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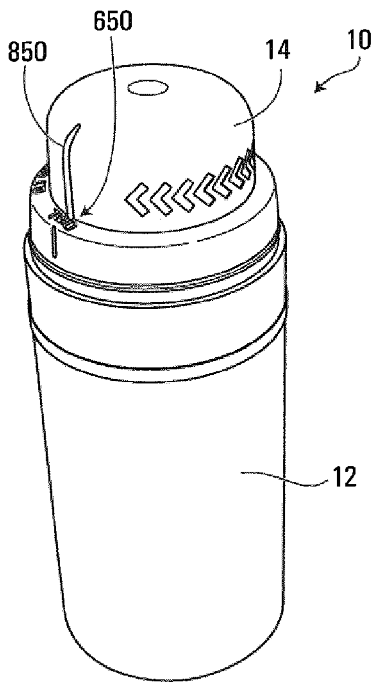

FIG. 1A

(57) Abstract: A fluid dispenser, comprising: an actuator with a rotatable dial; a valve assembly connected to the actuator, the valve assembly being configured so as to cause fluid to be drawn from a reservoir and released from the dispenser during at least part of the time when the dial is rotated from a start position to one of a plurality of dosage positions and back to the start position, the plurality of dosage positions being at different respective angular positions of the dial; the actuator being configured to provide perceptible feedback at each of the plurality of dosage positions.

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DISPENSER, ACTUATOR THEREFOR, AND DISPENSING CONTAINER INCORPORATING SAME

FIELD

The present invention relates generally to dispensing containers and, in particular, to dispensing containers for fluids such as creams and ointments, and to dispensers and actuators for use in such containers.

BACKGROUND

Dispensers for dispensing fluids such as creams and ointments exist. A drawback of existing dispensers is that they are unsatisfactory in terms of their accuracy, and/or preciseness, and/or controllability in terms of the amount of fluid they dispense from a container such as a bottle. As a result, such dispensers are not suitable for creams or ointments that are medicated and may require that they be dispensed in a prescribed dose which itself may vary over the duration of treatment.

When control over how much fluid to dispense is desired, users sometimes resort to approaches such as the use of a syringe, dropper or other measuring device. However, the act of directly accessing the product from a jar or bottle may contaminate the user as well as contaminate or oxidize the remaining product, which accelerates spoilage and leads to increased costs for the user. In specific applications, the use of a syringe, dropper or other measuring device may further require significant patient compliance to ensure a correct dosage administration.

As such, existing techniques for dispensing fluids in certain applications are unsatisfactory.

SUMMARY

According to a first aspect, there is provided a fluid dispenser, comprising: an actuator with a rotatable dial; a valve assembly connected to the actuator, the valve assembly being configured so as to cause fluid to be drawn from a reservoir and released from the dispenser during at least part of the time when the dial is rotated from a start position to one of a plurality of dosage positions and back to the start position, the plurality of dosage positions being at different respective angular positions of the dial; the actuator being configured to provide perceptible feedback at each of the plurality of dosage positions.

According to a second aspect, there is provided an actuator for a fluid dispenser, comprising: a housing attachable to a mouth of a container; a dial rotatably mounted to the housing, the dial including an egress port; a stem mounted to the housing and attachable to a valve assembly for releasing fluid from the container through the egress port of the dial, the housing configured to permit axial displacement of the stem relative to the housing while blocking rotational motion of the stem relative to the housing; the dial and the stem having respective contacting surfaces which are configured to urge the stem to undergo axial motion as the dial is rotated; the surfaces being further configured to provide perceptible feedback at a plurality of angular displacements of the dial.

According to a third aspect, there is provided a dispensing container, comprising: a casing defining a longitudinal axis; a reservoir disposed within an interior of the casing and movable along the longitudinal axis of the casing, the reservoir capable of holding fluid to be dispensed; a fluid dispenser mounted to the casing and to the reservoir, the fluid dispenser being configured so as to cause fluid to be drawn from the reservoir and released towards an exterior of the container via the dispenser during at least part of the time when an element of the dispenser is angularly moved from a start position to one of a plurality of dosage positions and back to the start position, the plurality of dosage positions being at different respective angular positions of the dial; the dispenser being configured to provide perceptible feedback at each of the plurality of dosage positions.

According to a fourth aspect, there is provided a method, comprising: guiding rotation of a dispenser actuator dial from a start position to a first dosage position, the dial covering a first angular displacement between the start positon and the first dosage position, the first dosage position corresponding to the smallest volume of fluid that can be dispensed by the dispenser; guiding further rotation of the dial from the first dosage position to an adjacent dosage position, the dial covering a second angular displacement between the first dosage position and the adjacent dosage position, the adjacent dosage position corresponding to the next smallest volume of fluid that can be dispensed by the dispenser, the first and second angular displacements being different; and providing perceptible feedback when each of the first and next dosage positions of the dial has been reached.

These and other aspects and features of the present invention will now become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1A is a perspective view of a dispensing container in accordance with a non-limiting embodiment, the container including a casing and a dispenser;

Fig. 1B is a perspective view of the dispensing container of Fig. 1A with a cap mounted thereon;

Fig. 2 is an exploded perspective view of the dispensing container of Fig. 1B, showing the cap, the casing and the dispenser;

Fig. 3 is a perspective view of a plurality of containers of different sizes and each including a fill window, in accordance with various non-limiting embodiments;

Fig. 4 is a cross-sectional view of the dispenser, including an actuator and a valve assembly, in accordance with a non-limiting embodiment;

Fig. 5 is a block diagram illustration of the actuator including a housing body, a housing shoulder, a dial inner shell, a dial outer shell and stem, in accordance with a non-limiting embodiment;

Figs. 6A and 6B are bottom and top perspective views, respective, of the shoulder of the housing of the actuator, in accordance with a non-limiting embodiment;

Figs. 7A and 7B are bottom and top perspective views, respective, of the body of the housing of the actuator, in accordance with a non-limiting embodiment;

Figs. 8A and 8B are bottom and top perspective views, respective, of the outer shell of the dial of the actuator, in accordance with a non-limiting embodiment;

Figs. 9A and 9B are bottom and top perspective views, respective, of the inner shell of the dial of the actuator, in accordance with a non-limiting embodiment;

Figs. 10A and 10B are bottom and top perspective views, respectively, of the stem of the actuator, in accordance with a non-limiting embodiment;

Fig. 11 is a side elevational cross-sectional view of the valve assembly, in accordance with a non-limiting embodiment;

Figs. 12A to 12E are a sequence of perspective views of the container in accordance with a non-limiting embodiment, showing the dial at different stages of rotation and the dispenser at different stages of dispensing;

Figs. 13A to 13C are side elevational cross-sectional views of the valve assembly, in accordance with a non-limiting embodiment, at different points along the trajectory of the dial from a start position to a selected dosage position;

Fig. 13D is a side elevational cross-sectional view of the valve assembly, in accordance with a non-limiting embodiment, at a point along a return trajectory of the dial;

Fig. 14 is a perspective view of the stem of the actuator, in accordance with a non-limiting embodiment, showing a surface profile that permits the dial of the actuator to be rotated both clockwise and counter-clockwise relative to the start position;

Fig. 15 is a partial perspective cutaway view of the shoulder of the housing and of the outer shell of the dial, in accordance with a non-limiting embodiment, showing complementary parts that participate in snap action to provide audible feedback;

Figs. 16A and 16B are a sequence of diagrams showing a relationship between rotational motion of the dial relative to the housing and the resultant axial motion of the stem;

Fig. 17 is a partial side elevational cross-sectional view of the valve assembly, in accordance with a non-limiting embodiment, illustrating a release of negative pressure formed by axial movement of a reservoir of the valve assembly relative to the casing of the container;

Fig. 18 is a graph of the force needed to turn the dial at different angular positions, in accordance with a non-limiting embodiment;

Fig. 19 is a bottom perspective view of the shoulder of the housing of the actuator, in accordance with another non-limiting embodiment;

Fig. 20 is a top perspective view of the stem of the actuator, in accordance with another non-limiting embodiment;

Fig. 21 is a partial perspective cutaway view of the shoulder of the housing and of the outer shell of the dial, in accordance with another non-limiting embodiment; and

Fig. 22 is a graph of the force needed to turn the dial at different angular positions, in accordance with another non-limiting embodiment.

It is to be expressly understood that the description and drawings are only for the purpose of illustration of certain embodiments of the invention and are an aid for understanding. They are not intended to be a definition of the limits of the invention.

DETAILED DESCRIPTION

With reference to Figs. 1A, 1B and 17, there is shown a dispensing container 10, such as a bottle or a jar, comprising a casing 12 to which is mounted a dispenser 14 for dispensing fluid contained in reservoir 18. The fluid contained in the reservoir 18 may be a cream, ointment, lotion, emulsion, gel or any other topical formulation or other fluid. The reservoir 18 may be movable within an inner wall 20 of the casing 12. In use, the reservoir 18 migrates upwards towards the dispenser 14 as the volume of fluid it contains decreases. In some embodiments, the container 10 may further include a bottom end 22. The bottom end 22 may include one or more vents 24 to equalize a pressure differential caused by displacement of a base 718 of the reservoir 18 towards the dispenser 14 as the volume of fluid held in the reservoir 18 decreases during use. In other embodiments, the bottom end 22 of the container 10 may be omitted, rendering the casing 12 a bottomless casing.

The container 10 may be generally in the form of a cylinder with a longitudinal axis and two ends, such that the dispenser 14 is located at one longitudinal end of the container 10. However, other shapes and configurations are possible. The container 10 may be made of a plastic or any other suitable material. By way of non-limiting example, certain components of the container 10 may be moulded or 3D-printed.

With reference to Fig. 2, the dispensing container 10 and optional cap 90 are shown in exploded view. It will be appreciated that once assembled onto the casing 12, the dispenser 14 creates a substantially hermetic seal, which in specific implementations, may advantageously minimize tampering, contamination and oxidation of the fluid contained therein.

Moreover, as shown in Fig. 3, the dispenser 14 is modular and can be used with casings 12A-12F capable of holding different volumes, but having the same size mouth 16.

Turning now to Fig. 5, the dispenser 14 comprises an actuator 400 and a valve assembly 1100. In the present non-limiting embodiment, the actuator 400 includes a housing 410 attachable to the casing 12, a rotatable dial 420 mounted to the housing 410 and a stem 1000 in contact with both the dial 420 and the housing 410. The housing 410 includes a shoulder 600 and a body 700, while the dial includes an outer shell 800 and an inner shell 900. The body 700, the shoulder 600, the outer shell 800, the inner shell 900 and the stem 1000 will now be described in the context of a non-limiting embodiment of the present invention.

With reference to Figs. 4 and 7A-7B, the body 700 includes an annular shell with a flange 702 around its periphery, conceptually dividing the annular shell into a top ring and a bottom ring. The flange 702 is recessed therebeneath to accommodate a thinned outer wall 704 at the mouth 16 of the casing 12. The flange 702 is designed to have an outer diameter that corresponds to the outer diameter of the casing 12, so that an exterior of the body 700 (i.e., the surface of the flange 702) is flush with the exterior of the casing 12 when the body 700 is mounted thereto. In order to secure the body 700 to the casing 12, the inner wall of the casing 12 includes one or more dimples or tracks 706 which accommodate complementary projections 708 on the surface of the body 700 below the flange 702. By urging the body 700 downwards onto the casing 12 while the projections 708 are axially aligned with the dimples or tracks 706, the projections 708 ultimately enter the dimples or tracks 706 and the body 700 snaps onto the casing 12.

Towards an interior of the body 700, there is provided a cylindrical chamber 710 that accommodates the valve assembly 1100. The chamber 710 is connected to the reservoir 18 via an orifice 714 in the body 700. The reservoir 18 is defined by a cylindrical inner wall 716 of the casing 12 and a base 718 (see Fig. 17). The reservoir 18 normally contains fluid to be dispensed by the dispenser 14.

The cylindrical chamber 710 is surrounded by a moat 720 which is itself surrounded by a thin cylindrical wall 722 comprising axial slots 724. The moat 720 accommodates a spring 726 which can be compressed by downwards axial motion of a stem undersurface 728 (see Fig. 10A).

The shoulder 600 is separate from the body 700 but snaps to the body 700 when assembly of the actuator 400 is complete. With additional reference to Figs. 6A and 6B, the shoulder 600 generally includes an upper ring 602 that sits on top of a lower ring 604, the lower ring 604 having an outer diameter larger than the outer diameter of the upper ring 602 and having an inner diameter larger than the inner diameter of the upper ring 602, thus forming an annular lip 606 on the inside of the shoulder 600. The upper ring 602 includes a radially inwardly facing ledge 608, on which information about a start position, dosages and/or other information may be printed, embossed or debossed.

The lower ring 604 of the shoulder 600 includes a plurality of recesses or dimples 610 while the top ring of the body 700 includes complementary protrusions 730 (see Fig. 7B) that are configured to snap into these dimples/recesses 610 when the shoulder 600 and the body 700 are urged together. The size of the outer diameter of the lower ring 604 corresponds to the size of the outer diameter of the casing 12 and also to the outer diameter of the flange 702 of the body 700. In this way, when the shoulder 600 is mated to the body 700, the resulting container 10 including the casing 12 and the actuator 400 presents a smooth and uniform outer surface.

For purposes of assembly of the actuator 400 and/or the dispenser 14, the shoulder 600 and the body 700 are mated to another (i.e., the dimples/recesses 610 of the lower ring 604 of the shoulder 600 engage the protrusions 730 of the top ring of the body 700), however this is done only once the stem 1000, the valve assembly 1100 and the dial 420 are set in place.

The dial's outer shell 800 is rotated by the user during operation of the actuator 400. With additional reference to Figs. 8A and 8B, the outer shell 800 may include a textured surface to facilitate gripping, such as a relief pattern 802, although other grip facilitating features could be provided, such as areas of surface depression, wings, knobs, etc. The outer shell 800 also includes at least one egress port 804 through which fluid exits the actuator 400. Fluid dispensing could occur upon turning the dial 800 in one rotational direction (e.g., clockwise), in an opposite rotational direction, or in both. The shape of the egress port 804 is not particularly limiting, and may be in the form of a ring, one or more holes, one or more slits, etc. Also, while in the illustrated embodiment, the egress port 804 is centered, this need not be the case in all embodiments.

The outer shell 800 of the dial 420 further includes a circular band 806 around its outer surface. Also, the outer shell 800 includes a plurality of feet 808 that protrude radially outward at a base of the outer shell 800. When the outer shell 800 is inserted through the shoulder 600, the circular band 806 comes up against the ledge 608 formed by the upper ring 602 of the shoulder 600, while the feet 808 come up against the annular lip 606 on the inside of the shoulder 600. When, in addition, the body 700 is snapped to the shoulder 600, the feet 808 of the outer shell 800 are now caught between the annular lip 606 on the inside of the shoulder 600 and the top ring of the body 700. This blocks axial displacement of the dial's outer shell 800 relative to the housing 410 while permitting rotational motion of the dial 420 relative to the housing 410. Axial displacement can refer to displacement along an axis that is normal to a plane of rotation of the dial 420.

With additional reference to Figs. 9A-9B, the inner shell 900 of the dial 420 includes a disk 902 circumscribed by an upper wall 904 on the periphery of an upper surface of the disk 902 and a lower wall 906 on the periphery of an underside of the disk 902. A cylindrical channel 908 passes longitudinally through a center of the disk 902. The inner shell 900 is mounted to the outer shell 800 through a pair of mating, hollow cylindrical connectors, a first one 810 on the outer shell 800 of the dial 420 and a second one 910 on the inner shell 900. The hollow cylindrical mating connector 810 on the outer shell 800 passes through a center of the dial 420 and creates a conduit for fluid towards the egress port 804. Engagement of the connectors 810, 910 acts as a stop against axial motion of the inner shell 900 relative to the outer shell 800. Also, rotational motion of the inner shell 900 relative to the outer shell 800 is blocked by a set of axially oriented ribs 812 disposed on an inner surface of the outer shell 800 and a corresponding set of axially oriented slits 912 located on the upper wall 904 on the periphery of the upper surface of the disk 902 of the inner shell 900. Thus, when the ribs 812 of the outer shell 800 are aligned with the slits 912 of the inner shell 900, the inner shell 900 can be pushed towards the outer shell 800 from the inside, resulting in engagement of the cylindrical mating connectors 910, 810. At this point, practically speaking, the outer shell 800 and the inner shell 900 form one and the same component, namely the dial 420.

The inner shell 900 of the dial 420 also includes a plurality of hanging arms, in this case two such hanging arms 914 disposed at 180 degrees to one another. Each of the hanging arms 914 occupies a certain arc length (e.g., around 10 degrees) around an outer periphery of the circular surface on the underside of the disk 902. In other embodiments, there may be a single hanging arm 914, while in still other embodiments, there may be more than two hanging arms.

Turning now to the stem 1000, and with additional reference to Figs. 10A-10B, this cap-shaped component includes a disk 1002 under which hangs a cylindrical outer wall 1004. On top of the disk 1002 is a plurality of contoured ridges. In this case, there are two contoured ridges 1006 that are at 180 degrees apart around a periphery of the disk 1002. In other embodiments, there may be a single contoured ridge 1006, while in still other embodiments, there may be more than two contoured ridges. The stem 1000 and the inner shell 900 of the dial 420 are in contact through a pair of mating, hollow cylindrical connectors, one connector 1010 being on the stem 1000 and the other connector 916 being on the inner shell 900. The hollow cylindrical mating connectors 1010, 916 pass through a center of the dial 420 and create a conduit for passage of fluid towards the egress port 804 of the dial 420.

The stem 1000 also includes wings 1008 that slide into the aforementioned axial slots 724 made in the thin cylindrical wall 722 of the body 700, which blocks rotational motion of the stem 1000 relative to the body 700 (and also relative to the housing 410 as a whole).

Although the dial 420 is permitted to move rotationally relative to the housing 410, it is blocked by the housing 410 from moving axially. (In the present description, the terms "axial" and "longitudinal" are sometimes used interchangeably.) Specifically, the feet 808 of the dial's outer shell 800 are sandwiched between the annular lip 606 on the inside of the shoulder 600 and the top ring of the housing's body 700. For its part, the stem 1000 is permitted to move axially within a certain range of motion, but is blocked by the housing 410 from rotating. This blocking is achieved by the wings 1008 of the stem being caught in the axial slots 724 of the housing's body 700.

