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(54) Titre : **SYSTEME DE SOINS BUCCO-DENTAIRES**
(54) Title: **ORAL CARE SYSTEM**

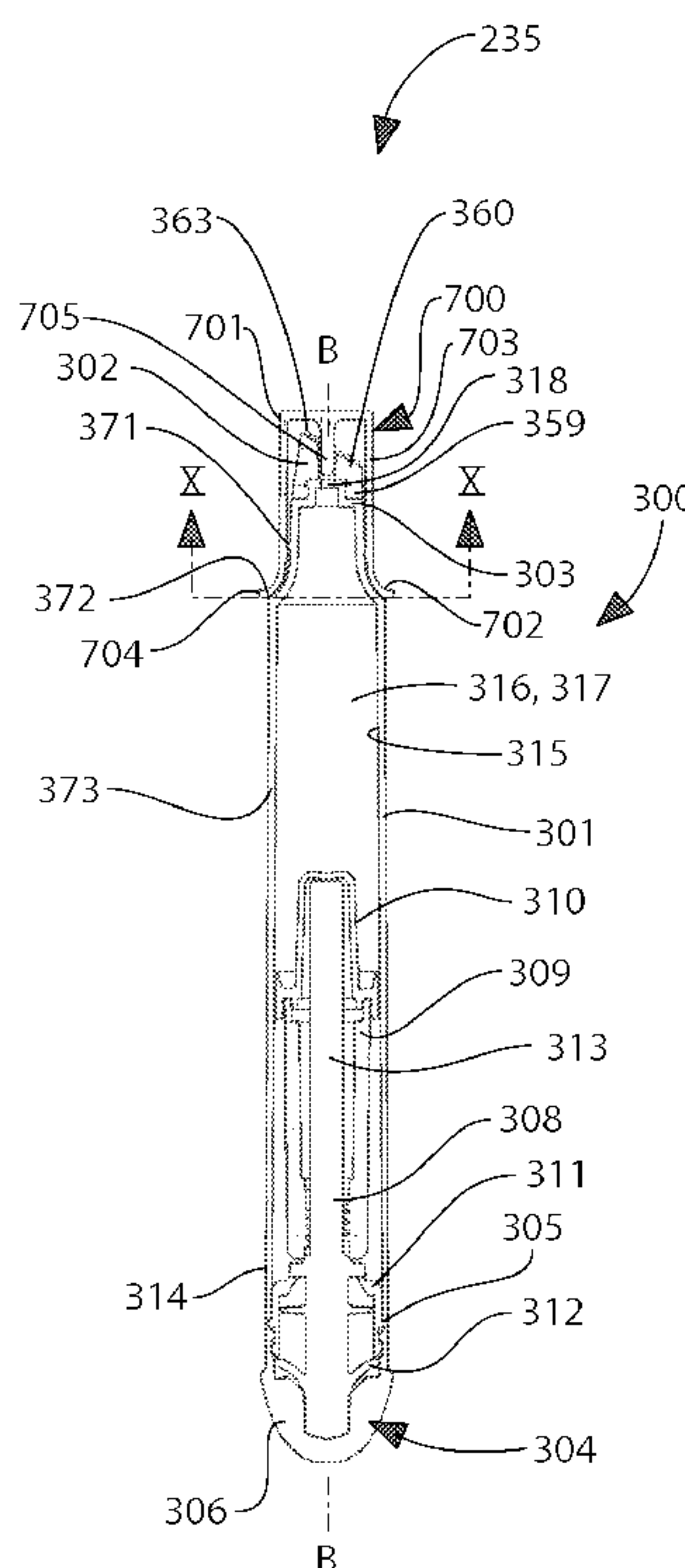


FIG. 7

(57) **Abrégé/Abstract:**

An oral care system comprising an oral care implement, such as a toothbrush, and dispenser containing a fluid detachably coupled to the toothbrush. The invention is an oral care system comprising: a toothbrush having a cavity; a dispenser comprising a reservoir

(57) **Abrégé(suite)/Abstract(continued):**

containing a fluid; a cap detachably coupled to the dispenser; wherein when the cap is coupled to the dispenser, the cap prohibits the dispenser from being inserted into the cavity; and wherein when the cap is detached from the dispenser, the dispenser can be inserted into the cavity and detachably coupled to the toothbrush.

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[Continued on next page]

(54) Title: ORAL CARE SYSTEM

(57) Abstract: An oral care system comprising an oral care implement, such as a toothbrush, and dispenser containing a fluid detachably coupled to the toothbrush. The invention is an oral care system comprising: a toothbrush having a cavity; a dispenser comprising a reservoir containing a fluid; a cap detachably coupled to the dispenser; wherein when the cap is coupled to the dispenser, the cap prohibits the dispenser from being inserted into the cavity; and wherein when the cap is detached from the dispenser, the dispenser can be inserted into the cavity and detachably coupled to the toothbrush.

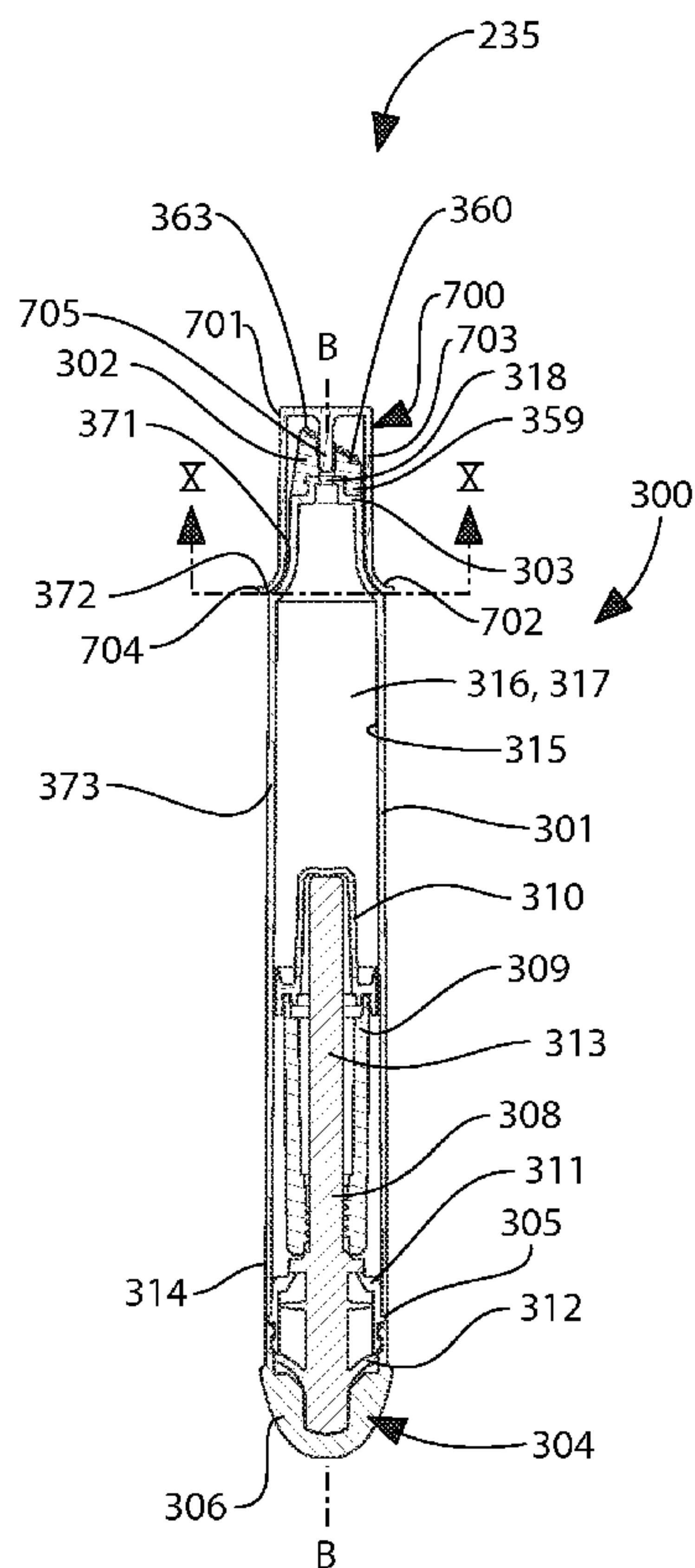


FIG. 7

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ORAL CARE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to International Application No. PCT/US2009/069408 filed on December 23, 2009; International Application No. PCT/US2009/069402 filed on December 23, 2009; U.S. Provisional Application No. 61/410,514 filed on November 5, 2010; U.S. Provisional Application No. 61/423,397 filed on December 15, 2010; U.S. Provisional Application No. 61/423,414 filed on December 15, 2010; U.S. Provisional Application No. 61/423,435 filed on December 15, 2010; and U.S. Provisional Application No. 61/423,449 filed on December 15, 2010, all of which are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates generally to oral care systems, kits and methods, and more specifically to a system, kit and method including a toothbrush and a dispenser containing a fluid that detachably couples to the toothbrush.

BACKGROUND OF THE INVENTION

[0003] Oral care products or agents are applied in different ways. For example, without limitation, a common technique used for applying tooth whitening products is to cast an impression of a person's teeth and provide a tray of the shape of this impression. A person then only needs to add a whitening composition to the tray and to apply the tray to his/her teeth. The tray is left in place for a period of time and then removed. After a few treatments the teeth gradually whiten. Another technique is to use a strip that has a whitening composition on one surface. This strip is applied to a person's teeth and left in place for about 30 minutes. After several applications the teeth are gradually whitened. Yet another technique is to apply a whitening composition to teeth using a small brush. This brush is repeatedly dipped back into the container during the application of the tooth whitening composition to one's teeth. After a few treatments the teeth gradually whiten.

[0004] A problem with existing brushing techniques is that saliva in the mouth contains the enzyme catalase. This enzyme will catalyze the decomposition of peroxides. The brush can pick up some catalase during the application of some of the whitening product

to teeth and transport that catalase back to the bottle. This catalase now in the bottle can degrade the peroxide in the bottle. Another problem with this latter technique is that it does not adapt for use with anhydrous whitening compositions. Here the brush may transport moisture from saliva from the mouth back into the bottle. This will have a negative effect on the whitening composition by potentially decomposing the peroxide active ingredient. In addition, if a person washes the brush each time after use, moisture from the wet bristles can enter the bottle.

[0005] While tray-based systems are suitable, many people do not use them due to the fact that they tend to be uncomfortable and/or awkward. Moreover, in order to use a whitening tray, a user must keep the tray and the required components at hand. This not only requires extra storage space in already cramped bathroom cabinets but also requires that the user remember to use the whitening system. Furthermore, these tray-based systems are not conveniently portable for transport and/or travel.

[0006] In addition to difficulties in applying some oral care products, storage is sometimes cumbersome and inconvenient for the user. The oral care product must typically be stored separately from oral care tooth cleaning implements such as a toothbrush since the oral care product package and toothbrush heretofore are generally treated as separate and distinct parts of an oral care regimen.

[0007] A more portable, compact and convenient way to store oral care products, and to dispense and apply those oral care products to oral surfaces is desired.

BRIEF SUMMARY OF THE INVENTION

[0008] Embodiments of the present invention provide an efficient, compact, and portable oral care system that combines an oral care implement, such as a toothbrush, with a fluid dispenser. Advantageously, certain embodiments are especially suited for easy transport and/or travel.

[0009] Exemplary embodiments of the present invention are directed to a toothbrush that detachably retains a removable dispenser containing a fluid reservoir. In some exemplary embodiments, the oral care system includes fluids, either active or non-active agents, that may include without limitation, whitening, enamel protection, anti-sensitivity, fluoride, tartar protection, or other fluidic materials. The dispenser can be detachably coupled to the toothbrush. In one embodiment, the dispenser may be at least partially located within

the handle of the toothbrush so that a portion of the dispenser protrudes from the toothbrush. The dispenser can be completely removable from the toothbrush in certain embodiments so that the user can apply the fluid to his/her oral surfaces with ease, and then re-couple the dispenser to the toothbrush for convenient storage. In certain embodiments, the dispenser may be a pen-like component.

[0010] In one embodiment, the invention can be an oral care system comprising: a toothbrush having a cavity and a plug in the cavity; a dispenser comprising a reservoir containing a fluid and a dispensing orifice; a cap detachably coupled to the dispenser that seals the dispensing orifice; wherein when the cap is coupled to the dispenser, the cap prohibits the dispenser from being inserted into the cavity; and wherein when the cap is detached from the dispenser, the dispenser can be inserted into the cavity so that the plug penetrates the dispensing orifice and the dispenser is detachably coupled to the toothbrush.

