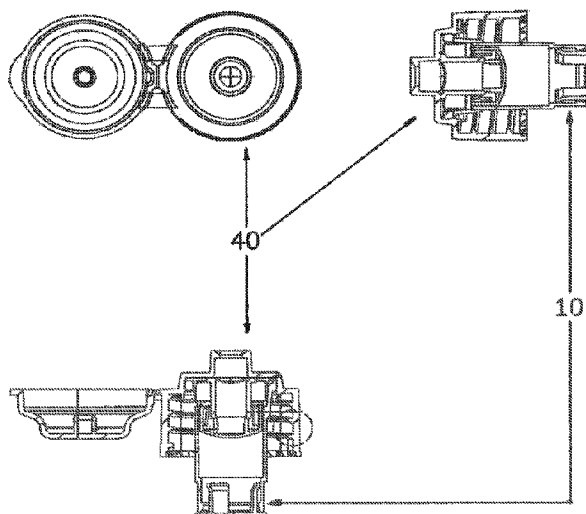




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(54) Title: DOSING APPARATUS AND A CONTAINER



(57) Abrégé/Abstract:

A dosing apparatus suitable for dispensing a dose of liquid from a resilient squeezable container, comprises: a cap, suitable for attachment to said container, said cap comprising an expulsion channel for the expulsion of liquid; a dosage chamber attached to said cap, said dosage chamber comprising side walls extending from said cap, at least one inlet opening in said side walls proximal to said cap; a pressure chamber located underneath said dosage chamber; a valve provided at the end of the pressure chamber distal to said dosage chamber, said valve being moveable from an open position, allowing liquid to flow through one or more discharge openings, and a closed position where the valve closes the or each discharge opening, said valve incorporating at least one aperture; and a plunger provided in said dosage chamber, and moveable relative to said dosage chamber so as to advance upon squeezing of said container, up to a blocking position.

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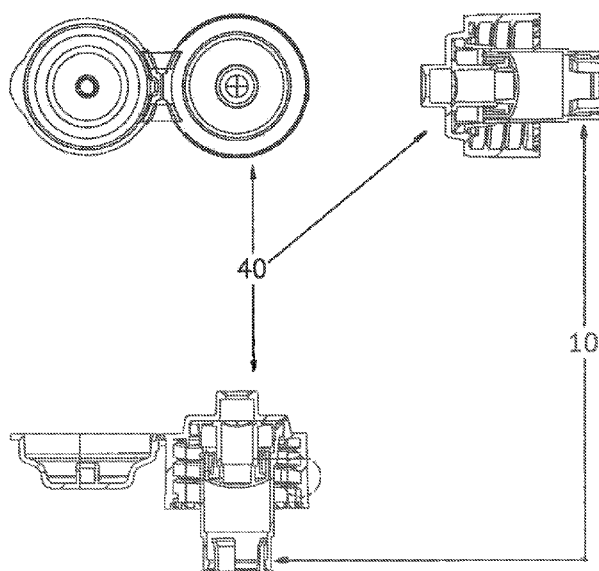


FIG 1

(57) Abstract: A dosing apparatus suitable for dispensing a dose of liquid from a resilient squeezable container, comprises: a cap, suitable for attachment to said container, said cap comprising an expulsion channel for the expulsion of liquid; a dosage chamber attached to said cap, said dosage chamber comprising side walls extending from said cap, at least one inlet opening in said side walls proximal to said cap; a pressure chamber located underneath said dosage chamber; a valve provided at the end of the pressure chamber distal to said dosage chamber, said valve being moveable from an open position, allowing liquid to flow through one or more discharge openings, and a closed position where the valve closes the or each discharge opening, said valve incorporating at least one aperture; and a plunger provided in said dosage chamber, and moveable relative to said dosage chamber so as to advance upon squeezing of said container, up to a blocking position.

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Dosing Apparatus and a Container

Field of the Invention

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This invention relates to an apparatus suitable for dispensing regular doses of a liquid from a dosing cap. The invention further relates to containers comprising a dosing apparatus.

Background to the Invention

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Liquids are often kept in bottles which are sufficiently flexible to be squeezed by an operator with either simple or valve controlled spouts, to enable straightforward dispensing of their contents. The relative costs of products, their potential high concentration and their impact on the environment creates a desire to only use the required amount of product for the task. One of the limitations of the classic bottle design, is the difficulty in using the exact amount of force required to dispense the volume of liquid desired. As a result several systems have been developed which produce exact metered out doses of their liquid contents each and every time the bottle is squeezed.

25

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These systems often use a multiplicity of chambers functionally connected, so that, during the pouring process one of the chambers will fill to the desired volume. This volume will then be transferred to the dispensing chamber where it can be dispensed. The limitation of

such systems is the requirement for multiple chambers of a size suitable for housing the desired dosing volume. This makes the dosing equipment more bulky in size and complex to produce. A second limitation of such designs is that they often require separate inversions of the bottle to effectively fill the measuring chamber, before the fluid can be dispensed. This slows and further complicates the dispensing process.

More recent advances have utilised a single chamber design to eliminate these limitations. WO2013158732 discloses a design with a single dosing chamber with integral inlet openings to allow the liquid to enter the chamber. A valve at the base of the chamber and proximal discharge openings allow the pressure produced by squeezing the bottle, to force an internal piston towards the outlet opening, thus dispensing the liquid contained in the dispensing chamber.

US4811871 also discloses designs with a single dosing chamber.

These designs, however, have their own inherent limitations which the current invention seeks to overcome.

Summary of the Invention

This is advantageous because it does not require a separate collection chamber to meter out doses of liquid, allowing it to remain compact. In addition, the pressure chamber is particularly advantageous because it creates a time lag between the creation of pressure on the container and the transmission of that full pressure to the plunger. This enables the dosing chamber to fill with liquid before the pressure on the plunger causes it to move along the dosing chamber and engage, in certain embodiments, with a slit valve, sealing it. The pressure chamber also ensures that the pressure on the plunger is even and consistent. The pressure on the plunger is created by the movement of a large body of liquid contained within the pressure chamber and the force on the back of the plunger will therefore be even across its surface area. By contrast if the plunger is disposed directly on the pressure apertures, the influx of liquid through those pressure apertures would create

uneven force on the plunger increasing the chance of the plunger rotating within the dosing chamber and becoming blocked.

Furthermore, this configuration advantageously removes any requirement of providing a
5 base whilst defining the dosage chamber with accuracy.

In a subsidiary aspect, the dosing apparatus further comprises an insert with a slit valve which is provided between said cap and said dosage chamber. This reduces or even in certain embodiments eliminates any undesirable dribbling from the container after
10 dispensing the dose.

In a further subsidiary aspect, the insert incorporates a tubular portion projecting away from said slit valve; said plunger interacting, in use, with the lower extremity of said tubular portion when said plunger is, in use, at the end of the dosage chamber proximal to
15 said cap. This facilitate a separation between the slit valve and the plunger.