By proper configuration of the inner shell 900 of the dial 410 and of the stem 1000, a transfer of rotational motion of the dial 420 to axial motion of the stem 1000 can be achieved. Specifically, the stem 1000 and the inner shell 900 of the dial 420 are in contact with each other through the hanging arms 914 of the inner shell 900 and the contoured ridges 1006 of the step 1000, which act as cams. The hanging arms 914 are shaped in such a way that when the dial 420 is rotated, rotation of the hanging arms 914 pushes obliquely against the surface of the contoured ridges 1006. Since the stem 1000 cannot rotate, the rotational force that it receives from the hanging arms 914 is redirected by the oblique shape of the contoured ridges 1006, urging the stem 1000 to undergo a "downwards" axial displacement (away from the dial 420). Also subjected to this downwards axial displacement of the stem 1000 is a cylindrical base 1030 that interacts with the valve assembly 1100.

As shown in Fig. 4, the valve assembly 1100 can be an airless valve assembly incorporating a reciprocating piston rod 1102. The valve assembly 1100 is configured to draw fluid from the reservoir 18 by suction and push it through a hollow portion of the piston rod 1102, through the stem 1000 and ultimately out through the egress port 804 of the outer dial 800.

In this embodiment, the valve assembly is of the type that expels fluid as a result of upward axial displacement of the piston rod 1102, i.e., this occurs during a return stroke of the piston rod 1102, namely, during decompression of the spring 726. However, other valve assemblies are possible. For example, another possible valve assembly is configured to push fluid through the stem 1000 upon downward axial displacement of a piston rod (i.e., during compression of the spring 726). Yet another possible valve assembly is configured to expel fluid upon both downward and upward axial displacement of a piston rod, for example in respective fluid volume ratios (resulting from the downward : upward axial displacement of the piston rod) of 50:50, 90:10, 80:20, 70:30, 60:40, 40:60, 30:70, 20:80, 10:90, and the like. Each of these valve assemblies may be suitable in different embodiments. Still other valve assemblies may be based on the valve assembly described in U.S. Patent 6,375,045, hereby incorporated by reference herein.

As an aid in understanding, a specific non-limiting embodiment of a valve assembly is now described with reference to Fig. 11, which shows a valve assembly 1100A. It should be noted that the valve assembly 1100A is a variant of the valve assembly 1100 because it is of the type that expels fluid on a downward (rather than upward) stroke of a piston rod. Persons skilled in the art will know what variations are needed in order to change the valve assembly so that it becomes of the type that expels fluid on the return stroke of the piston rod 1102A. In the following, a reference to a component of the actuator 400 is labelled with a suffix “A”, since the design of this component may be slightly different in order to accommodate the specific type of valve assembly being described in the embodiment of Fig. 11 when compared with the one provided for in Fig. 4.

Thus, with reference to Fig. 11, the valve assembly 1100A includes a piston rod 1102A connected to the stem 1000A. The piston rod 1102A of the valve assembly 1100A is secured to the cylindrical base 1030A of the stem 1000A by virtue of a protruding ring 1020A of the stem 1000A being caught in a circular recess 1104A of the piston rod 1102A. Thus, when the stem 1000A undergoes downwards axial displacement, so too does the piston rod 1102A of the valve assembly 1100A; similarly, when the stem 1000A undergoes upwards axial displacement, so too does the piston rod 1102A of the valve assembly 1100A. The valve assembly 1100A also comprises a seal cap 1106A disposed circumferentially near the top of the chamber 710A and a check valve 1108A disposed circumferentially at the bottom of the bottom of the chamber 710A. The seal cap 1106A is slidably mounted to an inner wall of the chamber 710A so that axial motion of the seal cap 1106A relative to the inner wall of the chamber 710A is permitted. Axial motion in the downwards direction is caused by the base 1030A of the stem 1000A pushing down on an upper portion 1120A of the seal cap 1106A. Axial motion in the upwards direction is caused by a base 1116A of the piston rod 1102A pushing up on a lower portion 1122A of the seal cap 1106A. The seal cap 1106A provides a seal against fluid leakage between the inner wall of the chamber 710A and the piston rod 1102A. The check valve 1108A has a plug 1110A that nominally blocks the orifice 714A of the body 700A but is sufficiently flexible to be raised and dislodged from the orifice 714A. The check valve 1108A also has one or more eccentric openings 1112A. The check valve 1108A is made of a material that is sufficiently flexible to allow fluid to be drawn into the chamber 710A from the reservoir 18A via the orifice 714A and the eccentric openings 1112A (with the plug 1110A raised) but does not permit fluid to be pushed out from the chamber 710A into the reservoir 18A. The piston rod 1102A acts as a conduit for fluid traveling from the chamber 710A to the stem 1000A. To this end, the piston rod 1102A includes one or more openings 1114A near the base 1116A.

Operation of the valve assembly 1100A is now described with reference to Figs. 13A-13D. Fig. 13A shows the piston rod 1102A at its highest longitudinal position in the chamber 710A. In this position, the openings 1114A in the piston rod 1102A are sealed by the seal cap 1106A. However, the openings 1114A will be liberated as the piston rod 1102A begins its journey down into the chamber 710A. Specifically, for a first portion of this longitudinal displacement of the piston rod, the seal cap 1106A remains stationary, as there is a gap 1124A between the base 1030A of the stem 1000A and the upper portion 1120A of the seal cap 1106A. Then, as the gap 1124A is closed by downward motion of the base 1030A of the stem 1000A, the base 1030A eventually contacts the upper portion 1120A of the seal cap 1106A, as is shown in Fig. 13B. At this point, fluid is allowed to travel through the openings 1114A and upwards through the center of the piston rod 1102A. The fluid continues to travel upwards through the piston rod 1102A as shown in Fig. 13C until the base 1116A of the piston rod 1102A is stopped by the check valve 1108A at the bottom of the chamber 710A. Meanwhile, it will be noted that the spring 726A has become compressed.

On the return stroke of the piston rod 1102A, the piston rod 1102A rises due to rising of the stem 1030A, which could be caused by user actuation of the dial 420 or by the force of decompression of the spring 726A or both. Fluid is now drawn from the reservoir 18A into the chamber 710A through the orifice 714A and the openings 1112A of the check valve 1108A. The lower portion 1122A of the seal cap 1106A is meanwhile being dragged upwards by the base 1116A of the piston rod 1102A, until the seal cap 1106A hits an abutment 780A formed in the body 700A. At this point, and with reference to Fig. 13D, the seal cap 1106A stops its ascent and the aforementioned gap 1124A is re-formed between the upper portion 1122A of the seal cap 1106A and the base 1030A of the stem 1000A.

Irrespective of the type of valve assembly that is used, the volume of fluid that is dispensed depends on the amount of axial displacement of the piston rod. This could include the amount of axial displacement on the way down, or on the way up, or both, depending on the design of the valve assembly. Returning now to the embodiment that had been described with reference to Figs. 1A through 10B and 17, the amount of axial displacement of the piston rod 1102 is itself a function of the amount of displacement of the stem 1000, which in turn depends on the extent of angular rotation of the outer shell 800 of the dial 420.

With reference to Figs. 1A and 8B, to facilitate use of the dispenser 14, the outer shell 800 of the dial 420 may include a marker 850. In two example non-limiting embodiments, the marker 850 may be printed or embossed on the outer surface of the outer shell 800 of the dial 420. The marker 850 is located at a certain point around the periphery of the outer shell 800. Assume that the spring 726 is completely decompressed and that the actuator 400 is at the beginning of a dispensing cycle. This position may be referred to as a “start position” for the dial 420, and an area on the ledge 608 of the shoulder 600 opposite the marker 850 is marked by an indicator 650 referred to as a “start indicator”, which may be printed, or debossed, or embossed with information such as “zero”, “0”, “start”, etc., or any other kind of symbol. In some embodiments where rotation of the dial 420 in the opposite direction from the start position may be blocked, the start indicator 650 may be omitted, as the start position of the dial can be easily perceived by the user.

As the outer shell 800 of the dial 420 is turned relative to the shoulder 600, the marker 850 follows a curved path, defining an angular displacement. Pre-determined angular displacements for the marker 850 (referred to as “dosage positions” for the dial 420) are marked on the ledge 608 of the shoulder 600 with respective “dosage indicators” 660A-660C. Each given dosage position corresponds to a dosage that the dispenser 14 is configured to dispense during the time period when the outer shell 800 of the dial 420 is rotated from the start position (i.e., when the marker 850 is aligned with the start indicator 650) to the given dosage position (i.e., when the marker 850 is aligned with one of the indicators 660A-0660C) and back to the start position. Actual dispensing of the fluid may occur only during the first half of the dispensing cycle (i.e., rotation of the dial 420 from the start position to the given dosage position) or only during the second half (from the given dosage position back to the start position) or during both halves, depending on the type of valve assembly that is used, as has been previously described. The dosage indicators 660A-660C may specify (e.g., by virtue of being printed, debossed or embossed with, or including a sticker indicating) the actual dosage that is dispensed. In a non-limiting embodiment, the dial 420 may acquire three dosage positions (which do not include the start position), each corresponding to a different dosage, although there may be more or fewer possible dosage positions in other practical embodiments.

The range of possible dosages that can be dispensed will naturally depend on the capacity of the chamber 710. As such, example dosages could be 0.1 ml, 0.2 ml, 0.25 ml, 0.5 ml, 1 ml, 1.5 ml, 2.0 ml and 5.0 ml, to name a few non-limiting possibilities. It should be appreciated that the dosages corresponding to the various dosage positions of the dial 420 may be independent of one another. Specifically, although it is possible for the second smallest dosage to be an integer multiple of the smallest dosage, this need not be the case. Thus, dosage positions corresponding to dosages of 0.1, ml, 0.25 ml and 0.5 ml may be a feasible and acceptable combination of dosages. Dosage positions that correspond to numerous other dosages and combinations of dosages are of course possible, again with no particular restriction as to whether any of the dosages are multiples of one another. It should be appreciated that in the case dosages X and Y are among the dosages that can be dispensed by the dispenser 14, and where the prescribed dosage for a medicated cream or lotion changes over time between dosage X and dosage Y, this can allow the user to easily change from dosage X to dosage Y by simply rotating the dial 420 to / from the new dosage position corresponding to dosage Y (which will be attained when the marker 850 is aligned with the corresponding dosage indicator). The simplicity with which this can be done on the part of the user may facilitate patient compliance with a time varying dosage regime.

From a user's point of view, and with reference to Figs. 12A-12E, the user turns the outer shell 800 of the dial 420 in a certain direction from the start position (see Fig. 12A, where the marker 850 is aligned with the start indicator 650), to a selected (or desired) dosage position (see Fig. 12B, where the marker 850 is aligned with dosage indicator 660A), and then back to the start position (see Fig. 12C). Finger grips (e.g., the relief pattern 802) may facilitate gripping of the outer shell 800 of the dial 420 and/or may include a particular pattern which indicates the possible direction of rotation for actuation. Depending on the angular displacement imparted by the user to the dial 420, the selected dosage position may be the first dosage position (which would result in dispensing of the smallest amount of volume of fluid that the dispenser is able to dispense), the last dosage position (which would result in dispensing of the largest amount of volume of fluid that the dispenser is able to dispense) or an intermediate dosage position. In the case of the sequence from Figs. 12A-12E, the selected dosage position was the first dosage position (whereby the marker 850 is aligned with dosage indicator 660A corresponding to a dosage of 0.1 ml), while in the continuation of this sequence, i.e., Figs. 12C-12E, the selected dosage position was an intermediate dosage position (whereby the marker 850 is aligned with dosage indicator 660B corresponding to a dosage of 0.25 ml), which leads to a total dispensed volume of 0.35 ml through the egress port 804. In this embodiment, it will be observed that fluid dispensing occurs on the return path from the selected dosage position to the start position, but as mentioned previously, this need not be the case in all embodiments.

It should be appreciated that when the dial 420 is rotated away from the start position towards one of the dosage positions, the spring 726 is compressed. Conversely, when the dial 420 is brought back to the start position, this creates headroom for the compressed spring 726, which expands and applies pressure to the stem 1000 against the inner shell 900 of the dial 420 towards its original axial position as the dial 420 returns to the start position. In some non-limiting embodiments, the spring 726 may be sufficiently strong so as to urge the dial 420 back to its start position without user manipulation of the dial 420. That is to say, merely by the user letting go of the dial 420 after reaching a selected dosage position, the decompression force of the spring 726 will cause the dial 420 to return to the start position. One should also bear in mind that the strength of the spring 726 required to force the dial 420 back to the start position may also be influenced by the configuration of the profile of the connecting surfaces of the stem 1000 and the dial's inner shell 900, as will now be described.

Indeed, to dispense the amount of fluid indicated by a particular dosage indicator, a calibrated design of the stem 1000 and the dial's inner shell 900 is needed. To this end, in order to provide a certain degree of precision and/or accuracy with which predetermined doses of fluid can be dispensed, the contoured ridges 1006 of the stem 1000 are specially profiled, taking into account the predetermined dosage positions of the dial 420, as will now be described, with reference to Figs. 16A and 16B.

Recalling that the contoured ridges 1006 each have a surface in contact with a surface of a corresponding one of the hanging arms 914, Fig. 16A conceptually relates the changing angular positions of one of the hanging arms 914 to the changing axial positions of the corresponding contoured ridge 1006 in the case where the dial 420 acquires a first dosage position. This is continued in Fig. 16B, which presents the situation in the case where the dial 420 acquires the next dosage position. The diagrams of Figs. 16A and 16B are in fact curvilinear projections, such that clockwise rotation of the hanging arm 914 is represented as lateral movement towards the right, which is associated with downward movement of the contoured ridge 1006. The upper image in each of Figs. 16A and 16B illustrates the angular position of the outer shell 800 of the dial 420 and the corresponding relative lateral position of the hanging arm 914 is shown in the lower image. Also shown are the start indicator 650 and the dosage indicators 660A-660C as indicated on the shoulder 600 of the housing 410, as well as the marker 850 on the outer shell 800 of the dial 420.

With reference to Figs. 16A and 16B, a non-limiting embodiment of a possible profile of one of the contoured ridges 1006 is shown. Changes in axial displacement of the contoured ridge 1006 occur due to a lower extremity of the hanging arm 914 obliquely pushing against the surface of the contoured ridge 1006. It will be observed that the surface of the contoured ridge 1006 varies with the angle of rotation. Specifically, the contoured ridge 1006 presents a surface that has a plurality of sections 1602-1614, including a plurality of segments, in this case alternating plateaus 1602, 1606, 1610, 1614 and inclines 1604, 1608, 1612. Of course, contoured ridges 1006 with shapes other than a combination of plateaus and inclines are possible, including curved shapes, shapes that are not monotonically increasing, etc.

The transitional regions from plateau to incline, and from incline to plateau provide perceptible feedback to the user. In particular, with reference to Fig. 16A, consider the situation where the outer shell 800 of the dial 420 is in the start position and a surface of the hanging arm 914 is in contact with plateau 1602. Now consider that the user applies (clockwise) torque on the dial 420. This forces the hanging arm 914 against incline 1604. Some initial resistance is presented by the contoured ridge but with sufficient torque applied by the user, the initial resistance is overcome and the hanging arm 914 begins to turn, which urges the contoured ridge 1006 downwards. Having overcome the initial resistance, the resistance now presented by the contoured ridge 1006 decreases to a somewhat lower level, although it may be somewhat counterbalanced by a slight increase in resistance provided the spring 726 in response to compression thereof. During this time (while the hanging arm 914 is in moving contact with incline 1604), the contoured ridge 1006 moves downward and presses down on the piston rod 1102 as has been previously described. After a certain angular displacement of the dial 420, the surface of the contoured ridge 1006 transitions to plateau 1606. This will be felt as a sudden falloff in the resistance applied against turning of the dial 420. This is an example of tactile feedback capable of signaling to the user that a dosage position has been reached. If the user is unsure of which dosage position has been reached he or she need simply look at the actuator 400 and observe the alignment of the marker 850 with the corresponding dosage indicator, in this case dosage indicator 660A. The user may continue to apply torque to the outer shell 800 of the dial 420. This will continue to move the hanging arm 914 rotationally but, because it has met plateau 1606, this will not result in additional dispensing. At some point, the hanging arm 914 reaches a point on the surface of the contoured ridge 1006 where incline 1608 begins, and this will be felt by the user as an increase in resistance to turning of the dial 420. Thus, depending on the embodiment, the dosage marker 660A corresponding to the first dosage may be placed at the angular position where the hanging arm 914 first reaches plateau 1606 (as shown in Figs. 16A and 16B), or it may be placed at a somewhat further angular distance, where a portion of or the entirety of the hanging arm 914 rests on the plateau 1606, or where the hanging arm 914 reaches incline 1608.

Consider now the situation in Fig. 16B, wherein the hanging arm 914 has reached a point on the surface of the contoured ridge 1006 where incline 1608 begins. Incline 1608 has to be overcome by the application of sufficient force to the dial 420 on the part of the user. Again, the hanging lever 914 begins to turn, which urges the contoured ridge 1006 further downwards. After this somewhat higher resistance is overcome, the resistance presented by the contoured ridge 1006 decreases, but may be partially counterbalanced by an increase in resistance from the spring 726, which is becoming increasingly compressed. During this time (while the hanging arm 914 is in moving contact with incline 1608), the contoured ridge 1006 moves downward and presses down on the piston rod 1102 as has been previously described. After a certain additional angular displacement of the dial, 420 corresponding to the second dosage position (i.e., when the marker 850 is aligned with the second dosage indicator 660B), the surface of the contoured ridge 1006 transitions to plateau 1610. This will be perceived as a sudden falloff in the resistance applied against turning of the dial 420. After a slight amount of additional rotation, the hanging arm 914 hits incline 1612, which is perceived as an increase in the resistance to rotation of the dial 420. The decrease in perceived resistance at the beginning of plateau 1610 and/or the perceived increase in resistance at the end of plateau 1610 (i.e., at the beginning of incline 1612) demonstrate non-limiting examples of tactile feedback capable of signaling to the user that a dosage position has been reached. As previously discussed, if the user is unsure of which dosage position has been reached he or she need simply look at the dial 420 and observe the alignment of the marker 850 with the corresponding dosage indicator, in this case dosage indicator 660B.