[0011] In another embodiment, the invention can be an oral care system comprising: a toothbrush having a cavity extending along a longitudinal axis and an opening forming a passageway into the cavity, the opening having a first transverse cross-sectional profile; a dispenser comprising a housing having a reservoir containing a fluid and a dispensing orifice, the housing having a second transverse cross-sectional profile that fits entirely within the first transverse cross-sectional profile; and a cap detachably coupled to the dispenser, the cap having a portion having a third cross-sectional profile that does not fit entirely within the first transverse cross-sectional profile.

[0012] In yet another embodiment, the invention can be an oral care system comprising: a toothbrush having a cavity; a dispenser comprising a reservoir containing a fluid; a cap detachably coupled to the dispenser; wherein when the cap is coupled to the dispenser, the cap prohibits the dispenser from being inserted into the cavity; and wherein when the cap is detached from the dispenser, the dispenser can be inserted into the cavity and detachably coupled to the toothbrush.

[0013] In still another embodiment, the invention can be an oral care system comprising: a toothbrush having a cavity; a dispenser comprising a reservoir containing a fluid; the dispenser alterable between: (1) a storage state in which the dispenser is located within the cavity and detachably coupled to the toothbrush; and (2) an application state in which

the dispenser is separated from the toothbrush; a cap detachably coupled to the dispenser that seals the dispensing orifice; wherein when the cap is coupled to the dispenser, the dispenser can not altered into the storage state; and wherein when the cap is detached from the dispenser, the dispenser can be altered into the storage state.

[0014] In certain exemplary embodiments, any suitable fluid may be used with embodiments and methods described herein according to the present invention. Accordingly, the oral care treatment system may be any type of system including without limitation tooth whitening, enamel protection, anti-sensitivity, fluoride, tartar protection/control, and others. The invention is expressly not limited to any particular type of oral care system or oral care material, unless specifically claimed.

[0015] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The features of the exemplified embodiments will be described with reference to the following drawings in which like elements are labeled similarly. The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0017] FIG. 1 is a front perspective view of an oral care system including a toothbrush and a fluid dispenser according to one embodiment of the present invention, wherein the dispenser is detachably coupled to the toothbrush in the storage state.

[0018] FIG. 2 is a rear perspective view of the oral care system of FIG. 1.

[0019] FIG. 3 is a left side view of the oral care system of FIG. 1, wherein the fluid dispenser is fully detached from the toothbrush and in an application state.

[0020] FIG. 4 is a longitudinal cross-sectional view of the toothbrush of the oral care system of FIG. 3.

[0021] FIG. 5 is a longitudinal cross-sectional view of the fluid dispenser of the oral care system of FIG. 3.

[0022] FIG. 6 is a longitudinal cross-sectional view of the oral care system of FIG. 1, wherein the fluid dispenser is in the storage state.

[0023] FIG. 7 is a transverse cross-sectional view of the fluid dispenser of FIG. 5 wherein a cap is detachably coupled to the dispenser.

[0024] FIG. 8 is a transverse cross-sectional profile of the opening of the toothbrush of the oral care system of FIG. 3 taken along view XIII-XIII of FIG. 3.

[0025] FIG. 9 is a transverse cross-sectional profile of the housing of the fluid dispenser of the oral care system of FIG. 3 taken along view IX-IX of FIG. 3.

[0026] FIG. 10 is a transverse cross-sectional profile of the cap of FIG. 7 taken along view X-X of FIG. 7.

[0027] FIG. 11 is a longitudinal cross-sectional view of the fluid dispenser being prohibited from being inserted into the cavity of the toothbrush by nature of the cap being coupled to the dispenser.

[0028] FIG. 12 is a close-up of area XII-XII of FIG. 11.

DETAILED DESCRIPTION OF THE INVENTION

[0029] The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0030] The description of illustrative embodiments according to principles of the present invention is intended to be read in connection with the accompanying drawings, which are to be considered part of the entire written description. In the description of embodiments of the invention disclosed herein, any reference to direction or orientation is merely intended for convenience of description and is not intended in any way to limit the scope of the present invention. Relative terms such as “lower,” “upper,” “horizontal,” “vertical,” “above,” “below,” “up,” “down,” “top” and “bottom” as well as derivative thereof (e.g., “horizontally,” “downwardly,” “upwardly,” etc.) should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These relative terms are for convenience of description only and do not require that the apparatus be constructed or operated in a particular orientation unless explicitly indicated as such. Terms such as “attached,” “affixed,” “connected,” “coupled,” “interconnected,” and similar refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening

structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise. Moreover, the features and benefits of the invention are illustrated by reference to the exemplified embodiments. Accordingly, the invention expressly should not be limited to such exemplary embodiments illustrating some possible non-limiting combination of features that may exist alone or in other combinations of features; the scope of the invention being defined by the claims appended hereto.

[0031] Exemplary embodiments of the present invention will now be described with respect to one possible oral care system. Embodiments of the oral care system may include without limitation the following fluids: tooth whitening, antibacterial, enamel protection, anti-sensitivity, anti-inflammatory, anti-attachment, fluoride, tartar control/protection, flavorant, sensate, colorant and others. However, other embodiments of the present invention may be used to store and dispense any suitable type of fluid and the invention is expressly not limited to any particular oral care system or oral care material alone.

[0032] Referring to FIGS. 1-2, an oral care system **100** is illustrated according to one embodiment of the present invention. The oral care system **100** is a compact readily portable self-contained user-friendly system that comprises all of the necessary components and chemistries necessary for a user to perform a desired oral care treatment routine. As will be described in greater detail below, the oral care system **100** in one exemplary embodiment comprises a modified toothbrush **200** having a removable dispenser **300** disposed at least partially within its handle **210**. Because the dispenser **300** is located within the handle **210** of the toothbrush **200**, the oral care system **100** is portable for travel, easy to use, and reduces the amount of required storage space. Furthermore, since the toothbrush **200** and dispenser **300** are housed together, the user is less likely to misplace the dispenser **300** and more inclined to maintain the oral treatment routine with the dispenser **300** since brushing will remind the user to simply detach and apply the contents of the dispenser **300**.

[0033] As discussed above, the oral care system **100** generally comprises the toothbrush **200** and the dispenser **300**. While the invention is described herein with respect to the use of a toothbrush as one of the two primary components of the oral care system **100**, it is to be understood that other alternate oral care implements can be used within the scope

of the invention, including tongue cleaners, tooth polishers and specially designed ansate implements having tooth engaging elements. In certain instances, the toothbrush **200** may include tooth engaging elements that are specifically designed to increase the effect of the oral care material in the dispenser on the teeth. For example, the tooth engaging elements may include elastomeric wiping elements that assist in removing stains from teeth and/or assist with forcing the oral care material into the tubules of the teeth. Moreover, while the toothbrush **200** is exemplified as a manual toothbrush, the toothbrush may be a powered toothbrush in certain embodiments of the invention. It is to be understood that the inventive system can be utilized for a variety of intended oral care needs by filling the dispenser **300** with any fluid, such as an oral care agent that achieves a desired oral effect. In one embodiment, the fluid is free of (i.e., is not) toothpaste as the dispenser **300** is intended to augment not supplant the brushing regimen. The fluid can be selected to complement a toothpaste formula, such as by coordinating flavors, colors, aesthetics, or active ingredients.

[0034] The toothbrush **200** generally comprises a handle **210**, a neck **220** and a head **230**. The handle **210** provides the user with a mechanism by which he/she can readily grip and manipulate the toothbrush **200**. The handle **210** may be formed of many different shapes, sizes and materials and may be formed by a variety of manufacturing methods that are well-known to those skilled in the art. Preferably, the handle **210** can house the dispenser **300** therein as described in detail below. If desired, the handle **210** may include a suitable textured grip made of soft elastomeric material. The handle **210** can be a single or multi-part construction. The handle **210** extends from a proximal end **212** to a distal end **213** along a longitudinal axis A-A. A cavity **280** (FIG. 4) is formed within the handle **210**. An opening **215** is provided at the proximal end **212** of the handle **210** that provides a passageway into the cavity through which the dispenser **300** can be inserted and retracted. While the opening **215** is located at the proximal end **212** of the handle **210** in the exemplified embodiment, the opening **215** may be located at other positions on the handle **210** in other embodiments of the invention. For example, the opening **215** may be located on a longitudinal surface of the handle **210** (e.g., the front surface, the rear surface and/or the side surfaces) and be elongated to provide sufficient access to the cavity **280**.

[0035] The handle **210** transitions into the neck **220** at the distal end **213**. While the neck **220** generally has a smaller transverse cross-sectional area than the handle **220**, the invention is not so limited. Broadly speaking, the neck **220** is merely the transition region between the handle **210** and the head **230** and can conceptually be considered as a portion of the handle **210**. In this manner, the head **230** is connected to the distal end **213** of the handle **210** (via the neck **220**).

[0036] The head **230** and the handle **210** of the toothbrush **200** are formed as a single unitary structure using a molding, milling, machining or other suitable process. However, in other embodiments, the handle **210** and the head **230** may be formed as separate components which are operably connected at a later stage of the manufacturing process by any suitable technique known in the art, including without limitation thermal or ultrasonic welding, a tight-fit assembly, a coupling sleeve, threaded engagement, adhesion, or fasteners. Whether the head **230** and the handle **210** are of a unitary or multi-piece construction (including connection techniques) is not limiting of the present invention, unless specifically claimed. In some embodiments of the invention, the head **230** may be detachable (and replaceable) from the handle **210** using techniques known in the art.

[0037] The head **230** generally comprises a front surface **231**, a rear surface **232** and a peripheral side surface **233** that extends between the front and rear surfaces **231**, **232**. The front surface **231** and the rear surface **232** of the head **230** can take on a wide variety of shapes and contours, none of which are limiting of the present invention. For example, the front and rear surfaces **231**, **232** can be planar, contoured or combinations thereof. Moreover, if desired, the rear surface **232** may also comprise additional structures for oral cleaning or tooth engagement, such as a soft tissue cleaner or a tooth polishing structure. An example of a soft tissue cleaner is an elastomeric pad comprising a plurality of nubs and or ridges. An example of a tooth polishing structure can be an elastomeric element, such as a prophylactic cup(s) or elastomeric wipers. Furthermore, while the head **230** is normally widened relative to the neck **220** of the handle **210**, it could in some constructions simply be a continuous extension or narrowing of the handle **210**.

[0038] The front surface **231** of the head **230** comprises a collection of oral cleaning elements such as tooth engaging elements **235** extending therefrom for cleaning and/or

polishing contact with an oral surface and/or interdental spaces. While the collection of tooth engaging elements **235** is suited for brushing teeth, the collection of tooth engaging elements **235** can also be used to polish teeth instead of or in addition to cleaning teeth. As used herein, the term “tooth engaging elements” is used in a generic sense to refer to any structure that can be used to clean, polish or wipe the teeth and/or soft oral tissue (e.g. tongue, cheek, gums, etc.) through relative surface contact. Common examples of “tooth engaging elements” include, without limitation, bristle tufts, filament bristles, fiber bristles, nylon bristles, spiral bristles, rubber bristles, elastomeric protrusions, flexible polymer protrusions, combinations thereof and/or structures containing such materials or combinations. Suitable elastomeric materials include any biocompatible resilient material suitable for uses in an oral hygiene apparatus. To provide optimum comfort as well as cleaning benefits, the elastomeric material of the tooth or soft tissue engaging elements has a hardness property in the range of A8 to A25 Shore hardness. One suitable elastomeric material is styrene-ethylene/butylene-styrene block copolymer (SEBS) manufactured by GLS Corporation. Nevertheless, SEBS material from other manufacturers or other materials within and outside the noted hardness range could be used.

[0039] The tooth engaging elements **235** of the present invention can be connected to the head **230** in any manner known in the art. For example, staples/anchors, in-mold tufting (IMT) or anchor free tufting (AFT) could be used to mount the cleaning elements/tooth engaging elements. In AFT, a plate or membrane is secured to the brush head such as by ultrasonic welding. The bristles extend through the plate or membrane. The free ends of the bristles on one side of the plate or membrane perform the cleaning function. The ends of the bristles on the other side of the plate or membrane are melted together by heat to be anchored in place. Any suitable form of cleaning elements may be used in the broad practice of this invention. Alternatively, the bristles could be mounted to tuft blocks or sections by extending through suitable openings in the tuft blocks so that the base of the bristles is mounted within or below the tuft block.