In a further subsidiary aspect, said insert includes a skirt which partially covers said inlet openings. This configuration advantageously allows the insert to control the flow rate into the dosage chamber. It is also particularly advantageous since it can at least partially block
20 the inlet openings so that the plunger more readily returns once the dose has been dispensed.

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Said valve incorporates a disc attached to said pressure chamber by one or more retaining means. This provides a particularly compact and responsive structure.

5 Said retaining means incorporate one or more tines which extend against the inner surface of said pressure chamber. This allows the valve to be retained by the inherent flexibility in tines of this kind. It also advantageously allows displacement of the valve without any components located outside of the pressure chamber.

10 Said tines incorporate a hook and said pressure chamber incorporates a lower ledge at least partially extending around the inner diameter of said chamber in order to retain said tines when said valve is, in use, in an open position. This advantageously secures the valve without requiring additional components since the shape of the chamber itself can be used to facilitate the retention of the valve.

15 Said disc has an upper surface which abuts, in use, against the distal extremity of said pressure chamber when in the closed position. This provides a relatively large potential area for a discharge from the contents of the chambers.

20 The disc has a diameter greater than the external diameter of said pressure chamber. This allows advantageous sealing and release from its abutting sealing position to improve the response of the valve.

In a further subsidiary aspect, the plunger incorporates a domed portion. This configuration increases the area which can be pressurised for improved performance of the plunger.

25 In a further broad aspect, the invention provides a container comprising a dosing apparatus according to any of the preceding aspects.

30 Preferably, the dosing apparatus includes a slit valve provided between said cap and said dosage chamber. This is particularly advantageous because it prevents liquid from leaking out of the expulsion channel when it is not desired. The slit valve is only opened when the internal pressure exceeds a given threshold, creating a selective opening mechanism and prevents accidental spillage.

Preferably, said plunger is able to interact with said slit valve functionally blocking said slit valve when at the end of the dosage chamber proximal to said cap. This is particularly advantageous because it means the plunger provides both a means of forcing the collected liquid out of the dosing chamber and a means of blocking exit from the dosing apparatus when the plunger reaches the end of the dosing chamber and the desired dose has been metered out. This removes the requirement for more complex and bulky mechanisms for cutting off the flow of liquid when the desired dose had been metered out.

Preferably, said slit valve includes a skirt which partially covers said inlet openings. This is particularly advantageous because it enables the size of the inlet openings to be altered and consequently the volume of dose, without alteration to the housing of the dosing apparatus or inlet openings themselves. This enables the same dosing apparatus to be used to create alternative doses by only changing the slit valve. In certain embodiments, since the skirt is located inside the inlet opening and since it is inherently flexible it can bend to allow liquid to fill the chamber and can abut against the surrounding portion of the inlet opening after the dose has been dispensed and the air travels into the container after the squeezing of the container.

Preferably, said pressure aperture is centrally located in said valve. This is advantageous because it helps to ensure even pressure is created on the base of the plunger, reducing the likelihood that it rotates within the dosing chamber. In a preferred embodiment it also allows the use of a single aperture which reduces the complexity of the structure.

Preferably, said pressure chamber is of decreased volume when compared to said dosage chamber. In certain embodiments this is advantageous because it prevents the time lag created by the dosage chamber form extending beyond the maximum amount of time the dosing chamber may take to fill. The size of the inlet openings are larger than the pressure aperture and therefore if the pressure chamber and the dosing chamber were of equal volume the dosing chamber would be full of liquid long before the pressure chamber.

Brief Description of the Figures

The invention and comparative examples will now be described, by way of example only, with reference to the accompanying drawings.

Figure 1 shows a dispensing apparatus in perspective view, in cross-sectional view, in side views and in an upper elevation.

5 Figure 2 shows a cap in perspective view.

Figure 3 shows a dispensing apparatus when attached to the cap, in perspective view when separate from the cap, in cross-sectional view and in an upper elevation.

10 Figure 4 shows a plunger in perspective view, in side elevation, in cross-sectional view and in an upper elevation.

Figure 5 shows a disc valve in perspective view, in an upper elevation, in a cross-sectional view and in a side elevation.

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Figure 6 show a slit valve in multiple perspective views, in a cross-sectional view, in side elevation, and in an upper elevation.

20 Figure 7 shows a comparative example, and in particular a perspective view of a cap equipped with a dosing apparatus.

Figure 8 shows perspective views of the various disassembled components of the cap of Figure 7.

25 Figure 9 shows the cross-sectional view of the cap of Figures 7 and 8.

Figure 10 shows a perspective view of the underside of valve body.

30 Figure 11 shows a top view of the valve body.

Figure 12 shows a perspective view of the outside of the cylinder defining the dosing chamber.

Figure 13 shows a perspective view of the piston.

Figure 14 shows a cross-sectional view of a further comparative example, with the piston in its lower most position.

5 Figure 15 shows a cross-sectional view of the piston when engaging with the valve body.

Figure 16 shows a further cross-sectional view of the piston engaging with a platform.

Figure 17 shows a further comparative example in cross-section of a dosage cap.

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Figure 18 shows a further comparative example in cross-section.

Figure 19 shows a further comparative example with both a dosage chamber and a pressure chamber.

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Figure 20 shows a further comparative example of a dosage cap in cross-section with a ball located in a pressure chamber.

Figure 21 shows a further comparative example where the ball valve is provided in a pressure chamber.

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Detailed Description of the Figures

Figure 1 shows the dispensing apparatus 10, operably attached to the cap 40. The dispensing apparatus 10 and cap 40 are suitable for attachment to a resilient squeezable container, capable of storing a given liquid.

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Figure 2 shows the cap 40, with the lid 43 in an open configuration. At the centre of the cap 40 is an expulsion channel 41 with aperture 42 through which liquid contained in the dosing chamber 11 can pass. The cap 40 can be securely attached to a resilient squeezable container by the attachment means 45. Preferably, the attachment means 45 are interlocking male and female threaded regions on the inner surface of the cap 40 and the outer surface of the container respectively. Alternatively, the attachment means 45 could be a frictional fit or a push-fit mechanism.

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A lid 43 is attached to the cap 40 by a hinge region 44. A sealing means 45 on the base of the lid 43 enables the aperture 42 in the cap 40 to be securely sealed when the lid 43 is in a closed configuration on the cap 40. In the currently displayed embodiment, the sealing means 45 consist of a cylinder so shaped that when the cap 43 is in a closed configuration, the cylinder enters the aperture 42, producing a frictional fit with the inner surface of the expulsion channel 41, effectively sealing it. Those skilled in the art would be aware that alternative means of sealing the outlet tube are available.

The dosing apparatus 10 as shown for example in figures 1 and 3, is operably attached to the cap 40 due to the close frictional fit of the upper ring 14 with the inner surface of the base of the cap 40. An annular lip may be provided in one or more downwardly projecting walls to secure upper ring 14 to the inside of the cap.

In addition, a flexible insert may be secured on the inside of the cap above the dosing chamber.