The same scenario applies with the third and, and in this case, last dosage position for the dial 420. Once this dosage position has been reached, and the hanging arm 914 reaches plateau 1614, the contoured ridge 1006 presents a wall 1616, which inhibits further angular displacement of the hanging arm 914 and blocks further rotation of the dial 420 under normal usage conditions.

Fig. 18 shows a graph of the force needed to turn the dial at different points along the surface of the contoured ridge 1006, thereby illustrating one non-limiting example of perceptible dosage feedback that can be provided to a user. This force profile (or, equivalently, resistance profile) is of course non-limiting, as other force profiles may occur in other embodiments.

As can be appreciated from Figs. 16A and 16B, the contoured ridge 1006 will undergo a displacement “A” caused by rotation of the outer shell 800 of the dial 420 from the start position to the first dosage position, and will undergo a displacement “B” caused by rotation of the outer shell 800 of the dial 420 from the start position to the second dosage position. These displacements can be directly related to the quantity of fluid that is dispensed during the dispensing cycle in each case (where the dispensing cycle includes a return to the start position). This quantity (volume) of fluid depends substantially on (i) the design of the valve assembly 1100 and (ii) the slopes and arc lengths and total number of the inclines as well as location of the plateaus in the profile of the contoured ridges 1006. Assuming that the design of the valve assembly 1100 is fixed and/or cannot be easily changed, the ability to calibrate the dosages of dispensed fluid rests with the design of the number of inclines, their slopes and their arc lengths as well as the location of the plateaus in the profile of the contoured ridges.

For example, while in the illustration, the inclines appear to have the same slope and the same arc lengths, this need not be the case, particularly if the difference in the dosages corresponding to adjacent pairs of dosage positions is not the same from one adjacent pair to another. Moreover, it is possible that depending on the valve assembly design, the relationship between axial displacement of the piston rod 1102 and the quantity of dispensed fluid is not linear. This would imply that the axial displacement needed to dispense a certain amount of fluid would vary depending on how much fluid was already dispensed. As a result, in such an embodiment, the arc length of different inclines would need to be different, even if the differential amount of dispensed fluid is to be the same. Alternatively, the arc length could be kept the same, but the slope could be made to vary.

People skilled in the art will appreciate that there are design trade-offs in terms of the design of the contoured ridges 1006. In one example of a trade-off, the greater the number of dosage positions to be made available, the smaller the difference in resistance at a transition between an incline and a plateau, meaning that the tactile feedback may be less pronounced. This could lead to a lack of dispensing precision and/or accuracy if too many dosage positions are included in the design. Conversely, designing for a high degree of tactile feedback may curtail the number of dosage positions that can be provided. In another example of a trade-off, it is possible to reduce the resistance presented during rotation of the dial 420 between dosage positions by making the slope of the corresponding incline smaller. This would result in a “smoother” feel during dispensing of the fluid. However, this could also require a significant angular distance to be covered before a particular dosage position is reached, which could be inconvenient for a user when the total required rotation of the dial 420 to reach that dosage position exceeds, say, 90 or 180 degrees. Thus, it may be desirable to limit the total angular distance between the start position and the last attainable dosage position to less than 180 degrees or even 90 degrees or less, such as between 45 and 90 degrees, for example. While in this embodiment, it may be desirable to limit the total angular distance between the start position and the last attainable dosage position to less than 180 degrees, the person of skill will appreciate that other practical implementations may limit the total angular distance between the start position and the last attainable dosage position to another degree value, for example but without being limited thereto, less than 270 degrees, less than 225 degrees, less than 200 degrees, and the like. Also, persons skilled in the art will appreciate that the hanging arm 914 may also be designed to have a different shape so that its interaction with the surface of the contoured ridge 1006 enhances the tactile feedback felt when the dial 420 reaches certain angular distances relative to the start position.

The above described embodiments have shown one example of providing tactile dosage feedback by designing the contacting surfaces of the stem 1000 and the inner shell 900 of the dial 420 to exhibit steps in the resistance against rotation of the dial 420, thereby alerting a user as to when a particular dosage position has been reached. In other embodiments, tactile feedback may be provided in different ways. For example, one may inverse the positions of the contoured edge and the hanging arm, i.e., the contoured edge may appear on the dial 420 and the hanging arm could be an erect arm that emerges from the stem 1000. In other embodiments, both the contoured edge and the hanging arm may be profiled. Still other ways of converting rotational motion of the dial into translational motion of a stem and, ultimately, the piston rod, would be apparent to those of skill in the art. It should be appreciated that in other embodiments, a different form of tactile feedback could be provided.

In still other embodiments, various segments of the surface of the contoured ridge 1006 may include small inclined teeth or nodules, such as at the beginning of—or in lieu of—plateaus 1606, 1610, 1614 that cooperate with the hanging arms 914 in order to provide not only a greater resistance differential immediately before and after a given tooth or nodule is traversed, but also may provide auditory feedback that a dosage position has been reached. Audible feedback may include a snap or click that is caused because of the hanging arm 914 being put under pressure from the inclined tooth / nodule of a particular segment and then such pressure being released as the tooth / nodule is forcibly traversed.

The use of auditory feedback may also be incorporated as a separate feature, to be used in addition to or instead of the tactile feedback (such as would be obtained from the contoured ridges 1006 described earlier). In a non-limiting embodiment, auditory feedback may be provided by snap action. As illustrated in Figs. 6A, 8B and 15, complementary elements are provided on the outer shell 800 of the dial 420 and on the inner surface of the shoulder 600. In this embodiment, the outer shell includes a tongue 1504 and the shoulder 600 optionally includes ribs 1502, 1502A-C. The ribs 1502A-C are spaced apart angularly by the same angular distance as the dosage indicators 660A-C. The ribs 1502A-C and the tongue 1504 are designed so that they are forced into contact with one another when the user rotates the dial 420 and to snap away from each other as a dosage position is reached. It is envisaged that a number of clicks other than 1 may be provided for a particular dosage position.

In the case of auditory feedback, one may choose to design the ribs 1502A-C and the tongue 1504 so that the audible signal emitted by the snap action differs from one dosage position to another, e.g., by making the dosage positions corresponding to higher dosages result in a different (e.g., higher) pitched sound, etc.

The above description has pertained to embodiments where the dosage positions are all located to one side of the start position, namely if the dial is to be turned clockwise to reach a first dosage position from the start position, then the dial is also to be turned clockwise to reach the second dosage position from the start position. This is due to the configuration of the contoured ridges 1006, which can be seen in Fig. 10B to present an abutment 1038 that guards against turning of the hanging arm 914 in the opposite (in this case counter-clockwise) direction from the start position. However, this need not be the case in all embodiments. For example, Fig. 14 shows an embodiment of the stem 1400 in which two contoured ridges 1402, 1404 are provided that allow rotation of the hanging arm 914 (caused by rotation of the outer shell 800 of the dial 420) in both the clockwise and counter-clockwise direction from the start position. In other words, an incline is accessible from the start position, irrespective of the direction of rotation. As such, turning the dial in either direction from the start position starts a dispensing cycle, keeping in mind that depending on the embodiment, actual dispensing of fluid may occur during either or both halves of such dispensing cycle. This type of implementation could allow more flexibility in terms of the number or gradation of dosages of fluid to be dispensed, or may allow greater convenience, depending on whether a user may be more comfortable with one direction of rotation versus another.

In various embodiments, the container 10 may be see-through or opaque. As shown in Figs. 1A and 1B the container 10 is opaque. Fig. 3 shows a variety of containers 300A-300F, each of which may correspond to a different volume of fluid, such as 30 ml, 50 ml, 80 ml, 100 ml, 150 ml and 200 ml. Each of the containers 300A-300F is opaque, and includes a respective translucent fill window 302A-302F of a size (length) that depends on the axial length of the container. The fill window allows an observer to gauge how much fluid is left in the container by observing, for example, a level of the base 718 of the reservoir 18. A given container may include one fill window or more than one window. When two or more windows are provided, pairs of windows may be disposed opposite one another so that there exists a line of sight through the center of the container that goes through the opposite fill windows.

In some embodiments, such as in Fig. 1B, 2 and 4, a cap 90 may optionally be disposed atop the dispenser 14 for purposes of concealment or protection. The cap 90 may have a circular opening defined by a ring of a certain thickness that rests atop a circular ledge 692 (see Figs. 4 and 6B) formed by the shoulder 600. The ledge 692 creates a thin, lowered region at a wider diameter surrounding the upper ring 602 which has a narrower diameter. With proper dimensioning of the outer surface of the upper ring 602 of the shoulder 600 and the inner surface of the opening of the cap 90, the cap 90 can be made to fit snugly to the dispenser 14. In other embodiments, the cap 90 may be a screw-on cap, including for example a child-resistant cap. The cap 90 has an outer surface that may be designed in thickness to be flush with the outer surface of the casing 12 when the cap 90 is mounted to the dispenser 14, which may give a sleek look to the container 10.

With reference to Fig. 20, a further non-limiting embodiment of a possible profile of a contoured ridge is shown. The contoured ridge may be one of a plurality of contoured ridges 2006 similar to the contoured ridges 1006 in Figs 10B except that there are no intermediate plateaus, i.e., the contoured ridges 2006 may present a steady incline. As a result, the resistance to turning the dial that is provided by the interface between the hanging arms 914 and the contoured ridges 2006 may be continuous, linear or even constant, but in this embodiment does not undergo sudden drops or increases. As such, there may be little or no tactile or audible feedback provided by the contoured ridges 2006 as the dial 420 is turned. Rather, in this embodiment, and with additional reference to Figs. 19 and 21, tactile (and possibly also audible) feedback during rotation of the dial is provided by ribs 1502, 1902 provided on the shoulder 1900 (which is similar to the shoulder 600).

In particular, ribs 1502 provide first tactile feedback when a certain dosage is about to be reached and ribs 1902 provide second tactile feedback when the certain dosage has been reached. The first and/or second tactile feedback may be accompanied by audible feedback too. The first tactile feedback may be offer a different resistance to turning the dial 420 than the second tactile feedback. This may be due to the shape or size of ribs 1502 being different form the shape or size of ribs 1902. Ribs 1502 may thus function to alert the user to the fact that a certain dosage is about to be reached, while ribs 1902 may function to alert the user to the fact that this dosage has been reached. In other embodiments, only ribs 1902 may be provided.

Finally, when it comes to the final dosage position, and therefore the last dosage position for the dial 420, the contoured ridge 2006 presents the aforementioned wall 1616, which inhibits further angular displacement of the hanging arm 914 and blocks further rotation of the dial 420 under normal usage conditions.

Fig. 22 shows a graph of the rotational force that a user would need to exert on the dial 420 in order to turn it, for different points along the surface of the contoured ridge 2006, thereby illustrating a further non-limiting example of perceptible dosage feedback that can be provided to a user. It is seen that each of the first peak is caused by one of the ribs 1502 just prior to a certain dosage position being reached, while a corresponding one of the second peaks is caused by the corresponding one of the ribs 1902 once the certain dosage position has been reached and the correct dosage of fluid has been dispensed. In this embodiment, the second peaks have a greater magnitude than the first peaks, but this could be designed to be the contrary. This force profile (or, equivalently, resistance profile) is again to be taken as non-limiting, as other force profiles may occur in other embodiments.

The non-limiting embodiment shown in the Figures only illustrates specific practical examples in which a person of skill may use the concept presented in the present document in order to provide dispensing containers for fluids such as creams and ointments. Other practical implementations may be possible. For example, while the dispenser illustrated in the Figures includes one egress port, a dispenser including a plurality of egress ports can also be contemplated in alternative implementations. For instance, it will be apparent to the person of skill that a dispenser with a plurality of egress ports can be advantageous when dispensing a fluid having an increased viscosity. In another example, it will be apparent to the person of skill that, in specific practical implementations, the dial can serve as direct or indirect topical applicator to a user's skin. It will also be apparent that at least a portion of the surface of the dial can be made of a material which may vary according to an intended application. In another example, It will also be apparent that the dispensing container may be configured so as to include a structural "no touch" application surface, for example a pad, that may allow for hygienic, localized application of the dispensed fluid to a therapeutic area on the user.

Thus, there has been described a method that includes guiding a user's rotation of a dispenser actuator dial from a start position to a first dosage position, the dial covering a first angular displacement between the start positon and the first dosage position, the first dosage position corresponding to the smallest volume of fluid that can be dispensed by the dispenser, and then guiding the user's further rotation of the dial from the first dosage position to an adjacent dosage position, the dial covering a second angular displacement between the first dosage position and the adjacent dosage position, the adjacent dosage position corresponding to the next smallest volume of fluid that can be dispensed by the dispenser, the first and second angular displacements being different, whereby perceptible feedback is provided when each of the first and next dosage positions of the dial has been reached.

It will be understood by those of skill in the art that throughout the present specification, the term "a" or "an" used before a term encompasses embodiments containing one or more to what the term refers. It will also be understood by those of skill in the art that throughout the present specification, the term "comprising", which is synonymous with "including," "containing," or "characterized by," is inclusive or open-ended and does not exclude additional, un-recited elements or method steps.

Certain adaptations and modifications of the described embodiments can be made. Therefore, the above discussed embodiments are to be considered illustrative and not restrictive. Also it should be appreciated that additional elements that may be needed for operation of certain embodiments of the present invention have not been described or illustrated as they are assumed to be within the purview of the person of ordinary skill in the art. Moreover, certain embodiments of the present invention may be free of, may lack and/or may function without any element that is not specifically disclosed herein.

CLAIMS

1. A fluid dispenser, comprising:
   - an actuator with a rotatable dial;
   - a valve assembly connected to the actuator, the valve assembly being configured so as to cause fluid to be drawn from a reservoir and released from the dispenser during at least part of the time when the dial is rotated from a start position to one of a plurality of dosage positions and back to the start position, the plurality of dosage positions being at different respective angular positions of the dial;
   - the actuator being configured to provide perceptible feedback at each of the plurality of dosage positions.
2. The fluid dispenser defined in claim 1, wherein the actuator includes a stem held within a housing that allows axial displacement of the stem while restricting rotational motion of the stem and that allows rotational motion of the dial while restricting axial displacement of the dial, wherein the stem and the dial have respective contacting surfaces that are profiled so as to urge the stem axially upon rotation of the dial.
3. The fluid dispenser defined in claim 2, wherein the respective contacting surfaces are profiled to include a plurality of segments associated with corresponding ones of the dosage positions.
4. The fluid dispenser defined in claim 1, wherein providing the perceptible feedback comprises providing tactile feedback to a user of the dial.
5. The fluid dispenser defined in claim 1, wherein providing the perceptible feedback comprises providing a resistance to rotation of the dial that peaks when the dial reaches one of the dosage positions.
6. The fluid dispenser defined in claim 1, wherein providing the perceptible feedback comprises providing a resistance to rotation of the dial that undergoes first peaks prior to the dial reaching respective ones of the dosage positions and second peaks when the dial reaches said respective ones of the dosage positions.
7. The fluid dispenser defined in claim 6, wherein the second peaks have a greater magnitude than said first peaks.

8. The fluid dispenser defined in claim 1, the actuator being further configured to provide auditory feedback at one or more of the plurality of dosage positions.

9. The fluid dispenser defined in claim 8, wherein the actuator includes a housing that allows rotational motion of the dial and restricts axial displacement of the dial, the housing and the dial including corresponding contacting surfaces that are profiled so as to produce an audible snap during rotation of the dial as each dosage position is reached.

10. The fluid dispenser defined in claim 1, the actuator being further configured to provide said tactile feedback without providing audible feedback at any of the dosage positions.

11. The fluid dispenser defined in claim 1, wherein the dial undergoes a first movement when the dial is rotated from the start position to a given one of the dosage positions and a return movement when the dial is rotated from the given one of the dosage positions back to the start position, wherein the valve assembly is configured so as to cause fluid to be released from the dispenser during the time that the dial undergoes the return movement and not during the time that the dial undergoes the first movement.

12. The fluid dispenser defined in claim 1, wherein the dial undergoes a first movement when the dial is rotated from the start position to a given one of the dosage positions and a return movement when the dial is rotated from the given one of the dosage positions back to the start position, wherein the valve assembly is configured so as to cause fluid to be released from the dispenser during the time that the dial undergoes the first movement and not during the time that the dial undergoes the return movement.

13. The fluid dispenser defined in claim 1, wherein the dial undergoes a first movement when the dial is rotated from the start position to a given one of the dosage positions and a return movement when the dial is rotated from the given one of the dosage positions back to the start position, wherein the valve assembly is configured so as to cause fluid to be released from the dispenser during the time that the dial

undergoes the first movement and also during the time that the dial undergoes the return movement.

14. The fluid dispenser defined in claim 1, wherein at least one of the dosage positions is reached when the dial is rotated clockwise from the start position and wherein at least another one of the dosage positions is reached when the dial is rotated counter-clockwise from the start position.

15. The fluid dispenser defined in claim 1, wherein the dosage positions are predetermined and built into the dispenser.

16. The fluid dispenser defined in claim 1, wherein the plurality of dosage positions includes at least three dosage positions.

17. The fluid dispenser defined in claim 1, wherein the plurality of dosage positions includes at least three dosage positions corresponding to respective dosages one of which is the smallest dosage and the others being larger dosages, at least one of the larger dosages not being a multiple of the smallest dosage.

18. The fluid dispenser defined in claim 1, wherein the actuator comprises an egress port through which the fluid is released from the dispenser.

19. The fluid dispenser defined in claim 18, wherein the egress port is disposed on the dial.

20. The fluid dispenser defined in claim 19, wherein the egress port is a first egress port of a plurality of egress ports.

21. The fluid dispenser defined in claim 1, wherein the valve assembly comprises a piston that reciprocates axially to draw the fluid from a reservoir and push the fluid out through an egress port of the fluid dispenser.

22. The fluid dispenser defined in claim 21, wherein the actuator comprises a stem, wherein the piston is moved in one axial direction by the stem that exhibits displacement in said one axial direction in response to rotation of the dial in one rotational direction.

23. The fluid dispenser defined in claim 22, further comprising a biasing element that is compressed by motion of the piston in said one axial direction.

