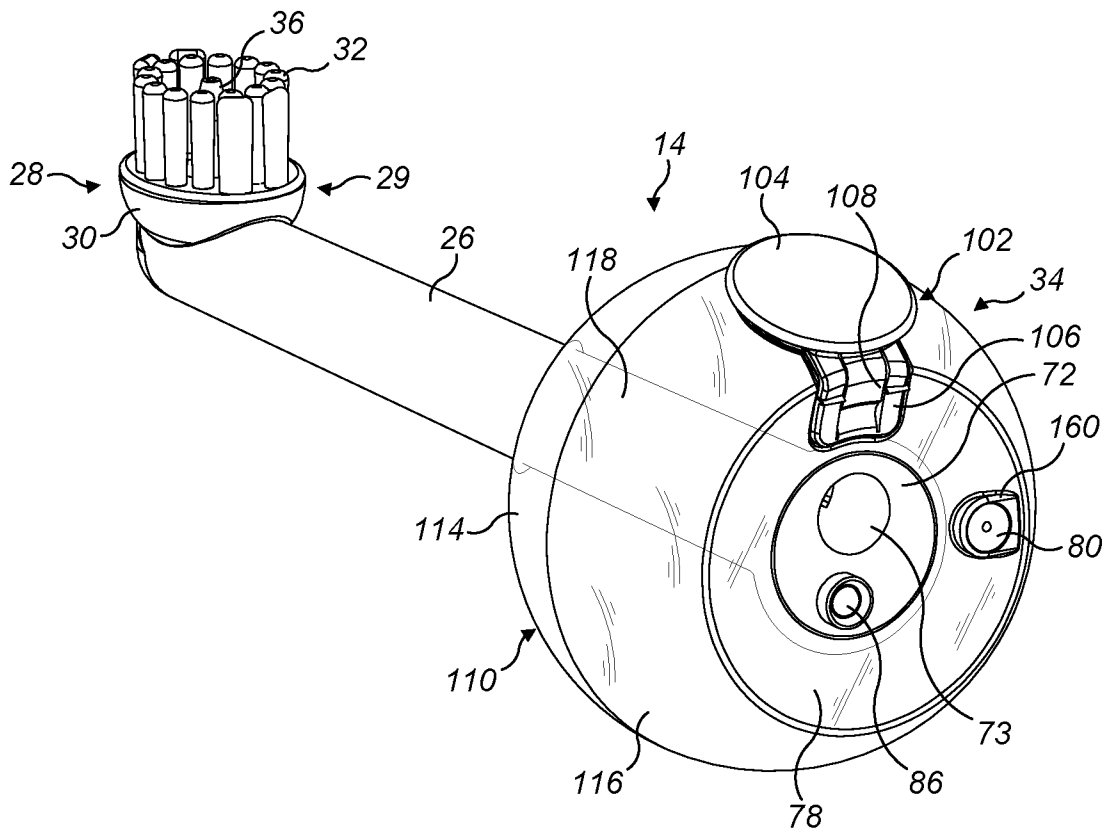


FIG. 3

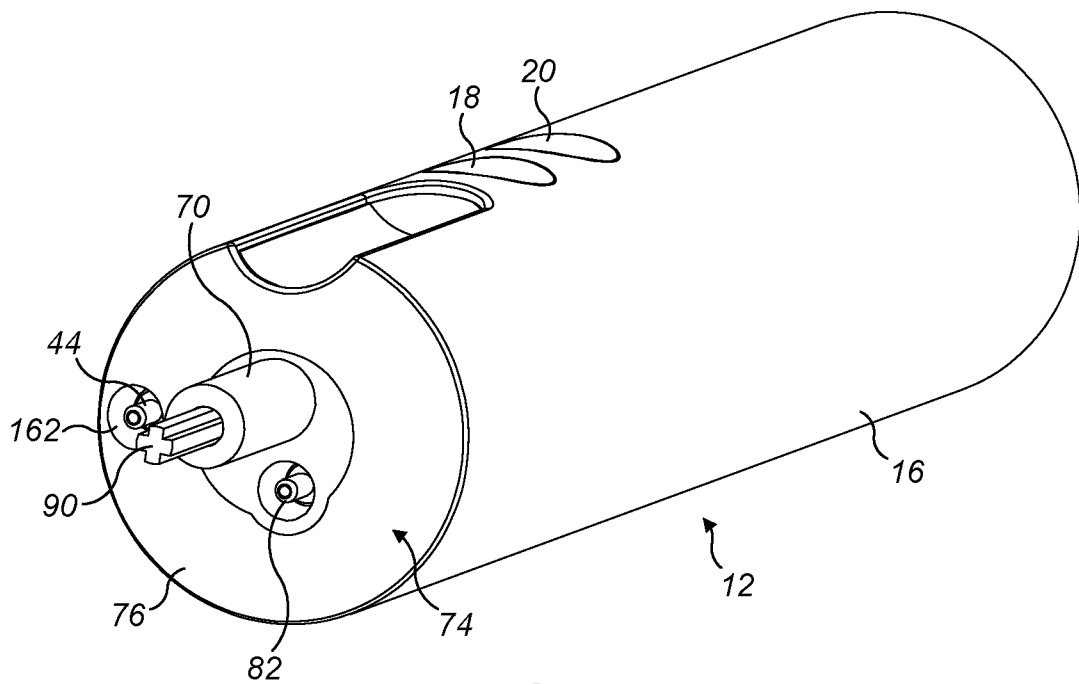


FIG. 4