[0040] The toothbrush **200** and the dispenser **300** are non-unitary separate structures that are specially designed to be detachably coupled together when in an assembled state (referred to herein as a storage state) and completely isolated and separated from one

another when in a disassembled state (referred to herein as an application state). The toothbrush **200** and the dispenser **300** are illustrated in the storage state in FIGS. 1-2 and in the application state in FIG. 3. The dispenser **300** can be slidably manipulated and altered between the storage state (FIGS. 1-2) in which the dispenser **300** is located (or docked) in the toothbrush handle **210** and the application state (FIG. 3) in which the dispenser **300** is removed from the handle **210** by the user as desired.

[0041] Referring now to FIG. 4, additional details of the handle **210** of the toothbrush **200** will be described. As mentioned above, the toothbrush **200** comprises an internal cavity **280** in which the dispenser **300** can be inserted (i.e., slid) to effectuate a detachable coupling between the dispenser **300** and the toothbrush **200**. The cavity **280** is formed by the inner surface **240** of the toothbrush **200** and extends along the longitudinal axis **A-A** of the toothbrush **200** from an opening **215** to a transverse end wall **281**. The opening **215** forms a passageway into the cavity **280** through which the dispenser **300** can be axially translated.

[0042] A plug **282** extends axially from the transverse end wall **281**. In the exemplified embodiment, the plug **282** is integrally formed with the handle **210** of the toothbrush **200**. However, in other embodiments, the plug **282** may be a separate component and/or formed of a different material. As discussed in greater detail below, the plug **282** is provided as a means to seal a dispensing orifice **318** of the dispenser **300** when the dispenser **300** is in the storage state to prevent the fluid from leaking and/or drying out (see FIG. 6).

[0043] In the exemplified embodiment, the cavity **280** has generally circular transverse-cross sectional profile. However, the invention is not so limited and in other embodiments, the cavity **280** may have non-circular transverse cross-sectional profiles as desired. As can be seen in FIG. 8, the opening **215**, which is defined by the proximal edge **251** of the toothbrush **200** has a circular transverse cross-sectional profile in the exemplified embodiment. However, as with the cavity **280**, the opening **215** may have non-circular transverse cross-sectional profiles as desired. The transverse cross-sectional profile of the opening **215** has a center point **C₁** and a diameter **D₁**. As discussed below, the size and/or shape of the transverse cross-sectional profile of the opening **215** is selected to cooperate with the transverse cross-sectional profiles of the dispenser **300** and

detachable cap **700** so that: (1) the dispenser **300** can be inserted into the cavity **280** when the cap **700** is detached from the dispenser **300**; and (2) the dispenser **300** can not be inserted into the cavity **280** when the cap **700** is coupled to the dispenser **300**. This will be described in greater detail below.

[0044] Referring now to FIGS. 3 and 5 concurrently, an embodiment of the dispenser **300** will be described in greater detail. Generally, the dispenser **300** is an elongated tubular pen-like structure that extends along a longitudinal axis **B-B**. The dispenser **300** generally comprises a housing **301**, an applicator **302** located at a distal end **303** of the housing **301**, and a rotatable actuator **304** located at a proximal end **305** of the housing **301**. The dispenser **300** is designed so as to be capable of being operated to dispense the fluid stored therein using a single hand. Specifically, the dispenser **300** is positioned in a user's hand so that the rotatable actuator **304** is lodged in the palm of the user's hand. The user then uses the fingers of that same hand to rotate the housing **301** relative to the actuator **303**. As a result, the fluid contained therein is dispensed from the dispenser **300**. While a rotatable actuator **304** is exemplified as the structural mechanism that is activated by the user to dispense the fluid from the dispenser's internal reservoir **317**, it is to be understood that other fluid delivery mechanism can be utilized, including without limitation mechanical pumps, electrical pumps, compressible bladders, ratchets, syringe dispensers and/or combinations thereof. Unless specifically recited in a claim, the invention is not to be limited in any manner to the delivery mechanism of the dispenser **300**.

[0045] The housing **301** is constructed of a material that is sufficiently rigid to provide the necessary structural integrity for the dispenser **300**. For example, the housing **301** can be formed of a moldable hard plastic. Suitable hard plastics include polymers and copolymers of ethylene, propylene, butadiene, vinyl compounds and polyesters such as polyethylene terephthalate. The chosen plastic(s), however, should be compatible with the oral care material that is to be stored within the dispenser **300** and should not be corroded or degraded by the oral care agents.

[0046] While the housing **301** is exemplified as a single layer construction, in certain embodiments, the housing **301** may be a multilayer construction. In certain multi-layer embodiments, an inner layer can be formed from the hard plastic materials described

immediately above while an outer layer can be formed of a soft resilient material, such as an elastomeric material. Suitable elastomeric materials include thermoplastic elastomers (TPE) or other similar materials used in oral care products. The elastomeric material of the outer layer may have a hardness durometer measurement ranging between A13 to A50 Shore hardness, although materials outside this range may be used. A suitable range of the hardness durometer rating is between A25 to A40 Shore hardness. While an over-molding construction is one suitable method of forming the outer layer, a suitable deformable thermoplastic material, such as TPE, may be formed in a thin layer and attached to inner layer with an appropriate adhesive, sonic welding, or by other means.

[0047] The housing **301** is an elongated hollow tubular structure extending along the longitudinal axis **B-B** from the proximal end **305** to the distal end **303**. The housing **301** comprises a nozzle portion **371** to which the applicator **302** is coupled, a shoulder portion **371**, and a barrel portion **372**. The shoulder portion **371** is the transition between the narrow nozzle portion **371** and the larger barrel portion **373**. In the exemplified embodiment, the barrel portion **373** has a substantially constant transverse cross-sectional profile extending from the shoulder portion **372** to the distal end **312** of the housing **301**. However, in other embodiments, the barrel portion **373** may have a tapered transverse cross-sectional profile. Moreover, in certain embodiments, the housing **301** may not contain a nozzle portion **371** but may merely comprise a barrel portion **373** along the entire length of the housing **301**.

[0048] In the exemplified embodiment, the housing **301** has a circular transverse cross-sectional profile at both the nozzle portion **371** and the barrel portion **373** (shown in FIGS. 4-5). Of course, in other embodiments, the transverse cross-sectional profile of the housing **301** can take on non-circular shapes as desired. As shown in FIG. 9, transverse cross-sectional profile of the shoulder portion **372** at its maximum size (which also corresponds to the transverse cross-sectional profile of the barrel portion **373**) has a center point **C₂** and a diameter **D₂** (measured to an outer surface **314** of the housing **301**). As discussed below, the size and/or shape of the transverse cross-sectional profile of the shoulder portion **372** of the housing **301** is selected to cooperate with the transverse cross-sectional profile of the opening **215** so that the dispenser **300** can be inserted (i.e.

slid) into the cavity **280** when the cap **700** is detached from the dispenser **300**. This will be described in greater detail below.

[0049] The housing **301** comprises an outer surface **314** and an inner surface **315** that forms an elongated internal cavity **316**. As discussed in greater detail below, when the dispenser **300** is fully assembled, the internal cavity **316** of the housing **301** acts as a reservoir **317**.

[0050] The reservoir **317** contains the desired fluid or product, which can be any active or inactive oral care agent. The oral care agent and/or its carrier may be in any form such as a solid or a flowable material including without limitation viscous pastes/gels or less viscous liquid compositions. The fluid is a flowable material having a low viscosity in certain embodiments. Any suitable fluid can be used in the present invention. For example, the fluid can be an oral care agent that includes whitening agents, including without limitation, peroxide containing tooth whitening compositions. Suitable peroxide containing tooth whitening compositions are disclosed in U.S. Patent Serial No. 11/403,372, filed April 13, 2006, to the present assignee, the entirety of which is hereby incorporated by reference. While a tooth whitening agent and a sensitivity agent are two of the exemplified active agents in the present invention, any other suitable oral care agents can be used with embodiments of the present invention and, thus, stored within the reservoir **317**. Contemplated fluids can be oral care agents including active or non-active ingredients, including without limitation, antibacterial agents; oxidative or whitening agents; enamel strengthening or repair agents; tooth erosion preventing agents; anti-sensitivity ingredients; gum health actives; nutritional ingredients; tartar control or anti-stain ingredients; enzymes; sensate ingredients; flavors or flavor ingredients; breath freshening ingredients; oral malodor reducing agents; anti-attachment agents or sealants; diagnostic solutions; occluding agents; anti-inflammatory agents; dry mouth relief ingredients; catalysts to enhance the activity of any of these agents; colorants or aesthetic ingredients; and combinations thereof. The fluid in one embodiment is free of (i.e., is not) toothpaste. Instead, the active agent is intended to provide supplemental oral care benefits in addition to merely brushing one's teeth. Other suitable fluids could include lip balm or other materials that are typically available in a semi-solid state.

[0051] A dispensing orifice **318** is provided in the distal end **303** of the housing **301** through which fluid stored in the reservoir **317** can be dispensed from the dispenser **300**. In the exemplified embodiment, the dispensing orifice **318** is located in a transverse end wall at the distal end **303** of the housing **301** and extends through the applicator **302**. In certain other embodiments, the dispensing orifice **318** can be located in other areas of the housing **301**, such as on one of the longitudinal side walls. In some embodiments, a plurality of dispensing orifices **318** can be provided. For example, the plurality of dispensing orifices **318** can be provided in a generally circular configuration that may be used to facilitate the fluid being dispensed through the applicator **302**.

[0052] The applicator **302**, in the exemplified embodiment, is formed of a soft resilient material, such as an elastomeric material. Suitable elastomeric materials include thermoplastic elastomers (TPE) or other similar materials used in oral care products. The elastomeric material of the outer layer may have a hardness durometer measurement ranging between A13 to A50 Shore hardness, although materials outside this range may be used. A suitable range of the hardness durometer rating is between A25 to A40 Shore hardness.

[0053] In alternative embodiments, the applicator **302** may be constructed of bristles, a porous or sponge material, or a fibrillated material. Suitable bristles include any common bristle material such as nylon or PBT. The sponge-like materials can be of any common foam material such as urethane foams. The fibrillated surfaces can be comprised of various thermoplastics. The invention, however, is not so limited and the applicator **302** can be any type of surface and/or configuration that can apply a viscous substance onto the hard surface of teeth, including merely an uncovered opening/orifice.

[0054] The exemplary applicator **302** comprises a tubular sidewall **359** and a transverse end wall **360**. An aperture **361** (which can be considered a portion of the dispensing orifice **318**) is provided in the end wall **360** through which fluid from the reservoir **317** can be dispensed. A plurality of protuberances **363**, such as nubs, extends from the outer surface of the end wall **360**.

[0055] The rotatable actuator **304** protrudes axially from the proximal end **305** of the housing **301** so that a user can easily grip and rotate the actuator **304**. The actuator **304** comprises a dome portion **306** and an anti-rotation feature, which in the exemplified

embodiment is in the form of two members **307A**, **307B** that extend axially from the dome portion **306** toward the distal end **303** of the housing **301** and overlie a portion of the outer surface **314** of the housing **301**.

[0056] In the exemplified embodiment, the rotatable actuator **304** is rotatable with respect to the housing **301** and also axially reciprocates along axis **B-B** during rotation. The exemplified internal dispensing subsystem of the dispenser **300** generally comprises a reciprocator **308**, an extension member **309**, an elevator **310**, and a collar **311**. The reciprocator **308** comprises the rotatable actuator **304**, a resilient member **312** and a drive screw **313**. The rotatable actuator **304** is rotatably coupled to the housing **301**. Upon rotation of the rotatable actuator **304** relative to the housing **301**, the elevator **310** is translated axially along the drive screw **313**, thereby forcing the fluid from the reservoir **317** through the dispensing orifice **318** and out of the applicator **302**. While one embodiment of an internal dispensing subsystem is illustrated and described above, it is to be understood that a wide variety of mechanisms and subsystems can be used to dispense the fluid from the dispenser **300** in accordance with the present invention. The exact structural and functional details of the internal dispensing subsystem are not limiting of the present invention, unless specifically recited in a claim.