Figure 3 shows a cross-sectional view of part of a dosing apparatus 10, consisting of a cylindrical dosing chamber 11, with inlet openings 13 in the side wall 12 proximal to the upper ring 14, a plunger 16 for forcing liquid into and out of the dosing chamber, a pressure chamber 17, and a valve 20 with a central pressure aperture 21. Optionally, the valve 20 is a disc valve with peripheral tines or hooks 26 to attach the valve 20 to the dosing apparatus 10.

Alternatively, the valve 20 could be attached to the dosing apparatus 10 by a central attachment means or external holdings.

In one embodiment, there are three rectangular inlet openings 13, with upper edges defined by upper ring 14. The size of the inlet openings 13 is proportional to the desired volume of the dose. The volume of the combined inlet openings, in combination with the viscosity of the liquid within the container, helps define the volume of dose created. Those skilled in the art will be aware that the inlet openings 13 are not constrained by their shape or number. The inlet openings 13 could be square, circular or triangular, with the combined volume not the number being important to the functioning of the invention.

Directly beneath the dosing chamber 11, as oriented for use, is a cylindrical pressure chamber 17. The pressure chamber 17 is of a volume smaller than that of the dosing chamber 11. At the junction between the dosing chamber 11 and the pressure chamber 17 is a ridge or flange 15. Preferably the ridge 15 is internally chamfered so that, in use, no liquid can accumulate on the ridge 15 and interfere with the plunging mechanism. Inside the dosing chamber 11 is a plunger 16.

Figure 4 shows a perspective view of a first embodiment of the plunger 16. The plunger 16 has a concave domed base with diameter larger than that of the aperture 50 created by the ridge 15, but smaller than that of the dosing chamber 11. As a result the plunger 16 can move relative to the dosing chamber 11 (or primary chamber) but cannot enter the pressure or secondary chamber 17, where it rests on the ridge 15. The domed shape of the plunger 16 helps to ensure that the plunger 16 does not rotate around its horizontal axis. The force created by the liquid entering the pressure chamber will be pushed to the peripheries of the plunger 16 helping to stabilise the plunger 16. At rest, the plunger 16, rests on the ridge 15 and defines the boundaries of the dosing or primary chamber 11 and the pressure or secondary chamber 17. When orientated with the cap at the top of the dosing chamber 11, the plunger 16 can only move in a vertical direction relative to the dosing chamber 11. Around the periphery of the plunger 16 are projections 23 extending away from the plunger 16 in a substantially perpendicular direction relative to the plane of the domed portion 24 of the plunger. The projections 23 help to prevent the plunger 16 from rotating around the horizontal axis of the plunger 16 and becoming stuck in the dosing chamber 11. The projections 23 help reduce the surface area of the plunger 16 in contact with the dosing chamber 11 reducing the drag the plunger 16 experiences as it moves relative to the dosing chamber 11.

At the centre of the plunger 16 on the face proximal to the cap 40, is a plug 25. The plug 25 will interact with and seal the expulsion channel 41 when the plunger 16 reaches the end of the dosing chamber 11 proximal to the cap 40. In the current embodiment, the plug 25 is a cylinder which interacts with a tubular portion 32 of the insert which carries the slit valve 27 as best seen in Figure 6.

Figure 5 shows a perspective view of a first embodiment of the valve 20. The current embodiment of the valve 20 is a disc valve. The disc valve 20 attached at the base of the

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dosing apparatus 10, controls the discharge of liquid from the dosing chamber 11 via the discharge openings 22, and the influx of liquid into the pressure chamber 17 via the pressure aperture 21.

- 5 The valve 20 has arms 19 at the periphery of a circular base 18, extending away perpendicular to the base 18. At the end of the arms or tines 19, distal from the base 18 are hooks 26 which are suitable to catch the ridge 51 at the base of the pressure chamber 17. At the centre of the valve 20 is a pressure aperture 21. The diameter of the pressure aperture 21 is proportional to the volume of the dose required and the volume of the pressure chamber. The diameter of the pressure aperture 21 is also determined by considering the viscosity of the liquid contained in the resilient squeezable container. In an alternative embodiment there are more than one pressure apertures 21 in the valve 20. The valve 20 can move from an open position, allowing liquid to flow through the one or more discharge openings 22, and a closed position where no liquid can flow through the discharge openings 22. In the open configuration, the valve 20 is supported by the interaction of the hook 26 with the inner surface of the ridge 51. The discharge openings 22 are defined, at their upper surface by the ridge 51, at their lower surface by the circumference of the base 18, and at the sides by the arms 19 of the valve 20. In its closed configuration, the base 18 of the valve 20 comes into contact with the ridge 51. The arms 19 and the hooks 26 of the valve 20 are enclosed within the pressure chamber 17 effectively closing the discharge openings 22.

- Figure 6 shows a first embodiment of an insert which carries a slit valve 27 as shown in multiple views. The slit valve 27 is housed in the upper ring 14 at the end of the dosing apparatus 10 and forms the boundary between the aperture 42 of the expulsion channel 41 and the dosing chamber 11. In a preferred embodiment, the slit valve 27 is made from a flexible polymeric material, preferably of silicone or other like materials. The slit valve 27, comprises a central head region 33 and a radial outer portion 28, attached by a connection tag 30, allowing the head region 33 and the radial outer portion 28 to move independent of each other whilst still attached due to a spacing provided between the two movable components and the inherent flexibility of the material employed. At the centre of the head region 33 are self-sealing slits 34 which together define a closed orifice when the slit valve 27 is in a closed configuration. The self-sealing slits may be preferentially opened in one direction, allowing liquid to move from within the dosing chamber 11 to the exterior

but not in the reverse direction. A cylindrical projection 32 extends from the head region 33 in a perpendicular direction. In use, the cylindrical projection 32 can interact with the plug 25, effectively sealing the slit valve 27 and preventing liquid in the resilient squeezable container from exiting through the expulsion channel 41.

5

A skirt region 29, extends perpendicular from the radial outer portion 28 when orientated as shown in Figure 6A. In use, the skirt portion 29 interacts with the inner surface of the upper ring 14 attaching the slit valve 27 to the dosing apparatus 10. In one embodiment, the skirt 29 partially covers the inlet openings 13, altering the volume of the inlet openings
10 13 and therefore altering the volume of liquid dose metered out. By altering the size of the skirt 29 it is therefore possible to alter the size of dose metered out without altering other components of the dosing apparatus. In a preferred embodiment, the skirt 29 is of uneven size, creating the ability to alter the volume of the inlet openings by rotating the slit valve insert 27.

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In use, the squeezable container – with cap 40 and dosing apparatus 11 securely attached – is inverted, and the container is squeezed. The squeezing of the container decreases the volume of the container and therefore increases the pressure within the container.