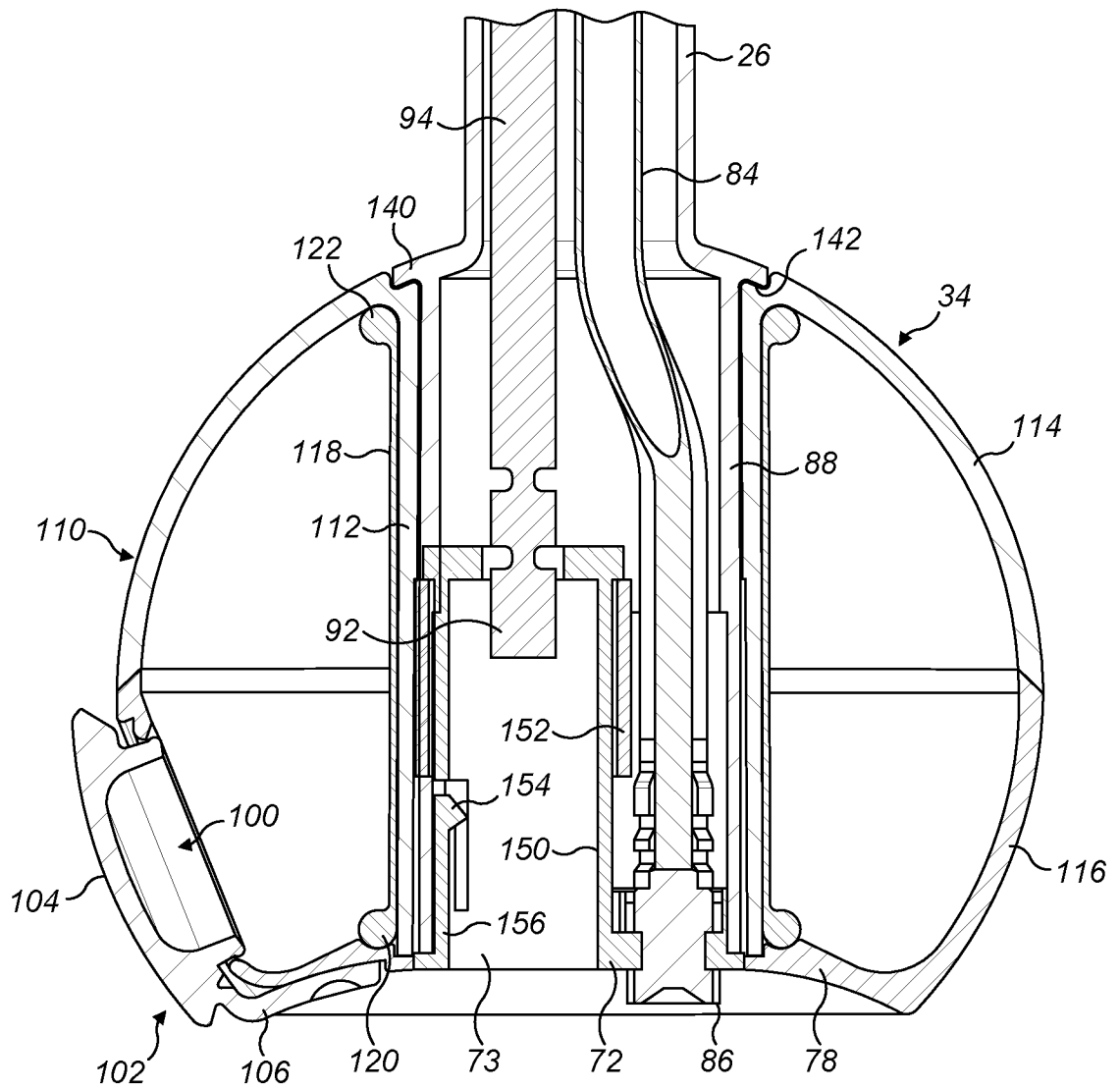


FIG. 5

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