[0057] When the dispenser **300** is in the application state (as illustrated in FIGS. 3 and 5), the rotatable actuator **304** of the dispenser **300** can be rotated to dispense the fluid from the dispenser **300**. More specifically, when the dispenser **300** is in the application state, the rotatable actuator **304** of the dispenser **300** can be rotated with respect to the housing **301** to dispense the fluid from the dispenser **300**. As a result, the user can use the dispenser **300** to apply the fluid directly to the desired oral surface. However, when the dispenser **300** is in the storage state (as shown in FIGS. 1-2), it is desirable that the dispenser **300** be unable to dispense the fluid, which may occur due to inadvertent rotation of the rotatable actuator **304**. Thus, the toothbrush **200** and the dispenser **300** are designed so that when the dispenser is in the storage state, the rotatable actuator **304** can not be rotated in a manner that would inadvertently dispense the fluid from the dispenser **300**.

[0058] Referring now to FIGS. 1, 2 and 6 concurrently, the dispenser **300** is illustrated in the storage state. When in the storage state, the dispenser **300** is docked within the cavity

280 of the handle **210** of the toothbrush **200**. An interference fit between the outer surface **314** of the dispenser **300** and an inner surface **240** of the toothbrush **200** detachably couples the dispenser **300** to the toothbrush **200**. When the dispenser **300** is in the storage state, at least a portion, and preferably a majority, of the dispenser **300** is located within the internal cavity **280** of the toothbrush **200**.

[0059] In the exemplified embodiment, the entirety of the housing **301** of the dispenser **300**, including the applicator **302**, are located within the cavity **280** of the toothbrush **200** when the dispenser **300** is in the storage state. Moreover, as can be seen in FIG. 6, the plug **282** of the toothbrush extends through a portion of the dispensing orifice **318** and seals the dispensing orifice **318** of the dispenser **300** when the dispenser **300** is in the storage state. In some embodiments, the extension of the plug **282** through a portion of the dispensing orifice **318** may assist with coupling the dispenser **300** within the cavity **280** of the toothbrush **200**.

[0060] The rotatable actuator **304** of the dispenser **300** protrudes axially from the proximal end **212** of the handle **210** of the toothbrush **200** when in the storage state. In this manner, the rotatable actuator **304** of the dispenser **300** forms a longitudinal extension of the handle **210** of the toothbrush **200**. The dome portion **306** of the rotatable actuator **304** continues the natural contour of the handle **210** and provides a rounded proximal end to the oral care system **100**, thereby providing a look that aesthetically resembles a traditional manual toothbrush.

[0061] While the housing **301** of the dispenser **300** is located within the cavity **280** of the toothbrush **200** and the rotatable actuator **304** protrudes from the handle **210** of the toothbrush **200**, the rotatable actuator **304** can not be rotated relative to the toothbrush **200** (or relative to the housing **301** of the dispenser **300**) due to a mechanical interference created between the anti-rotation feature of the rotatable actuator **304** and the anti-rotation feature of the toothbrush **200**. In the exemplified embodiment, the anti-rotation feature of the rotatable actuator **304** comprises the two members **307A**, **307B** that extend from the dome portion **306** while the anti-rotation feature of the toothbrush **200** comprises two recesses **250A**, **250B** that are formed into a proximal edge **251** of the handle **210** of the toothbrush **200**.

[0062] Referring now to FIG. 7, the dispenser **300** is illustrated having a cap **700** detachably coupled thereto. The cap **700** comprises a closed top end and an open bottom end. The cap **700** also generally comprises a tubular portion **701** and a flanged portion **702** extending radially outward from a bottom end of the tubular portion **701**. When the cap **700** is coupled to the dispenser **300**, the nozzle portion **371** of the housing **301** is located within the tubular portion **701** of the cap **700** while the flanged portion **702** overlies and abuts the shoulder portion **732** of the housing **301** of the dispenser **300**. The flanged portion **732** extends radially outward from the outer surface **703** of the tubular portion **701** and terminates at an annular flange edge **704**. The cap **700** is designed so that when the cap **700** is coupled to the dispenser **300**, the flanged portion **702** protrudes radially beyond the shoulder portion **732** of the housing **301**.

[0063] While the flanged portion **702** of the cap **700** is exemplified as a continuous annular structure, the flange portion **702** could take on other forms. For example, in other embodiments, the flanged portion **702** may take the form of a segmented flange or radially extending struts.

[0064] In the exemplified embodiment, both the tubular portion **301** and the flanged portion **702** of the cap have generally circular transverse-cross sectional profiles. However, the invention is not so limited and in other embodiments, the tubular portion **301** and/or the flanged portion **702** may have non-circular transverse cross-sectional profiles as desired. As can be seen in FIG. 10, the flanged portion **702** of the cap **700** has a center point **C₃** and a diameter **D₃** (measured to the flange edge **704**). As discussed below, the size and/or shape of the transverse cross-sectional profile of the flanged portion **702** is selected to cooperate with the transverse cross-sectional profile of the opening **215** of the toothbrush **200** to prohibit the dispenser **300** from being fully inserted into the cavity **280** when the cap **700** is coupled to the dispenser **300**.

[0065] In the exemplified embodiment, the cap **700** is coupled to the dispenser **300** via a mechanical interference fit. However, in other embodiments, the cap **700** can be detachably coupled to the dispenser **300** in other ways, such as by a threaded connection, a snap-fit connection, or the like. When the cap **700** is coupled to the dispenser, the cap **700** seals the dispensing orifice **318** so that the fluid within the reservoir **317** does not leak or dry out prior to its initial use. In order to seal the reservoir **317**, the cap **700** is

provided with a plug **705** that extends axially from a bottom surface of the closed top end of the cap **700**. Thus, when the cap **700** is coupled to the dispenser **300**, the plug **705** penetrates into and seals the dispensing orifice **318** of the dispenser **300**.

[0066] In certain embodiments of the present invention, it may be desirable to sell the oral care system **100** in an arrangement where the toothbrush **200** and the dispenser **300** are in an uncoupled state. In such a scenario, it will be desirable to couple the cap **700** to the dispenser **300** to preserve the fluid within the reservoir **317**. However, once the oral care system **100** is to be used by a customer, the cap **700** is no longer necessary because the dispenser **300** will be docked in the cavity **280** of the toothbrush **200** where the plug **281** of the toothbrush **200** will seal the dispensing orifice **318** during periods of non-use. However, it is possible that the customer will attempt to insert the dispenser **300** with the cap **700** still attached thereto into the cavity **280** of the toothbrush **200**. Such a situation is undesirable because the cap **700** could damage the plug **281** within the cavity **280** of the toothbrush or become lodged within the cavity, thereby preventing proper future functioning of the oral care system **100**. Thus, in accordance with the present invention, the cap **700** is designed so that it can not pass through the opening **215** of the toothbrush **200**. As a result, if the cap **700** is coupled to the dispenser **300**, the dispenser **300** will be prohibited from being fully inserted into the cavity **280** and into the storage state because the cap **700** would be obstructed from passing through the opening **215** (see FIGS. 11-12). More specifically, the flange portion **702** of the cap **700** will contact portions of the proximal edge **251** of the toothbrush **200** and be unable to pass through the opening **215**.

[0067] The aforementioned safety feature can be achieved by relatively designing the geometries of the cap **700**, the opening **215** of the toothbrush **200**, and the housing **301** of the dispenser **300** so that the cap **700** can not be translated through the opening **215** while the housing **301** of the dispenser **300** can be translated through the opening **215**. For example, in some embodiments, the proximal edge **251** may include one or more recesses and the flange portion **702** may include one or more protuberances, such that the one or more protuberances may mate with the one or more recesses. In these embodiments, the recesses and the protuberances may help to prohibit the cap **700** from translating through opening **215**.

[0068] Referring now to FIGS. 8-10 concurrently, the relative geometrical design of the cap **700**, the opening **215** of the toothbrush **200**, and the housing **301** of the dispenser **300** to achieve the aforementioned safety feature will be described in accordance with one embodiment of the present invention. Conceptually, in the exemplified embodiment of the oral care system **100**, the aforementioned safety feature can be achieved by proper design of the transverse cross-sectional profiles of the opening **215** of the toothbrush **200**, the flange portion **702** of the cap **700**, and the shoulder portion **372** (and/or the barrel portion **373**) of the housing **301** of the dispenser **300**.

[0069] As mentioned above, the transverse cross-sectional profile of the opening **215** of the toothbrush **200** is circular in shape, having a diameter D_1 and a center point C_1 . The transverse cross-sectional profile of the flange portion **702** of the cap **700** is also circular but instead has a diameter D_2 and a center point C_2 . The diameter D_2 is greater than the diameter D_1 . Thus, when the center points C_1 , C_2 of the transverse cross-sectional profiles of the flange portion **702** and the opening **215** are aligned, the transverse cross-sectional profile of the flange portion **702** does not fit entirely within the transverse cross-sectional profile of the opening **215**. As a result, the flange portion **702** of the cap **700** can not pass through the opening **215** of the toothbrush **200**. Therefore, if the cap **700** remains coupled to the dispenser **300**, the dispenser **300** will be prohibited from being fully inserted into the cavity **280** of the handle **210** and into the storage state (shown in FIG. 11-12).

[0070] Regarding the dispenser **300**, the transverse cross-sectional profile of the shoulder portion **372** (and the barrel portion **373**) is also circular and has a diameter D_3 and a center point C_3 . The diameter D_3 is less than the diameter D_1 . Thus, when the center points C_1 , C_3 of the transverse cross-sectional profiles of the opening **215** and the shoulder portion **372** (or barrel portion **373**) are aligned, the transverse cross-sectional profile of shoulder portion **372** (or barrel portion **373**) of the housing **301** fits entirely within the transverse cross-sectional profile of the opening **215**. As a result, the housing **301** of the dispenser **300** can pass through the opening **215** of the toothbrush **200** and into the cavity **280** until the dispenser **300** is in the storage state (as shown in FIG. 6).

[0071] The aforementioned geometric principles can be applied to any shape (or shapes) that the transverse cross-sectional profiles of the opening **215**, the cap **700**, and the

housing **301** may take on, whether or not the shapes are similar or dissimilar, and/or circular or non-circular. For example, assume that the opening **215** has a transverse cross-sectional profile that is circular in shape and has a diameter **D₁** and a center point **C₁**. Now assume that the flange portion **704** (or another portion) of the cap **700** has transverse cross-sectional profile that is rectangular shape having a diagonal and a center point. In this scenario, the flange portion **602** of the cap **700** should be designed so that the diagonal of its rectangular transverse cross-sectional profile is greater than the diameter **D₁** of the transverse cross-sectional profile of the opening **215**. When the diagonal is greater than the diameter **D₁**, the rectangular transverse cross-sectional profile of the flange portion **702** of the cap **700** will not fit entirely within the circular transverse cross-sectional profile of the opening **215** (the corners of the rectangle will lie outside of the perimeter of the circle). As a result, the cap **700** will prohibit the dispenser **300** from being fully inserted into the cavity **280** of the toothbrush **200** while the cap **700** is coupled thereto. Of course, similar calculations can be performed for any and all geometries.

[0072] As used throughout, ranges are used as shorthand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range. In addition, all references cited herein are hereby incorporated by reference in their entireties. In the event of a conflict in a definition in the present disclosure and that of a cited reference, the present disclosure controls.

[0073] While the foregoing description and drawings represent the exemplary embodiments of the present invention, it will be understood that various additions, modifications and substitutions may be made therein without departing from the spirit and scope of the present invention as defined in the accompanying claims. In particular, it will be clear to those skilled in the art that the present invention may be embodied in other specific forms, structures, arrangements, proportions, sizes, and with other elements, materials, and components, without departing from the spirit or essential characteristics thereof. One skilled in the art will appreciate that the invention may be used with many modifications of structure, arrangement, proportions, sizes, materials, and components and otherwise, used in the practice of the invention, which are particularly adapted to specific environments and operative requirements without departing from the principles of the present invention. The presently disclosed

embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being defined by the appended claims, and not limited to the foregoing description or embodiments.