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Concurrently with this increase in the pressure, the change in orientation and therefore the change in the direction of gravity, causes the valve 20 to enter its closed configuration, closing the discharge openings 22. The orientation and the increased internal pressure will cause liquid to enter the inlet openings 13 and fill the dosing chamber 11. Concurrently, liquid will be forced through the pressure aperture 21 filling the pressure chamber 17. The
25 size of the pressure chamber 17 and the size of the pressure aperture 21 work in combination to define how long the pressure chamber 17 takes to fill with liquid. When the pressure chamber 17 is full of liquid, pressure will push the plunger 16 along the dosing chamber 11 from its position proximal to the pressure chamber 17 to a position proximal to the cap 40. The movement of the plunger 16, will cause liquid which has entered the
30 dosing chamber 11 via the inlet apertures 13, to exit through the slit valve 27 and out of the expulsion channel 41. When the plunger 16 reaches the end of the dosing chamber 11, proximal to the cap 40, the plug 25 will interact with the cylindrical projection 32, sealing the slit valve and preventing any more liquid from exiting from the expulsion channel 41.

By controlling features, such as the volume of the dosing chamber 11 and the volume of the inlet openings 13 it is possible to create consistent doses of liquid. In certain modes of operation, the current system further uses a time lag between the initiation of pressure on the container and the initiation of pressure on the plunger 16 within the dosing chamber 11. This is due to the pressure chamber 17, which fills with liquid before transmitting pressure on the plunger 16. By altering the ratio of the size of the pressure chamber 17 and the pressure aperture 21, it is possible to alter the time the pressure chamber 17 takes to fill with liquid. The time lag allows liquid to enter through the inlet openings 13 and fill the dosing chamber 11 to a consistent level.

In certain modes of use, when the resilient squeezable container is righted and the pressure on it released, the container will return to its original configuration. This increase in volume will cause the pressure within the container to decrease and external air will enter through the expulsion channel 41 and through the slit valve 27, filling the dosing chamber 11 with air. The change in gravity and pressure will cause the plunger 16 to move relative to the dosing chamber 11 away from the cap 40 until it is resting on the ridge 15. The plug 25 will no longer be in contact with the cylindrical projection 32, unsealing the slit valve 27.

The valve 20 will move from a closed to an open configuration, opening the discharge openings 22. The liquid in the pressure chamber will exit through the discharge openings 22, returning the dosing apparatus 10 to its pre-use configuration.

In a preferred embodiment, the change of pressure when the container is released is sufficient to move the plunger 16 from its location proximal to the cap to a position proximal to the pressure chamber 17. This has the added benefit that the chamber is ready to be filled by fluid again via the inlet openings and the dosing apparatus 10 does not need to necessarily be rotated between uses.

Other Embodiments and Comparative Examples of the Invention

This section provides further examples of a dosing apparatus for dispensing a dose of liquid
5 from a resilient and thus squeezable container. These in particular concern improvements
to a bottle cap which comprises a first outlet towards the top of the cap. The cap
comprises means for attachment to a container such as a bottle. These may take the forms
described in the preceding section. A dispense housing or dosage chamber is attached to
the cap. It allows liquid into the chamber primarily through a first inlet located towards
10 the upper portion of the dispense housing. The dispense housing also incorporates a
second inlet located towards the bottom of the dispense housing.

A plunger or a piston is displaced up and down within the dispense housing. In its upper
position it substantially seals tube 103 and when in its lowest most position it
15 substantially seals the bottom inlet 111. In addition to the cap and the housing a
substantially elastic or flexible insert or valve 64 is suitable for connecting on the inside
surface of the bottle cap. The elastic valve includes a valve body which is sized and
configured in accordance with the size of the first outlet 71. The valve body 64 is
sufficiently flexible to adopt several configurations so that it is open when positive
20 pressure is applied and closed when negative pressure is present. The valve may
advantageously take the form of a cross valve 411. In other words, the aperture is formed
by two perpendicularly bisecting lines which may form a through-hole dependent upon the
pressure conditions applied on the valve. The top surface and edge of the valve body are
designed to fit against an inner portion of the bottle cap 61 and to be secured into place
25 by the upper perimeter of the dispenser housing 62. In a preferred embodiment, the cross
valve 411 may be secured on the inner side of the first outlet 71. In addition, the valve
body 64 also incorporates an output pipe which is secured under said cross valve. The
cross valve also at least partially obstructs the upper openings in the dispenser chamber.
These take the form of flaps or wings 102 which also extend downwards and are
30 sufficiently flexible to allow liquid to get through when the bottle is squeezed. As
previously indicated, the output pipe projects in use downwards. In a further subsidiary
aspect, a flow restriction disc 65 may be secured within the dispenser housing 62. This
flow restriction disc may be employed to seal the second inlet 82. The flow restriction disc
has a second or third inlet 94 which also allows liquid to flow into the dispense chamber.

The flow restriction disc 65 may be elastically detached to connect with a connecting ring 112 provided at the bottom of the dispense chamber 62. The flow restriction disc 65 comprises optionally an outer loop 112 and an inner loop defining a gap 113. The outer annular portion 83 of the second inlet may have a downward convex configuration. In use the flow restriction disc 65 interacts with the convex ring 83. In addition, one or more modulating orifices or timing orifices 89 may be provided in a lower side portion of the dispense housing. These timing orifices allow a connection with the inner chamber of the dispense housing which can assist in modulating the volume of the output. In a subsidiary aspect, the piston may incorporate a float or other buoyancy aid to facilitate its displacement in use. In addition, optionally the bottom of the piston may incorporate a downward dome 63. Furthermore, the piston may incorporate an upper central region shaped and configured to fit against the lower portion of the tube 103 in order to seal the or close the first outlet of the bottle cap. Optionally, the float may take the form of a floating ball which may itself provide the surface to seal the first outlet when the piston is in its upper position. It may also be configured optionally to seal the second inlet when the piston is in its lower position. Further optionally, the float may be positioned within float retaining means such as elastic claws 342. The elastic claws 342 or retaining means may be configured to encircle the float or ball 96 in order to allow it to move up and down freely in order to fulfil its upper and lower blocking functions. In a further subsidiary aspect, a platform 253 may be formed integrally with the inside of the wall of the dispenser housing allowing liquid to go through it. The floating part can go up and down freely in the secondary chamber located above the platform. Optionally, a floating ball 96 may be secured into place between the platform and the bottom of the dispenser housing.

In certain embodiments, the dosage dispenser is particularly advantageous because it allows accurate liquid dosage dispensing with a wide range of liquid viscosities. Embodiments of the invention are also particularly advantageous in terms of simplification. Furthermore, in certain embodiment, drips are substantially prevented in order to allow the dispensing chamber to be filled before any liquid can inadvertently drip out of the bottle. Embodiments of the invention may be suitable for liquids whose viscosity range from 1 to 2000mPa.s.