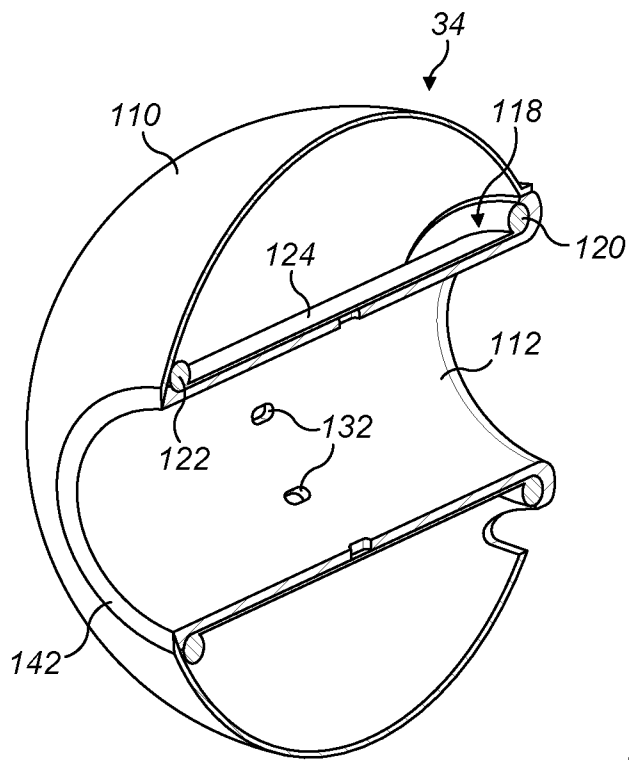


FIG. 6(a)

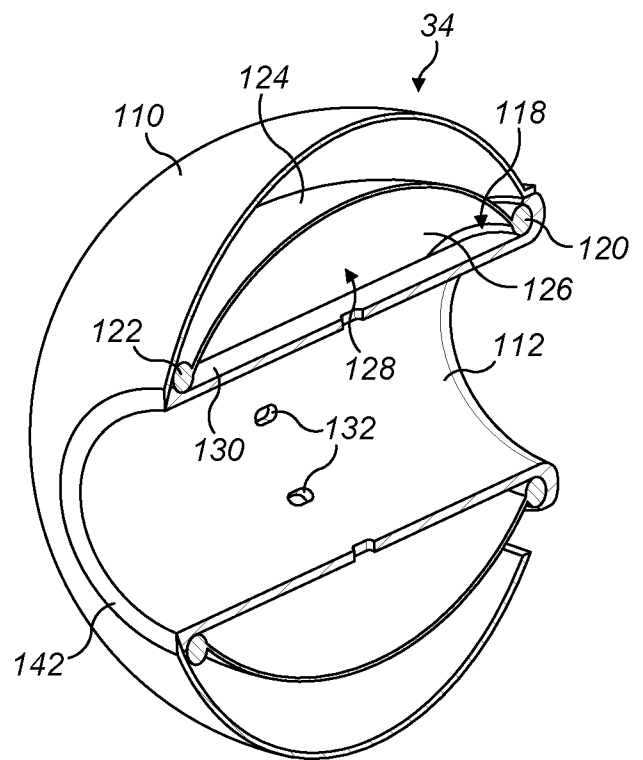


FIG. 6(b)

