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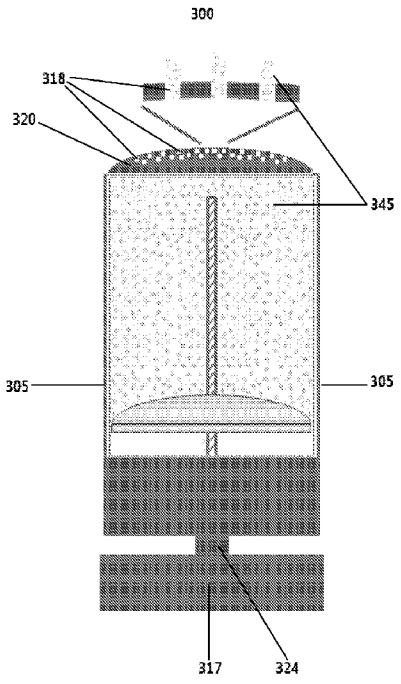



Figure 3C

(57) Abstract: The present invention provides devices for dispensing topical pharmaceutical compositions. In some embodiments, the dispensing device possesses a reservoir for storing the composition and means for metering the composition. In some embodiments, such reservoirs are: i. made from, or substantially lined with, a material that opaque and/or substantially nondepleting of at least one component of the composition; ii. optionally, volumetrically compressible; and iii. fitted with the means for metering the composition. And the means for metering are adapted to measure a fixed amount of the composition for application to a dermal region of a user of the device. In some embodiments, the compositions has a specific gravity in the range of from about 0.85 to about 1.20 at about room temperature and comprises a medicament; a thickening agent; and a solvent, and optionally a skin penetration enhancer and/or a deodorant.

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# DISPENSING DEVICES FOR TOPICAL PHARMACEUTICAL COMPOSITIONS

**[0001]** The present application claims the benefit of United States Provisional Patent Application Serial Number 62/079,112, filed on November 13, 2014 and hereby incorporated by reference in its entirety.

## Field of the Inventions

**[0002]** The present invention relates to devices adapted for containing and dispensing topically-administered, nonpourable, pharmaceutical compositions, such as gels, creams, ointments, pastes, or lotions, to skin and/or mucosa of a mammal, e.g., a human.

## Background of the Inventions

**[0003]** The topical administration of active pharmaceutical ingredients (APIs) offers several potential benefits. For instance, sites for the topical application of APIs, such as skin or mucosa, can be easily accessed by patients; and therefore allow for efficient administration. And such sites typically afford comfortable application of topical compositions, which promotes patient compliance with treatment regimens.

**[0004]** The topical delivery of APIs offers the potential for the targeted treatment of conditions that are local, either in causality or manifestation, with relatively high local concentrations of APIs; and therefore can both generally increase efficacy and, for APIs having toxicity or irritation potential, reduce side effects reduce. Topical administration of APIs further offers the potential for the effective treatment of systemic conditions because of the significant exposure of sites for the topical administration of APIs to the circulatory system. The availability of skin penetration or permeability enhancers for use in topical, pharmaceutical compositions can facilitate the formulation of certain APIs possessing relatively low skin permeation properties for systemic effect.

**[0005]** Other potential advantages of topically applied pharmaceutical formulations include avoidance of drawbacks associated with parenteral and/or oral dosage forms. Such



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drawbacks spanning risks of variable adsorption and/or metabolism of APIs; noncontinuity of target tissue exposure to APIs (e.g., for APIs having short biological half-lives); insufficient exposure of target tissue to APIs (e.g., for APIs having limited bioavailability/access to target tissue; and inconvenient, irritating, or painful administration.

## Summary of the Inventions

**[0006]** Prescription therapy of mental or physical condition, illness, or disease involves a health care professional selecting for administration a drug having curative or palliative effect. And prescription drug therapy requires, for achieving efficacy and minimizing side effects, accurate drug dosing, in terms of both amount and interval. Pharmaceutical dosage forms, such as tablets, capsules, powders, and liquids, which are disposed to unit dose administration of precisely calibrated amounts of drug afford accurate dosing.

**[0007]** Precision dosing is more difficult with topical pharmaceutical dosage forms, such as gels, creams, ointments, and lotions, which are not disposed to unit dose administration of precisely calibrated amounts of drug, due to variety of causations. For instance, topical pharmaceutical dosage forms, such as gels, creams, ointments, and pastes, are commonly packaged in tubes that have no means for measuring the amount of the formulation dispensed therefrom and subsequently administered by finger or hand to the target site of application of a patient. Such that the dispensed amount of formulation is frequently not the prescribed amount. In addition, some of the formulation is absorbed by the skin of the finger or hand of the administrator such that the dispensed amount is not the amount applied to the target site. The latter mechanism for inaccurate dosing of topical pharmaceutical compositions occurs even when they are dispensed in measured amounts, such as by pump or removal from a preloaded unit dose packet.

**[0008]** Another source of inaccurate dosing of topical pharmaceutical compositions is the absorption of drug or other excipient, such as a penetration or a permeation enhancer, by the material of the dispensing unit's reservoir for the composition. Such

absorption commonly occurs slowly, and removes drug or excipient from the composition over time. Thereby reducing the actual or effective amount of drug administered to the target tissue. Such reductions can also result, in the context of light sensitive drugs or excipients, from the construction of a dispensing unit's reservoir with transparent or translucent material allowing for the photolytic degradation of such drugs or excipients over time. Or from the construction of the dispensing unit's reservoir with materials that leach drug or excipient degrading chemicals into the composition.

**[0009]** Hand or finger administration of topical, pharmaceutical compositions has the potential for other problems. When administrators fail to take sufficient measures to clean residual formulation from their hand or finger post application, the residual formulation can be efficiently transferred to unintended persons by touch, either directly or indirectly. And such transfer can cause toxicity and other unwanted effects. Especially in the contexts of the transfer of potent drugs, such as hormones or steroids, and sensitive transferees, such as children or pregnant women. Although the problem of unintended transfer can be solved by the administrator wearing a latex glove during application, this solution is objectionable on many grounds. Many people find the feel of latex gloves unacceptable and uncomfortable. Also, many people are allergic to latex ,and their use of latex gloves can cause anaphylactic shock. Further, latex gloves are an additional expense to drug therapy.

**[0010]** There exists a need in the art for the development of a dispensing device and method for topical pharmaceutical compositions which addresses inaccurate dosing and other problems discussed above. Accordingly, embodiments of the present invention provide devices for metered dispensing of topical pharmaceutical compositions. In some embodiments, the dispensing device possesses a reservoir for storing the composition and means for metering the composition. In some embodiments, such reservoirs are: i. made from, or substantially lined with, a material that is opaque and/or substantially nondepleting of at least one component of the composition; ii. optionally, volumetrically compressible; and iii. fitted with the means for metering the composition. And the means for metering are adapted to measure a fixed amount of the composition for application to a dermal region of

a user of the device. In some embodiments, the metered compositions have a specific gravity of from about 0.85 to about 1.20, preferably about 0.90 to about 1.15 at about room temperature and comprise a medicament; a thickening agent; and a solvent, and optionally a skin penetration enhancer, an antiperspirant, and/or a deodorant.

## Brief Description of the Drawings

**[0011] FIG. 1** is a front view of an embodiment of a dispenser device according to the invention that possesses a dial actuator and an electronic dose indicator, with side wall cutouts indicated by dashed lines. **FIG. 1A** shows the dispensing device after one use, with cap off. **FIG. 1B** shows the same dispensing device after two actuations, but prior to second application. **FIG. 1C** shows the same dispensing device after two uses, with cap on. **FIG. 1D** is a cutout view of the cap for the dispenser device that possesses pins that seal application surface apertures and an O-ring that seals the cap to the sidewalls during storage of the device.

**[0012] FIG. 2** is a cross sectional view of a cap, for a dispenser device according to the invention, fitted with locking mechanism. **FIG. 2A** illustrates the cap in the lock position. **FIG. 2B** illustrates the cap in the release position.

**[0013] FIG. 3** is a front view of an embodiment of a dispenser device according to the invention that possesses a slot and key actuator, with side wall cutouts indicated by dashed lines. **FIG. 3A** illustrates the dispenser device with key-cap secured in a closed position. **FIG. 3B** illustrates the dispenser device with key-cap positioned with the key friction fitted into its receiving slot. **FIG. 3C** illustrates the dispenser after one advancing actuation executed by a $90^0$ rotation of key-cap.

**[0014] FIG. 4** is a front view of an embodiment of a dispenser device according to the invention that possesses a battery operated peristaltic pump, with side wall cutouts indicated by dashed lines. **FIG. 4A** shows the dispensing device prior to one use. **FIG. 4B** shows the same dispensing device after one actuation, but prior to application.

**[0015] FIG. 5** is a front view of an embodiment of a dispenser device according to the invention that possesses a crank operated peristaltic pump, with side wall cutouts indicated by dashed lines. **FIG. 5A** shows the dispensing device prior to one use. **FIG. 5B** shows the dispensing device prior to one use, with the slot key of its removable cap positioned in the actuator slot. **FIG. 5C** shows the dispensing device after one actuation, but prior to application.

**[0016] FIG. 6** is a front view of an embodiment of a squeezable dispenser device according to the invention that possesses a roller ball applicator, with side wall cutouts indicated by dashed lines. **FIG. 6A** shows the dispensing device prior to one use. **FIG. 6B** shows the dispensing device actuated by compression.

**[0017] FIG. 7** is a front view of an embodiment of a dispenser device according to the invention that possesses an actuator dial and a roller bar applicator, with side wall cutouts indicated by dashed lines. **FIG. 7A** shows the dispensing device prior to one use. **FIG. 7B** shows the dispensing device after actuation, but prior to application.

**[0018] FIG. 8** is a front view of an embodiment of a dispenser device according to the invention that possesses a dial actuator and a mechanical dose indicator, with side wall cutouts indicated by dashed lines. **FIG. 8A** shows the dispensing device after one use. **FIG. 8B** shows the same dispensing device after two actuations, but prior to second application.

## Detailed Description of the Inventions

**[0019] Devices**. **FIG. 1A** illustrates a front view of an embodiment of a semi-solid, topical, pharmaceutical composition dispensing device **100** according to the present invention, with sidewall cutouts indicated by dashed lines. Dispenser device **100** possesses sidewalls **105**, application end **110**, dispensing end **115**, and removable cap **117**. Dispenser device **100** is sized and shaped for facile and comfortable hand held use. Sidewalls **105** are integral with each of application end **110** and dispensing end **115**; and removable cap **117** is sized and shaped for frictional securement with the sidewalls **105** at application end **110**.

Application end **110** comprises convex, apertured **118** application surface **120**. Disposed within sidewalls **105** at dispensing end **115** is a dispensing assembly that includes platform **125**, threaded shaft **130**, and actuator dial **135**. Disposed within sidewalls **105**, application surface **120**, and platform **125**, is volumetrically collapsible reservoir **140** loaded with semi-solid, topical, pharmaceutical composition **145** that has a specific gravity of from about 0.85 to about 1.20, preferably about 0.90 to about 1.15 at about room temperature. Cap **117** possesses pins **119** that are arrayed and shaped such that they align with and plug dispensing surface apertures **118** when cap **117** is secured on device **100**. Cap **117** possesses O-ring **194** that forms a seal between sidewalls **105** and cap **117** (**FIG. 1D**). Actuator dial **135** is touch accessible through opening **155** in sidewalls **105**.

**[0020]** Platform **125** has convex surface **126** and is in circumferentially wiping contact with inner surfaces of sidewalls **105**. Platform **125** is threadedly secured to drive shaft **130**, which is fixedly secured to actuator dial **135** substantially at the center thereof. The thread pitch of threaded shaft **130** is selected in conjunction with the diameter of actuator dial **135,** the size of the apertures **118**, and the specific gravity of pharmaceutical composition **145** so that one advancing action of actuator dial **135** (to produce a shaft **130** rotation of from about 10° to about 150°) advances platform **125** a distance toward application surface **120** sufficient to result in a particular volume of pharmaceutical composition **145**, ranging from about 50 microliters to about 15,000 microliters, being extruded through apertures **118** (**FIG. 1B**). Accordingly, rubbing application surface **120** against skin after one, two, three, etc. advancing actions transfers to the skin a metered amount of extruded pharmaceutical composition **145**. After application, cap **117** is secured to dispensing end **115** for protective storage until the next application is desired (**FIG. 1C**).

**[0021]** In some embodiments, caps for dispensers are equipped with safety locks that inhibit unwanted (e.g., by child or accident) cap removal. **FIG'S 2A and 2B** illustrate cap **200**, which differs from cap **117** by way of being equipped with locking mechanisms made up of push button release units **210** and tongue lock members **215**. **FIG. 2A** illustrates cap **200** with locking mechanism in the locked position. In the locked position,

push button release units **210** are in the illustrated uncompressed position. Tongue lock members **215** are sized and positioned on cap **200** such that, in the locked position, tongue lock members **215** protrude into tongue lock receiving member groove **180** on dispensing device **100** (see **FIG. 1A**).