Figures 7 to 13 show comparative examples, and in particular a bottle cap 61 with the following features: a dispense housing 62, a piston 63, an elastic valve 64, a first outlet 71

in the top portion of the bottle cap 61, a flip top 72, which is hinged secured to the bottle cap 71. The flip top 72 covers and/or seals the top of the orifice of the first outlet 71 by employing a mating boss 73. This configuration also prevents any dirt and/or dust contaminating the first outlet 71. The dispensing or dispenser housing 62 has an inner chamber 80 (see Figure 9) which allows the amount of liquid to be measured. The dispensing housing 20 is configured to connect to the inner side of the top of the bottle cap 61. In the inner portion of the first outlet 71 is in effect surrounded by the dispenser housing 62 which is secured to the underside of the cap by push fit means. The dispenser housing 62 comprises an inlet 81 in the form of several rectangular apertures located in the upper most portion of the dispenser housing 62. The dispenser housing has a lower inlet 82 located in the lower portion of the dispenser housing. A flow restriction disc 65 is placed at the bottom of the dispenser housing 62 in order to selectively seal the second inlet 82. In the central region of the flow restriction disc there is provided a third inlet 94 which allows the liquid to flow into the inner chamber 80. The flow restriction disc 65 is preferably resilient and/or detachable in order to connect with a connecting ring 112. An annular gap 113 is provided between the flow restriction disc 65 and the connecting ring 112. Preferably, the flow restriction disc 65 and the connecting ring 112 are integrally formed. This may be achieved by the process of moulding a single component. The flow restriction disc 65 may be thinner than the connecting ring 112 for extra flexibility and to allow it to more readily open and close as appropriate.

As shown in Figure 12, the dispenser housing has an annular flange 120 with an inlet 82. The diameter of the inlet may be thickened by the provision of a downward convex ring 83. After securing the flow restriction disc 65 to the annular flange 120, the flow restriction disc is co-centrally disposed with the centre line of the inlet 82. When the bottle experiences a negative pressure condition when it is for example released by the operator, the flow restriction disc 65 will go down and leave the convex ring 83 allowing drainage to occur. The surrounding wall of the second inlet 80 may be convex in cross-section in the downward direction as shown in Figure 9.

In Figures 14, 15 and 16, the piston 63 can move up and down freely in the inner chamber 80 of the dispenser housing in order to seal the first outlet 71 of the bottle cap when it reaches it. The piston may also seal the second inlet 82 of the dispenser housing 62 when it reaches the bottom of the chamber. (See Figure 14). The top of the piston 63

incorporates an alternative arrangement with a plurality of tabs or upward projections 91. The bottom of the piston 63 may be configured to be part spherical or domed as shown under numerical reference 92. In the central upper most portion of the piston 63 there is provided a surface 93 which may be suitable to seal the first outlet 71 of the bottle cap when the piston abuts against the boss as shown in Figure 9. This configuration is particularly advantageous in order to allow the piston to float up faster during liquid filling. When a dispensing process is completed air may enter the dispenser housing 62 through the first outlet 71 of the bottle cap 61. In this condition, the dispenser housing 62 typically has a certain amount of liquid inside, the air and the liquid may exit in the form of bubbles which may take the form of bubbles 200 shown in Figure 17. The dome 92 and the seal end 93 are configured to gather the bubbles 200 which allow the piston to float up faster to make it faster and more rapidly ready for dispensing.

In Figures 8, 9, 10, and 11 the elastic valve 64 is placed on the inner side of the top of the bottle cap 61. Elastic valve 64 facilitates the opening of the first inlet 71 of the dispense housing when it is under positive pressure. It also facilitates the closing of the inlet 71 when it is in negative pressure status. Specifically, the elastic valve 64 is preferably made as a single piece of material such as an all-in-one moulded part. It has a valve body 100 with a cross valve 101, elastic projections 102 and an output pipe 103. The valve body 100 has a through-hole 401 which may take the form of a part annular aperture. The valve body 100 may have a plurality of elastic projections 102 which may be disposed about the perimeter of the valve body and radially outwards from the through hole 401. The projections 102 may extend downwards from the valve body 100. The elastic projections 102 may be made of several pieces and may be of flexible construction in order to open and seal one or more first inlet such as inlet 81. Once assembled, the top edge of the valve body 100 may be retained by friction fit to the bottle cap 61 and the dispenser housing 62. The dispenser housing 62 and the bottle cap 61 may surround the valve body on both sides. The elastic projections 102 may be located on the inner side of the first inlet 81 of the dispenser housing 62. Because the elastic valve 64 may be made of a soft material the elastic projections 102 it may stick on or be displaceable from the first inlet 81 to control its opening and closing dependent upon whether or not negative or positive pressure conditions are occurring. In the positive pressure condition, the elastic projection 102 leaves the first inlet 81 and allows the liquid to flow inside the dispenser housing 62. In the negative pressure status, the elastic projections 102 stick on the first inlet 81 to

prevent any liquid leaking out from the dispenser housing 82. The cross valve 101 is placed inside and connects with the through-hole 401 of the valve body 100. There is a second outlet 411 on the cross-valve 101. The top edge of the cross-valve 101 extends downward to form an output pipe or boss 103. When the bottle is upside down, and before squeezing the cross-valve ensures that there is no drips from the first outlet 71 of the bottle cap 61. Instead in that period, the liquid fills the dispenser housing. A modulating orifice 89 at the bottom of the dispenser housing 62 is provided and allows liquid to go through to the inner chamber. Preferably, there are more than one modulating orifices 89 which may be disposed at regular interval around the wall of the dispenser housing 62. Preferably, the size of the modulating orifice 89 may be varied in order to control the output dosage. At the moment of squeezing and dispensing, the liquid can come into the dispenser housing through the modulating orifice 89 and push the piston 63 to move downwards and further push the liquid inside the dispense housing 62 in order to exit the first outlet 71. By increasing the size of the modulating orifice 89 much more liquid may flow into the dispenser housing and push the piston 63 at much higher speed. The quicker the movement of the piston the smaller the dosage dispensed from the dispenser. If the modulating orifice 89 is of a smaller size there would be less flow of liquid into the dispenser housing and the piston 63 would move down slower and since this movement would be slower, a larger dose would be dispensed. In this comparative example, it is therefore envisaged to employ different sizes of modulating orifices 89 to control the output dose whilst retaining the overall relatively small size of the dispenser housing 62.

In Figure 14, the piston 63 has fallen under gravity towards the bottom of the dispenser housing 62 and the dome 92 of the piston 63 is shown laying on the second inlet 82 of the dispenser housing 62. When placing the bottle upside down, as shown in Figure 15, the piston 63 slides under gravity towards the first inlet 81 and the liquid inside the bottle begins to flow into the chamber 80 through the first inlet 81 and the second inlet 82. During this process the cross valve 101 of the elastic valve 64 will seal the first outlet 71 to prevent any drips happening during the filling period of the chamber. As the liquid increases inside the dispenser housing 62, the piston 63 floats are as shown in Figure 16. As the bottle is squeezed, the bottle is under a positive pressure condition where the elastic projections 102 of the elastic valve 64 move sufficiently to allow the liquid to flow into the dispenser housing 62 through the first inlet 81 and the second inlet 82.