24. The fluid dispenser defined in claim 23, wherein the piston is moved in an opposite axial direction by force of decompression of the biasing element upon motion of the stem in the opposite axial direction in response to rotation of the dial in an opposite rotational direction.

25. The fluid dispenser defined in claim 23, wherein the piston is moved in an opposite axial direction by force of decompression of the biasing element, the force of decompression being sufficiently strong so as to urge the stem in the opposite axial direction and cause rotation of the dial in an opposite rotational direction back to the start position in an absence of user manipulation of the dial.

26. The fluid dispenser defined in claim 21, further comprising a chamber, wherein the valve assembly provides airless suction of fluid from a reservoir into the chamber and from the chamber to an egress port of the dispenser via the piston.

27. An actuator for a fluid dispenser, comprising:

- a housing attachable to a mouth of a container;
- a dial rotatably mounted to the housing, the dial including an egress port;
- a stem mounted to the housing and attachable to a valve assembly for releasing fluid from the container through the egress port of the dial, the housing configured to permit axial displacement of the stem relative to the housing while blocking rotational motion of the stem relative to the housing;
- the dial and the stem having respective contacting surfaces which are configured to urge the stem to undergo axial motion as the dial is rotated;
- the surfaces being further configured to provide perceptible feedback at a plurality of angular displacements of the dial.

28. The actuator defined in claim 27, wherein the stem or the housing comprises at least one projection disposed about a periphery thereof and wherein the other of the stem and the housing comprises at least one elongated axially oriented recess disposed

about a periphery thereof, wherein the stem is mounted to the housing so that the projections enter the recesses, thereby locking the stem from rotational motion relative to the housing while allowing axial motion of the stem relative to the housing.

29. The actuator defined in claim 27, wherein the housing is configured to block axial motion of the dial relative to the housing.

30. The actuator defined in claim 27, the housing comprising a shoulder and a body, the body being mountable to the mouth of the container and defining a cylindrical region with an outer surface and certain radial thickness, the shoulder defining a cylindrical region with an inner surface having a diameter that has a first diameter at a first axial distance and a second, smaller diameter at a second axial distance, the dial comprising a lip at an exterior periphery of the dial, the lip being blocked from movement in one axial direction by the cylindrical region of the shoulder having the second diameter and being blocked from movement in an opposite axial direction by the cylindrical region of the body having the certain radial thickness.

31. The actuator defined in claim 27, wherein the dial comprises an exterior surface that is textured around at least a portion of a periphery thereof thereby to facilitate gripping of the dial by a user.

32. The actuator defined in claim 27, wherein the contacting surfaces of the dial and the stem are profiled so as to block rotational motion of the dial after the dial has covered one of the angular displacements that is furthest from a start position.

33. The actuator defined in claim 27, wherein the contacting surfaces of the dial and the stem are profiled so as to block rotational motion of the dial after the dial has covered a certain angular displacement relative to a start position.

34. The actuator defined in claim 33, wherein the certain angular displacement is less than 180 degrees.

35. The actuator defined in claim 34, wherein the certain angular displacement is about 90 degrees.

36. The actuator defined in claim 34, wherein the certain angular displacement is between 90 and 180 degrees.

37. The actuator defined in claim 34, wherein the certain angular displacement is between 45 and 90 degrees.

38. The actuator defined in claim 27, wherein the perceptible feedback is indicative of a corresponding dosage position having been reached.

39. The actuator defined in claim 27, wherein the perceptible feedback is indicative of a corresponding dosage position just about to be reached.

40. The actuator defined in claim 27, wherein the perceptible feedback includes first perceptible feedback indicative of a corresponding dosage position just about to be reached and second perceptible feedback indicative of the corresponding dosage position having been reached.

41. The actuator defined in claim 27, wherein the plurality of angular displacements include a first angular displacement and a second angular displacement, the first angular displacement being the smallest one of the angular displacements, the second angular displacement being the next smallest one of the angular displacements, wherein the second angular displacement is not twice the first angular displacement.

42. A dispensing container, comprising:

- a casing defining a longitudinal axis;
- a reservoir disposed within an interior of the casing and movable along the longitudinal axis of the casing, the reservoir capable of holding fluid to be dispensed;
- a fluid dispenser mounted to the casing and to the reservoir, the fluid dispenser being configured so as to cause fluid to be drawn from the reservoir and released towards an exterior of the container via the dispenser during at least part of the time when an element of the dispenser is angularly moved from a start position to one of a plurality of dosage positions and back to the start position, the plurality of dosage positions being at different respective angular positions of the dial;
- the dispenser being configured to provide perceptible feedback at each of the plurality of dosage positions.

43. The container defined in claim 42, wherein the fluid dispenser is adapted for mounting either to a first casing having a reservoir capable of holding a first volume of fluid, or to a second casing having a reservoir capable of holding a second volume of fluid, said first volume of fluid and second volume of fluid being different one from the other.

44. The container defined in claim 42, wherein the fluid dispenser comprises an egress port through which fluid exiting the container is dispensed.

45. The container defined in claim 44, wherein the egress port is a first egress port of a plurality of egress ports.

46. The container defined in claim 42, wherein the casing is hollow and cylindrical.

47. The container defined in claim 42, wherein the casing comprises a longitudinally oriented fill window to allow a level of fluid in the reservoir to be visually observed from an exterior of the container.

48. The container defined in claim 42, wherein the casing comprises a bottom that includes at least one opening to allow pressure equalization between the interior of the casing and an environment of the container.

49. A method, comprising:

- guiding rotation of a dispenser actuator dial from a start position to a first dosage position, the dial covering a first angular displacement between the start positon and the first dosage position, the first dosage position corresponding to the smallest volume of fluid that can be dispensed by the dispenser;
- guiding further rotation of the dial from the first dosage position to an adjacent dosage position, the dial covering a second angular displacement between the first dosage position and the adjacent dosage position, the adjacent dosage position corresponding to the next smallest volume of fluid that can be dispensed by the dispenser, the first and second angular displacements being different; and
- providing perceptible feedback when each of the first and next dosage positions of the dial has been reached.

50. The method defined in claim 49, further comprising:

- guiding rotation of the dial back to the start position.

51. The method defined in claim 49, further comprising:

- dispensing a volume of fluid that corresponds to a selected dosage position reached by the dial during at least part of a trajectory from the start position to the selected dosage position and back to the start position, the selected position being the furthest dosage position reached when rotating the dial.

52. The method defined in claim 49, wherein the first angular displacement is about half of the second angular displacement.

53. The method defined in claim 49, wherein the first angular displacement is less than half of the second angular displacement.

54. The method defined in claim 49, wherein the first angular displacement is about twice the second angular displacement.

55. The method defined in claim 49, wherein the first angular displacement is at least twice the second angular displacement.

56. The method defined in claim 49, further comprising:

- blocking the dial when an angular displacement has reached a maximum angular displacement.

57. The method defined in claim 56, wherein the maximum angular displacement is about 90 degrees.

58. The method defined in claim 57, wherein the maximum angular displacement is between 90 and 180 degrees.

59. The method defined in claim 58, wherein a ratio of (i) a volume of fluid dispensed when the selected dosage position corresponds to a first total angular displacement relative to the start position to (ii) a volume of fluid dispensed when the selected dosage position corresponds to a second total angular displacement relative to a start position is equal to a ratio of the first total angular displacement to the total second angular displacement.

60. The method defined in claim 59, wherein a ratio of (i) a volume of fluid dispensed when the selected dosage position corresponds to a first total angular displacement relative to the start position to (ii) a volume of fluid dispensed when the selected dosage position corresponds to a second total angular displacement relative to a start position is not equal to a ratio of the first total angular displacement to the total second angular displacement.

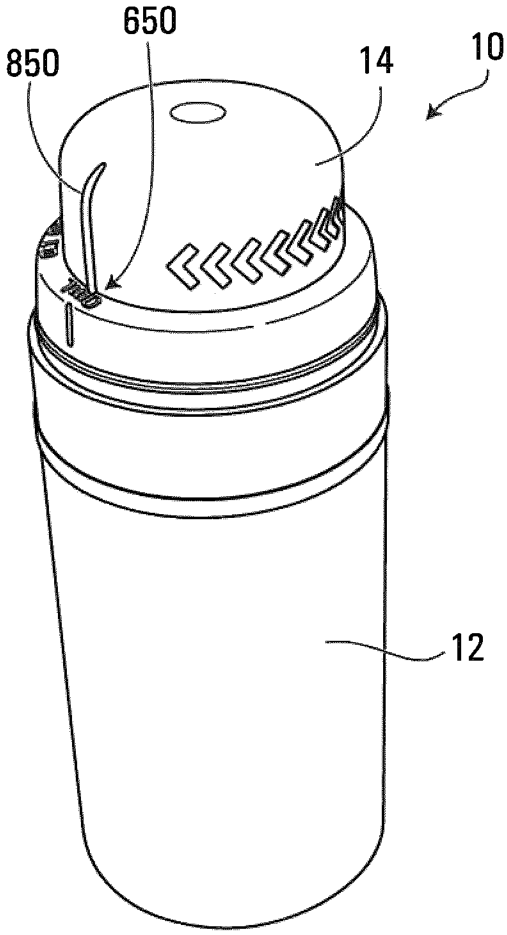


FIG. 1A

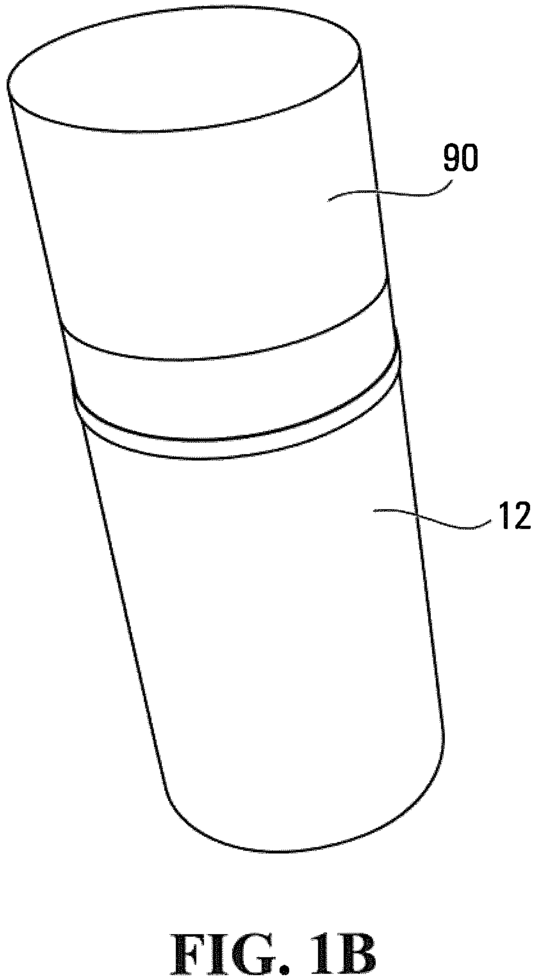


FIG. 1B

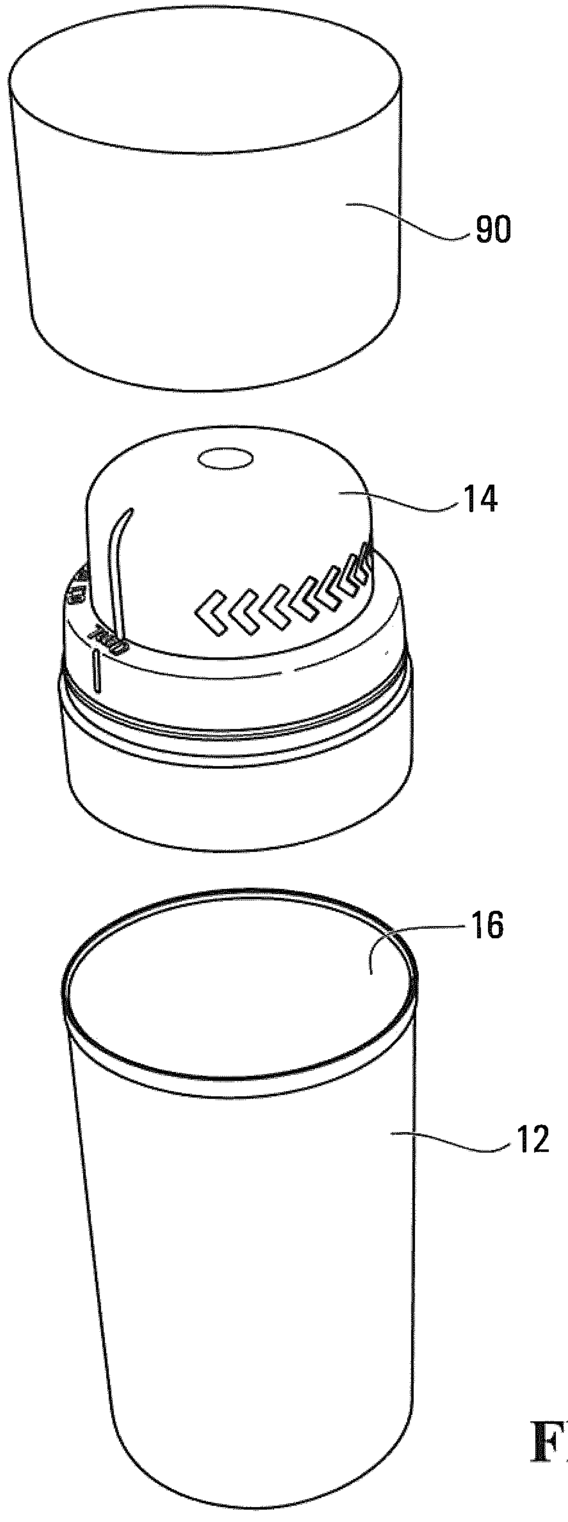
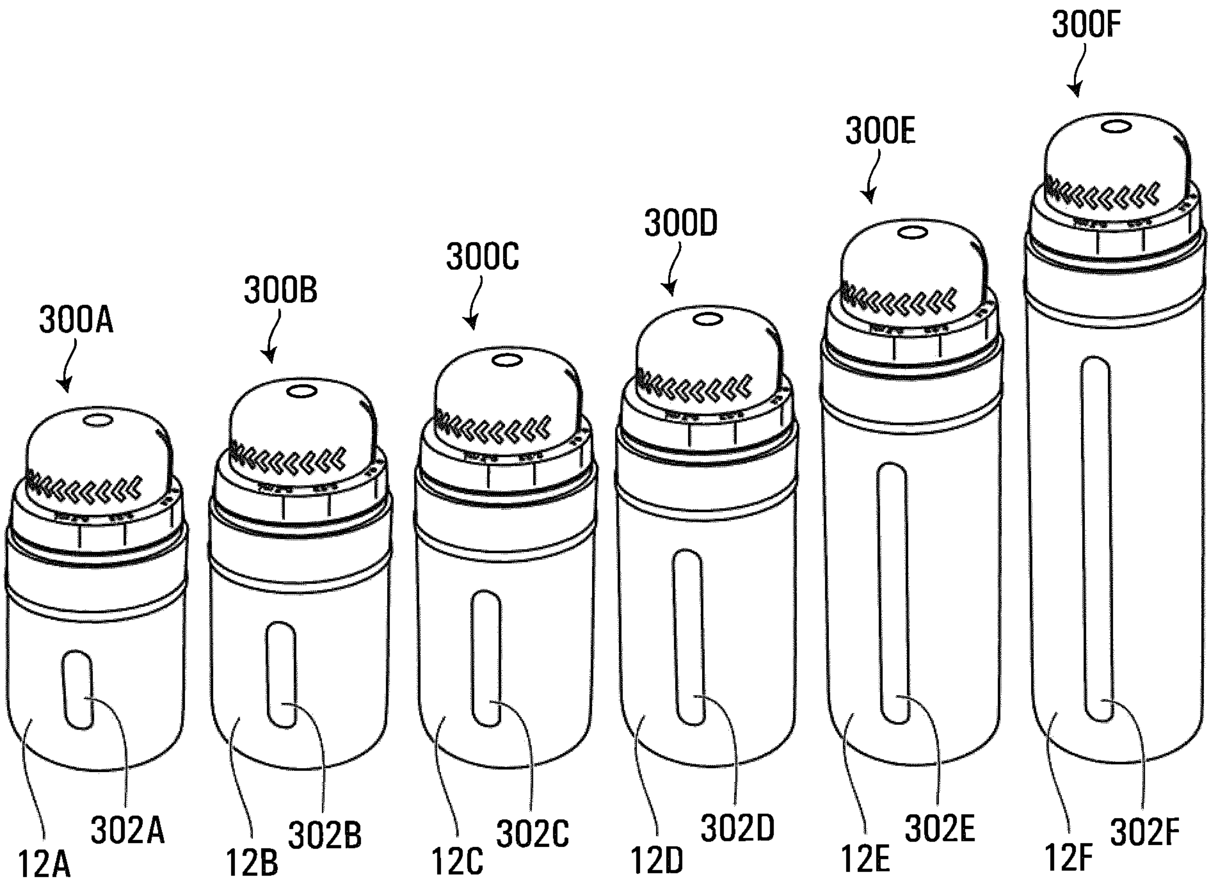