**[0022] FIG. 2B** illustrates cap **200** with locking mechanism **205** in the released position. In the released position, push button release units **210** are in the illustrated compressed position, which causes the retraction of tongue lock members **215** from lock receiving member groove **180** and allows for the removal of cap **200**.

**[0023]** Referring again to **FIG'S 1A-1C** The dispenser device **100** further possesses electronic a dose count display unit that comprises screen **150** in electronic communication with dose counter mechanism **155** via wire harness **160**. Screen **150** possesses readout lines for the date **152**, time **153**, and dose number of total daily doses **154** dispensed by device **100**. Dose counter mechanism **155** comprises pivot switch **165** and mechanism housing **170** fixedly mounted on sidewall **105**. Fixedly mounted on actuator dial **135** are a plurality of ball and stick dose counter triggers **175** (one shown). Dose counter triggers **175** are positioned along the circumference of a circle that is concentric with, and has a smaller radius than, actuator dial **135**.

**[0024]** Pivot switch **165** comprises deflection bar **166** fixedly secured to the top of switch pin **167**, which is rotatably mounted into the housing of douse counter mechanism **170**. Pivot switch **165** is tension mounted in the illustrated position. Toward the end of one advancing action of actuator dial **135**, movement of a dose counter trigger **175** along its arced path, caused by finger advancing actuator dial **135**, results in forceful contact by the ball portion of dose counter trigger **175** against deflection bar **166**. Such contact causes deflection bar **166** to deflect out of the path of dose counter trigger **175**, which in turn causes axial rotation of switch pin **167**. At the end of one advancing action of actuator dial **135**, dose counter trigger **175** moves further along its arced path out of contact with deflection bar **166**, which allows pivot switch **165** to return to its tension mounted position. At the point of maximal rotation of switch pin **167**, achieved at the point of maximum

deflection of deflection bar **166** away from its tension mounted position, the rotation of switch pin **166** causes the transmission of an electronic signal that results in dose counter display unit **150** updating readout lines **152-154** to reflect and describe the occurrence of an actuation event.

**[0025] FIG. 3** illustrates a front view of a dispenser device **300** that differs from the device illustrated in **FIG. 1** by lacking a dose count indicator and possessing a slot and key actuator rather than an actuator dial, with sidewall cutouts indicated by dashed lines. **FIG. 3A** illustrates dispenser device **300** with key-cap **317** secured in a closed position. Cap **317** possesses key **324** that is sized and shaped for friction fitment into slot **319** positioned substantially at the center of actuator dial **335**. **FIG. 3B** illustrates dispenser device **300** having key-cap **317** positioned with key **318** friction fitted into slot **319**. **FIG. 3C** illustrates the dispenser device **300** shown in **FIG. 3B** after one advancing actuation executed by a $90^0$ rotation of key-cap **317**.

**[0026] FIG. 4A** illustrates a front view of an embodiment of a dispensing device **400** according to the present invention, with sidewall cutouts indicated by dashed lines. Dispenser device **400** possesses sidewalls **405**, partition walls **407** and **408**, application end **410**, and dispensing end **415**. Dispenser device **400** is sized and shaped for facile and comfortable hand held use. Sidewalls **405** are integral with each of application end **410** and dispensing end **415**. Application end **410** comprises convex, apertured **418** application surface **420**. Dispensing end **415** possesses actuator button **425**, battery **430**, and peristaltic pump **435**.

**[0027]** Partition walls **407** and **408** sealingly adjoin sidewalls **405** at application end **410** and dispensing end **415**, respectively. Disposed within sidewalls **405**, partition wall **407**, and partition wall **408**, is storage reservoir **440** loaded with semi-solid, topical, pharmaceutical composition **445** that has a viscosity of from about 380 cPs to about 700 cPs, preferably from about 400 Cps to about 680 Cps at about room temperature. Disposed within application surface **420**, sidewalls **405**, and partition wall **407** is application end reservoir **422**. Tube **426** places storage reservoir **440** and application end reservoir **422** in

semi-solid gel communication. First end **427** of tube **426** is open and positioned in storage reservoir **440**; and second end **428** of tube **426** is open and positioned in application end reservoir **422**. From first open end **427**, tube **426** sealingly passes through: partition wall **408**, peristaltic pump **435**, partition wall **408** a second time, storage reservoir **440**, and partition wall **407**.

**[0028]** Peristaltic pump **435** comprises spring loaded rollers **436**, housing **441**, drive shaft **437**, and electric motor **438**. The section of tube **426** that passes through peristaltic pump **435** is compressible against housing **441** by spring loaded rollers **436**. Motor **438** rotates, counterclockwise in the illustrated perspective, drive shaft **437**, together with spring loaded rollers **436** mounted thereon. Such that pharmaceutical composition **445** is pumped from storage reservoir **440** through tube **426** into application end reservoir **422** and to application surface **420** through application surface apertures **418** by the running of running motor **438**.

**[0029]** Motor **438**, battery **430**, and actuator button **425** are in an electric circuit connected by wires **457**. Motor **438** is powered by battery **430** in response to depression of programmable actuation button **425**, which is rotatably adjustable, by turning slot **456** with a slot driver instrument (e.g., a screwdriver, coin, or the like) such that slot **456** points to one of five settings marked by numbered lines **451**. Setting actuation button **425** to each incrementally larger setting results in peristaltic pump **435** pumping a greater, predetermined amount of pharmaceutical composition **445** from storage reservoir **422** to application surface **420** by, e.g., causing motor **438** to run faster or for a longer period of time per actuation.

**[0030]** The compressibility and inner diameter of the section of tube **426** compressed against housing **441** by rollers **436** is selected in conjunction with the gap between rollers **436** and housing **441**, the circumference of the circle defined by the arced path along which rollers **426** travel and the rate and duration of motor **438** run time, and the viscosity of pharmaceutical composition **445** such that one actuation of peristaltic pump **435** results in a particular volume of pharmaceutical composition **445**, ranging from about

50 microliters to about 15,000 microliters being extruded through apertures **418**. **FIG. 4B** shows device **400** after one actuation.

**[0031]** **FIG. 5A** illustrates an embodiment of a dispensing device **500** according to the present invention that differs from the dispenser device illustrated in **FIG. 4** by possessing a crank peristaltic pump, with sidewall cutouts indicated by dashed lines. Dispenser device **500** possesses sidewalls **505**, partition walls **507** and **508**, application end **510**, dispensing end **515**, and removable key cap **517**. Dispenser device **500** is sized and shaped for facile and comfortable hand held use. Sidewalls **505** are integral with each of application end **510** and dispensing end **515**; and removable cap **517** is sized and shaped for frictional securement with the sidewalls **505** at application end **510**. Application end **510** comprises convex, apertured **518** application surface **520**. Dispensing end **515** possesses crank operated peristaltic pump **535**.

**[0032]** Partition walls **507** and **508** sealingly adjoin sidewalls **505** at application end **510** and dispensing end **515**, respectively. Disposed within sidewalls **505**, partition wall **507**, and partition wall **508**, is storage reservoir **540** loaded with semi-solid, topical, pharmaceutical composition **545** that has a viscosity of from about 380 cPs to about 700 cPs, preferably from about 400 Cps to about 680 Cps at about room temperature. Disposed within application surface **520**, sidewalls **505**, and partition wall **507** is application end reservoir **522**. Tube **526** places storage reservoir **540** and application end reservoir **522** in semi-solid gel communication. First end **527** of tube **526** is open and positioned in storage reservoir **540**; and second end **528** of tube **526** is open and positioned in application end reservoir **522**. From first open end **527**, tube **526** sealingly passes through: partition wall **508**, peristaltic pump **535**, partition wall **508** a second time, storage reservoir **540**, and partition wall **507**.

**[0033]** Peristaltic pump **535** comprises spring loaded rollers **536**, housing **541**, drive shaft **537**, which possesses crank slot **538**. The section of tube **526** that passes through peristaltic pump **525** is compressible against housing **541** by spring loaded rollers **536**. Counterclockwise cranking of slot **538** with a slot driver instrument (e.g., slot key **516** of key

cap **517**, a screwdriver, a coin, or the like) results in the counterclockwise rotation of drive shaft **537**, together with spring loaded rollers **536** mounted thereon. Such that pharmaceutical composition **545** is pumped from storage reservoir **520** through tube **526** into application end reservoir **522** and to application surface **520** through application surface apertures **518**.

**[0034]** The compressibility and inner diameter of tube section **539** is selected in conjunction with the gap between rollers **536** and housing **541**, the circumference of the circle defined by the arced path along which rollers **526** travel, and the viscosity of pharmaceutical composition **545** such that one actuation of peristaltic pump **535**, which corresponds to cranking drive shaft **537** such that it rotates from of from about 10° to about 150°) results in a particular volume of pharmaceutical composition **545**, ranging from about 50 microliters to about 15,000 microliters being extruded through apertures **518**. **FIG. 5B** shows device **500** with slot key **516** of positioned in crank slot **538**. key **FIG. 5C** shows device **500** after one actuation: a 90°, counterclockwise rotation of cap **517,** slot key **516**, and drive shaft **537**. Pressure release butter fly valve **594** is operative to relieve negative pressure from reservoir **540** after a plurality of uses of device **500** deplete pharmaceutical formulation **545** from reservoir **540**.

**[0035] FIG. 6A** illustrates a front view of an embodiment of a dispensing device **600** according to the present invention, with sidewall cutouts indicated by dashed lines. Dispenser device **600** possesses compressible sidewalls **605**, partition wall **607**, end walls **608** and **609**, and application end **610**. Dispenser device **600** is sized and shaped for facile and comfortable hand held use. Sidewalls **605** are integral with application end **610**. Application end **610** comprises partition wall **607**, window **625**, application roller ball **620**, and graduation lines **635**.

**[0036]** Sidewalls **605** sealingly adjoin each of partition wall **607** and endwalls **608** and **609**. Disposed within sidewalls **605**, partition wall **607**, and end wall **608**, is storage reservoir **640** loaded with semi-solid, topical, pharmaceutical composition **645** that has a specific gravity of from about 0.85 to about 1.20, preferably about 0.90 to about 1.15 at

about room temperature. Disposed within sidewalls **605**, partition wall **607**, and end wall **609**, is application reservoir **643**. One way openings **606** in partition wall **607** allow one-way flow of pharmaceutical composition **645** from storage reservoir **640** to application reservoir **643** upon mechanical compression (e.g., by hand squeezing) of side walls **605** (**FIG. 6B**).

**[0037]** Graduation lines **635** allow for the transfer of measured amounts of pharmaceutical composition **645** from storage reservoir **640** to application reservoir **643**. Graduation lines **635** allow for reliable metering into application reservoir **643** amounts of pharmaceutical composition **645**, typically ranging from about 50 microliters to about 15,000 microliters.

**[0038]** Application roller ball **620** possesses knurled surface **621** and is sized, shaped, and spinnably positioned such that less than half of its volume protrudes through the opening therefor in endwall **608** and more than half of its volume is disposed within application reservoir **643**. Contacting roller ball **620** with skin with moderate pressure, together with movement of device **600**, along a path substantially parallel to the surface of the skin, causes the spinning of roller ball **620** and efficient transfer of pharmaceutical formulation **645** from application reservoir **643** to application surface **621** and then to the skin.

**[0039]** **FIG. 7A** illustrates a front view of an embodiment of a dispensing device **700** according to the present invention, with sidewall cutouts indicated by dashed lines. Dispenser device **700** possesses sidewalls **705**, partition wall **707**, dispenser end **715**, and application end **710.** Dispenser device **700** is sized and shaped for facile and comfortable hand held use. Sidewalls **705** are integral with each of application end **710** and dispensing end **715**.

**[0040]** Disposed within sidewalls **705** at dispensing end **715** is a dispensing assembly that includes platform **725**, threaded shaft **730**, and actuator dial **735**. Disposed within sidewalls **705**, partition wall **707**, and platform **725**, is volumetrically collapsible reservoir **740** loaded with semi-solid, topical, pharmaceutical composition **745** that has a specific

gravity of from about 0.85 to about 1.20, preferably about 0.90 to about 1.15 at about room temperature. Actuator dial **735** is touch accessible through openings **755** in sidewalls **705**.

**[0041]** Platform **725** has convex surface **726** and is in circumferentially wiping contact with inner surfaces of sidewalls **705**. Platform **725** is threadedly secured to drive shaft **730**, which is fixedly secured to actuator dial **735** substantially at the center thereof. The thread pitch of threaded shaft **730** causes an advancing action of actuator dial **735** to result in the movement of platform **725** toward partition wall **707** (**FIG. 7B**).

**[0042]** Application end **710** is comprised of partition wall **707**, end wall **709**, window **750**, application roller bar **720**, roller bar axel **723**, and graduation lines **737**. Sidewalls **705** sealingly adjoin each of partition wall **707** and endwall **709**. Disposed within sidewalls **705**, partition wall **707**, and end wall **709**, is application reservoir **743**.