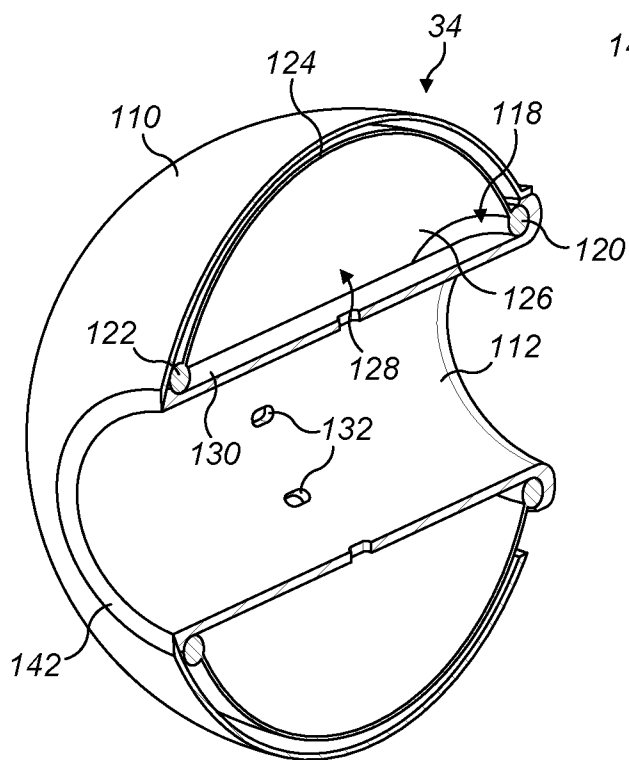


FIG. 6(c)

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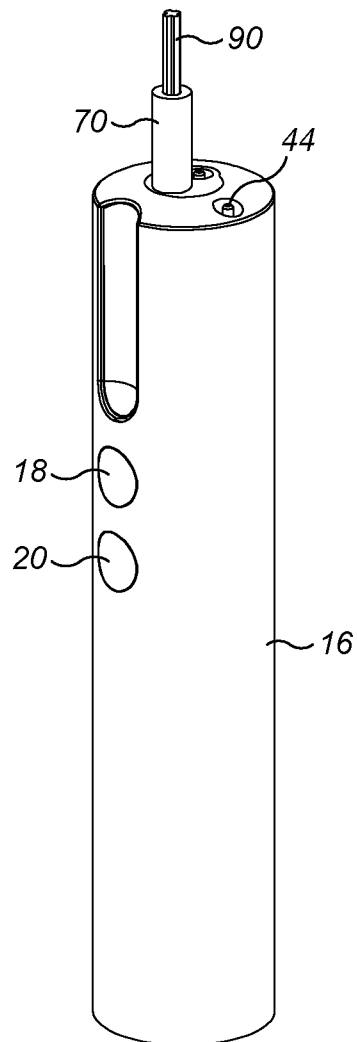
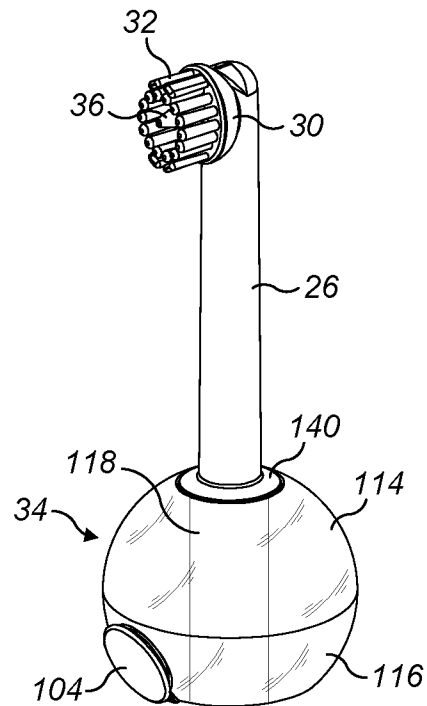


FIG. 7

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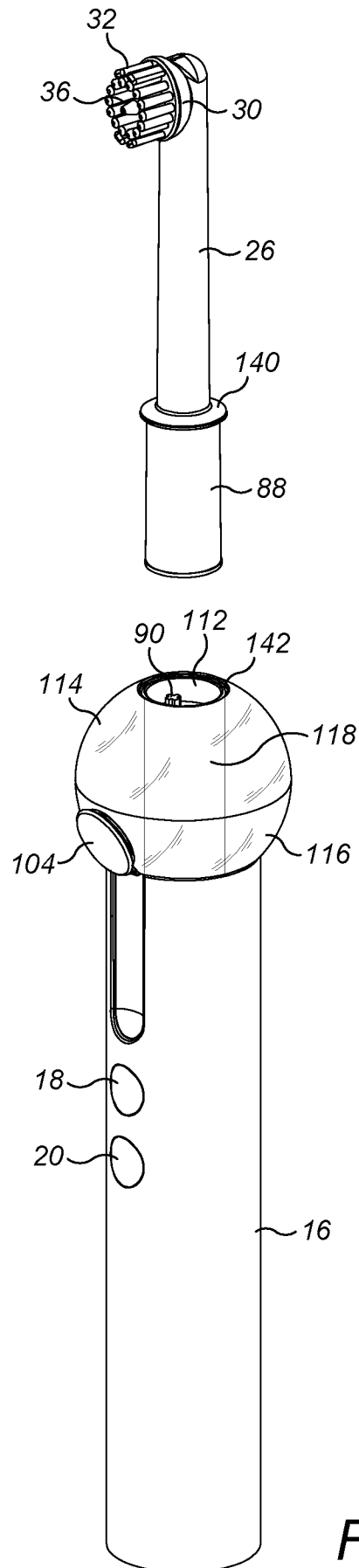