FIG. 2


300A
300B
300C
300D
300E
300F
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302A
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302B
12C
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12D
302D
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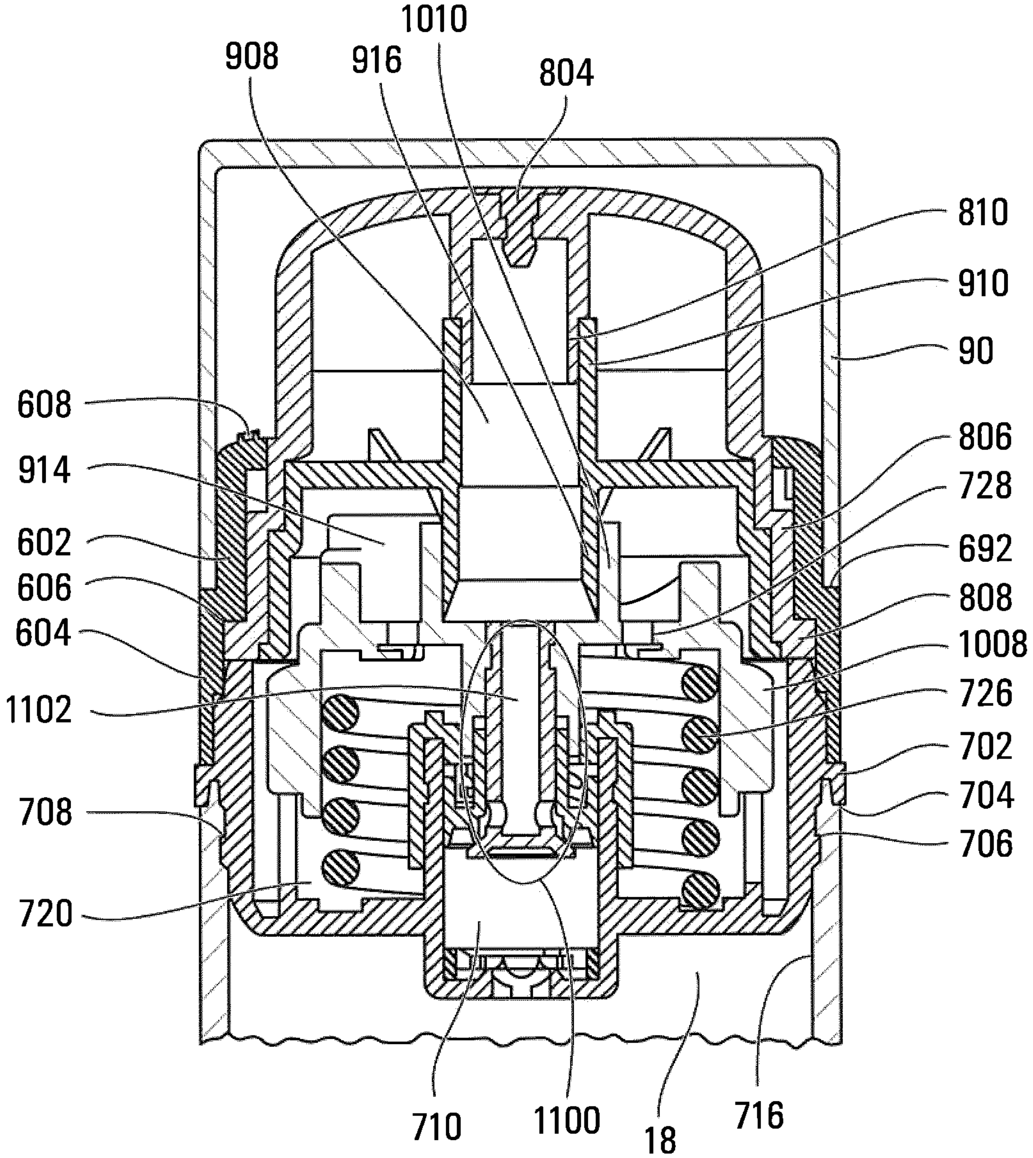
302E
12F
302F

FIG. 3



1010
908
916
804
810
910
90
608
806
914
728
602
692
606
808
604
1008
726
1102
702
704
708
706
720
710
1100
18
716

FIG. 4

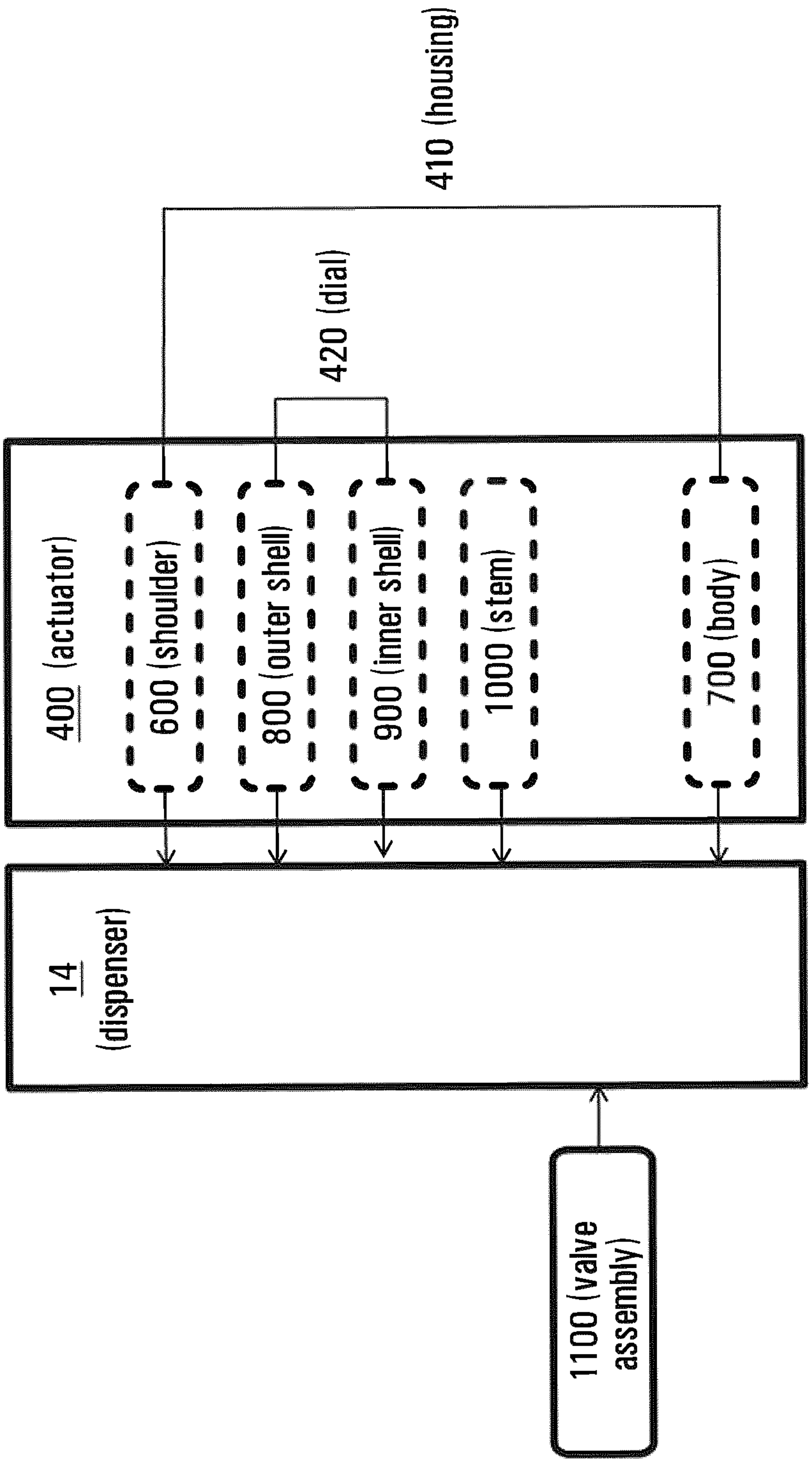

410 (housing)
420 (dial)
400 (actuator)
600 (shoulder)
800 (outer shell)
900 (inner shell)
1000 (stem)
700 (body)
14 (dispenser)
1100 (valve assembly)