**[0043]** One way openings **706** in partition wall **707** allow one-way flow of pharmaceutical composition **745** from storage reservoir **740** to application reservoir **743** upon volumetric compression (e.g., by an actuating advance of actuator dial **735**) of storage reservoir **740** (**FIG. 7B**). Graduation lines **737** allow for the transfer of measured amounts of pharmaceutical composition **745** from storage reservoir **740** to application reservoir **743**. Graduation lines **737** allow for reliable metering into application reservoir **743** amounts of pharmaceutical composition **745**, typically ranging from about 50 microliters to about 15,000 microliters.

**[0044]** Application roller bar **720** possesses knurled surface **721** and is rotatably mounted on axel **723**, which is fixedly mounted on endwall **709**. Contacting roller bar **720** with skin with moderate to high pressure, together with movement of device **700**, along a path substantially parallel to the surface of the skin, results in efficient transfer of pharmaceutical formulation **745** from application reservoir **743** to application surface **721** and then to the skin.

**[0045]** **FIG. 8A** illustrates a front view of an embodiment of a semi-solid, topical, pharmaceutical composition dispensing device **800** according to the present invention, with sidewall cutouts indicated by dashed lines. Dispenser device **800** differs from the device

illustrated in **FIG. 1** by possessing mechanical dose count indicator display unit **850**, rather than an electronic dose indicator.

**[0046]** Dispenser device **800** possesses sidewalls **805**, application end **810**, and dispensing end. Dispenser device **800** is sized and shaped for facile and comfortable hand held use. Sidewalls **805** are integral with each of application end **810** and dispensing end **815**. Application end **810** comprises convex, apertured **818** application surface **820**. Disposed within sidewalls **805** at dispensing end **815** is a dispensing assembly that includes platform **825**, threaded shaft **830**, and actuator dial **835**. Disposed within sidewalls **805**, application surface **820**, and platform **825**, is volumetrically collapsible reservoir **840** loaded with semi-solid, topical, pharmaceutical composition **845** that has a specific gravity of from about 0.85 to about 1.20, preferably about 0.90 to about 1.15 at about room temperature. Actuator dial **835** is touch accessible through opening **855** in sidewalls **805**.

**[0047]** Platform **825** has convex surface **826** and is in circumferentially wiping contact with inner surfaces of sidewalls **805**. Platform **825** is threadedly secured to drive shaft **830**, which is fixedly secured to actuator dial **835** substantially at the center thereof. The thread pitch of threaded shaft **830** is selected in conjunction with the diameter of actuator dial **835,** the size of the apertures **818**, and the specific gravity of pharmaceutical composition **845** so that one advancing action of actuator dial **835** (to produce a shaft **830** rotation of from about 10° to about 150°) advances platform **825** a distance toward application surface **820** sufficient to result in a particular volume of pharmaceutical composition **845**, ranging from about 50 microliters to about 15,000 microliters, being extruded through apertures **818** (**FIG. 8B**). Accordingly, rubbing application surface **820** against skin after one, two, three, etc. advancing actions transfers to the skin a metered amount of extruded pharmaceutical composition **845**

**[0048]** Dose count display unit **850** possesses pivot switch **865** and housing **870** fixedly mounted on sidewall **805**. Fixedly mounted on actuator dial **835** are a plurality of ball and stick dose counter triggers **875** (one shown). Dose counter triggers **875** are

positioned along the circumference of a circle that is concentric with, and has a smaller radius than, actuator dial **835**.

**[0049]** Pivot switch **865** comprises deflection bar **866** fixedly secured to the top of switch pin **867**, which is rotatably mounted into housing **870**. Pivot switch **865** is tension mounted in the illustrated position. Toward the end of one advancing action of actuator dial **835**, movement of a dose counter trigger **875** along its arced path, caused by finger advancing actuator dial **835**, results in forceful contact by the ball portion of dose counter trigger **875** against deflection bar **866**. Such contact causes deflection bar **866** to deflect out of the path of dose counter trigger **875**, which in turn causes axial rotation of switch pin **867**. At the end of one advancing action of actuator dial **835**, dose counter trigger **875** moves further along its arced path out of contact with deflection bar **866**, which allows pivot switch **865** to return to its tension mounted position. At the point of maximal rotation of switch pin **867**, achieved at the point of maximum deflection of deflection bar **866** away from its tension mounted position, the rotation of switch pin **866** causes the transmission of an mechanical signal that results in dose counter display unit **850** advancing dose count readout **851** to reflect the occurrence of an actuation event (**FIG. 8B**).

**[0050]** Application surfaces of devices according to the present invention are sized and shaped for comfortable and efficient application of pharmaceutical compositions to target skin surface regions of the human body including, without limitation, forehead, glabella, face, cheek, neck, shoulder, sternum, manubrium, axilla, hand, palm, finger, interdigital web, abdominal, buttock, leg, thigh, shin, calf, ankle, knee, volar, toe, and toe web regions.

**[0051] Medicaments**. As used herein "medicament" refers to drugs, pharmaceutical substances, active pharmaceutical ingredients, therapeutic agent, bioactive agents, and the like. Medicaments can comprise organic or inorganic compounds or molecules, nucleic acids, polypeptides, peptides, proteins, saccharides, lipids, and the like. Medicaments can fall under a variety of biological activity classes, including without limitation steroid and non-steroidal anti-inflammatory drugs, analgesics, anesthetics, antibiotics, antimicrobials,

tranquilizers, sedatives, narcotics, antihistaminics, antifungals, antivirals, disinfectants, antipsoriasis agents, local anesthetics, vasoactive agents, neuroactive agents, hormones, steroids, anticoagulants, antipruritics, immunomodulating agents, cytotoxic agents, anticancer agents, hormone replacement agents, antigens, and antibodies.

**[0052]** Specific medicaments that can be incorporated into pharmaceutical compositions dispensed by devices of the present invention include, without limitation: **anesthetics** such as benzocaine, procaine hydrochloride, cocaine, novocaine, xylocaine, tetracaine, tetracaine hydrochloride, dibucaine, lidocaine, lidocaine hydrochloride, bupivicaine, dyclonin, etidocaine, mepivicaine, butamen picrate, dimethisoquin hydrochloride, cyclomethylcaine sulfate, and the like; **analgesics and anti-inflammatory** agents such as buprenorphin, butophanol tartrate, acetaminophen, fentanyl, mefenamic acid, flutenamic acid, diclofenac, oxyphenbutazone, phenybutazone, ibuprofen, flurbiprofen, naproxen, menthol, methyl salicylate, phenol, salicylic acid, benzyl alcohol, camphor, camphorated metacresol, juniper tar, resorcinol, allyl isothiocyanate, capsaicin, and the like; **corticosteroids** such as alclometasone dipropionate, amcinocide, hydrocortisone, betamethasone dipropionate, betamethasone valerate, desoximetasone, clobetasol propionate, flurandrenolide, halcinonide, halobetasol, estradiol, testosterone, progesterone, fluticasone, clobetasol, dexamethasone, dexonide, fluocinolone acetonide, flucinonide, medroxyprogesterone, mometasone furoate, triamcinolone, and the like; **hormones** (such as estrogens, estradiol, progesterol, progesterone, testosterone, insulin, calcitonin, parathyroid hormone, peptide and vasopressin hypothalamus releasing factor); **antibiotics** such as β-lactams (e.g., amoxicillin, ampicillin, bacampicillin, carbenicillin, cloxacillin, dicloxacillin, flucloxacillin, methicillin, mezlocillin, nafcillin, oxacillin, penicillin G, penicillin V, piperacillin, pivampicillin, pivmecillinam, ticarcillin, sulbactam, tazobactam, clavulanate), cephalosporins (e.g., cefaclor, cefadroxil, cefamandole, cefazolin, cefdinir, cefditoren, cefepime, cefixime, cefonicid, cefoperazone, cefotaxime, cefotetan, cefoxitin, cefpodoxime, cefprozil, ceftazidime, ceftibuten, ceftizoxime, ceftriaxone, cefuroxime, cephalexin, cephalothin, cephapirin, cephradine), aminoglycosides (e.g., gentamycin, streptomycin,

amikacin, kanamycin, viomycin, capreomycin), ethionamide, prothionamide, cycloserine, dapsone, clofazimine, tetracyclines (e.g., tetracycline, doxycycline, chlortetracycline, oxytetracycline, minocycline demeclocycline), oxazolidinones (e.g., linezolid, eperezolid), quinolones (e.g., cinoxacin, nalidixic acid, oxolinic acid, piromidic acid, pipemidic acid, rosoxacin, ciprofloxacin, enoxacin, fleroxacin, lomefloxacin, nadifloxacin, norfloxacin, ofloxacin, pefloxacin, rufloxacin, balofloxacin, grepafloxacin, levofloxacin, pazufloxacin, sparfloxacin, temafloxacin, tosufloxacin, clinafloxacin, gatifloxacin, gemifloxacin, moxifloxacin, sitafloxacin, trovafloxacin, rulifloxacin, delafloxacin, and nemonoxacin) metronidazole, rifabutin, isoniazonid, and ethambutol) bacitracin, chlorhexadine gluconate, clindamycin, cliquinol, neomycin sulfate, polymyxin B sulfate, erythromycin, gentamicin, sulfathiazole, sulfacetamide, sulfabenzamide, oxytetracycline hydrochloride, and the like; **antimicrobial agents** such as benzalkonium chloride, chlorhexidine gluconate, hexachlorophene, mafenide acetate, nitrofurazone, nystatin, acetosulfamine, clortrimazole, povidone-iodine, and the like; **antifungal** agents such as amphotericin B, butoconazole, cetylpyridinium chloride, chlorxylenol, cyclopirox olamine, clioquinol, clotrimazole, sulconazole nitrate, nystatin, oxyconazole, econazole nitrate, ketoconazole, miconazole nitrate, naftifine hydrochloride, pentamycin, pyrrolinitrin, terbinafine, triacetin, and the like; debriding agents such as deoxyribonuclease, collagenolytic, debridement, fibrinolytic or proteolytic enzymes, papain, papain-urea, and the like; **antihistamines** such as chlorcyclizine hydrochloride, diphenylhydramine hydrochloride, tripelennamine hydrochloride, and the like; antiepileptics such as nitrazepam, meprobamate, clonazepam, and the like; **coronary vasodilators** such as nitroglycerine, dipyridamole, erythritol, tetranitrate, pentaerythritol tetranitrate, propatyinitrate, and the like; **antivirals** such as amantadine, rimantadine, pleconaril, acyclovir, gancyclovir, zidovudine, lamivudine, RNase H inhibitors, integrase inhibitors, protease inhibitors, rifampicin, zanamivir, oseltamivir, and interferons, and the like; **dermatologicals** such as retinal, retinol, retinoic acid and their derivatives, hydroxyacids, alphaketoacids, and the like; and **other drugs** such as benzoyl peroxide, podofilox, masoprocol, nicotine, scopolamine, nitroglycerine, fluorouracil,

hydrocolloids, hydroquinone, monobenzone, tretinoin and acyclovir; and combinations thereof. Other medicaments useful in the present invention include those described in United States Patent 8,343,962, the content of which is hereby incorporated by reference in its entirety.

**[0053]** Useful amounts of medicaments in pharmaceutical compositions of the invention include 0.001% w/w, 0.05% w/w, 0.1% w/w, 0.25% w/w, 0.5% w/w, 0.75% w/w, 1.0% w/w, 2.5% w/w, 5.0% w/w, 7.5% w/w, 10% w/w, 12.5% w/w, 15% w/w, 20% w/w, 25% w/w, 30% w/w, 40% w/w, 50% w/w, and ranges therebetween.

**[0054] Thickening agents**. The thickening agents that can be incorporated into pharmaceutical compositions dispensed by devices of the present invention include: celluloses (e.g., microcrystalline cellulose, methylcellulose, ethylcellulose, carboxymethyl cellulose, and carboxyethyl cellulose), high molecular weight polymers of acrylic acid crosslinked with alkyl esters of sucrose or pentaerythritol (e.g., carbomer 910, carbomer 934, carbomer 940, carbomer 941, carbomer 971, carbomer 974, carbomer 980, carbomer 981, and carbomer 1342); hyaluronic acid; glycosaminoglycanes (e.g., heparin and chondroitin sulfate); polyethylene glycol, fucoidan; polyamino acids (e.g,, poly-aspartic acid and poly-glutamic acid); alginates; pectins; gellan, carboxyalkyl chitins; carboxymethyl chitosans; sulfated polysaccharides; glycosaminoglycanes, polylactates; acrylic acid polymers crosslinked with divinyl glycol (e.g., polycarbophils); poloxamers; tyloxapols; silicone polymers; and mixtures thereof.

**[0055]** Useful amounts of thickening agents in pharmaceutical compositions of the invention include 0.001% w/w, 0.05% w/w, 0.1% w/w, 0.25% w/w, 0.5% w/w, 0.75% w/w, 1.0% w/w, 2.5% w/w, 5.0% w/w, 7.5% w/w, 10% w/w, 12.5% w/w, 15% w/w, 20% w/w, and ranges therebetween.

**[0056] Solvents**. Solvents that can be incorporated into pharmaceutical compositions dispensed by devices of the invention include, without limitation, polar and nonpolar solvents such as alcohols, propylene glycol, glycerol, ethers, polyethylene glycols, amides; esters, water, and other solvents known in the art.