Consequently, these apply a force to the piston which moves it downward. At this point, the second outlet 411 of the cross valve 101 is forced open and lets the liquid come out.

The piston 63 will move to the seal end 93 and close the output pipe 103 as shown in Figure 17 thus allowing a single dose to be dispensed. Once the bottle is released, it is in a negative pressure condition where the outside air comes through the second outlet 411 of the cross valve 101 into the dispenser housing. Under the negative pressure, the elastic projection 102 remain in the first inlet 81. The air inside the dispense housing 62 is prevented from going out to the bottle through the first inlet 81 and the liquid inside the bottle can't flow into the dispenser housing 62 through the first inlet 81. The piston 63 is forced by the air to move up whilst the flow restriction disc is forced by the air and thereafter leaves the convex ring 83 at the bottom of the dispense housing. Thus allowing the air to come through the gap 113 into the bottle as shown in Figure 18. The dome 92 of the piston 63 abuts against the second inlet of the dispense housing which allows the dispenser to be ready for the next cycle of dispensing.

Figure 19 shows a further comparative example of a dosage dispenser. In this comparative example, the piston 63 includes a floating part 343 and a floating ball 96. The floating part 343 is shaped and configured to seal the first outlet 71 of the bottle cap 61 when the piston 63 moves upwards towards the top. The floating ball 96 is configured to seal the second outlet 82 when the piston 63 is located on the bottom of the dispenser housing 62. Optionally, the floating part 343 is surrounded by a floating projection 341. At the bottom of the floating part 343 there is optionally provided an arrangement with elastic claws or tines 342. The elastic claws 342 surround the floating ball 96 whilst still allowing the floating ball to move up and down inside the small chamber formed by the combination of the elastic claws. A through-hole 343 is provided in the floating part to allow the liquid to flow through. At the bottom of the floating part 34, a downwardly projecting tube is provided forming a ring 344 with an inner chamfer. This ring has a relatively large diameter compared to the diameter of the through-hole 343. The inner wall of the ring 344 may be configured to be arc shaped to follow the contours of the floating ball 96.

In the comparative example of Figure 20, there are no elastic claws as in the embodiment of Figure 19 whereby the floating part 63 and the floating ball 95 are separate. Furthermore, the inner structure of the dispenser housing 62 is different. In this

comparative example, a platform 85 extends across the width of the dispenser housing 62 and they separate the inner chamber into a pressure chamber and a dosage chamber. The floating part 63 is configured to move up and down freely between a position where it abuts against the lower portion of the platform and a position where the floating part engages the tube as described in previous embodiments and comparative examples. In this comparative example, the floating ball 96 stays in place between the platform 85 and the bottom of the dispenser housing 62. In addition, there are optionally several first through-holes 251 between the pressure chamber and the dosing chamber. The central portion of the platform 85 may incorporate a part 252 which extends towards the first outlet 71. The extension part 252 may also incorporate a second through-hole 253. A portion of the platform 85 may incorporate an arc shaped surface configured to match the contour of at least part of the floating ball 96. The floating part 63 may also incorporate a groove or a recess to accommodate the projecting part 252 as it extends in the downward direction. In use, the liquid inside the bottle may come through the first inlet 81 and through the second inlet 82 into the dispensing housing 62. This combines to cause the floating of both part 63 and ball 96. When the bottle is squeezed in order to produce a positive pressure inside the bottle, ball 96 is forced to move down and engage with the arc surface of platform 85 which then seals the second through-hole 253. Consequently, the liquid which would flow through hole 253 would now flow through holes 251 to the bottom of the dispense housing 62. Floating part 63 would then move down along with the fluid. When the floating part 63 comes into contact with the first outlet 71 it forms a seal once the dose has been dispensed. Once the bottle is returned to a standing position, the outside air comes in through the first outlet 71 and the negative pressure causes the floating part 63 and the floating ball 96 to return under gravity to their original position preparing for the next dispensing cycle.

In the comparative example of Figure 21, the piston 63 is of a similar configuration as that presented in the embodiment of Figures 14 to 16. There are however differences for example a floating ball 96 is provided between a platform 85 and a base. The platform 85 may have a similar configuration to that described in detail with regard to Figure 20. In particular, the platform 85 may incorporate lateral apertures 251 and a central aperture 253.

Claims

1. A dosing apparatus (10) suitable for dispensing a dose of liquid from a resilient squeezable container, comprising:

a cap (40), suitable for attachment to said container, said cap comprising an expulsion channel (41) for the expulsion of liquid;

a cylindrical dosage chamber (11) attached to said cap, said dosage chamber comprising side walls (12) extending from said cap, at least one inlet opening (13) in said side walls proximal to said cap;

a cylindrical pressure chamber (17) located underneath said dosage chamber;

a valve (20) provided at the end of the pressure chamber (17) distal to said dosage chamber (11), said valve being moveable from an open position, allowing liquid to flow through one or more discharge openings (22), and a closed position where the valve (20) closes the or each discharge opening (22), said valve incorporating at least one aperture; and

a plunger (16) provided in said dosage chamber (11), and moveable relative to said dosage chamber (11) so as to advance upon squeezing of said container, up to a blocking position, wherein said pressure chamber (17) has a smaller diameter than said dosage chamber (11) in order to form a flange (15) above the pressure chamber (17) for said plunger (16) to rest against,

wherein said valve (20) incorporates a disc (18) attached to said pressure chamber (17) by one or more retaining means,

wherein said retaining means incorporate one or more tines (19) which extend against the inner surface of said pressure chamber (17),

wherein said tines (26) incorporate a hook (26) and said pressure chamber (17) incorporates a lower ledge (51) at least partially extending around the inner diameter of said chamber (17) in order to retain said tines (26) when said valve (20) is, in use, in an open position, the one or more discharge openings (22) being defined in the open position between the ridge (51), circumference of the disc (18) and tines (19) and ;

wherein said disc (18) has an upper surface which abuts, in use, against the distal extremity of said pressure chamber (17), closing the discharge openings (22) when in the closed position; and

wherein said disc (18) has a diameter greater than the external diameter of said pressure chamber (17).

2. A dosing apparatus (10) according to claim 1, further comprising an insert with a slit valve (27) which is provided between said cap (40) and said dosage chamber (11).

3. A dosing apparatus (10) according to claim 2, wherein said insert incorporates a tubular portion projecting away from said slit valve (27); said plunger (16) interacting, in use, with the lower extremity of said tubular portion when said plunger is, in use, at the end of the dosage chamber (11) proximal to said cap (40).

4. A dosing apparatus (10) according to either claim 2 or claim 3, wherein said insert includes a skirt (29) which partially covers said inlet openings (13).

5. A dosing apparatus (10) according to any one of claims 1 to 4, wherein said aperture (21) is centrally located in said valve (20).

6. A dosing apparatus (10) according to any one of claims 1 to 5 wherein said plunger (16) incorporates a domed portion (24).