CLAIMS

WHAT IS CLAIMED IS:

1. An oral care system comprising:
 - a toothbrush having a cavity and a plug in the cavity;
 - a dispenser comprising a reservoir containing a fluid and a dispensing orifice;
 - a cap detachably coupled to the dispenser that seals the dispensing orifice;
 - wherein when the cap is coupled to the dispenser, the cap prohibits the dispenser from being fully inserted into the cavity; and
 - wherein when the cap is detached from the dispenser, the dispenser can be fully inserted into the cavity so that the plug penetrates the dispensing orifice and the dispenser is detachably coupled to the toothbrush.
2. The oral care system according to claim 1 wherein the cavity is located in a handle of the toothbrush and extends along a longitudinal axis of the handle.
3. The oral care system according to claim 2 wherein the toothbrush comprises an opening located at a proximal end of the handle that forms a passageway into the cavity, wherein the cap comprises a portion having a transverse cross-section profile that can not fit through a transverse cross-sectional profile of the opening.
4. The oral care system according to any one of claims 1 to 3 wherein the toothbrush comprises an opening forming a passageway into the cavity, the cap comprising a tubular portion and a flange portion, and wherein the flange portion can not fit through the opening.
5. The oral care system according to claim 4 wherein the dispenser comprises a housing having the reservoir, the housing comprising a nozzle portion and a shoulder portion, the nozzle portion located within the tubular portion of the cap and the flange portion of the cap protruding radially beyond the shoulder portion of the dispenser when the cap is coupled to the dispenser.
6. The oral care system according to claim 1 wherein the cap comprises a flange portion and the dispenser comprises a shoulder portion, the flange portion of the

cap protruding radially beyond the shoulder portion of the dispenser when the cap is coupled to the dispenser.

7. The oral care system according to any one of claims 1 to 6 wherein the dispenser comprises a housing, an applicator located at a distal end of the housing and fluidly coupled to the dispensing orifice, and an actuator for dispensing the liquid from reservoir to the applicator.
8. The oral care system according to any one of claims 1 to 7 wherein the toothbrush comprises an opening forming a passageway into the cavity, the opening having a first transverse cross-sectional profile, the cap having a portion having a second transverse cross-sectional profile that does not fit entirely within the first transverse cross-sectional profile, and the dispenser having a housing having a third transverse cross-sectional profile that fits entirely within the first transverse cross-sectional profile.
9. The oral care system according to any one of claims 1 to 8 wherein the plug extends axially from a transverse end wall of the cavity.
10. An oral care system comprising:
 - a toothbrush having a cavity extending along a longitudinal axis and an opening forming a passageway into the cavity, the opening having a first transverse cross-sectional profile;
 - a dispenser comprising a housing having a reservoir containing a fluid and a dispensing orifice, the housing having a second transverse cross-sectional profile that fits entirely within the first transverse cross-sectional profile; and
 - a cap detachably coupled to the dispenser, the cap having a portion having a third cross-sectional profile that does not fit entirely within the first transverse cross-sectional profile.
11. The oral care system according to claim 10 wherein the portion of the cap is a flange portion.

12. The oral care system according to any one of claims 10 to 11 wherein when the cap is coupled to the dispenser, the portion of the cap prohibits the dispenser from being inserted into the cavity.
13. The oral care system according to any one of claims 10 to 12 wherein when the cap is detached from the dispenser, the dispenser can be inserted into the cavity and detachably coupled to the toothbrush.
14. The oral care system according to any one of claims 10 to 13 wherein the first transverse cross-sectional profile comprises a center point, the second transverse cross-sectional profile comprises a center point, and the third transverse cross-sectional profile comprises a center point, and wherein when the center points of the first, second and third transverse cross-sectional profiles are concentric, the third cross-sectional profile does not fit entirely within the first transverse cross-sectional profile and the second transverse cross-sectional profile fits entirely within the first transverse cross-sectional profile.
15. The oral care system according to any one of claims 10 to 14 wherein the second transverse cross-sectional profile of the housing of the dispenser is taken at a shoulder portion of the housing.
16. The oral care system according to any one of claims 10 to 15 wherein the toothbrush further comprises a plug extending axially from a transverse end wall of the cavity, wherein when the cap is detached from the dispenser, the dispenser can be inserted into the cavity so that the plug penetrates and seals the dispensing orifice and the dispenser is detachably coupled to the toothbrush.
17. The oral care system according to any one of claims 10 to 16 wherein the cap further comprises a plug that penetrates and seals the dispensing orifice when the cap is coupled to the dispenser.
18. An oral care system comprising:
 - a toothbrush having a cavity;
 - a dispenser comprising a reservoir containing a fluid;
 - a cap detachably coupled to the dispenser;

wherein when the cap is coupled to the dispenser, the cap prohibits the dispenser from being inserted into the cavity; and

wherein when the cap is detached from the dispenser, the dispenser can be inserted into the cavity and detachably coupled to the toothbrush.

19. The oral care system according to claim 18 wherein the cap comprises a portion that can not be translated through an opening that forms a passageway into the cavity.
20. The oral care system according to any one of claims 18 to 19 wherein the portion of the cap comprises a flange portion that protrudes radially beyond a shoulder portion of a housing of the dispenser when the cap is coupled to the dispenser.
21. The oral care system according to any one of claims 18 to 20 wherein the toothbrush further comprises a plug extending axially from a transverse end wall of the cavity, wherein when the cap is detached from the dispenser, the dispenser can be inserted into the cavity so that the plug penetrates and seals a dispensing orifice of the dispenser and the dispenser is detachably coupled to the toothbrush.
22. The oral care system according to claim 21 wherein the cap further comprises a plug that penetrates and seals the dispensing orifice of the dispenser when the cap is coupled to the dispenser.
23. An oral care system comprising:
 - a toothbrush having a cavity;
 - a dispenser comprising a reservoir containing a fluid;
 - the dispenser alterable between: (1) a storage state in which the dispenser is located within the cavity and detachably coupled to the toothbrush; and (2) an application state in which the dispenser is separated from the toothbrush;
 - a cap detachably coupled to the dispenser that seals the dispensing orifice;
 - wherein when the cap is coupled to the dispenser, the dispenser can not be altered into the storage state; and
 - wherein when the cap is detached from the dispenser, the dispenser can be altered into the storage state.

24. The oral care system according to claim 23 wherein the toothbrush further comprises a plug extending axially from a transverse end wall of the cavity, and wherein when the dispenser is in the storage state, the plug penetrates and seals a dispensing orifice of the dispenser.
25. The oral care system according to claim 24 wherein the cap further comprises a plug that penetrates and seals the dispensing orifice of the dispenser when the cap is coupled to the dispenser.