FIG. 8

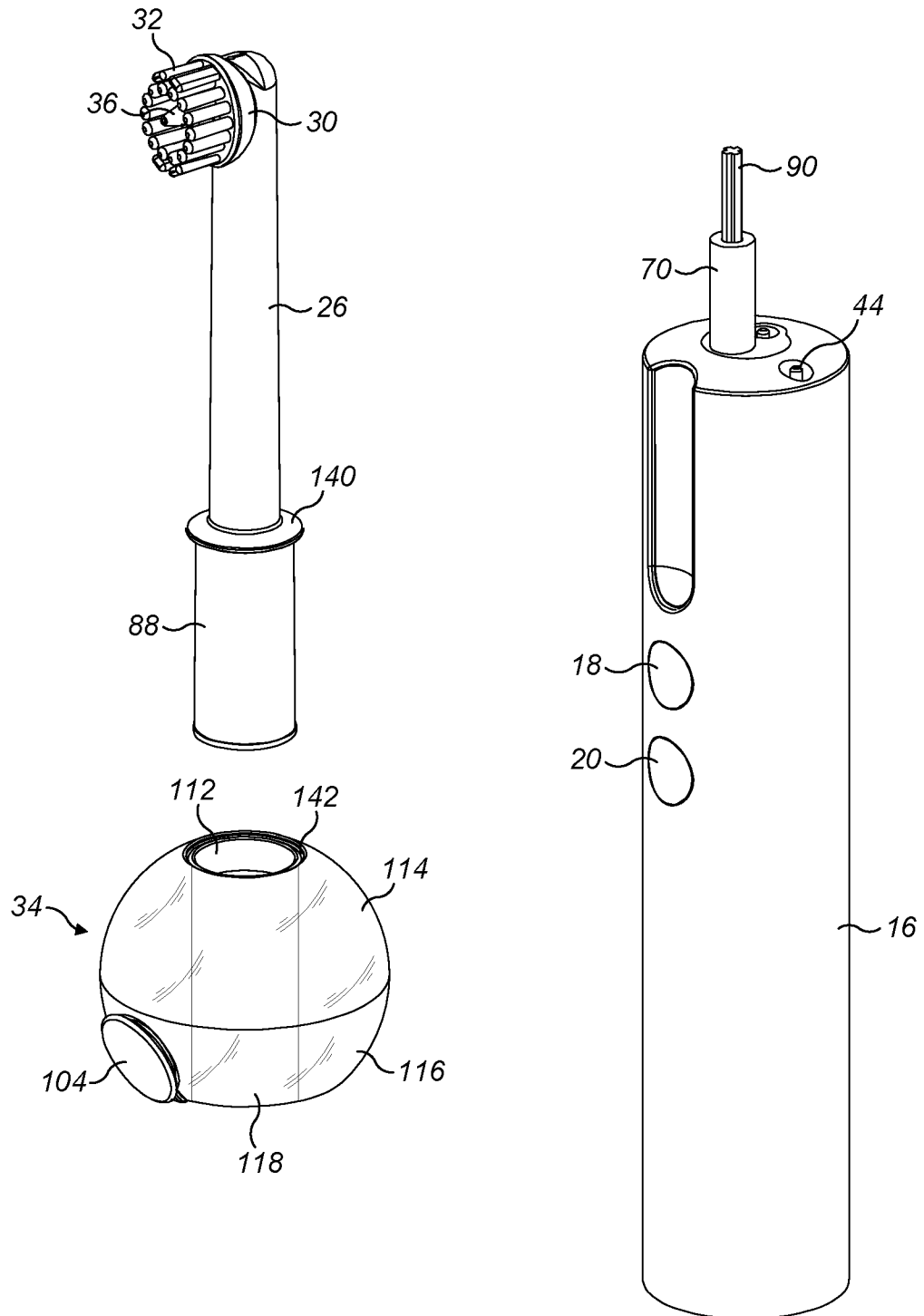


FIG. 9

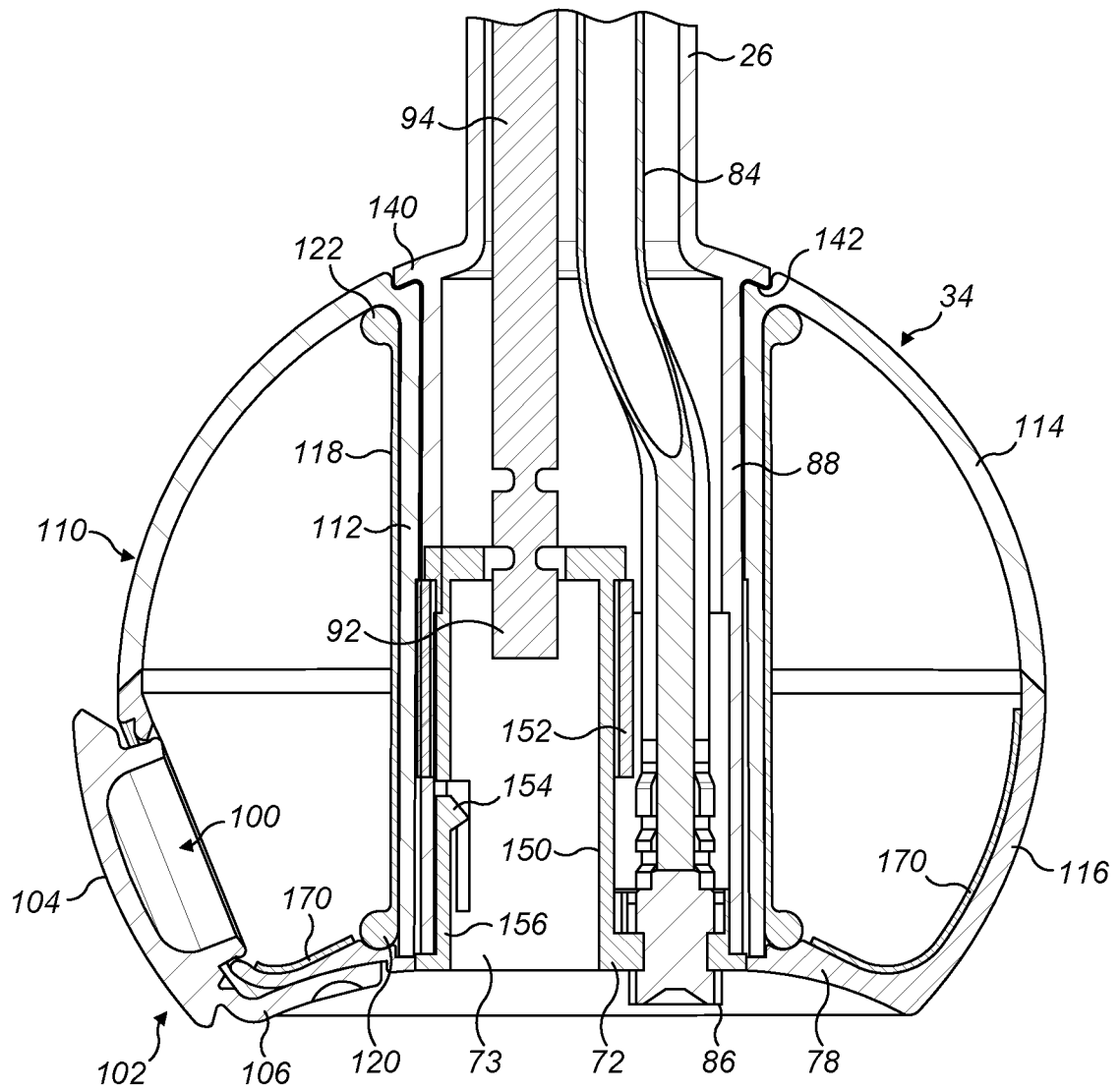


FIG. 10

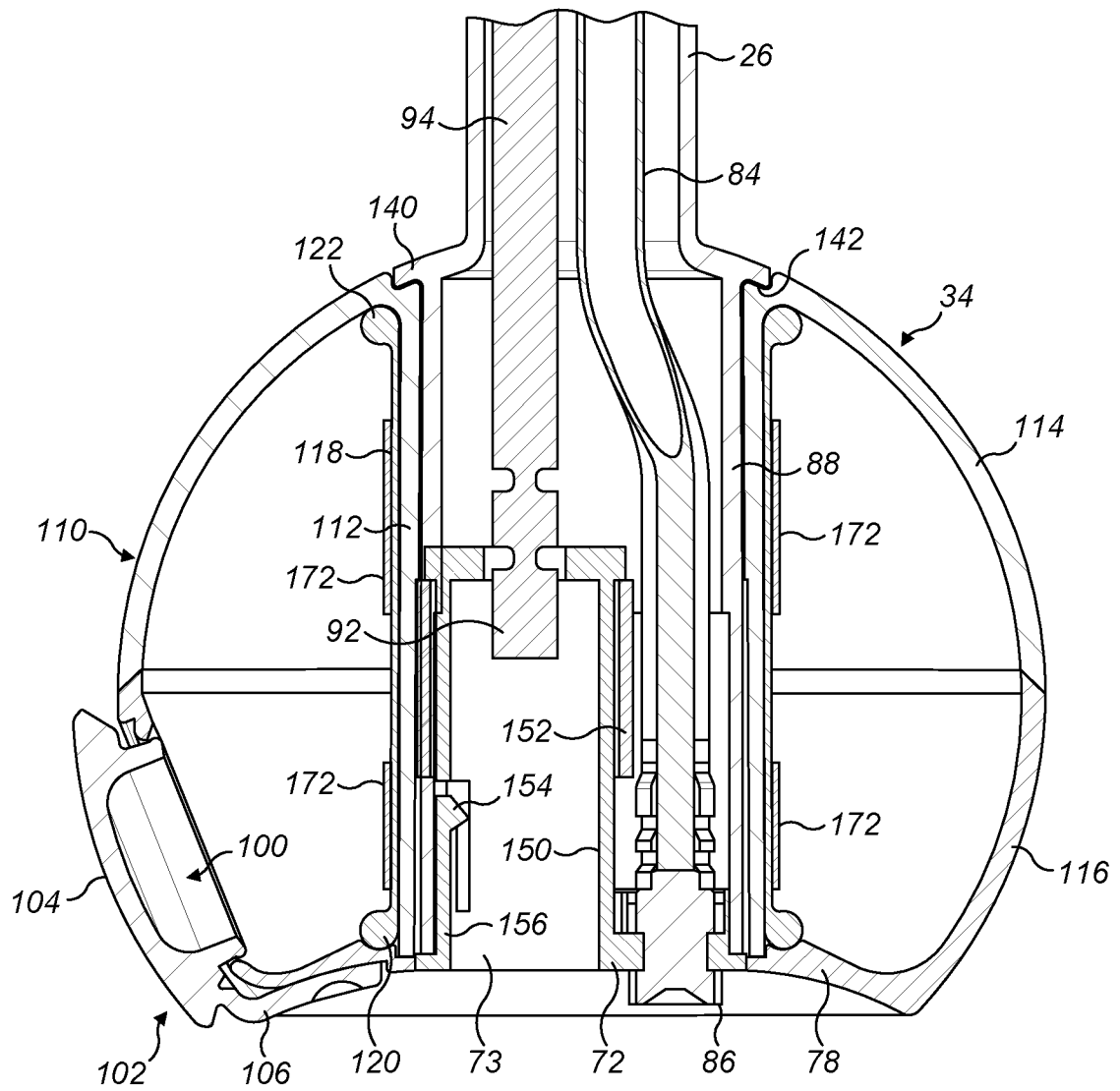


FIG. 11

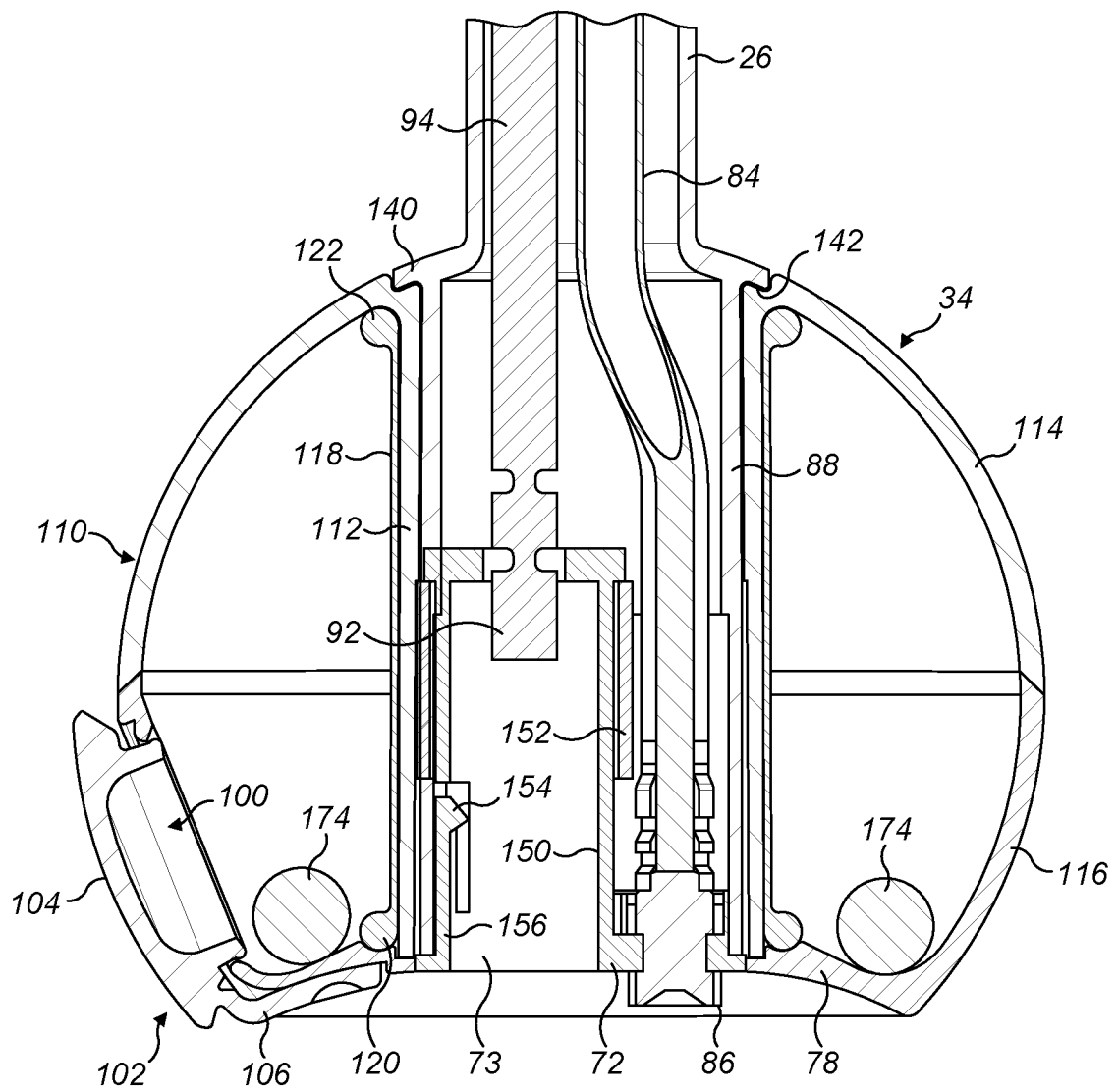


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2017/053139

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61C17/02 A61C17/22 A46B11/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61C