7. A container comprising a dosing apparatus (10) according to any one of claims 1 to 6.

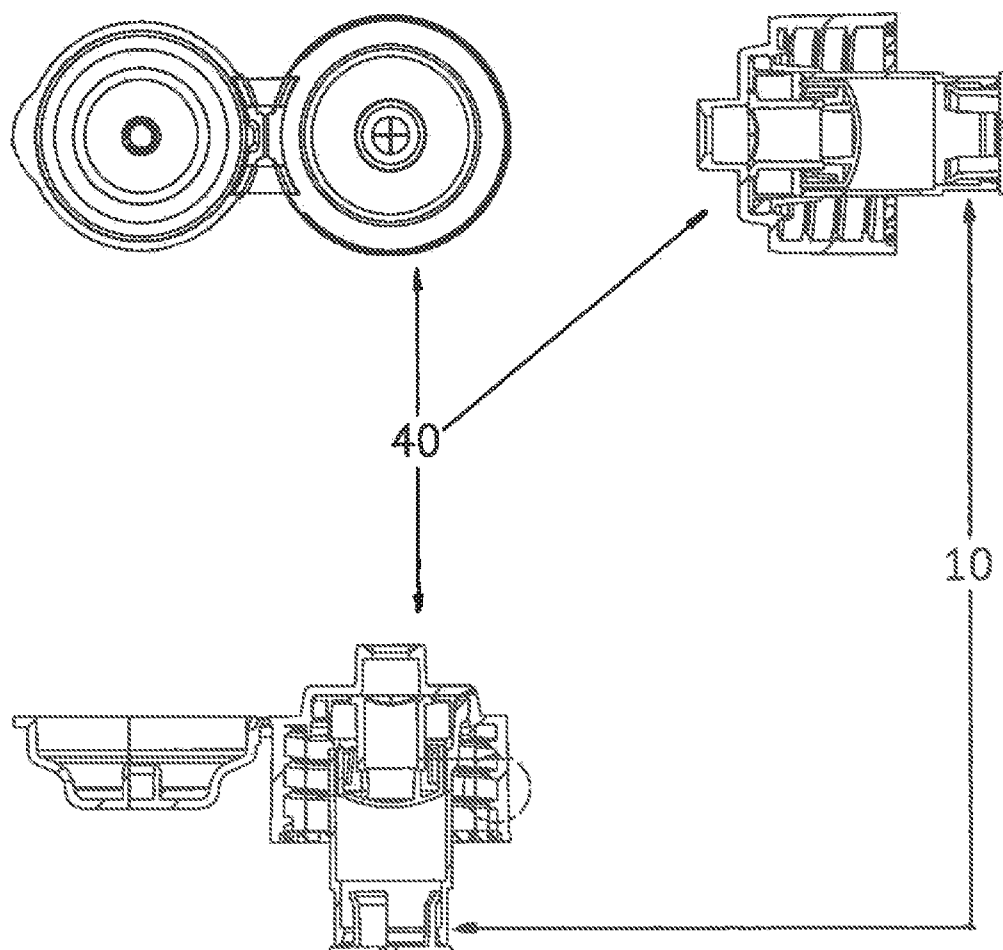


FIG 1