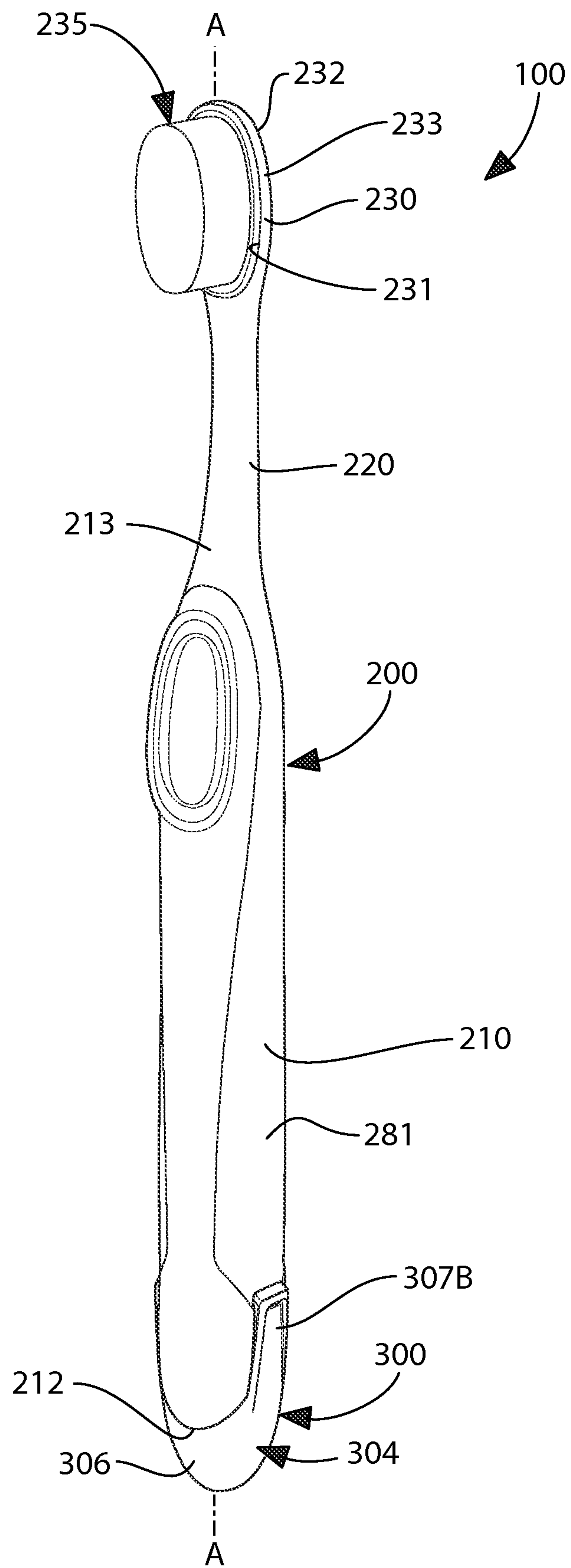


FIG. 1

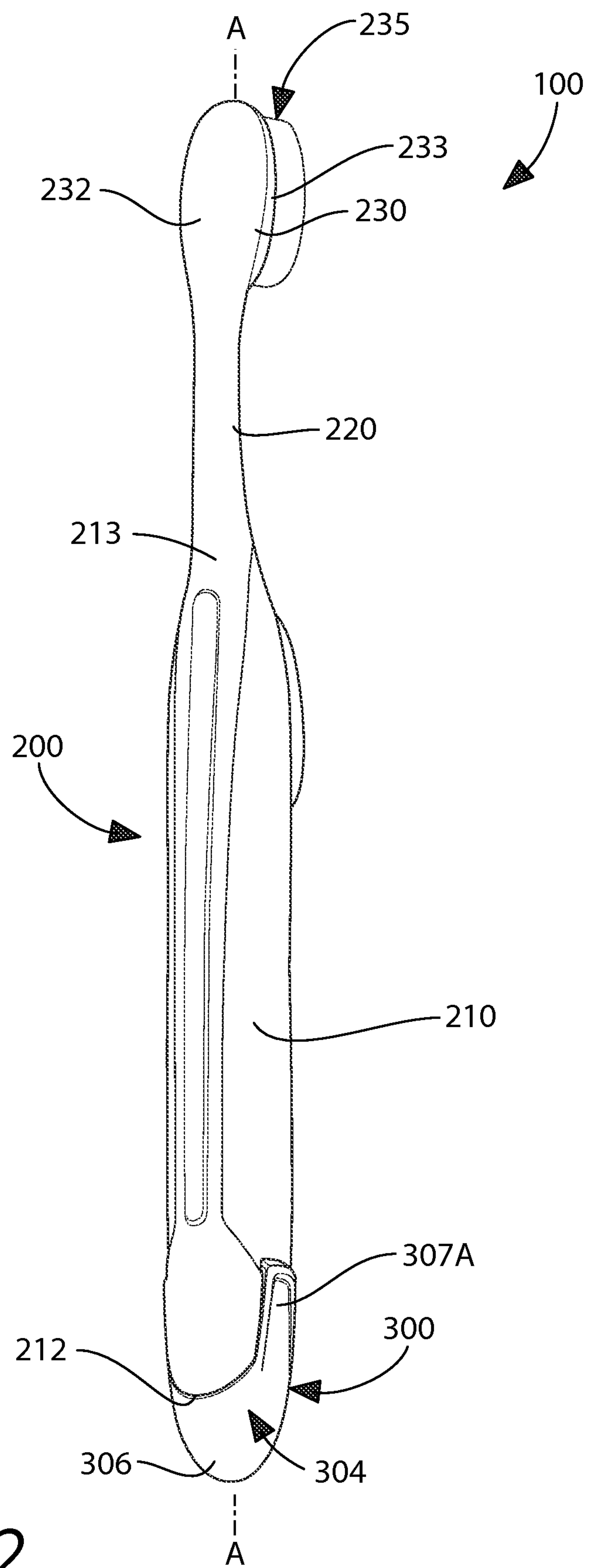


FIG. 2

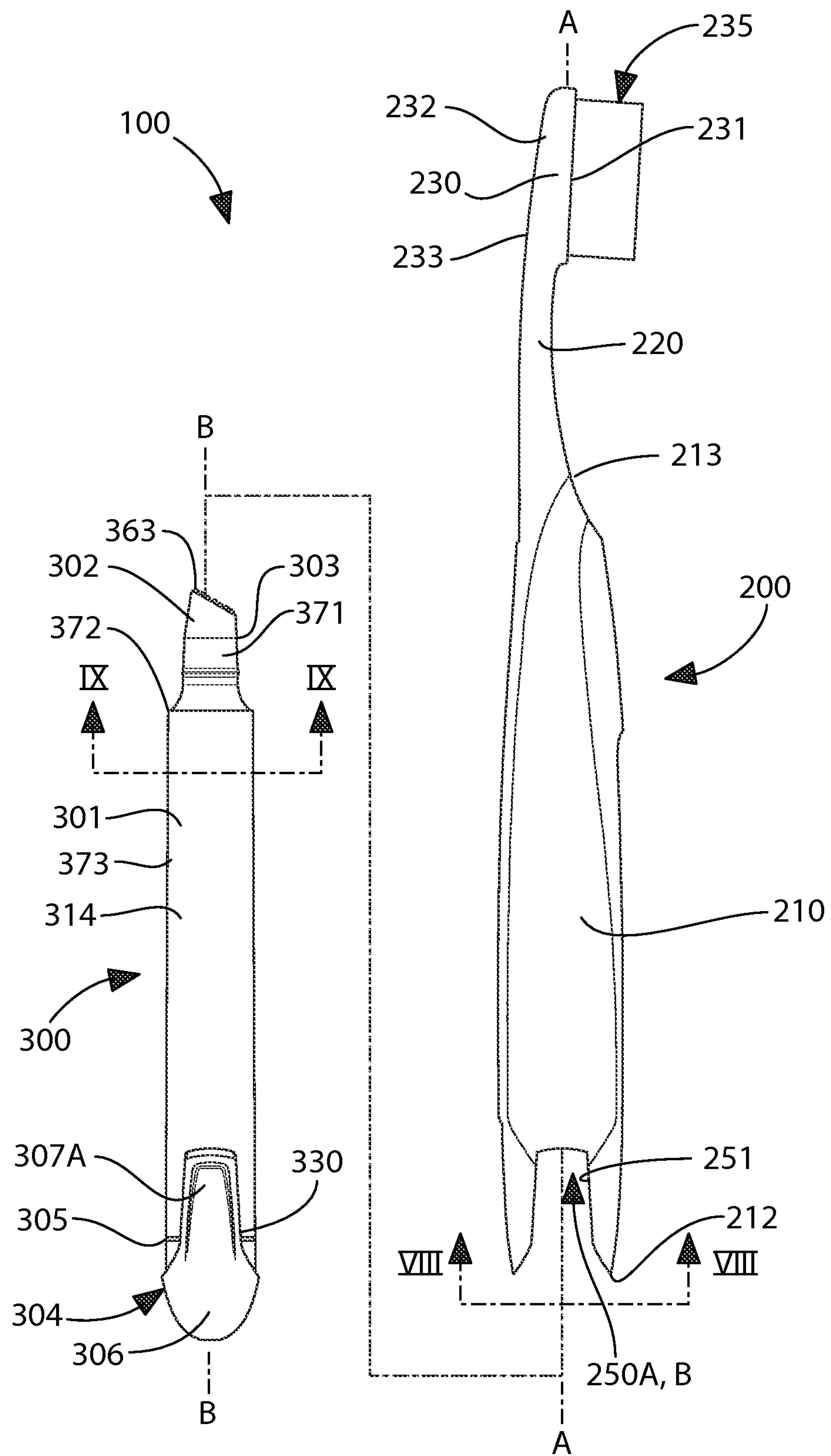


FIG. 3

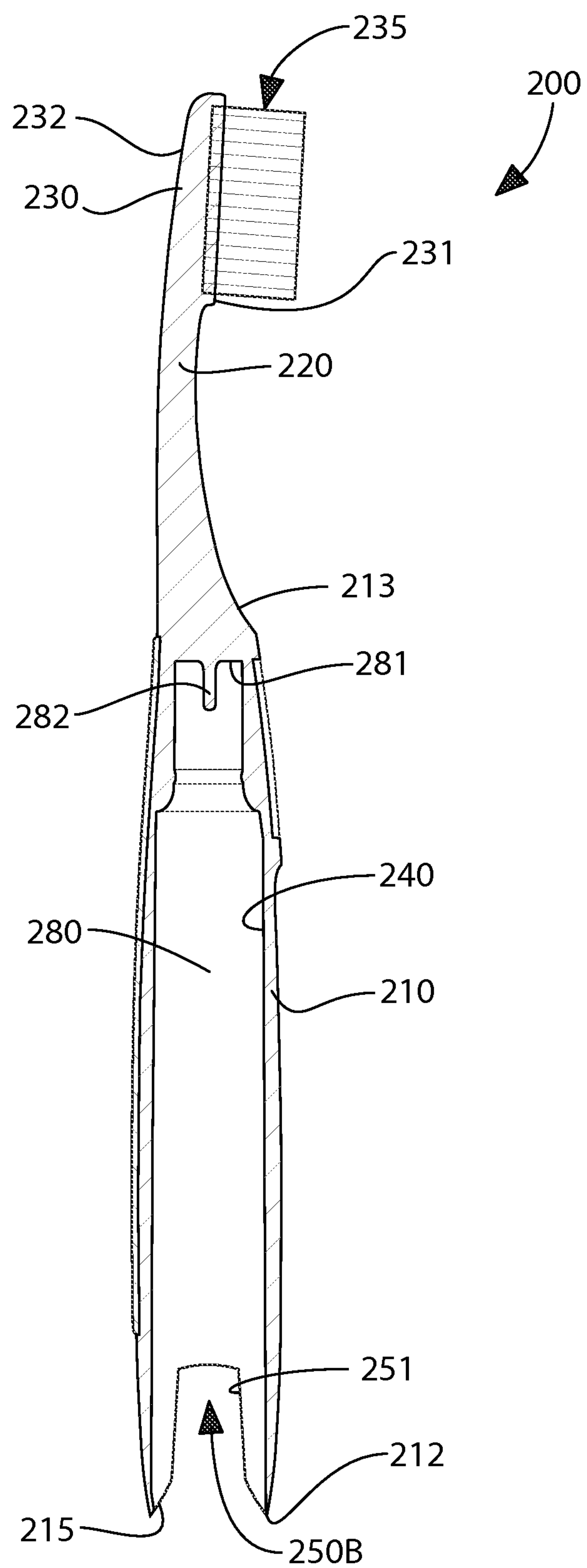


FIG. 4