A46B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/183926 A1 (SHALEV PINCHAS [IL]) 19 July 2012 (2012-07-19)	1,7,8
A	figures 1, 1a, 1b paragraphs [0028], [0032], [0034] -----	2-6
X	DE 299 04 059 U1 (ROWENTA WERKE GMBH [DE]) 27 May 1999 (1999-05-27)	1
A	page 4, paragraphs 1, 2 figure 1 -----	2-6
A	DE 81 34 787 U1 (KNORR-BREMSE-BOWLES FLUIDICS GMBH) 19 May 1983 (1983-05-19) figure 1 page 9, paragraph 1 page 10, paragraphs 2, 3 -----	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

11 December 2017

Date of mailing of the international search report

01/03/2018

Name and mailing address of the ISA/

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Authorized officer

Kerner, Bodo

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2017/053139

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-8

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-8

Details of the dental cleaning appliance

2. claims: 9-14

Details of the dissolvable material

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2017/053139

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012183926 A1	19-07-2012	US 2012183926 A1	19-07-2012
		US 2014302455 A1	09-10-2014
		US 2017071711 A1	16-03-2017
DE 29904059 U1	27-05-1999	DE 29904059 U1	27-05-1999
		FR 2790383 A1	08-09-2000
DE 8134787 U1	19-05-1983	NONE	