**[0057] Skin penetration enhancers.** Skin penetration enhancers that can be incorporated into pharmaceutical compositions dispensed by devices of the present invention include: glyceryl oleate (glycerol monooleate); isopropyl myristate; methyl laurate; N-lauroyl sarcosine; oleic acid (octadecenoic acid); sodium lauryl sulfoacetate; sodium octyl sulfate; and mixtures thereof.

**[0058]** Useful amounts of skin penetration enhancers in pharmaceutical compositions of the invention include 0.001% w/w, 0.05% w/w, 0.1% w/w, 0.25% w/w, 0.5% w/w, 0.75% w/w, 1.0% w/w, 2.5% w/w, 5.0% w/w, 7.5% w/w, 10% w/w, 12.5% w/w, 15% w/w, 20% w/w, 25% w/w, and ranges therebetween.

**[0059] Antiperspirants and deodorants.** Antiperspirants and deodorants that can be incorporated into pharmaceutical compositions dispensed by devices of the present invention include, without limitation, aluminum, zinc, or zirconium salts and complexes, such as halides, hydroxy halides, activated chlorohydrates (e.g., aluminum dichlorohydrate, aluminum-zirconium octachlorohydrate, aluminum sesquichlorohydrate, aluminum chlorohydrex propylene glycol complex, aluminum dichlorohydrex propylene glycol complex, aluminum sesquichlorohydrex propylene glycol complex, aluminum chlorohydrex polyethylene glycol complex, aluminum dichlorohydrex polyethylene glycol complex, aluminum sesquichlorohydrex polyethylene glycol complex, aluminum-zirconium trichlorohydrate, aluminum zirconium tetrachlorohydrate, aluminum zirconium pentachlorohydrate, aluminum zirconium octachlorohydrate, aluminum zirconium trichlorohydrex glycine complex, aluminum zirconium tetrachlorohydrex glycine complex, aluminum zirconium pentachlorohydrex glycine complex, aluminum zirconium octachlorohydrex glycine complex, zirconium chlorohydrate, aluminum chloride, aluminum sulfate buffered, and the like), and mixtures thereof.

**[0060]** Useful amounts of antiperspirants and deodorants in pharmaceutical compositions of the invention include 0.001% w/w, 0.05% w/w, 0.1% w/w, 0.25% w/w, 0.5% w/w, 0.75% w/w, 1.0% w/w, 2.5% w/w, 5.0% w/w, 7.5% w/w, 10% w/w, 12.5% w/w, 15% w/w, 20% w/w, and ranges therebetween.

**[0061] Surfactants**. Surfactants that can be incorporated into pharmaceutical compositions dispensed by devices of the invention include, without limitation, ionic, nonionic, and zwitterionic surfactants such as alkyl benzenesulfonates, alkanesulfonates, olefin sulfonates, alkylether sulfonates, glycerol ether sulfonates, α-methyl ester sulfonates, sulfofatty acids, alkyl sulfates, fatty alcohol ether sulfates, glycerol ether sulfates, fatty acid ether sulfates, hydroxy mixed ether sulfates, monoglyceride (ether) sulfates, fatty acid amide (ether) sulfates, mono- and dialkyl sulfosuccinates, mono- and dialkyl sulfosuccinamates, sulfotriglycerides, amide soaps, ether carboxylic acids and salts thereof, fatty acid isethionates, fatty acid sarcosinates, fatty acid taurides, N-acylamino acids, alkyl oligoglucoside sulfates, protein fatty acid condensates, alkyl (ether) phosphates, fatty alcohol polyglycol ethers, alkylphenol polyglycol ethers, fatty acid polyglycol esters, fatty acid amide polyglycol ethers, fatty amine polyglycol ethers, alkoxylated triglycerides, mixed ethers and mixed formals, glucuronic acid derivatives, fatty acid-N-alkyl glucamides, protein hydrolyzates, polyol fatty acid esters, sugar esters, sorbitan esters, polysorbates, amine oxides, dimethyl distearyl ammonium chloride, esterquats, alkylbetaines, alkylamidobetaines, aminopropionates, aminoglycinates, imidazoliniumbetaines and sulfobetaines, fatty alcohol polyglycol ether sulfates, monoglyceride sulfates, mono- and/or dialkyl sulfosuccinates, fatty acid isethionates, fatty acid sarcosinates, fatty acid taurides, fatty acid glutamates, α-olefin sulfonates, ether carboxylic acids, alkyl oligoglucosides, fatty acid glucamides, alkylamidobetaines, amphoacetals, and protein fatty acid condensates.

**[0062]** Useful amounts of surfactants in pharmaceutical compositions of the invention include 0.0001% w/w, 0.001% w/w, 0.05% w/w, 0.1% w/w, 0.25% w/w, 0.5% w/w, 0.75% w/w, 1.0% w/w, 2.5% w/w, 5.0% w/w, 7.5% w/w, 10% w/w, and ranges therebetween.

**[0063] Oils**. Surfactants that can be incorporated into pharmaceutical compositions dispensed by devices of the invention include, without limitation,

**[0064]** Useful amounts of oils in pharmaceutical compositions of the invention include 0.001% w/w, 0.05% w/w, 0.1% w/w, 0.25% w/w, 0.5% w/w, 0.75% w/w, 1.0% w/w, 2.5% w/w, 5.0% w/w, 7.5% w/w, 10% w/w, 12.5% w/w, 15% w/w, 20% w/w, 25% w/w, 30%

w/w, 40% w/w, 50% w/w, 60% w/w, 70% w/w, 80% w/w, 90% w/w, and ranges therebetween.

**[0065]** While particular embodiments of the invention have been illustrated and described, various modifications will be apparent to those skilled in the art. For example, several pharmaceutical compositions illustrated in the figures appear to have particles in suspension, the scope of the pharmaceutical compositions useful in the present invention is not limited to suspensions, but extends to solution compositions. Accordingly, it is not intended that the invention be limited to the disclosed embodiments or to details thereof, and departures may be made therefrom within the spirit and scope of the invention. In addition, the scope of the present invention extends to devices that comprise components illustrated separately in different figures, but mixed and matched into a single device.

WHAT IS CLAIMED IS:

1. A hand-held device, for applying a metered amount of a topical pharmaceutical composition to a dermal surface of a patient, the hand-held device comprising a reservoir for the topical pharmaceutical composition, an applicator surface adapted for administering the topical pharmaceutical composition to the dermal surface, and means for dispensing a metered amount of the topical pharmaceutical composition from the reservoir to the applicator surface,

wherein:

- the topical pharmaceutical composition is a nonpourable gel and comprises a medicament, a thickening agent, and a solvent,
- the reservoir is:
  i. sized and shaped for containing the topical pharmaceutical composition within the hand-held device;
  ii. formed from, or lined with, a material that is at least one member selected from the group consisting of: opaque and substantially nondepleting of the medicament;
  iii. adapted for transmission of the topical pharmaceutical composition from the reservoir to the applicator surface; and
  iii. fitted, on a first side or end of the reservoir and in a volumetrically compressible manner, with the means for dispensing the metered amount of the topical pharmaceutical composition, and
- the means for dispensing a metered amount of the topical pharmaceutical composition comprises a platform that possesses a hole sized to slideably receive a threaded shaft of uniform pitch that is in fixed connection to an actuator that is rotatably mounted to the hand-held device, such that rotation of the actuator by a particular number of degrees results in: a. the platform moving perpendicularly upwards along the shaft a corresponding particular distance that volumetrically compresses the reservoir, and b.

the transmission of the metered amount of the topical pharmaceutical composition from the reservoir to the applicator surface.

2. The device of claim 1, wherein the medicament is present in the topical pharmaceutical composition in an amount of from 0.001% w/w to 7.5% w/w, and wherein the medicament is selected from the group consisting of an estrogen and a testosterone.

3. The device of claim 2, wherein the thickening agent is present in the topical pharmaceutical composition in amount of from 0.001% w/w to 10.0% w/w, and wherein the thickening agent is at least one member selected from the group consisting of a celluloses, a carbomer; a hyaluronic acid; a glycosaminoglycanes; a polyethylene glycol, a fucoidan; an alginate; a pectin; a gellan, a polylactate; a poloxamer; a tyloxapol; and a silicone polymer.

4. The device of claim 3, wherein the solvent is at least one member selected from the group consisting of an alcohol, a propylene glycol, a glycerol, an ether, a polyethylene glycol, an amide; an esters, and water.

5. The device of claim 4, wherein the topical pharmaceutical composition further comprises a skin penetration enhancer, and wherein the skin penetration enhancer is present in the topical pharmaceutical formulation in an amount of from 0.001% w/w to 12.5% w/w, and wherein the skin penetration enhancer is at least one member selected from the group consisting of a glyceryl oleate, an isopropyl myristate; a methyl laurate; a N-lauroyl sarcosine; an octadecenoic acid, a sodium lauryl sulfoacetate; and a sodium octyl sulfate.

6. The device of claim 5, wherein the topical pharmaceutical composition further comprises a deodorant, and wherein the deodorant is present in the composition in an amount of from 0.001% w/w to 2.5% w/w, and wherein the deodorant is at least one member selected from the group consisting of an aluminum dichlorohydrate, an aluminum-zirconium

octachlorohydrate, an aluminum sesquichlorohydrate, an aluminum chlorohydrex propylene glycol, an aluminum dichlorohydrex propylene glycol, an aluminum sesquichlorohydrex propylene glycol, an aluminum chlorohydrex polyethylene glycol, an aluminum dichlorohydrex polyethylene glycol, an aluminum sesquichlorohydrex polyethylene glycol, an aluminum-zirconium trichlorohydrate, an aluminum zirconium tetrachlorohydrate, an aluminum zirconium pentachlorohydrate, an aluminum zirconium octachlorohydrate, an aluminum zirconium trichlorohydrex glycine complex, an aluminum zirconium tetrachlorohydrex glycine, aluminum zirconium pentachlorohydrex glycine complex, aluminum zirconium octachlorohydrex glycine, zirconium chlorohydrate, an aluminum chloride, and aluminum sulfate.

7. The device of claim 6, wherein the medicament is present in the topical pharmaceutical formulation in suspension.

8. The device of claim 6, wherein the medicament is present in the topical pharmaceutical formulation in solution.

9. The device of claim 6, wherein the topical pharmaceutical formulation possesses, at room temperature, a specific gravity in the range from about 0.85 to about 1.20.

10. The device of claim 6, wherein the particular number of degrees is 90 degrees.

11. The device of claim 6, wherein the actuator is a dial actuator.

12. The device of claim 6, wherein the actuator is a slot key actuator

13. The device of claim 6, further comprising a cap.

14. The device of claim 6, further comprising a dose counter.

15. The device of claim 6, wherein the metered amount of the pharmaceutical composition is between 50 microliters and 1,500 microliters.