FIG. 5

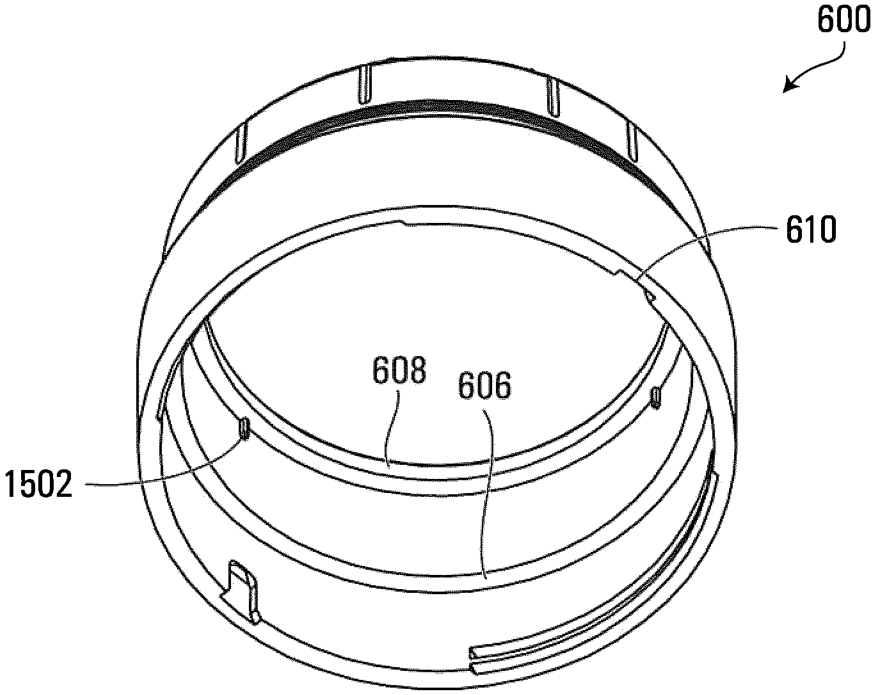


FIG. 6A

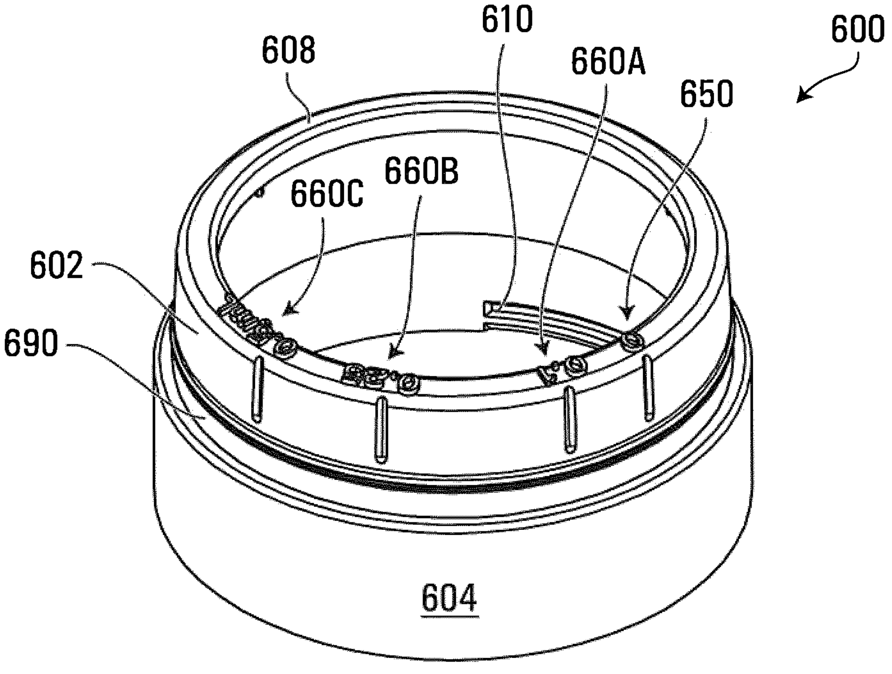


FIG. 6B

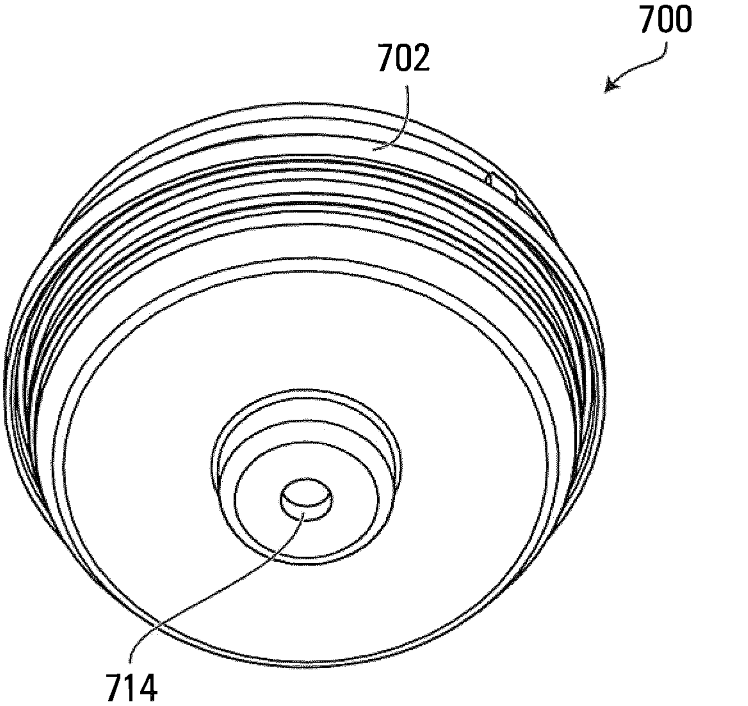


FIG. 7A

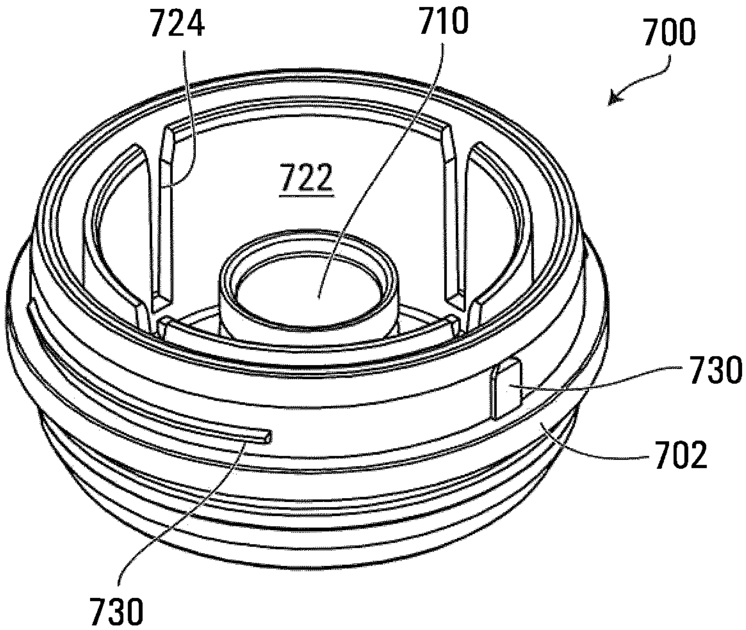


FIG. 7B

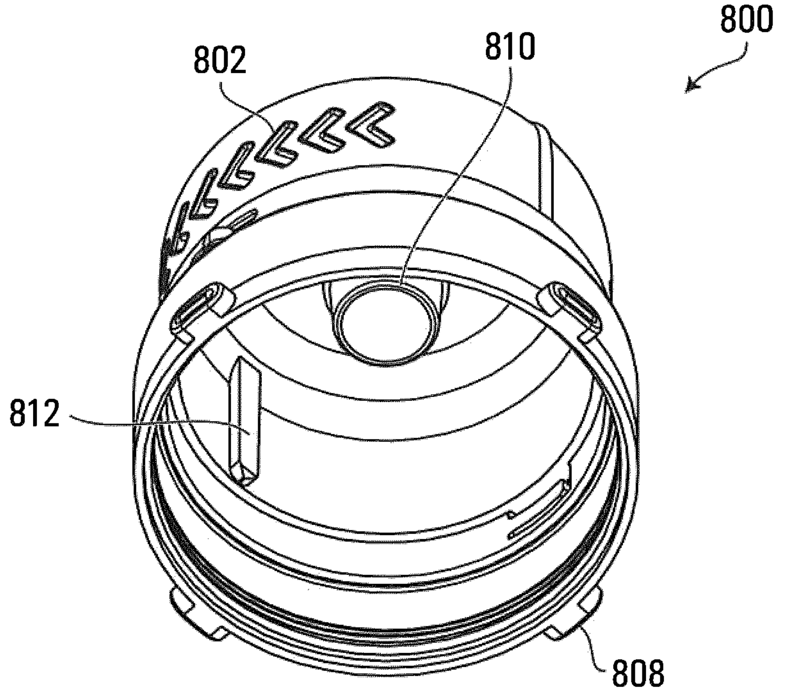


FIG. 8A

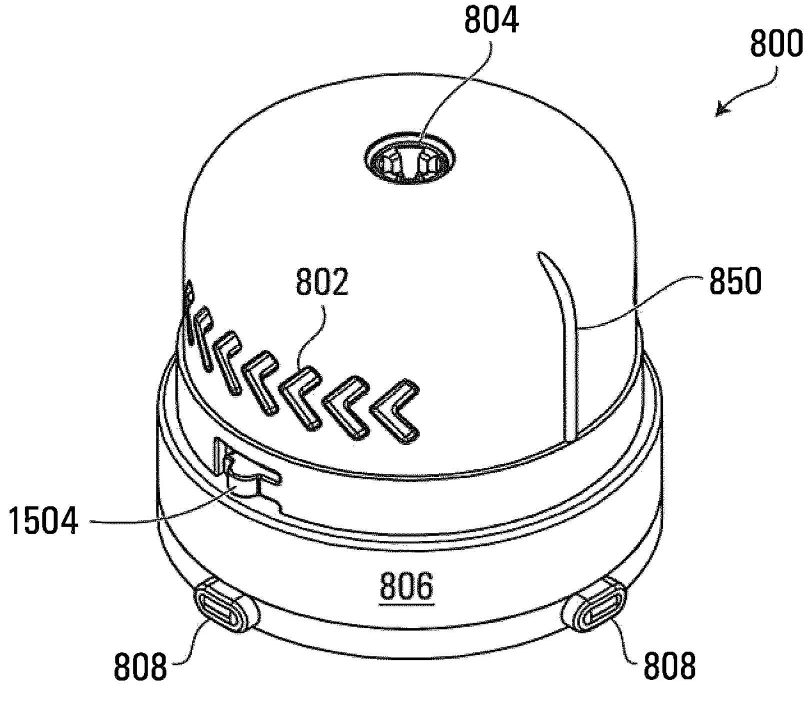


FIG. 8B

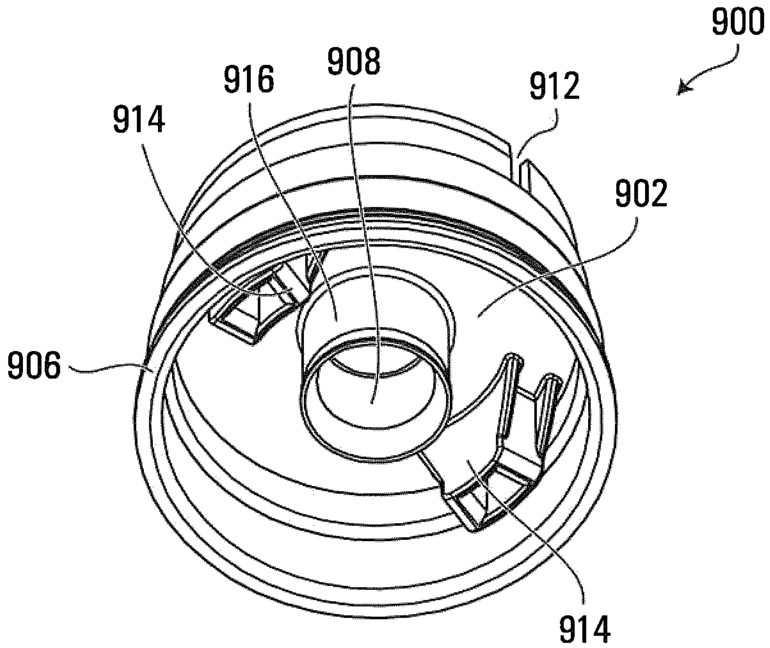


FIG. 9A

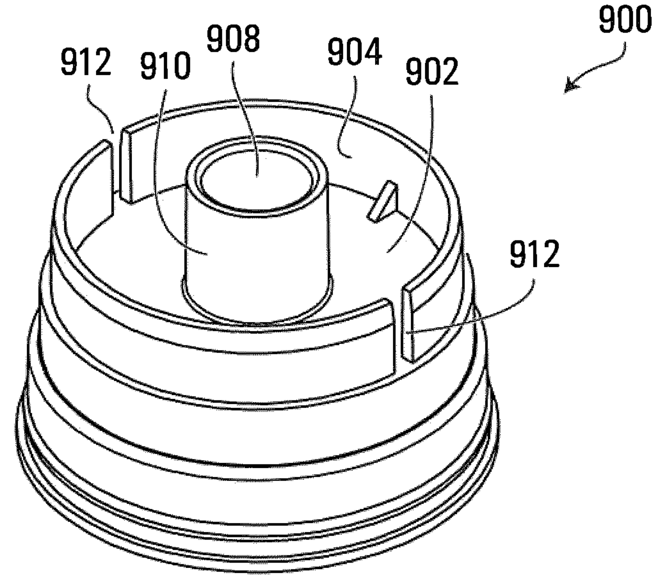


FIG. 9B

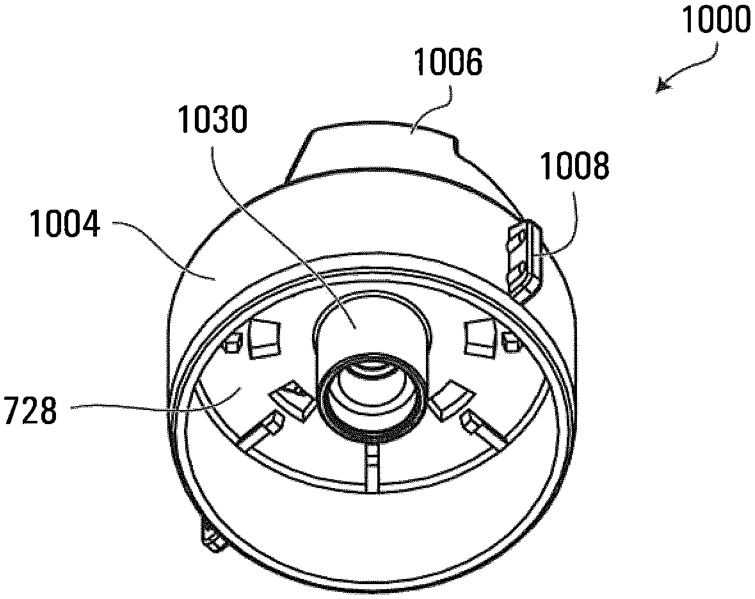


FIG. 10A

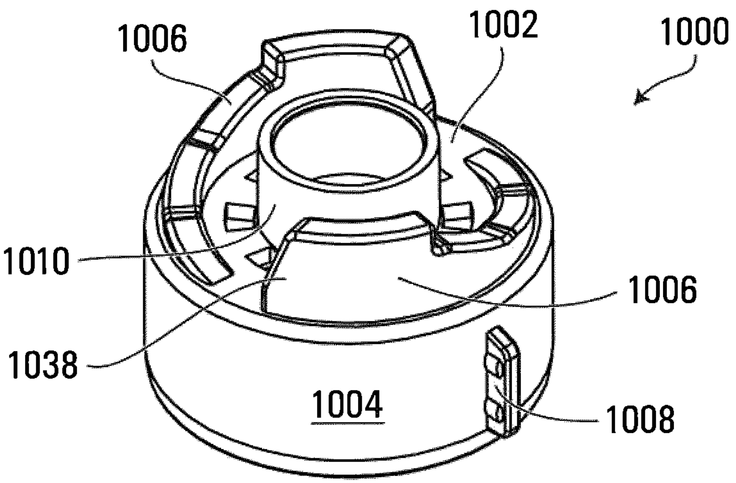
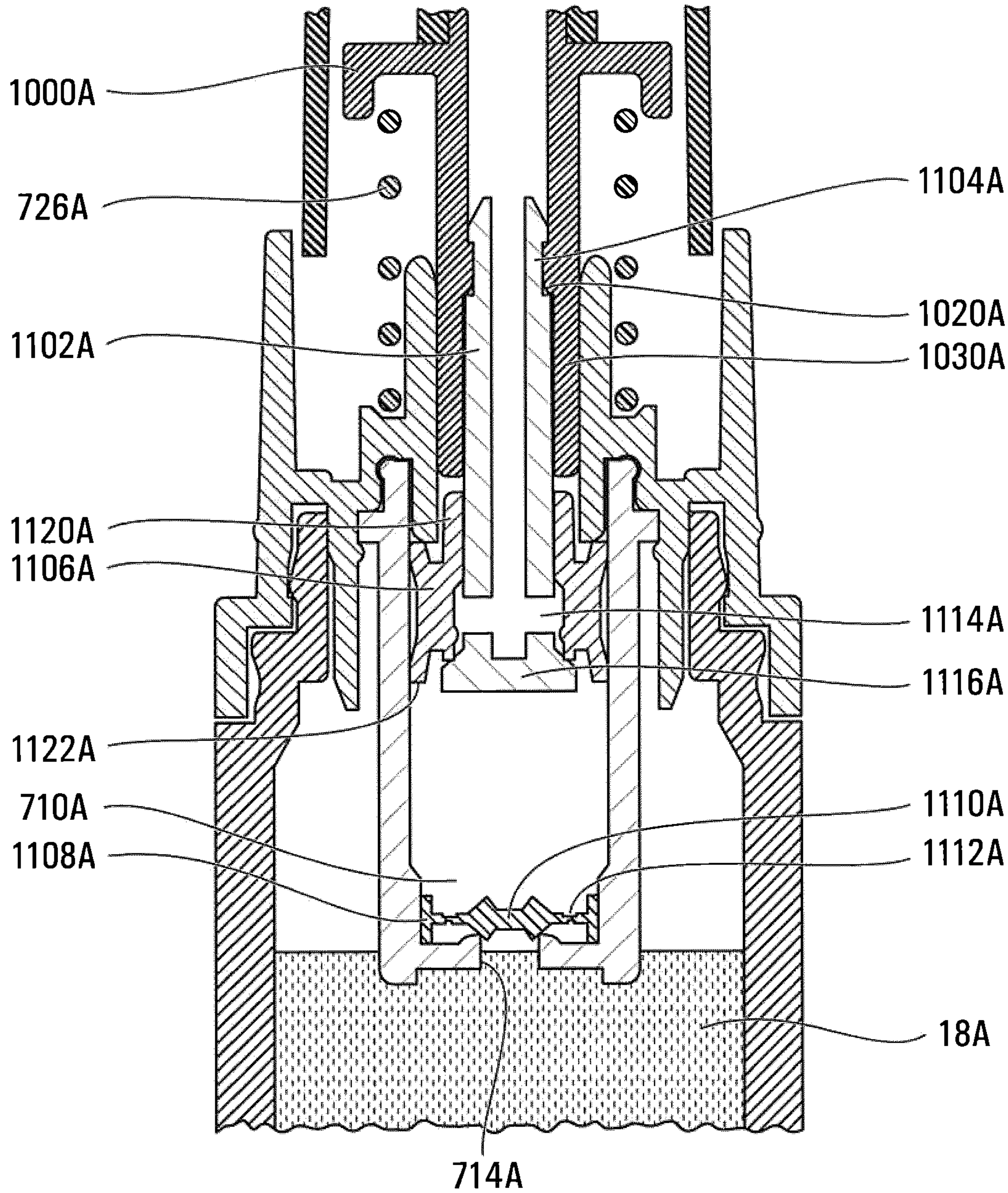


FIG. 10B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1120A
1106A
1122A
710A
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1104A
1020A
1030A
1114A
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18A
714A

FIG. 11

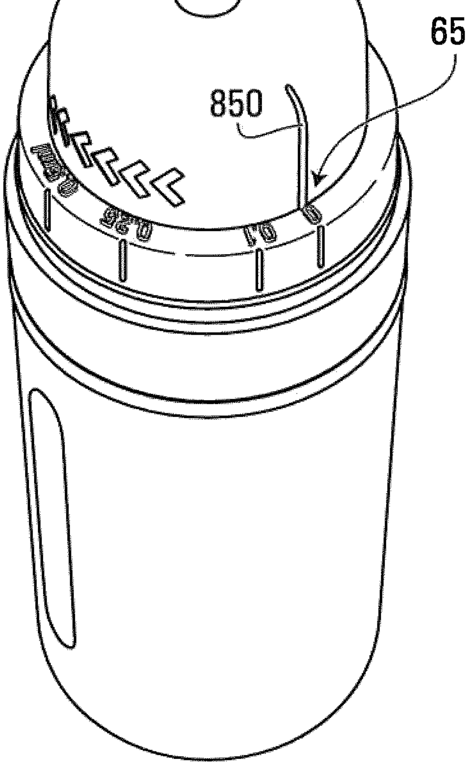


FIG. 12A

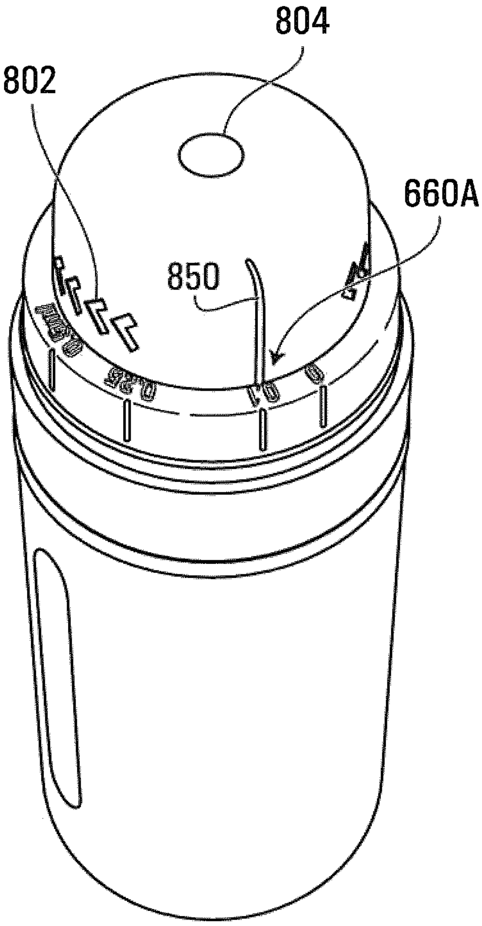


FIG. 12B

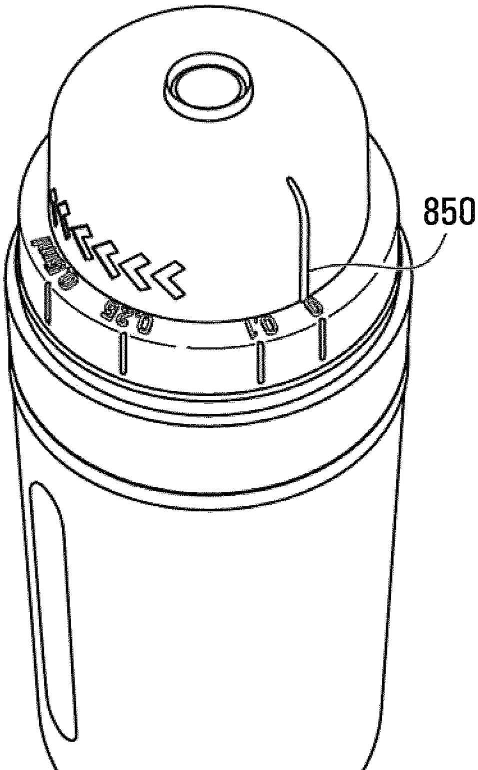


FIG. 12C

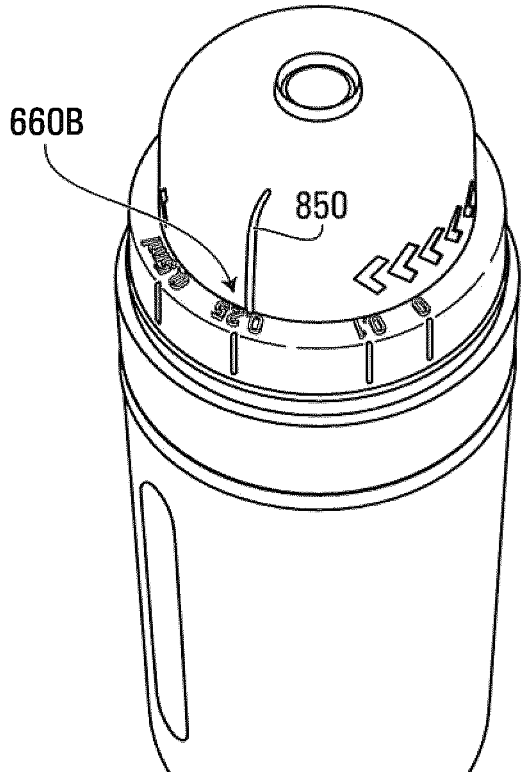


FIG. 12D

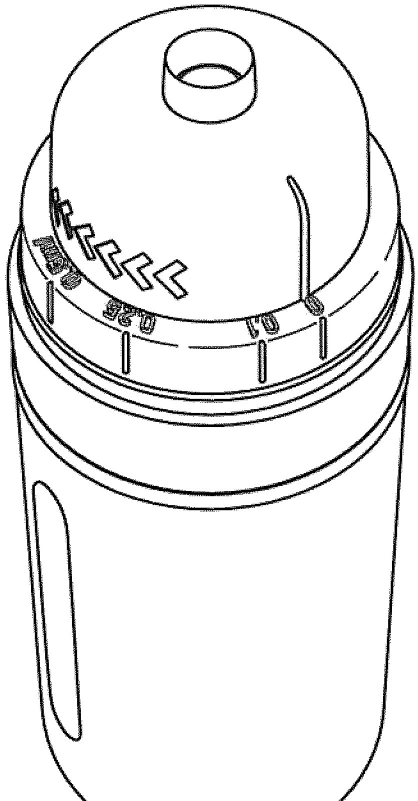
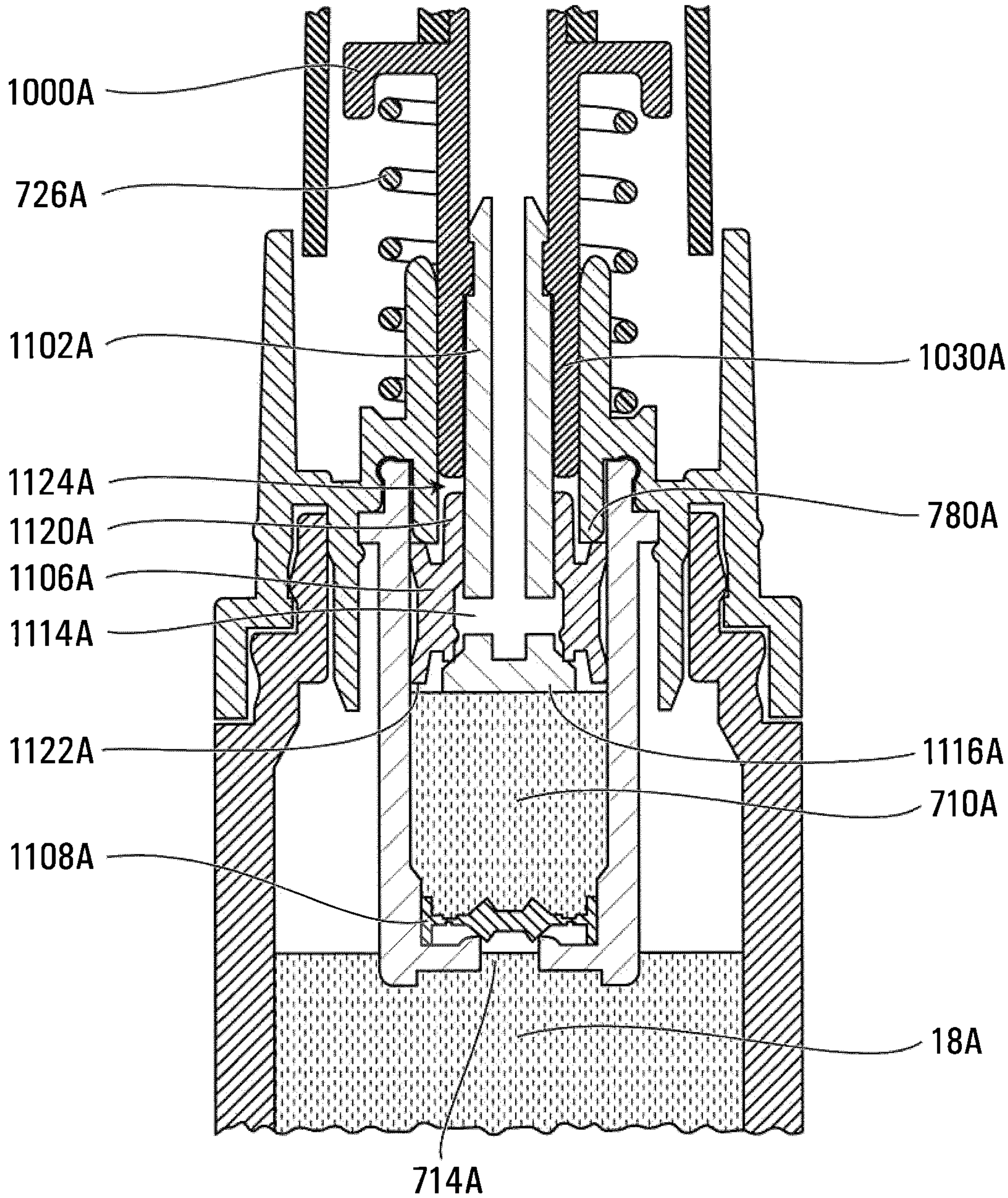