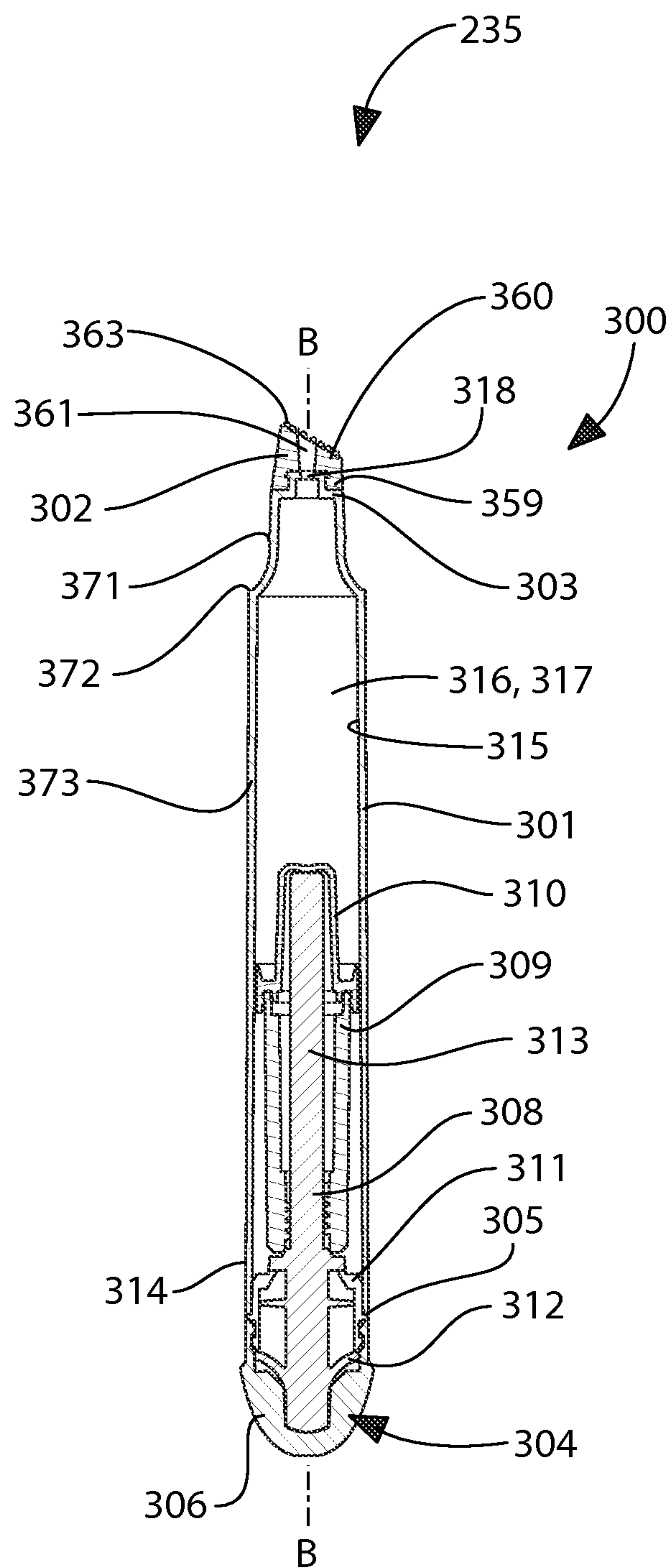


FIG. 5

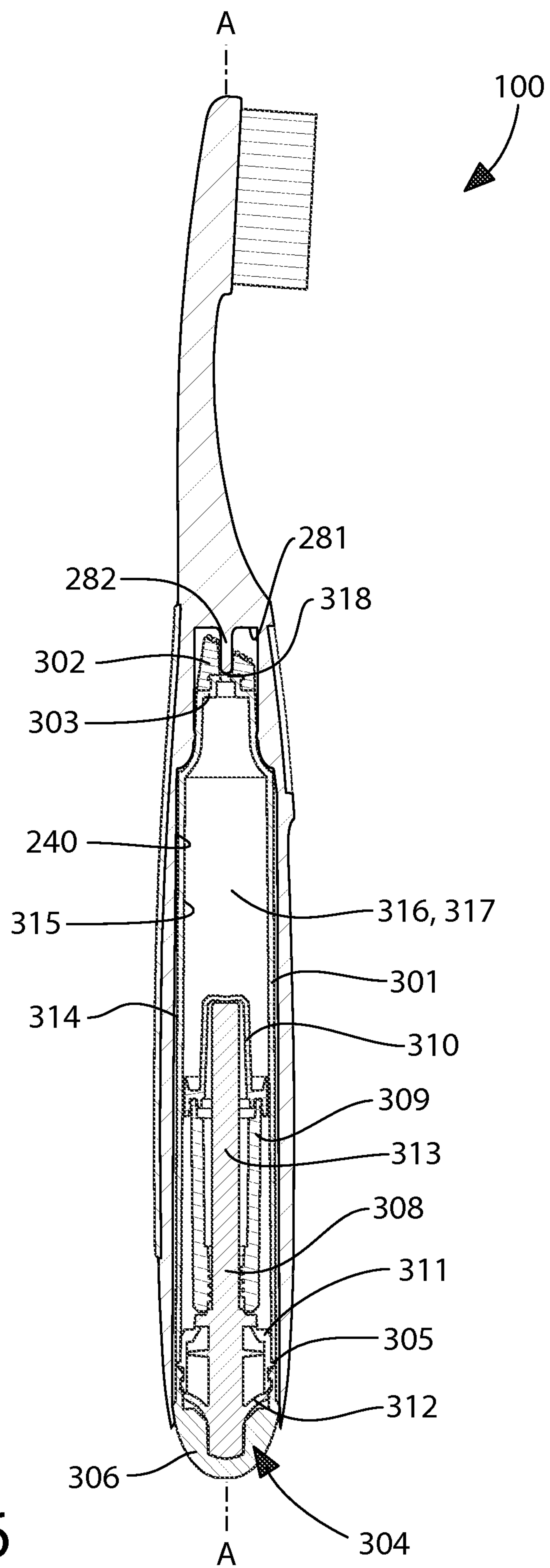


FIG. 6

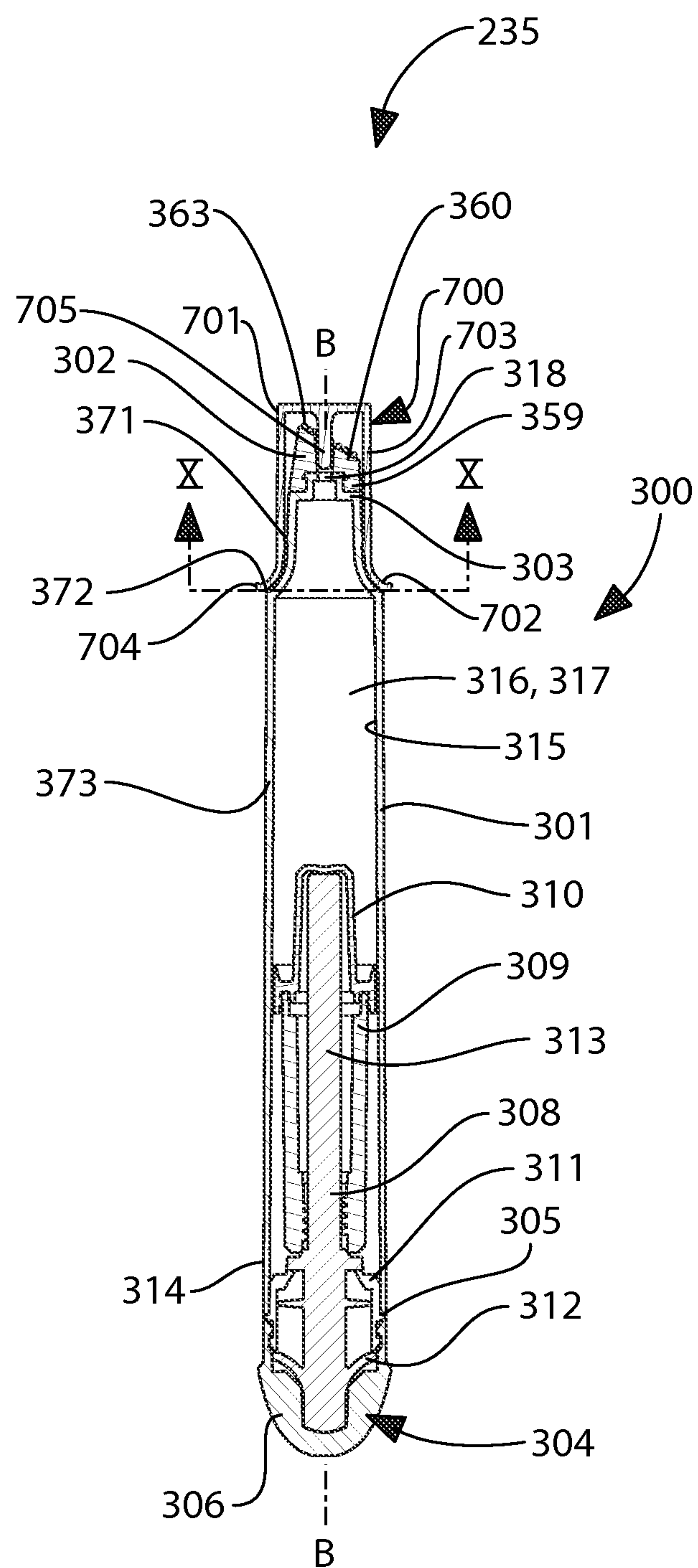


FIG. 7

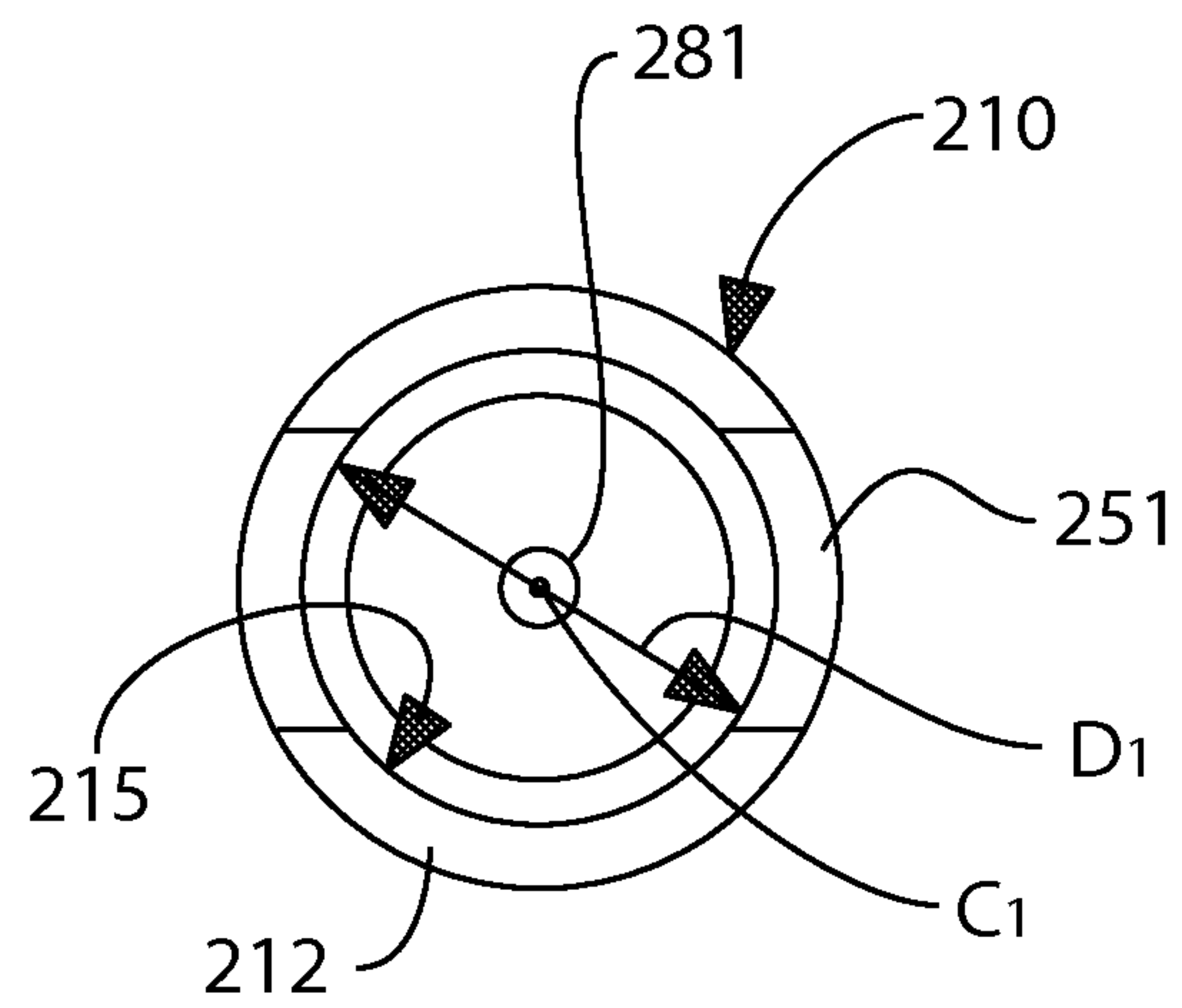


FIG. 8

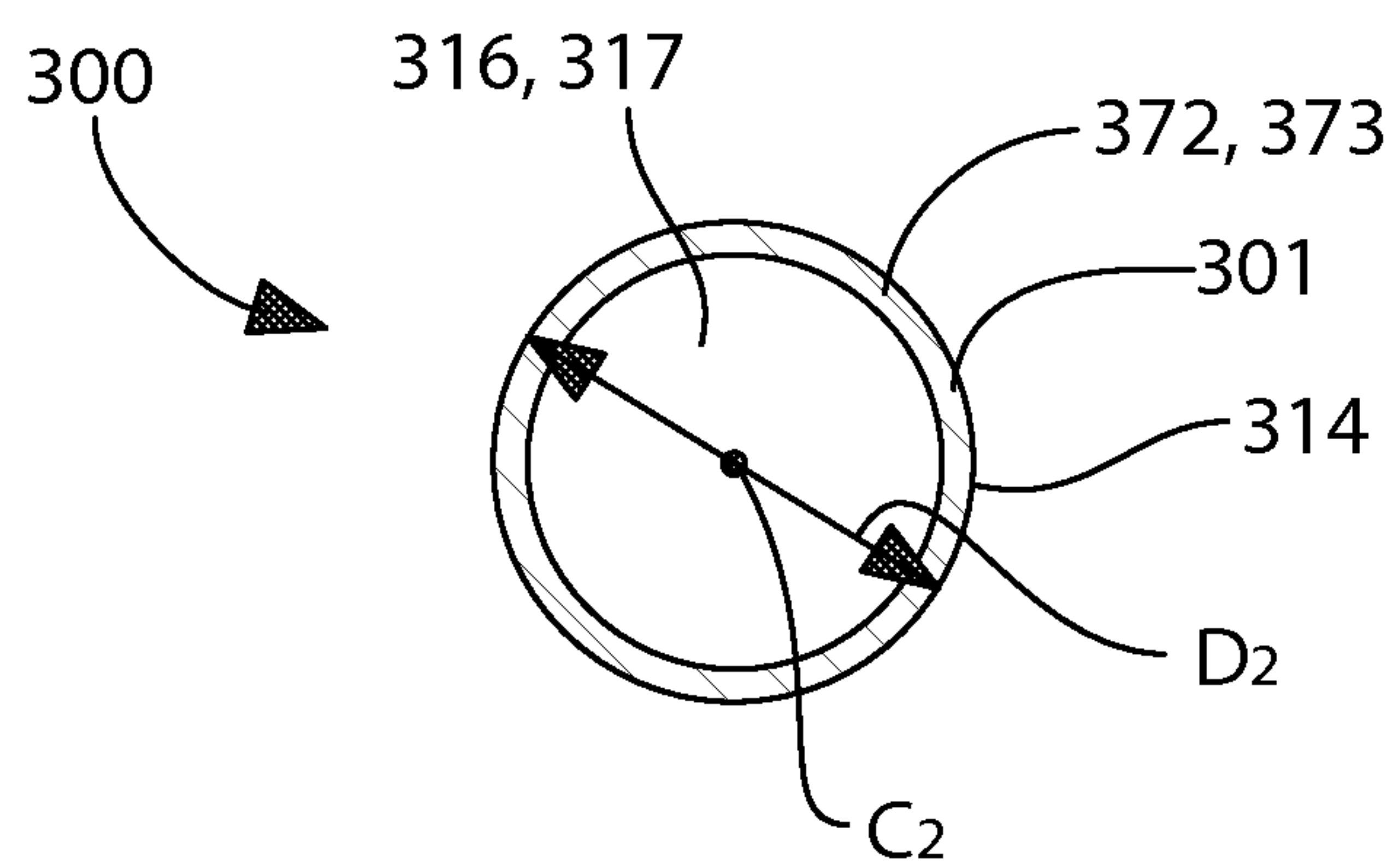