## Figures

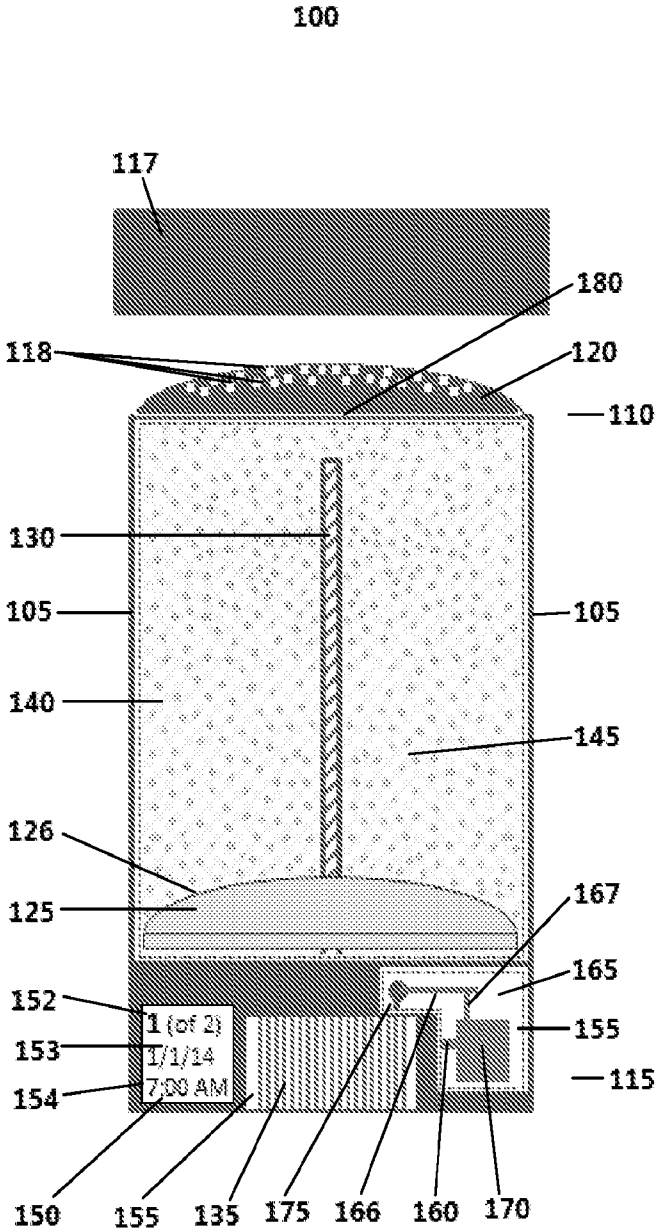



Figure 1A

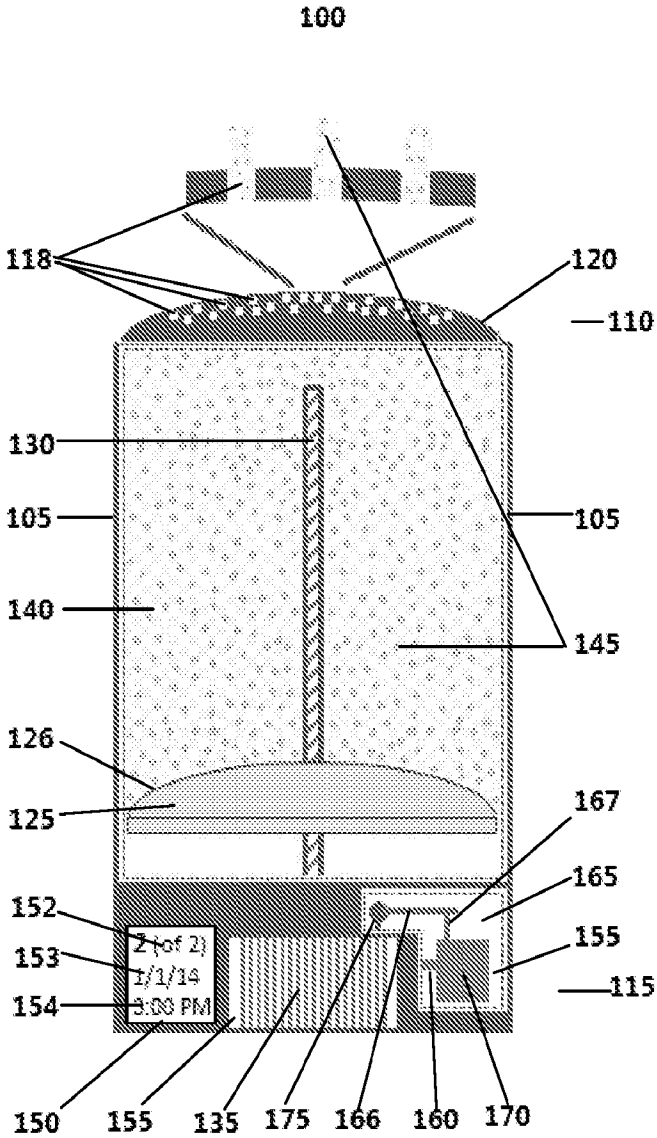

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**Figure 1B**

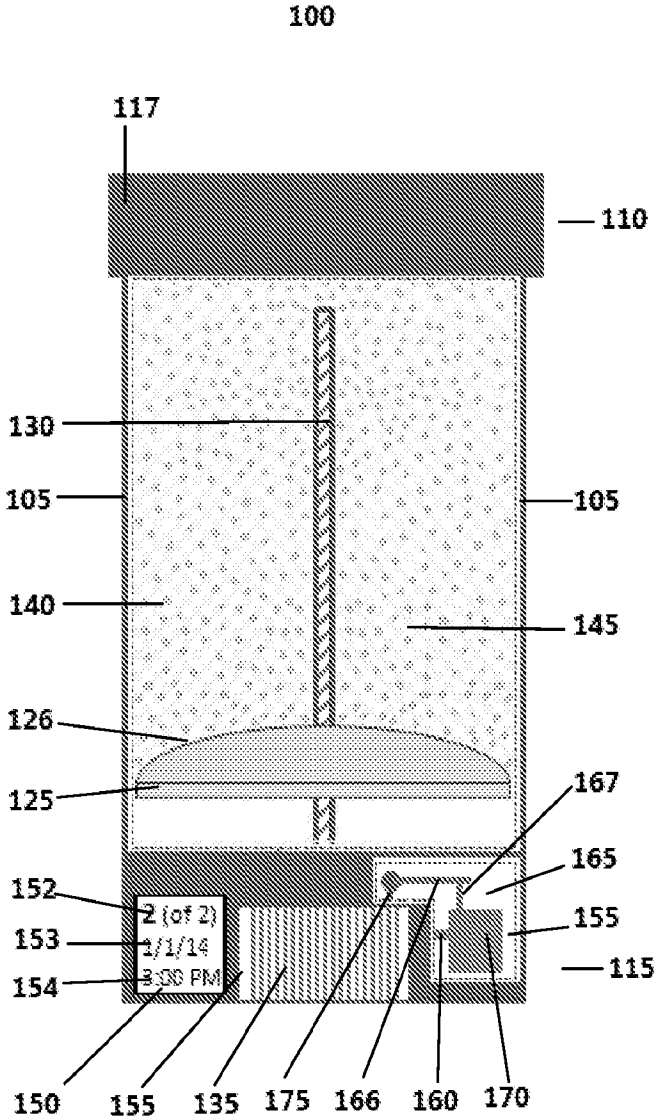

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**Figure 1C**

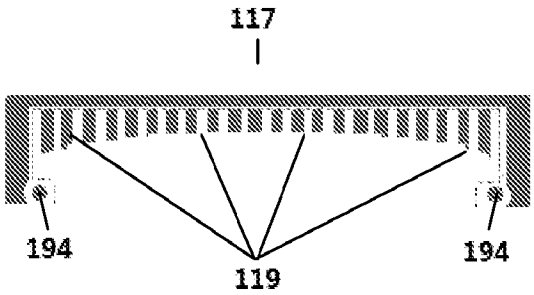



**Figure 1D**

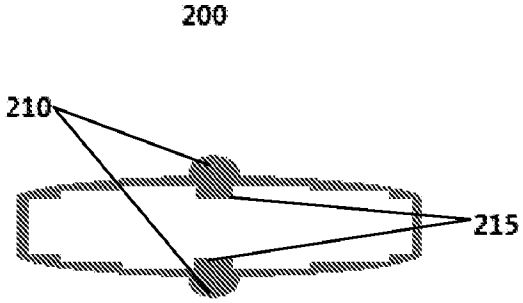



**Figure 2A**

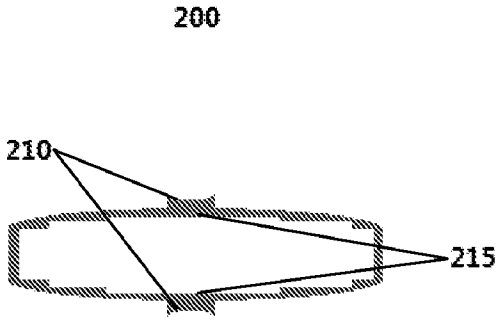



**Figure 2B**

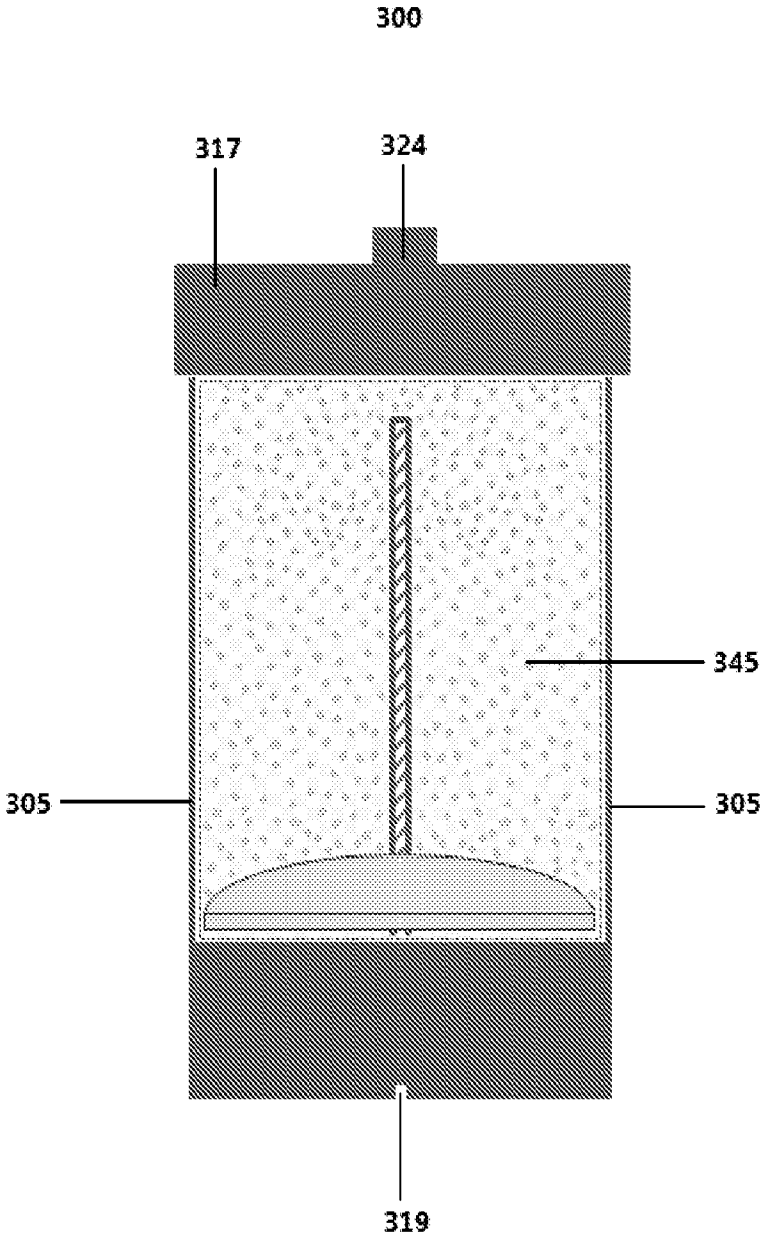