FIG. 12E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18A
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FIG. 13A

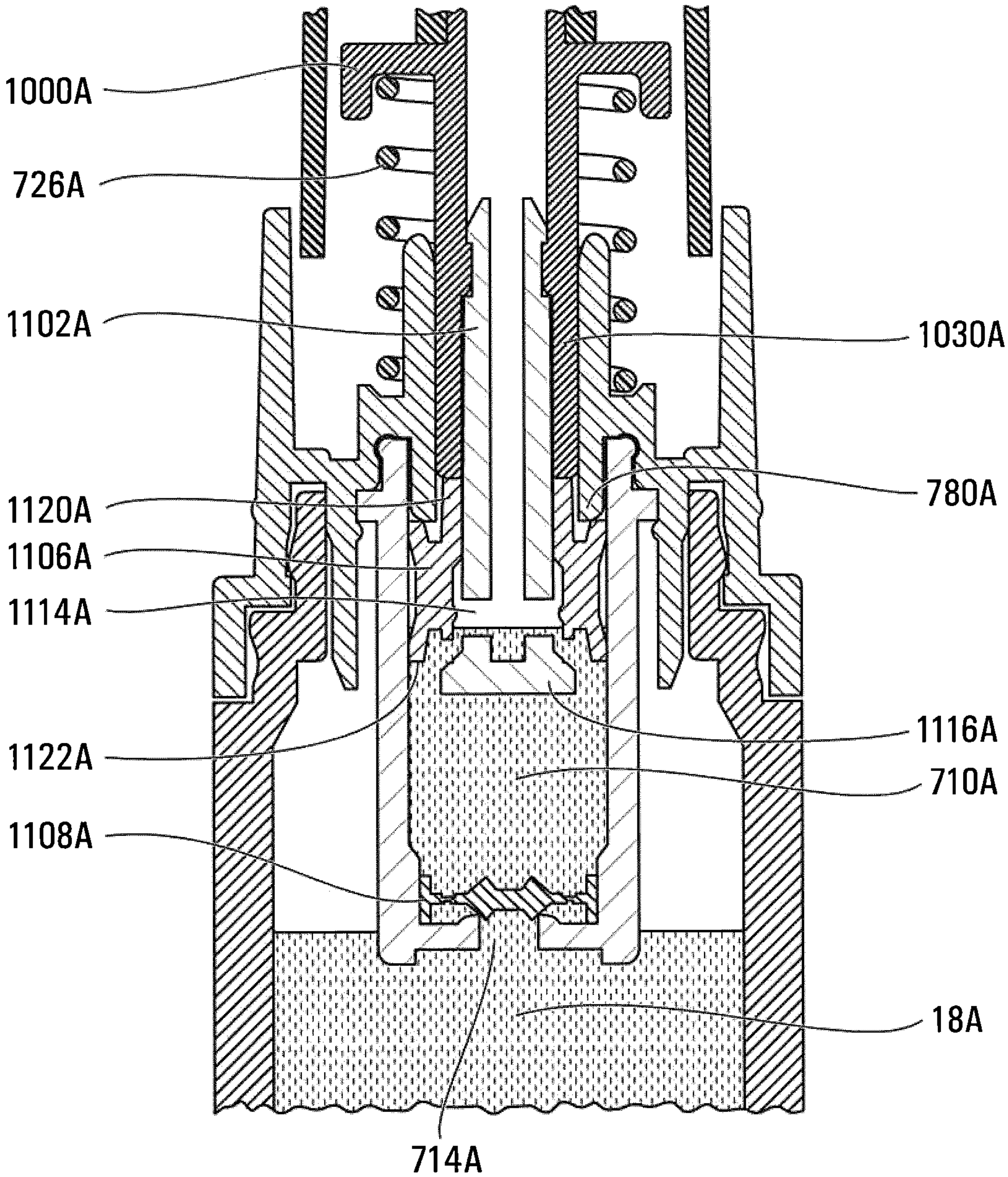
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FIG. 13B

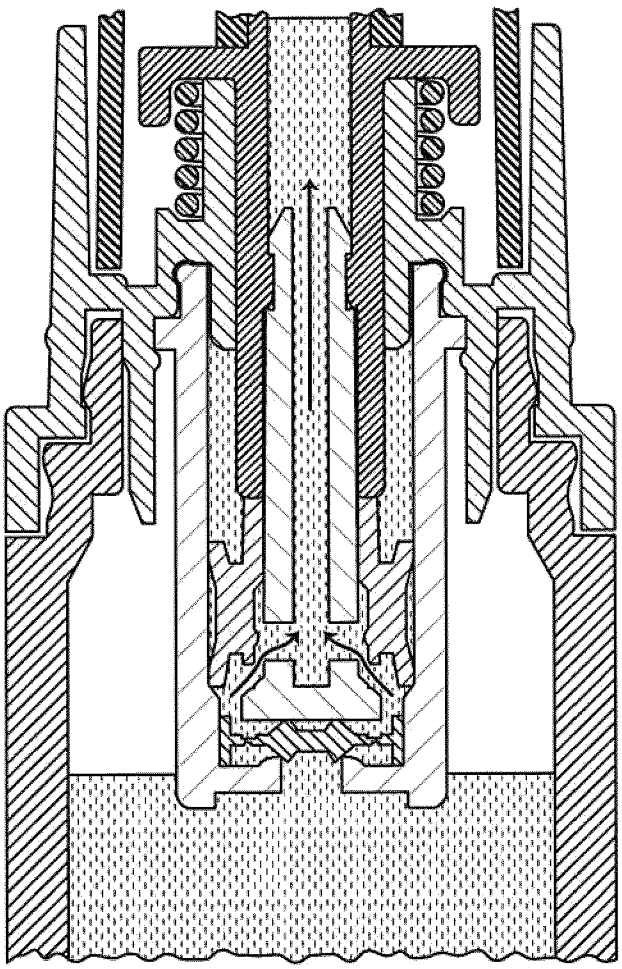
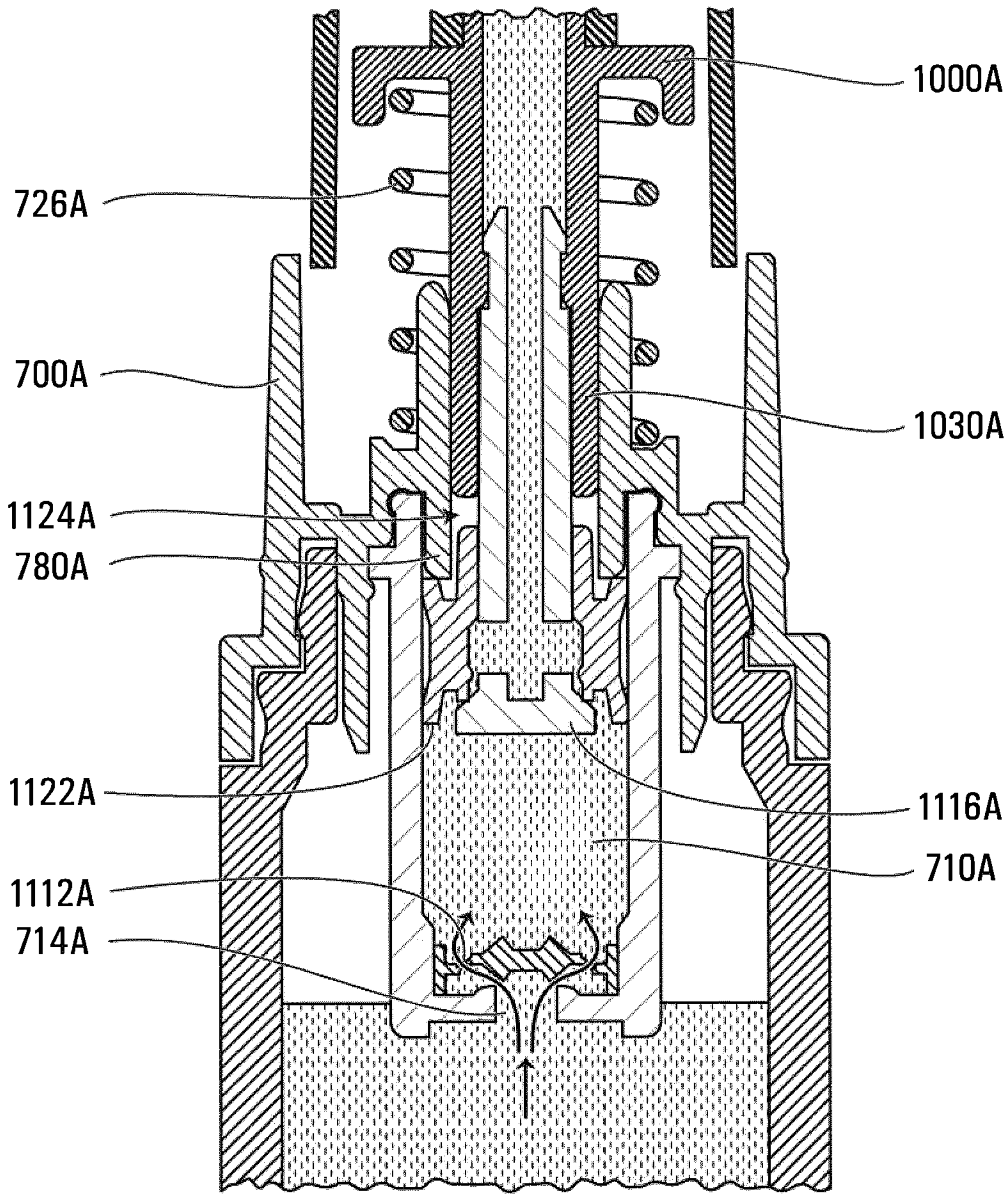


FIG. 13C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714A

FIG. 13D

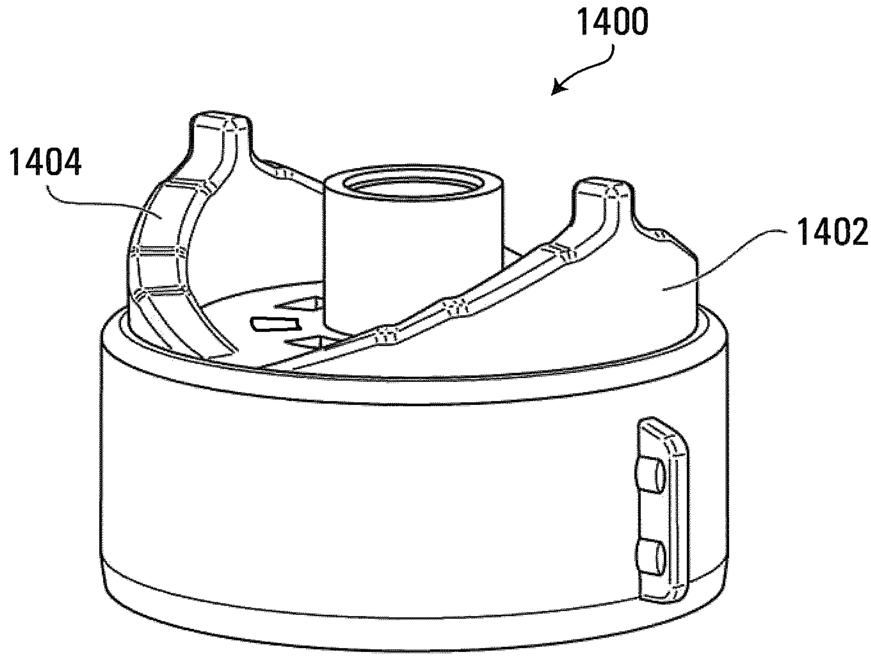


FIG. 14

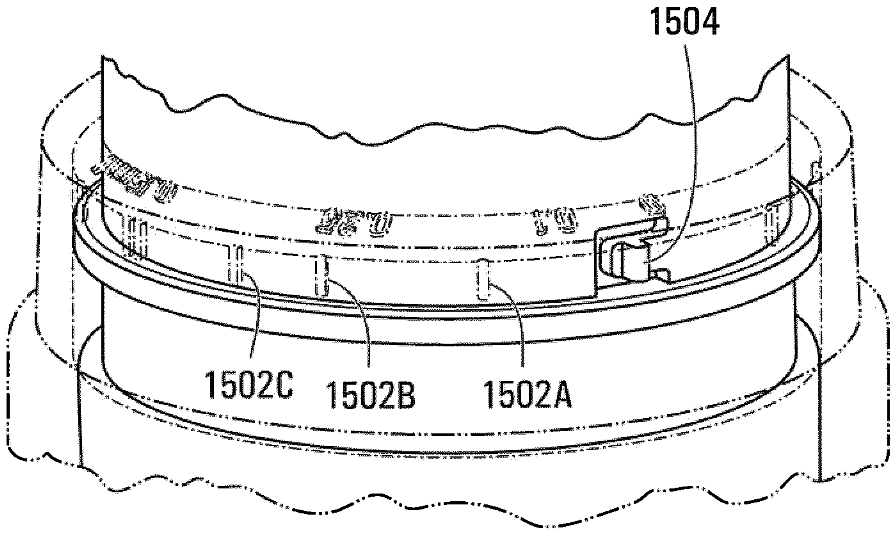
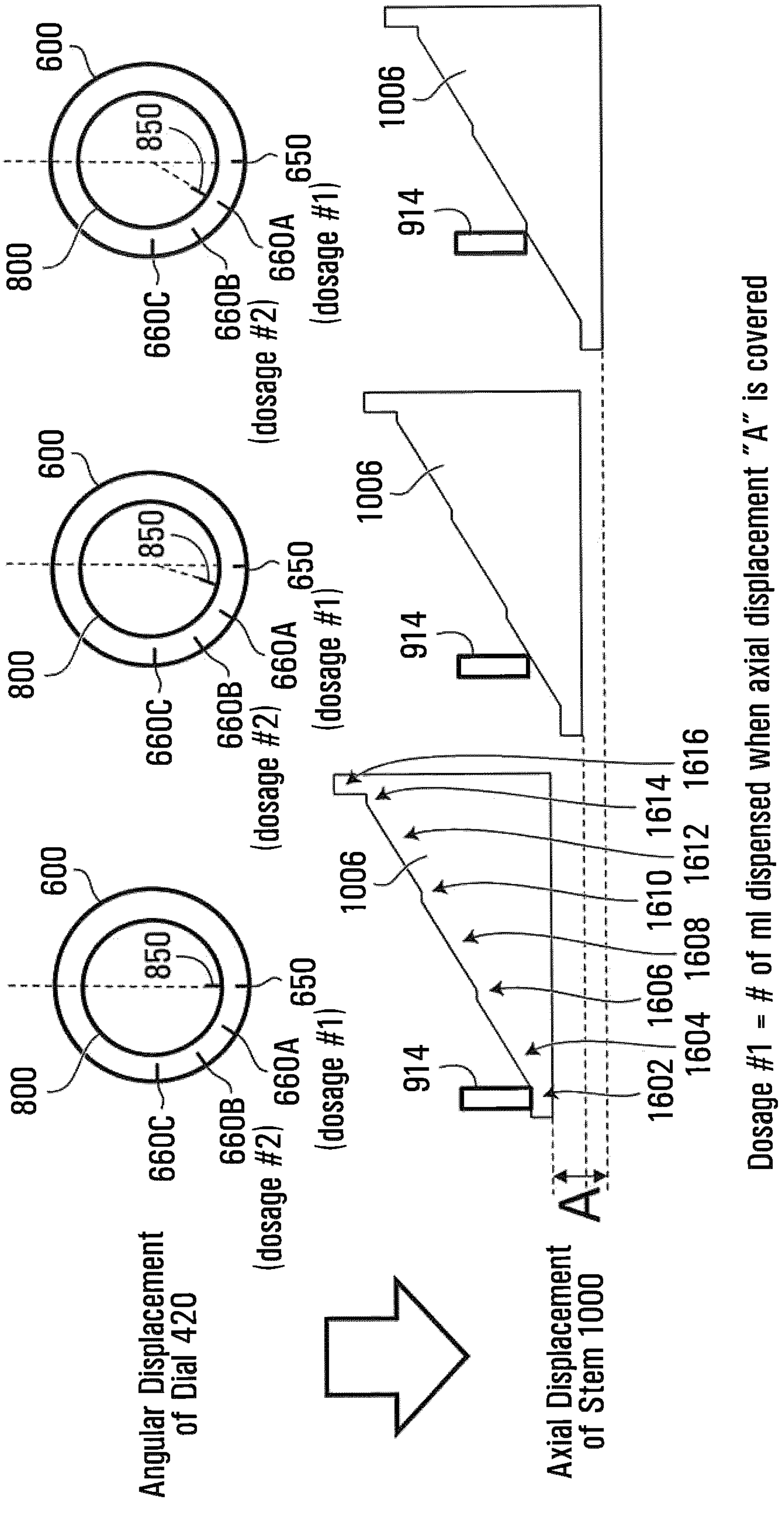


FIG. 15



Angular Displacement of Dial 420
Axial Displacement of Stem 1000
600
800
850
650
660A (dosage #1)
660B (dosage #2)
660C
914
1006
A
1602
1604
1606
1608
1610
1612
1614
1616
Dosage #1 = # of ml dispensed when axial displacement "A" is covered