FIG. 9

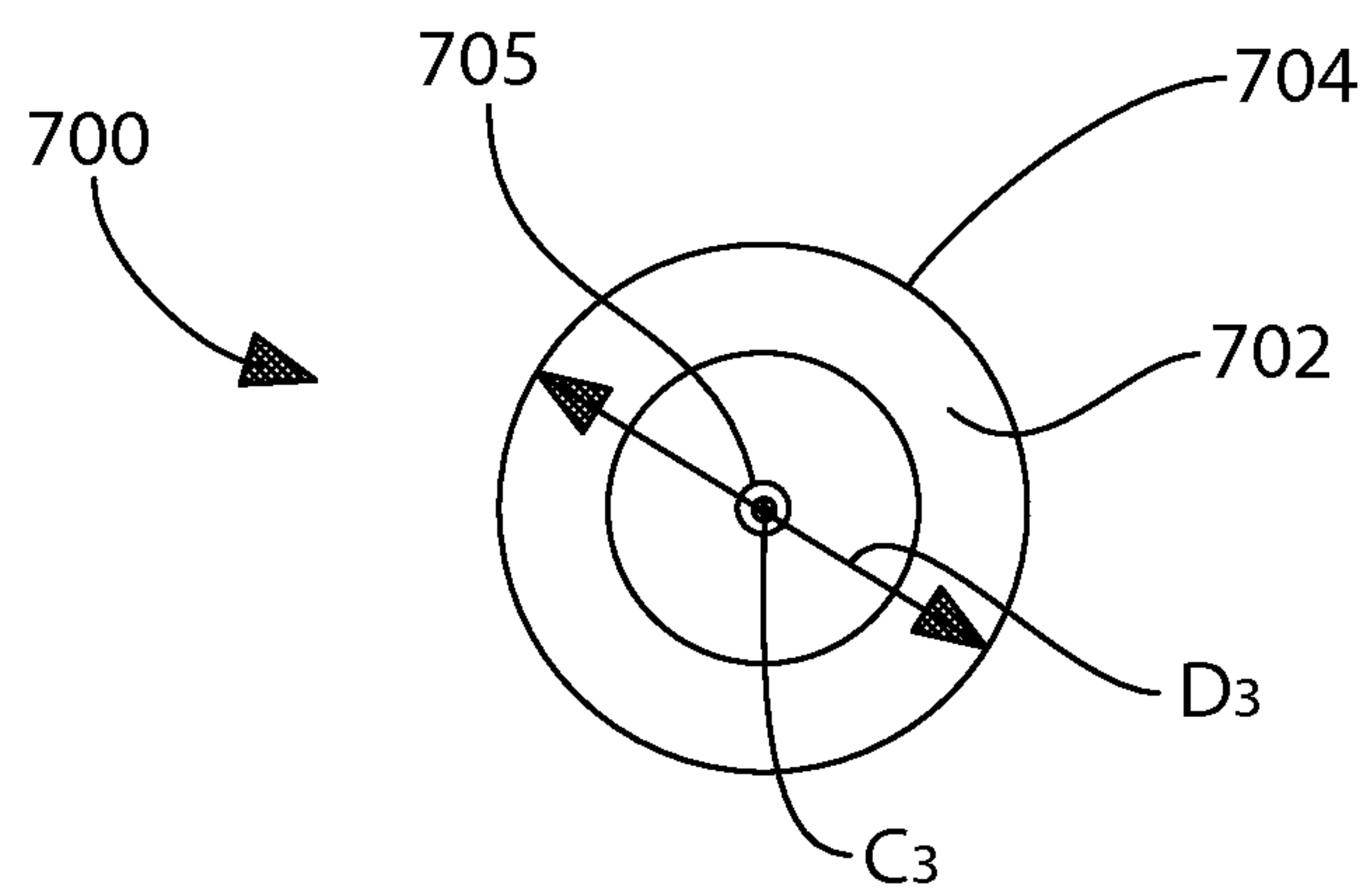


FIG. 10

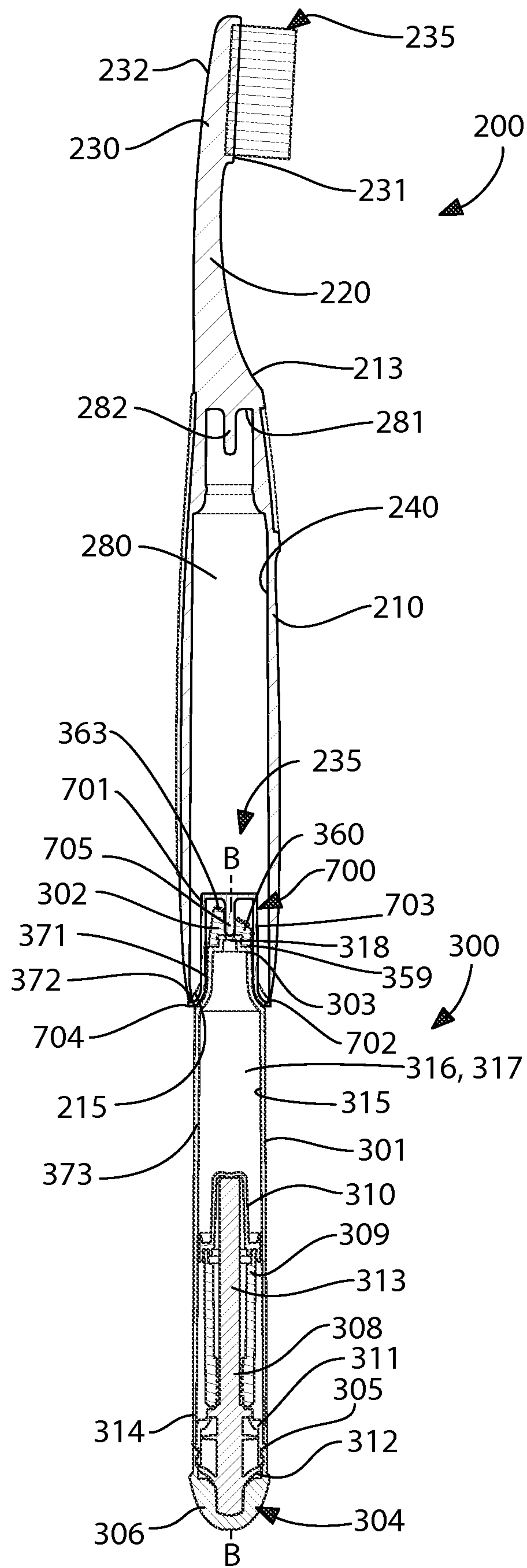


FIG. 11

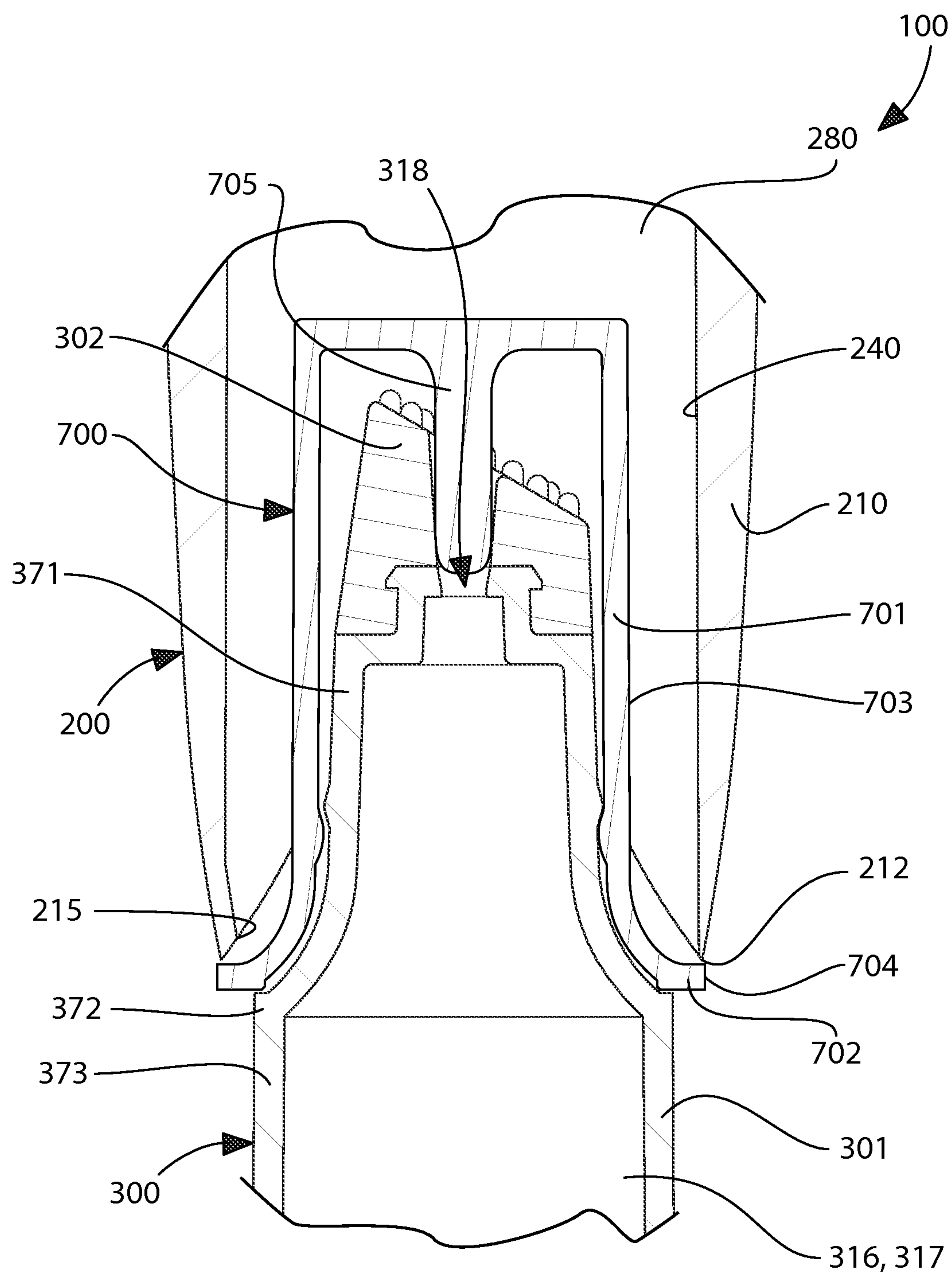


FIG. 12

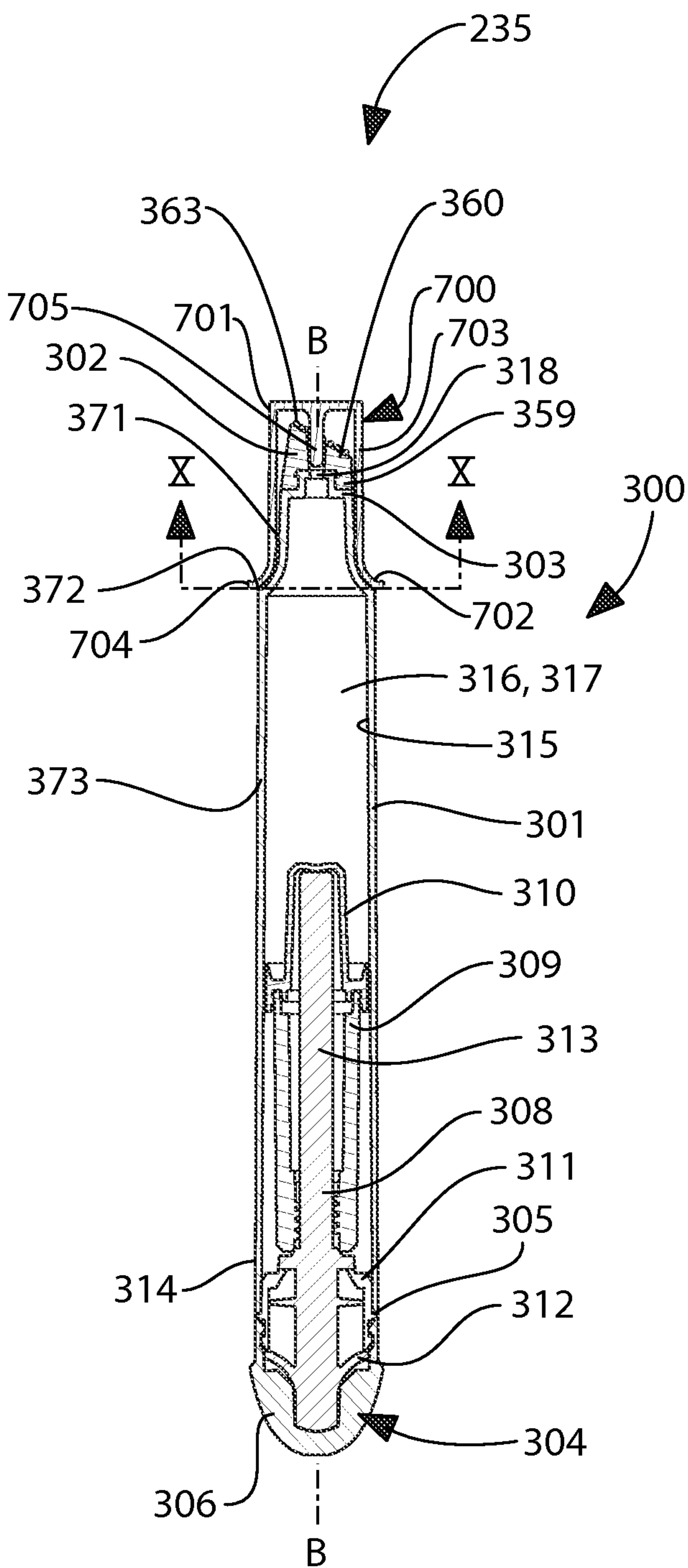


FIG. 7