**Figure 3A**

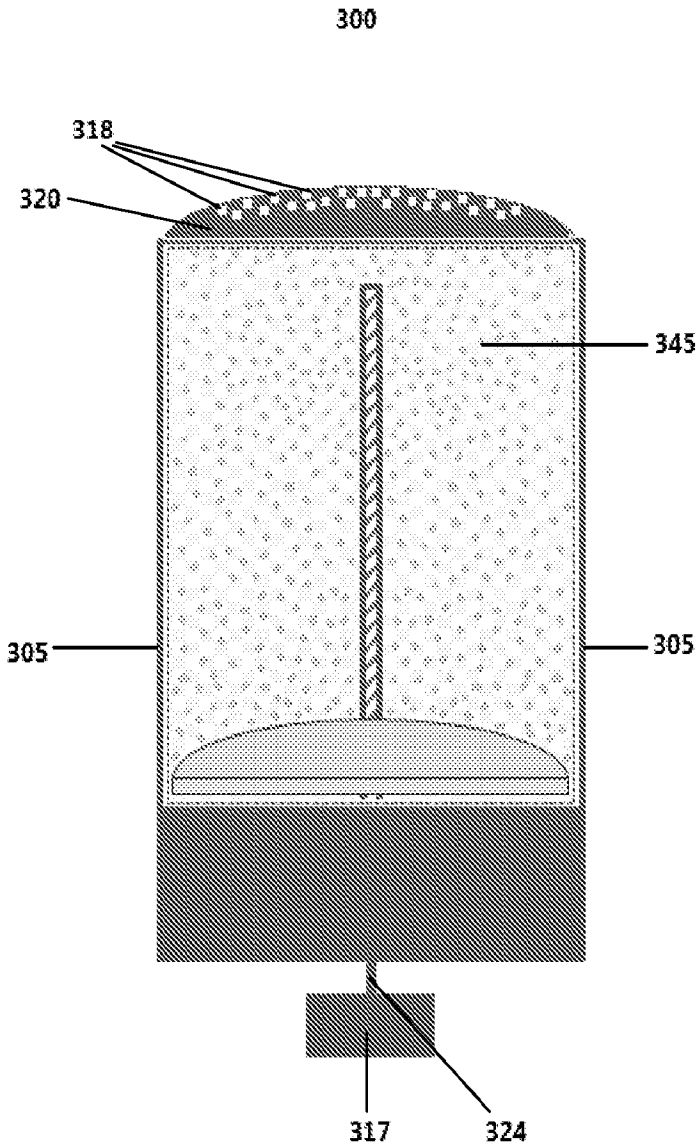



**Figure 3B**

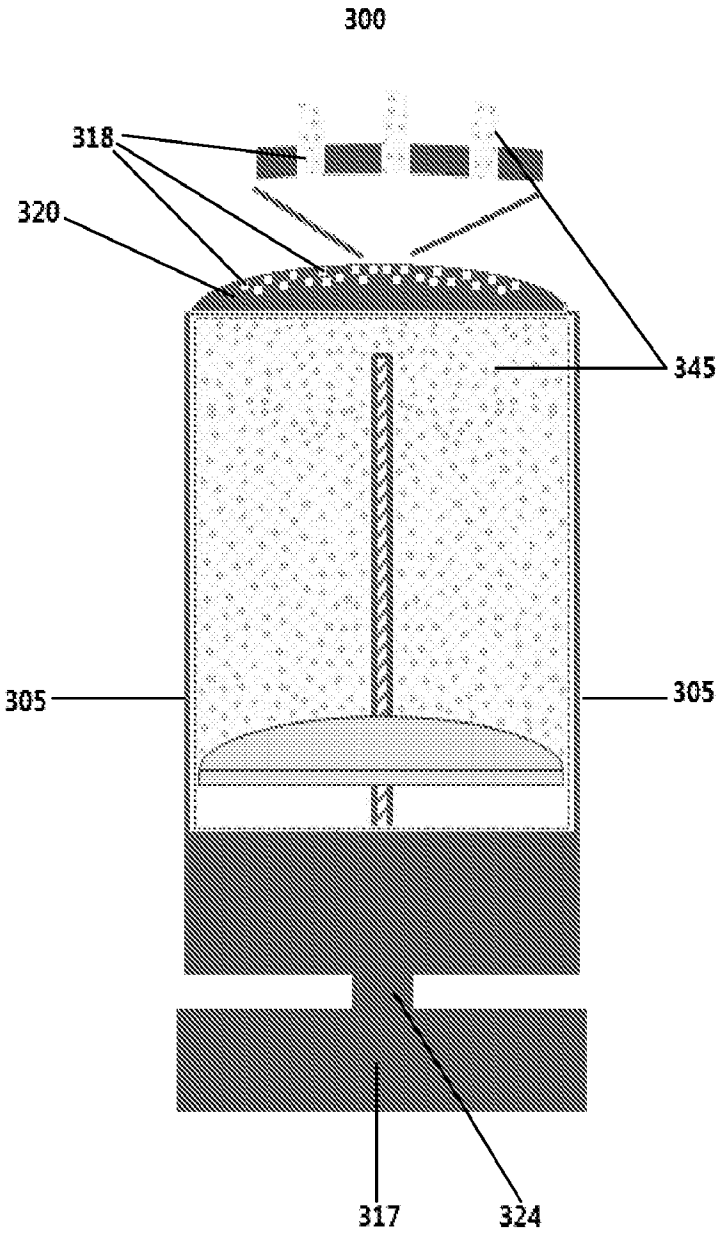



**Figure 3C**

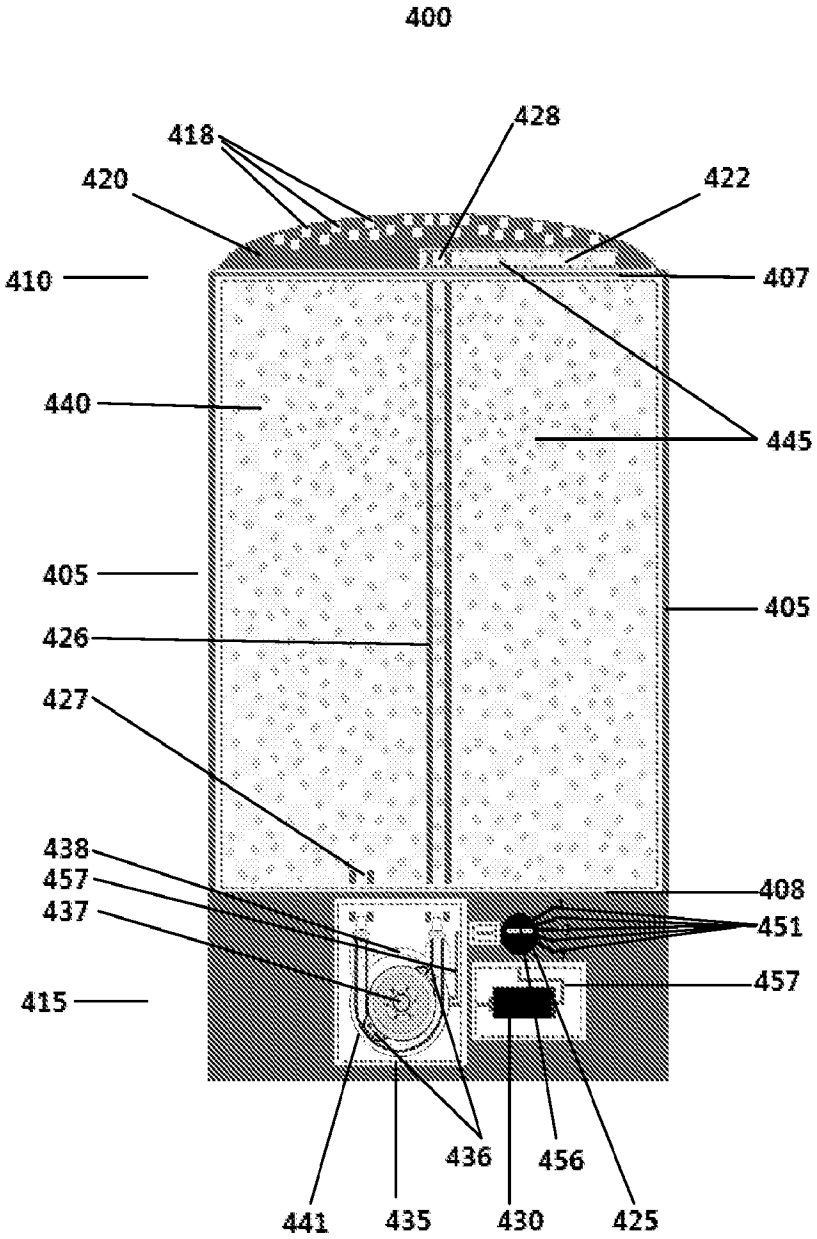

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Figure 4A

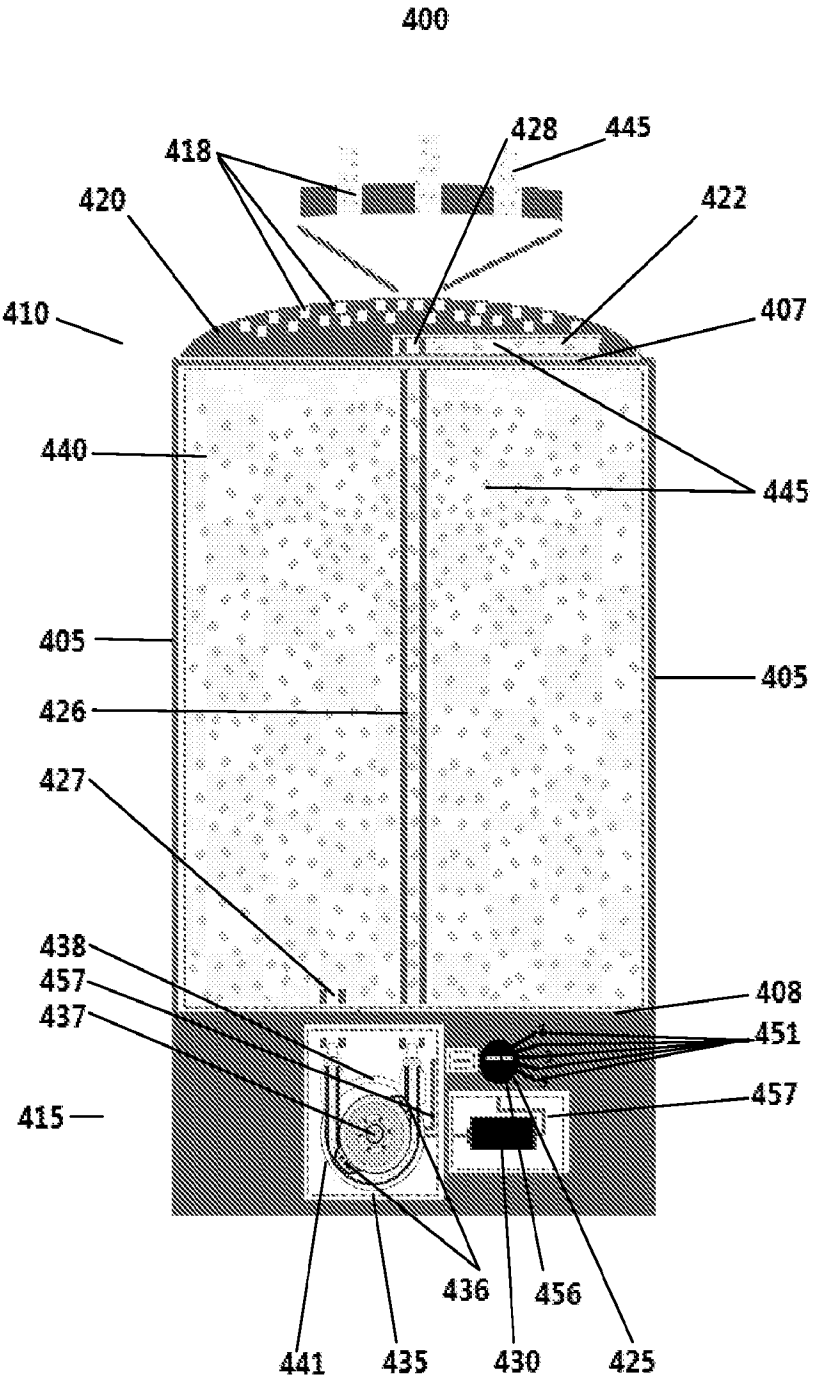

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**Figure 4B**

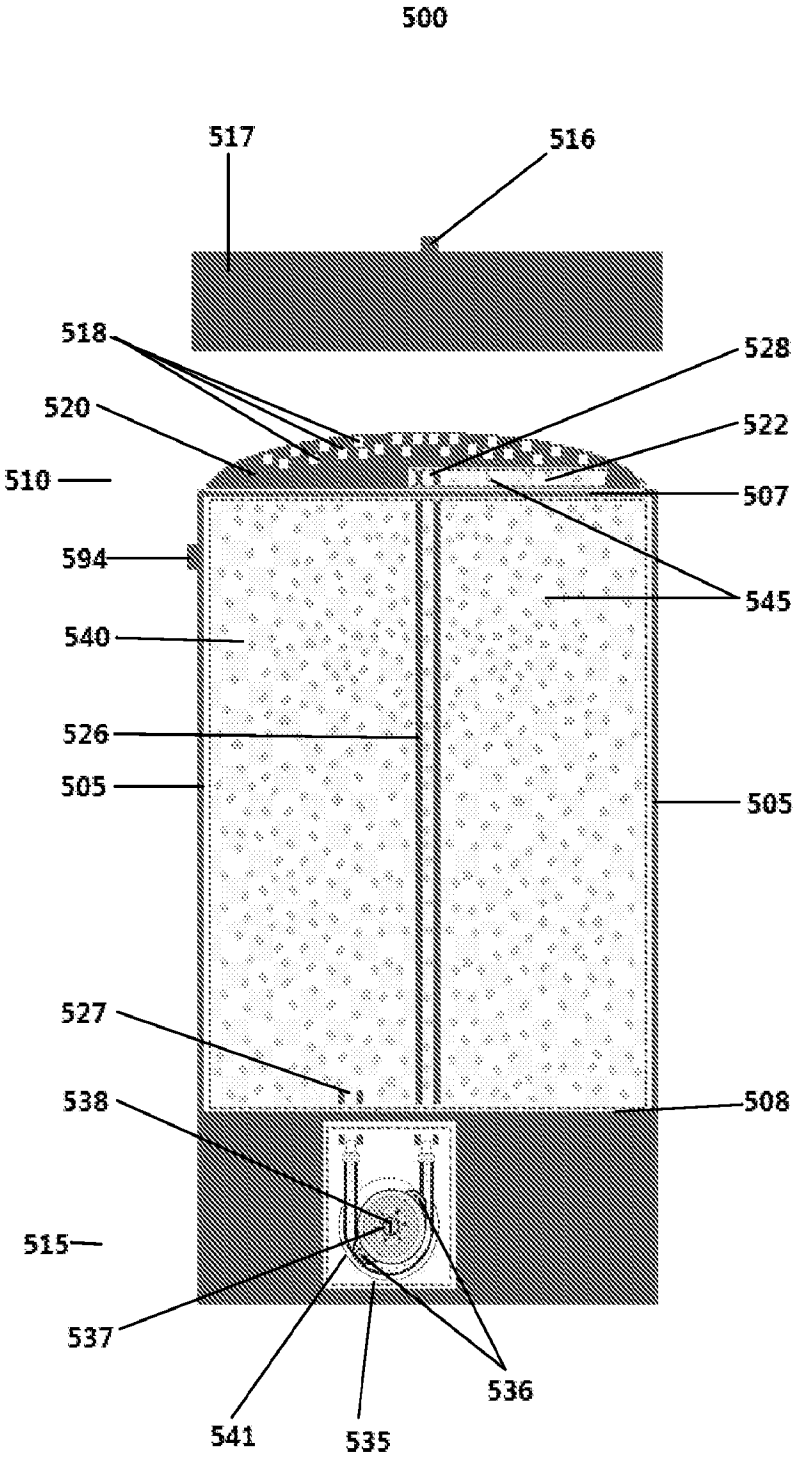

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Figure 5A

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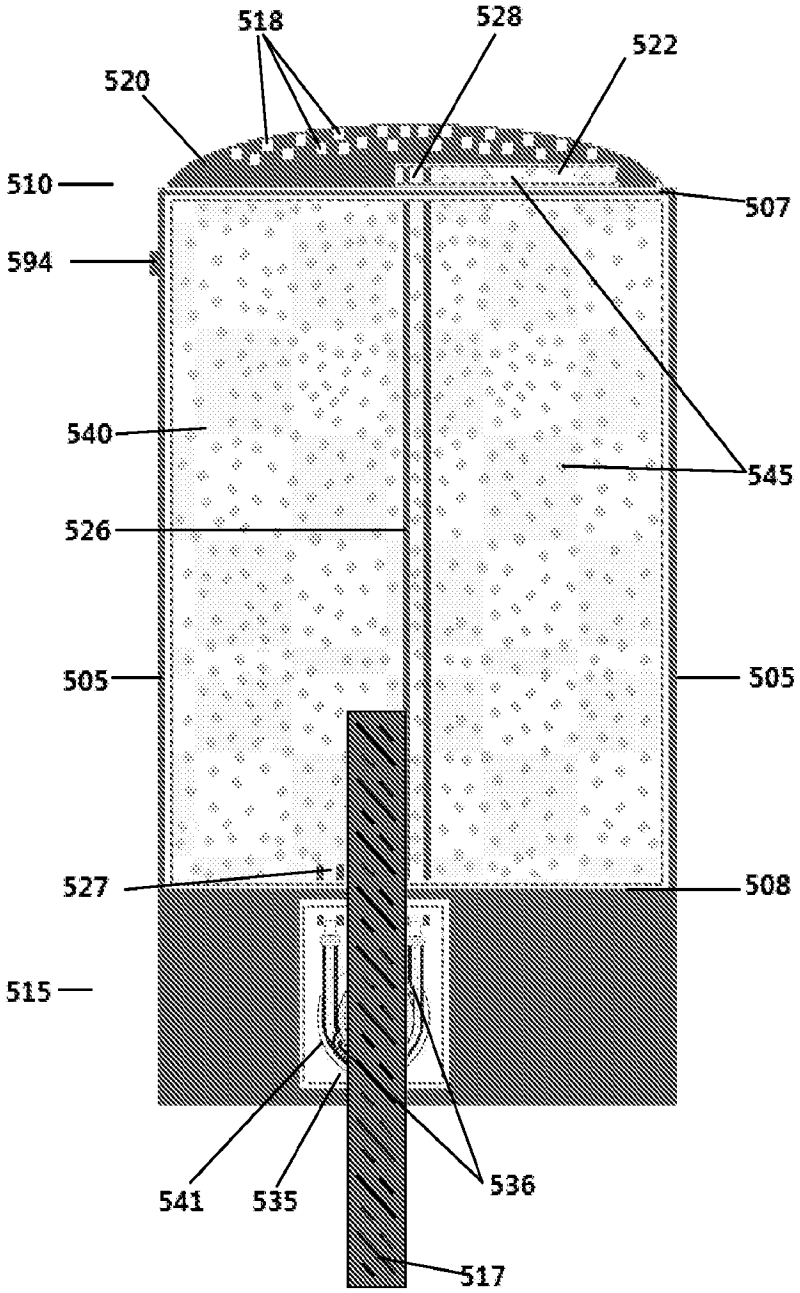