FIG. 16A

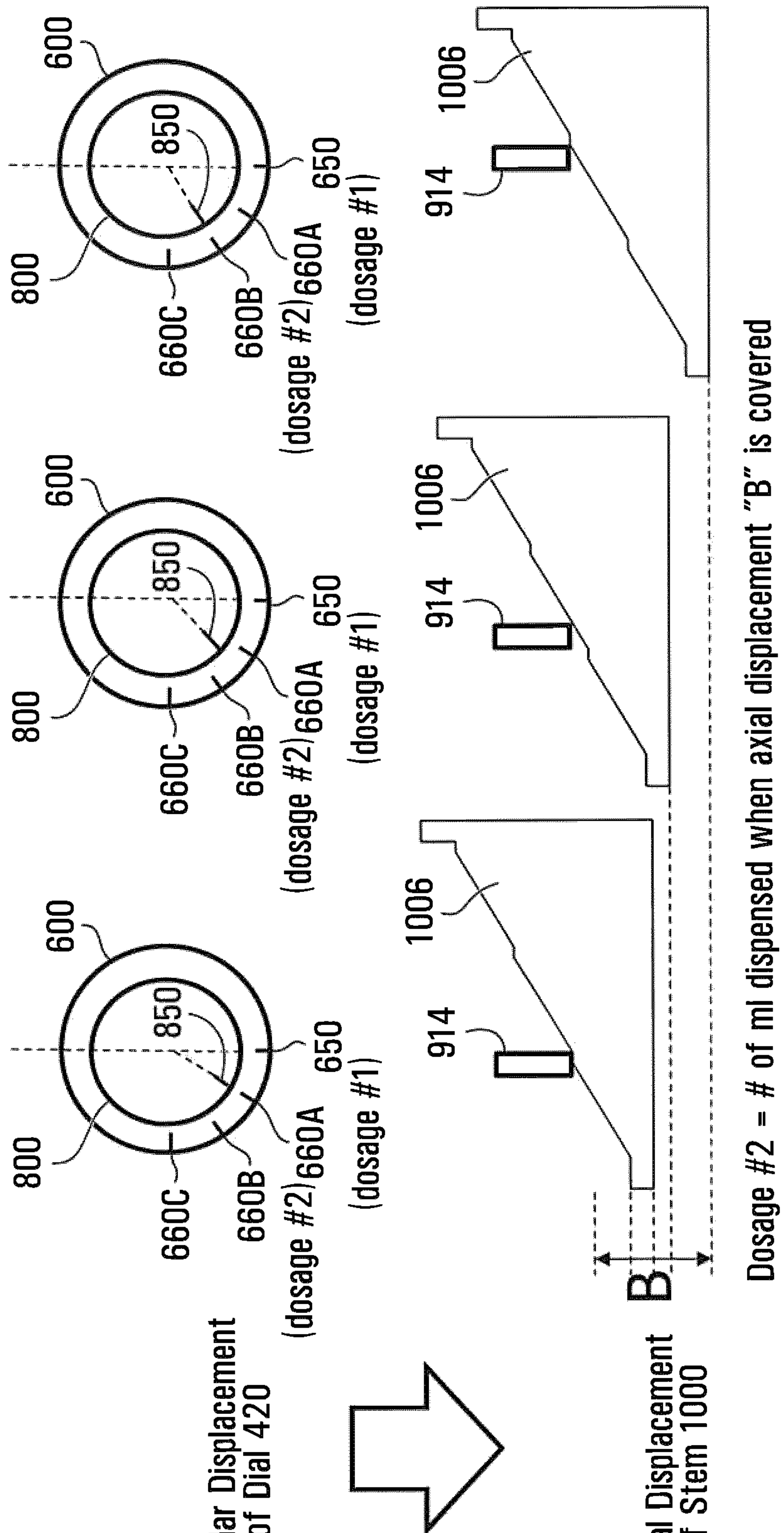

Angular Displacement of Dial 420
Axial Displacement of Stem 1000
600
800
850
650
660A
660B
660C
(dosage #1)
(dosage #2)
914
1006
B
Dosage #2 = # of ml dispensed when axial displacement "B" is covered

FIG. 16B

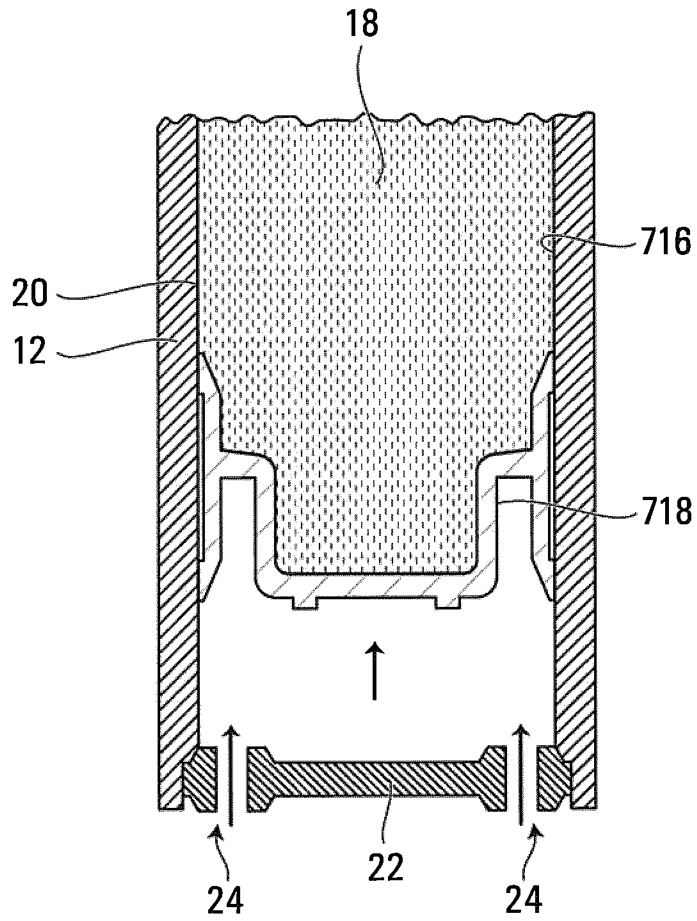


FIG. 17

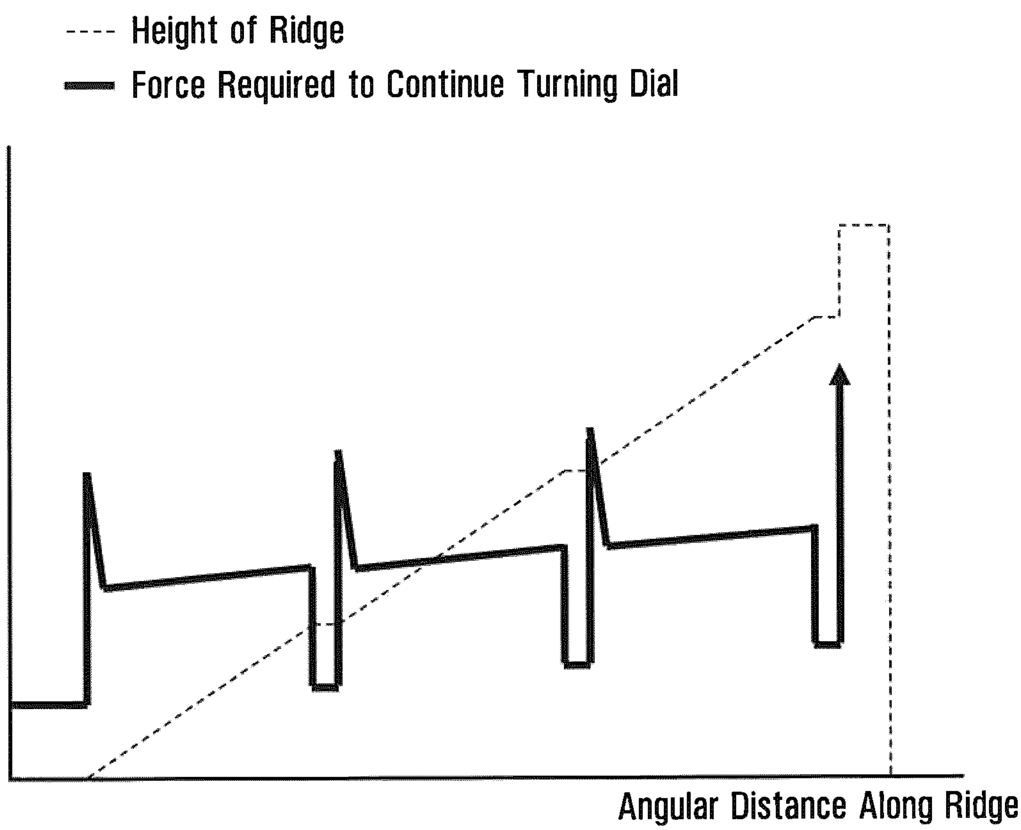

---- Height of Ridge
Force Required to Continue Turning Dial
Angular Distance Along Ridge

FIG. 18

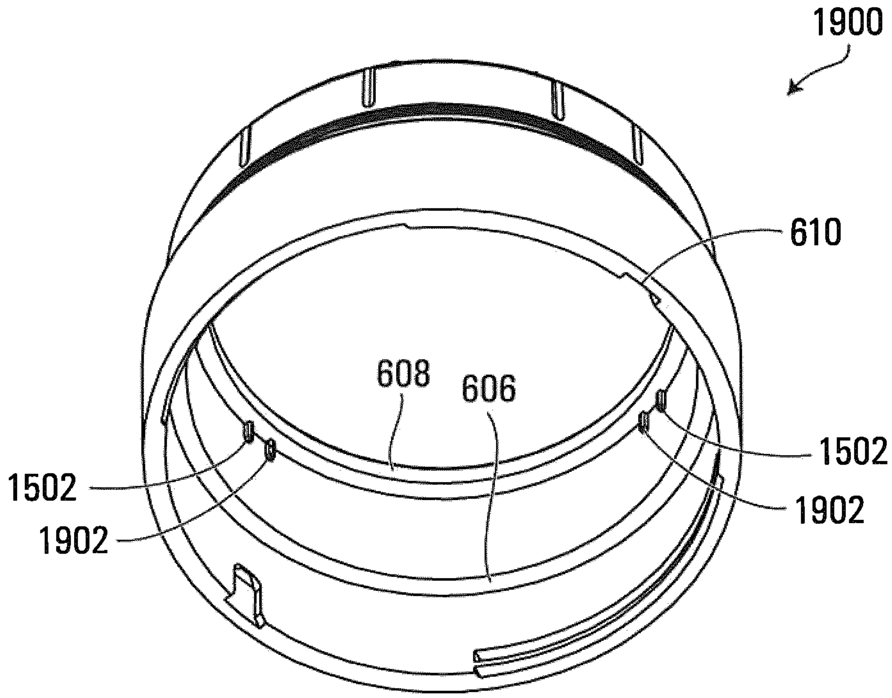


FIG. 19

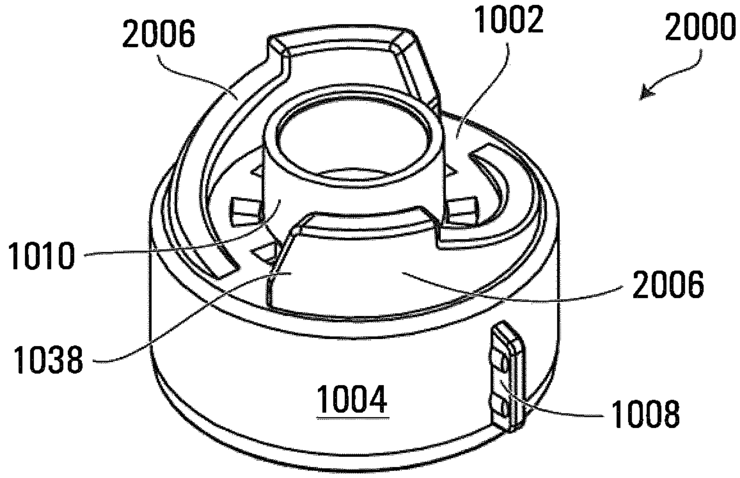


FIG. 20

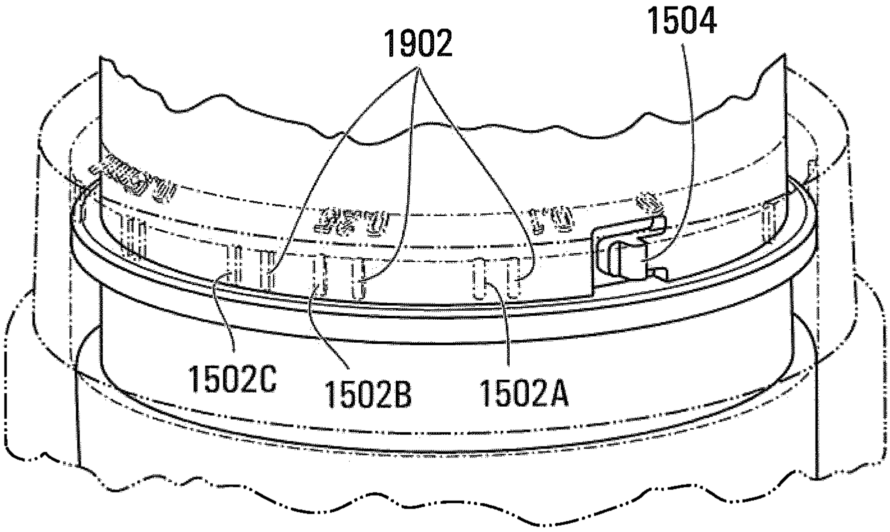
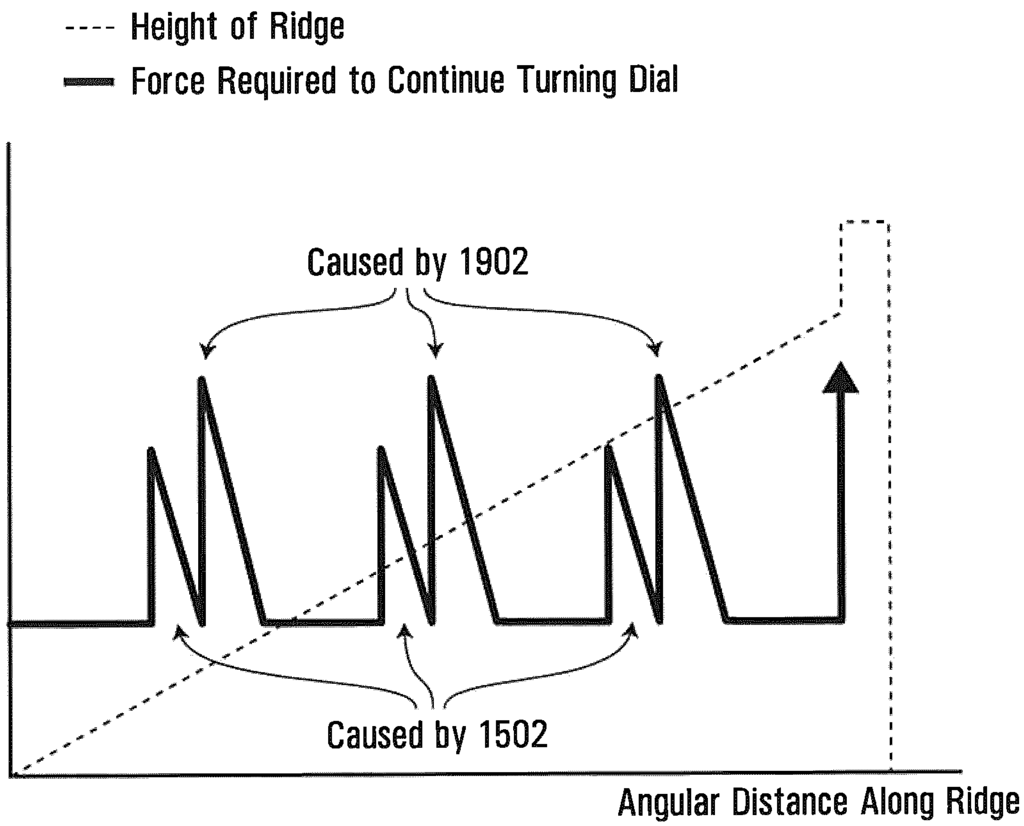


FIG. 21



---- Height of Ridge
Force Required to Continue Turning Dial
Caused by 1902
Caused by 1502
Angular Distance Along Ridge

FIG. 22

INTERNATIONAL SEARCH REPORT	International application No. **PCT/CA2016/050179**

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***B65D 83/76*** (2006.01)

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(2006.01): B65D, B65D-83/76

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

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

Questel-Orbit (FAMPAT), Canadian Patents Database
(Keywords: dispens*, fluid*, rotat*, angul*, angl, dos*, reservoir, feedback

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009/0326442 A1 (ROSS, C. et al.) 31December 2009 (31-12-2009) *pgh. [0032], [0033], [0034]; claim 21; Fig. 1*	1-60
A	WO 2008/071804 A1 (CHRISTIANSEN, A) 19 June 2008 (19-06-2008) *Abstract; pg. 3, ln. 6-17; Fig. 3A, 5, 7*	1-60
A	US 2014/0323993 A1 (WILCOX, A. et al.) 30 October 2014 (30-10-2014) *Abstract; pg. 1, pgh. [0014], [0028], [0038], [0048]; Fig. 5b, 6c*	1-60

☐ Further documents are listed in the continuation of Box C.　　☑ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search	Date of mailing of the international search report
27 October 2016 (27-10-2016)	28 October 2016 (28-10-2016)

Name and mailing address of the ISA/CA	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Harvey Berg (819) 639-7748

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US 2009/0326442 A1	31December 2009 (31-12-2009)		
	N/A	N/A	None
WO2008071804A1	19 June 2008 (19-06-2008)		
		CN101557849A	14 October 2009 (14-10-2009)
		CN101557849B	12 December 2012 (12-12-2012)
		EP2091598A1	26 August 2009 (26-08-2009)
		EP2091598B1	11 July 2012 (11-07-2012)
		JP2010512817A	30 April 2010 (30-04-2010)
		US2010324498A1	23 December 2010 (23-12-2010)
		US8617125B2	31 December 2013 (31-12-2013)
US 2014/0323993 A1	30 October 2014 (30-10-2014)		
	N/A	N/A	None