**Figure 5B**

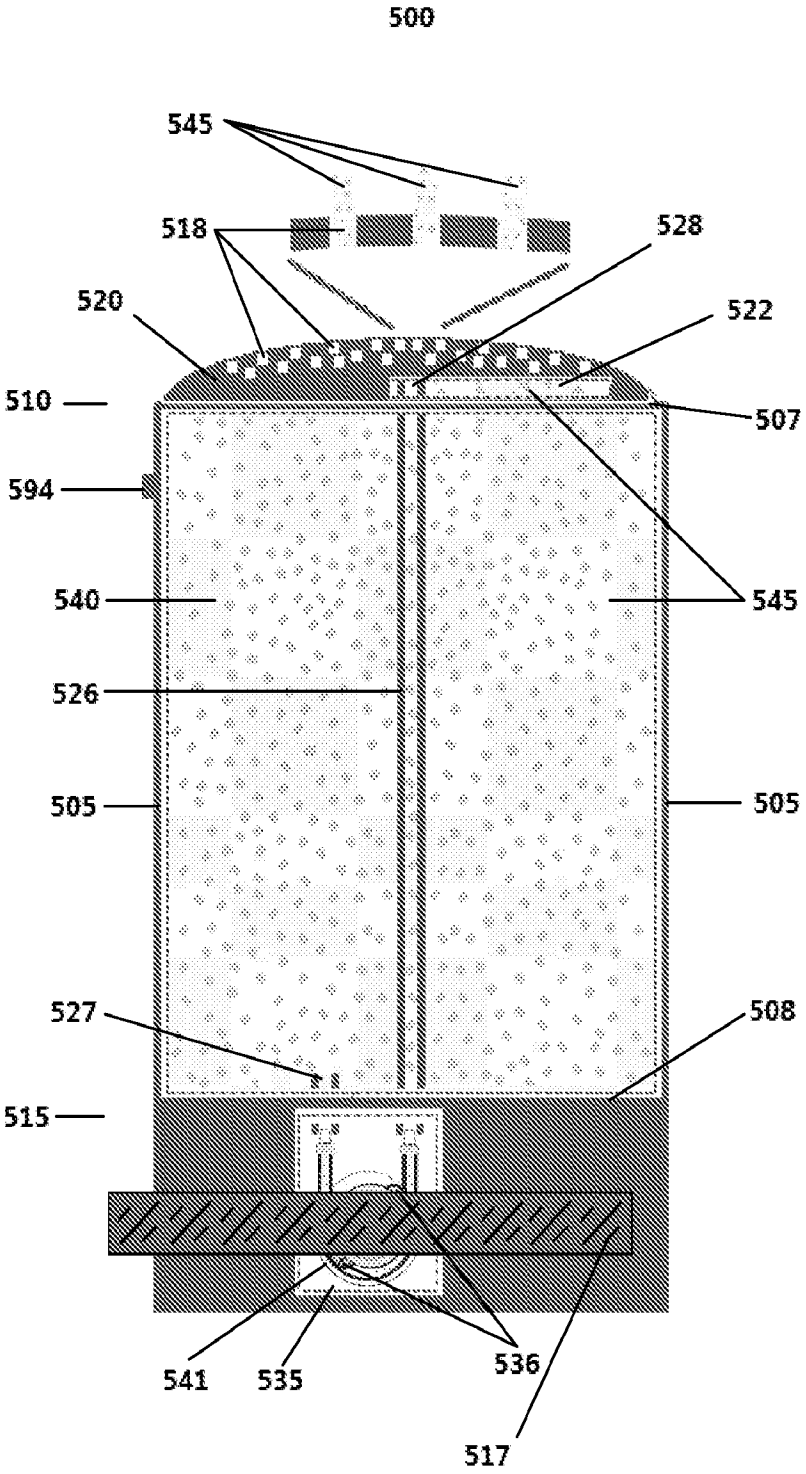

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**Figure 5C**

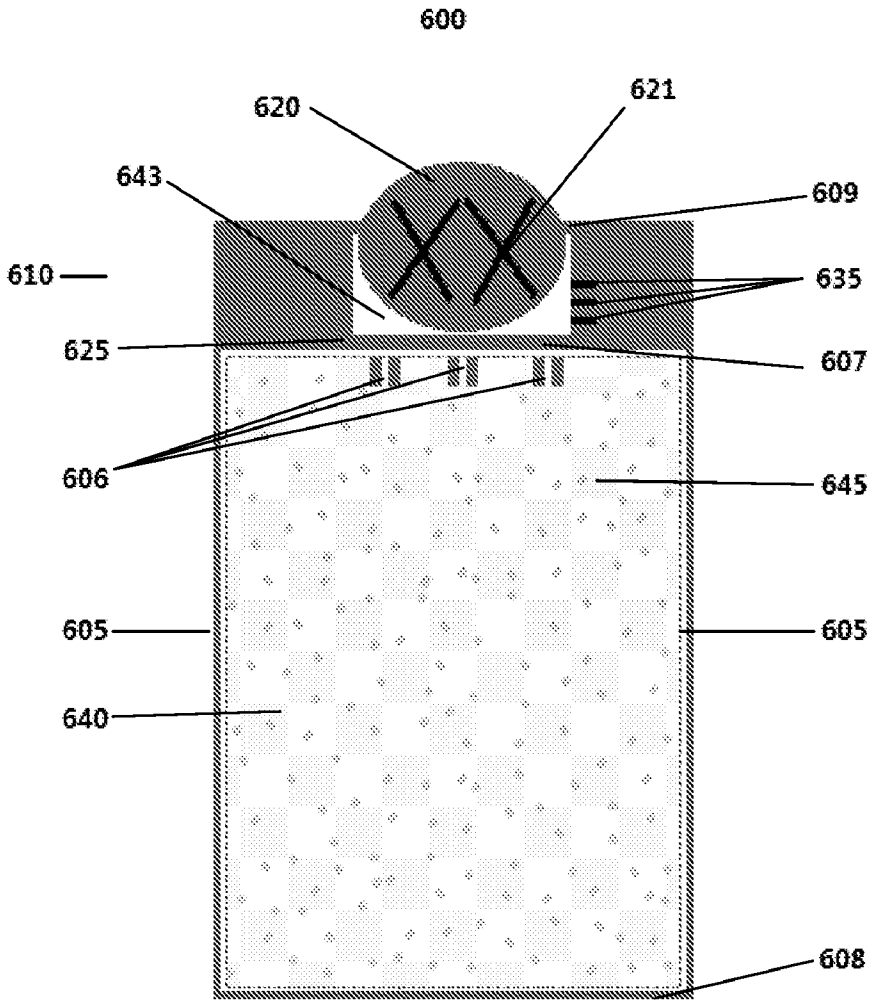



**Figure 6A**

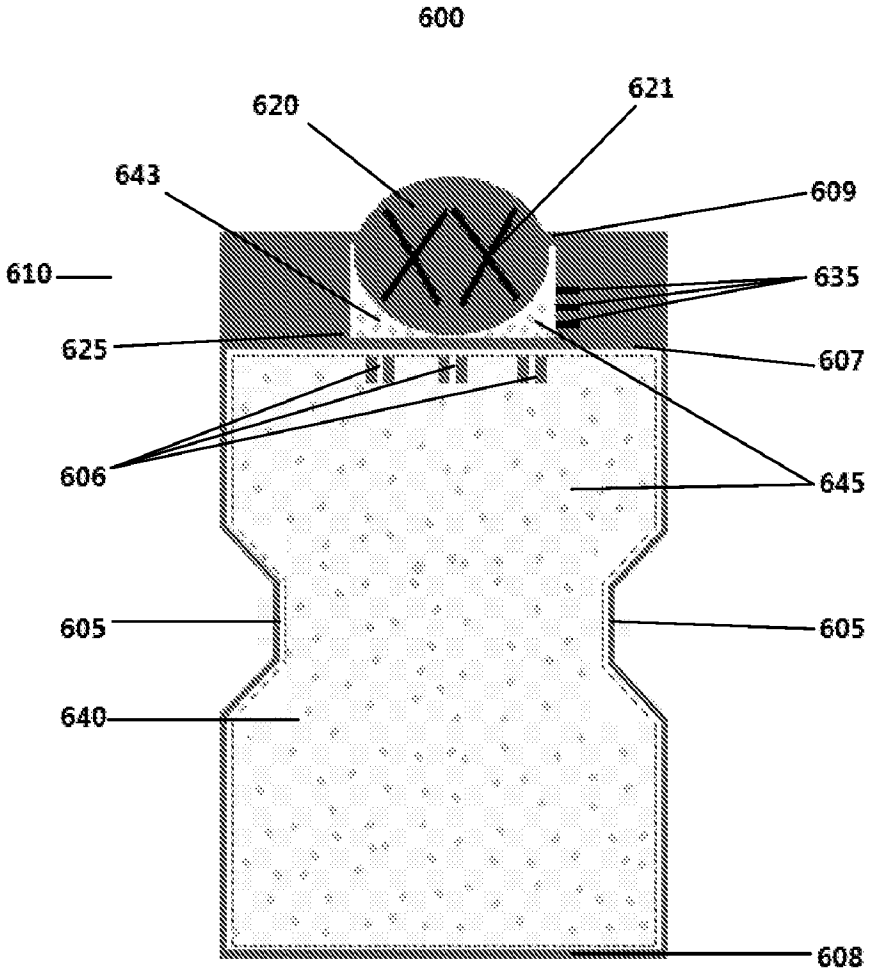



**Figure 6B**

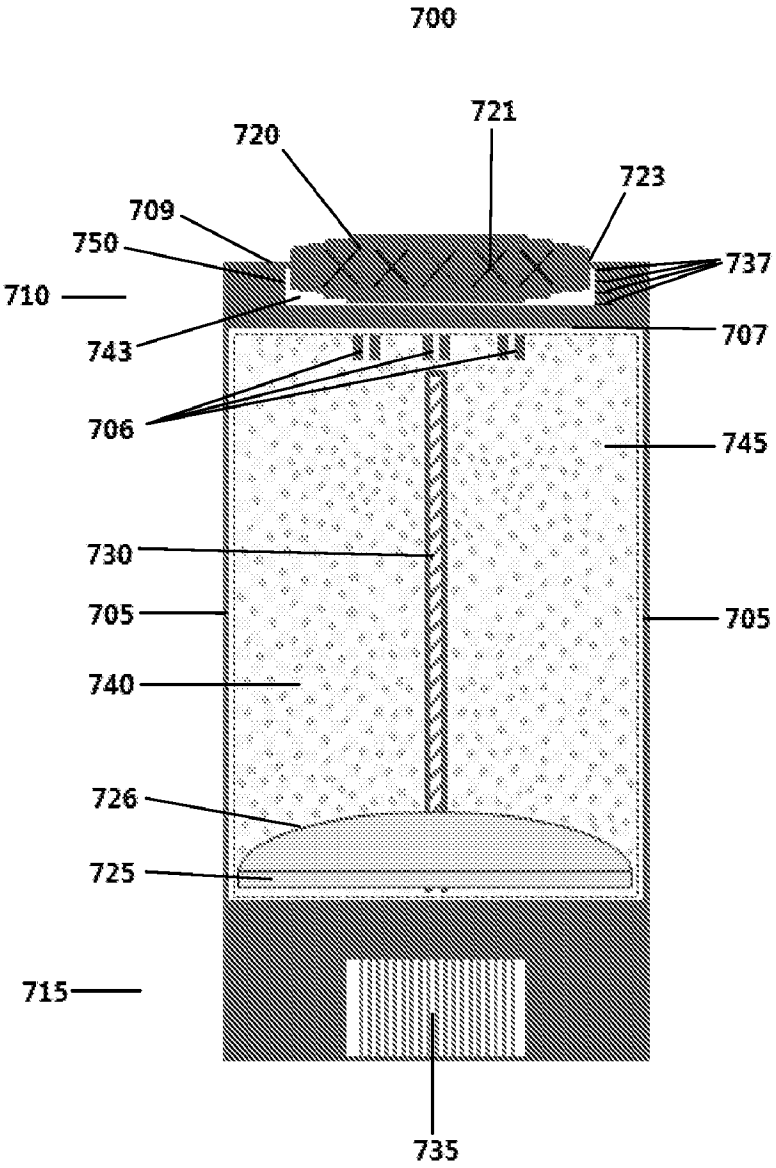

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**Figure 7A**

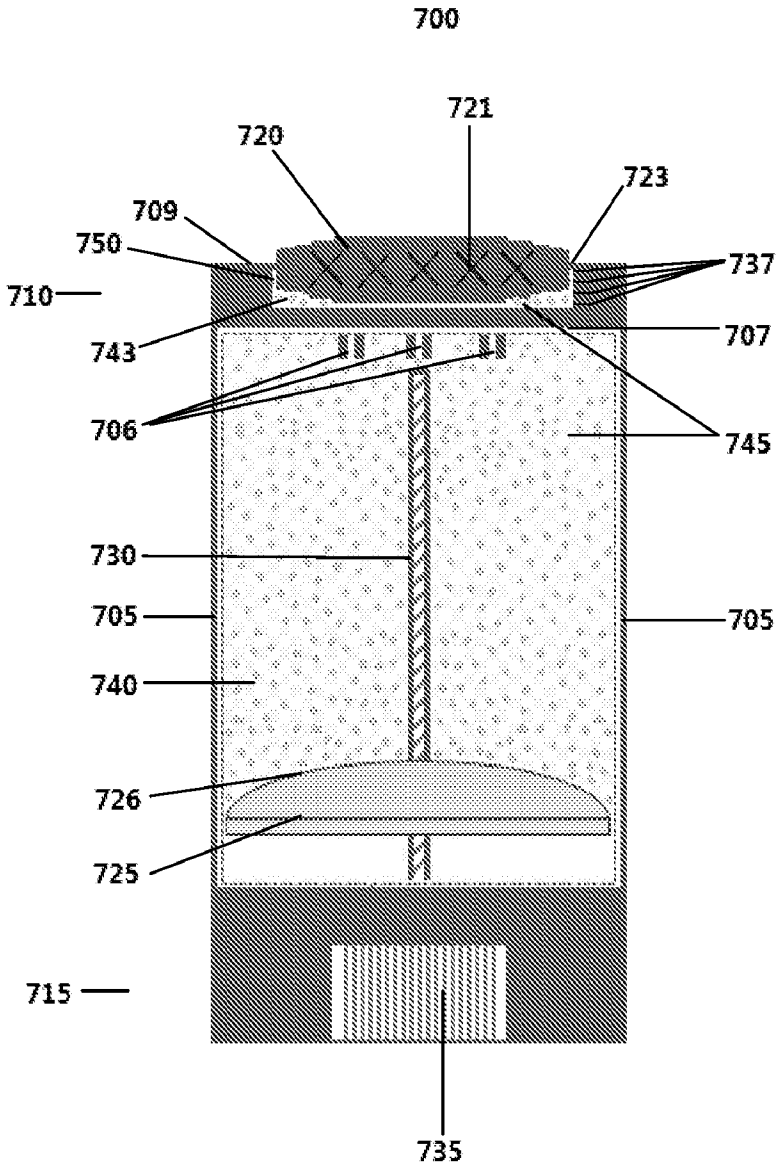

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**Figure 7B**

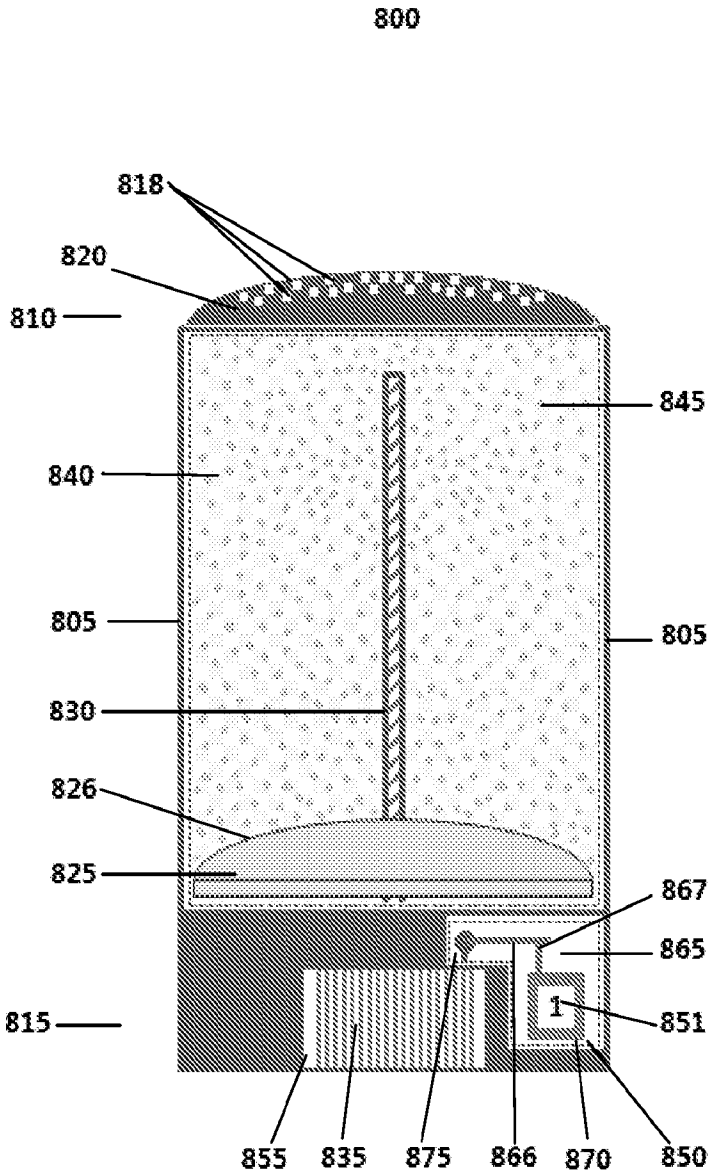

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**Figure 8A**

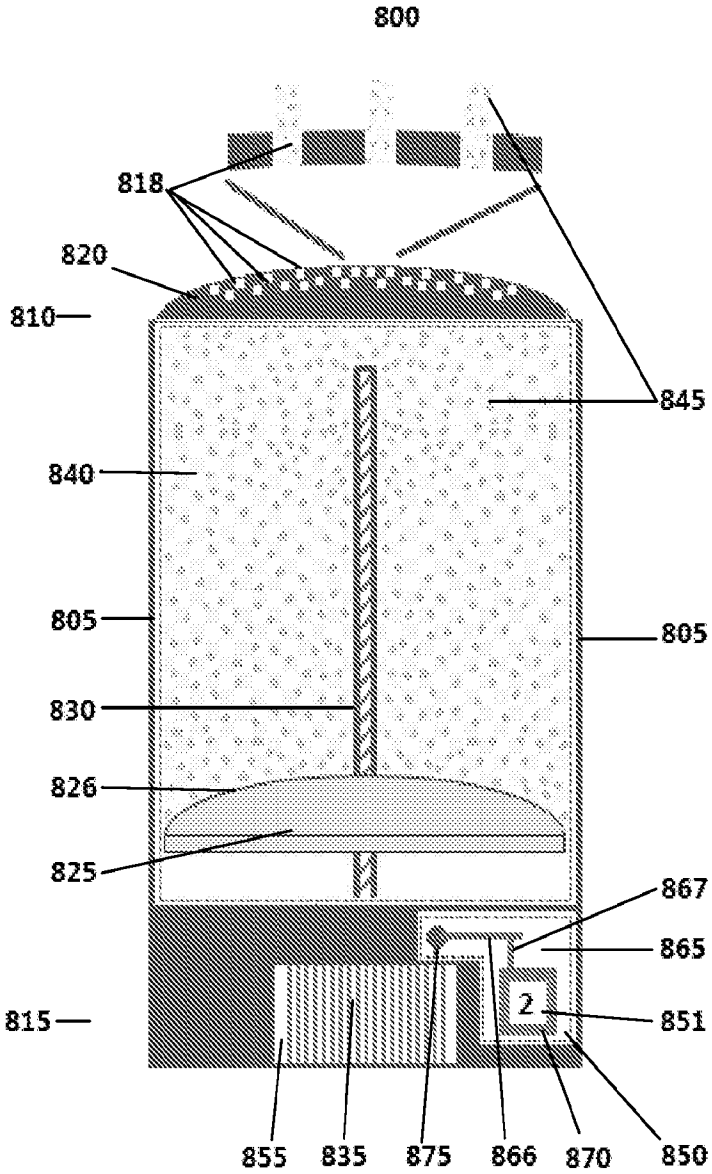

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**Figure 8B**

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 15/60152

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61K 47/00 (2016.01)
CPC - A61K 47/00
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)
IPC (8): A61K 47/00 (2016.01);
CPC: A61K 47/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC (8): A61K 47/00, B05C 1/00, B65B 1/20 (2016.01);
CPC: A61K 47/00, B05C 1/00, B65B 1/20

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Google Web, Google Patents, PatBase;
Search Terms Used: topical, formulation, dispenser, applicator, dermal, skin, deodorant, composition, dial, actuator, slot, key, slot key, twistable, driver, slot driver, medicament, medication, crank, pump, cap, rotate, lever, aluminum, removable, plunger, sidewall

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 2014/0270897 A1 (Laurusonis et al.) 18 September 2014 (18.09.2014), entire document, especially fig 32a-b, 39; para [0003], [0070], [0140], [0158]-[0159], [0168], [0189] | 1-15 |
| Y | US 2013/0079404 A1 (Kisak et al.) 28 March 2013 (28.03.2013), entire document, especially para [0019]-[0020], [0041], [0231], [0234]-[0236] | 1-15 |
| Y | US 2012/0205002 A1 (Walling et al.) 16 August 2012 (16.08.2012), entire document, especially fig 2-3; para [0026], [0044], [0047] | 6-15 |
| A | US 6,503,522 B2 (Lawson et al.) 07 January 2003 (07.01.2003), entire document | 1-15 |
| A | US 6,391,291 B1 (Clare et al.) 21 May 2002 (21.05.2002), entire document | 1-15 |
| A | US 2012/0074176 A1 (Sullivan et al.) 29 March 2012 (29.03.2012), entire document | 1-15 |
| A | US 2014/0221945 A1 (Dos Santos et al.) 07 August 2014 (07.08.2014), entire document | 1-15 |

☐ Further documents are listed in the continuation of Box C. ☐

* 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 | Date of mailing of the international search report |
|---|---|
| 20 January 2016 | 10 FEB 2016 |
| Name and mailing address of the ISA/US<br>Mail Stop PCT, Attn: ISA/US, Commissioner for Patents<br>P.O. Box 1450, Alexandria, Virginia 22313-1450<br>Facsimile No. 571-273-8300 | Authorized officer:<br>Lee W. Young<br>PCT Helpdesk: 571-272-4300<br>PCT OSP: 571-272-7774 |