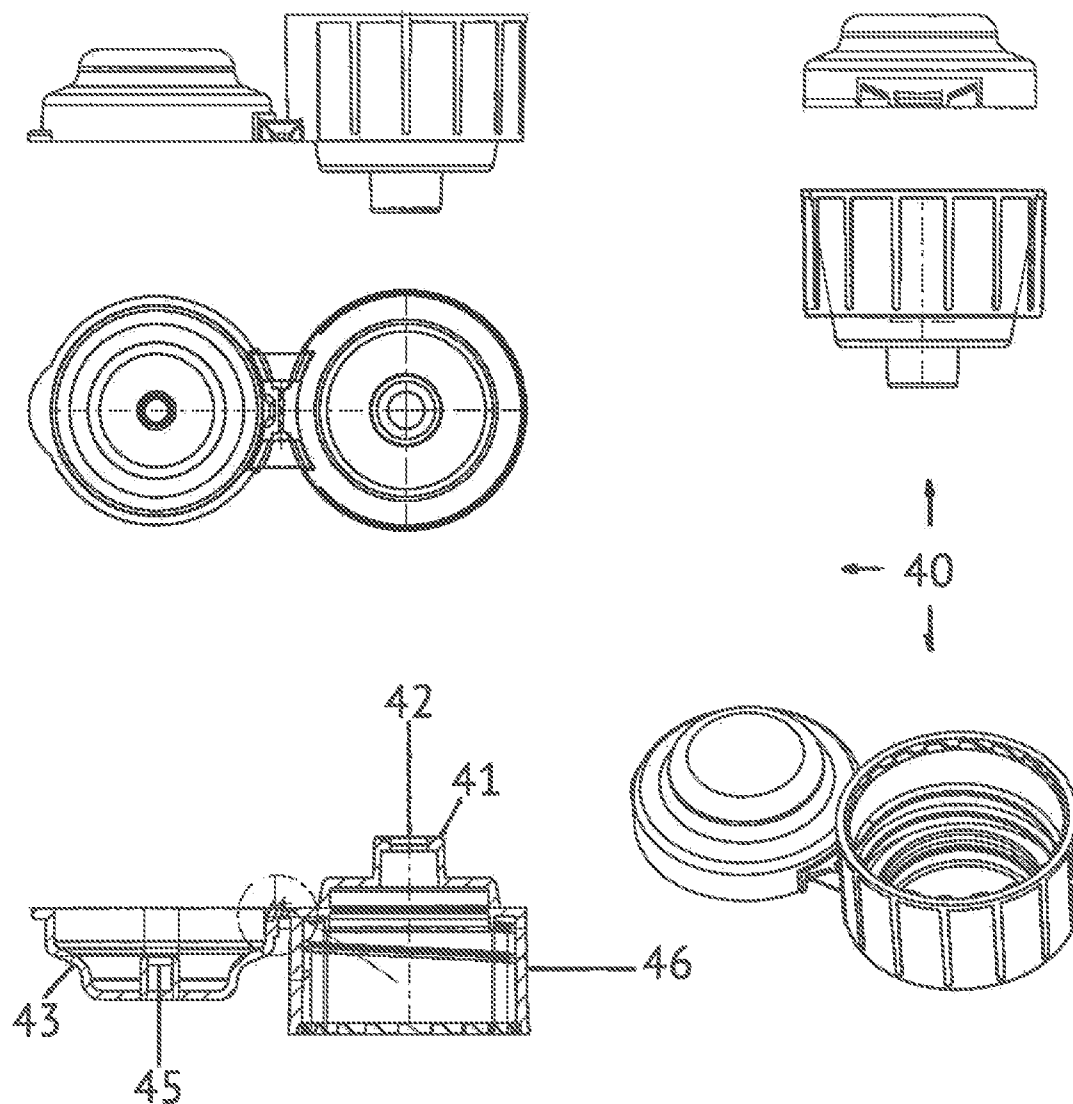


FIG 2

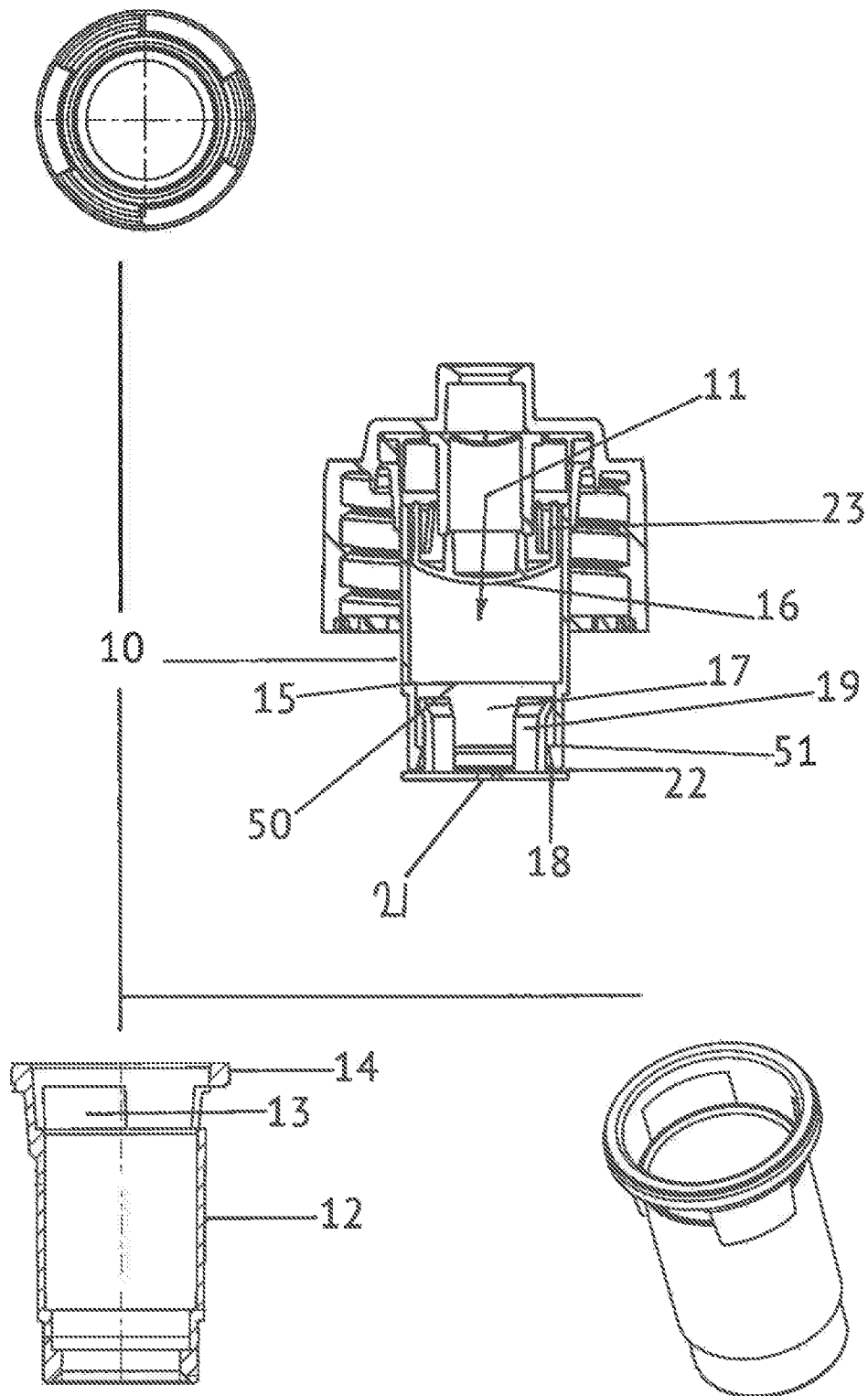
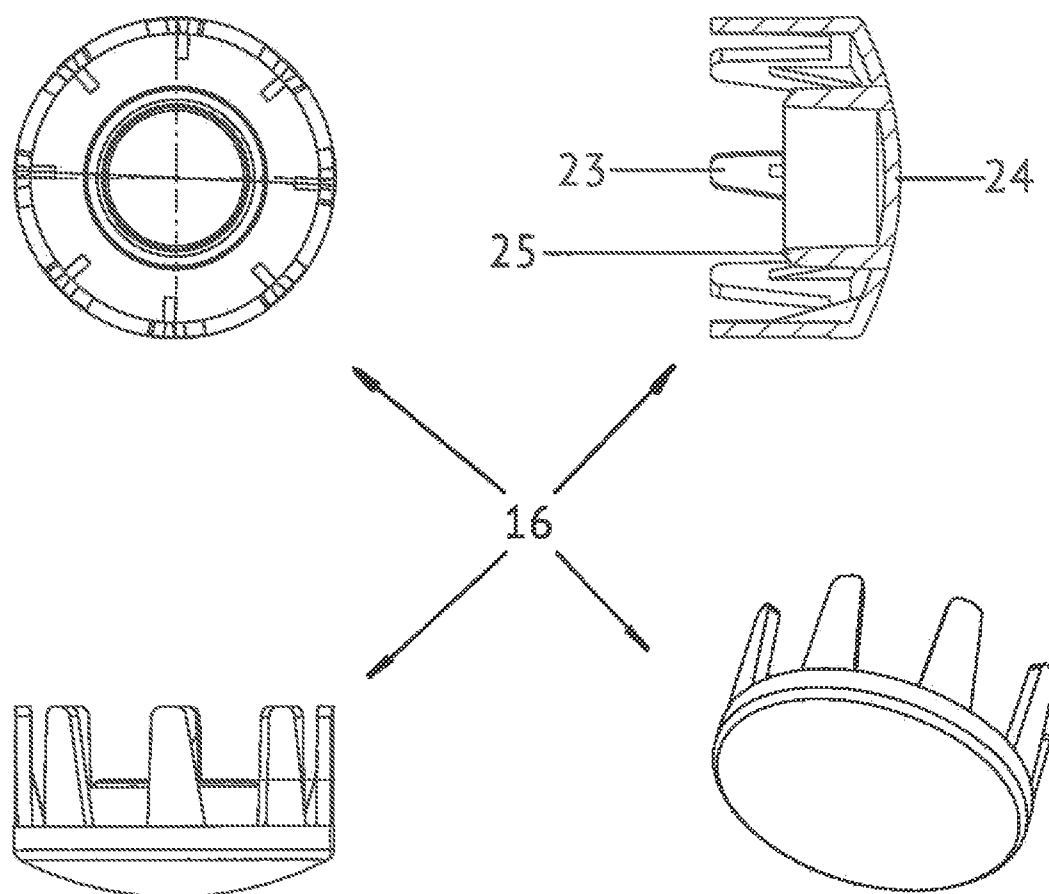


FIG 3



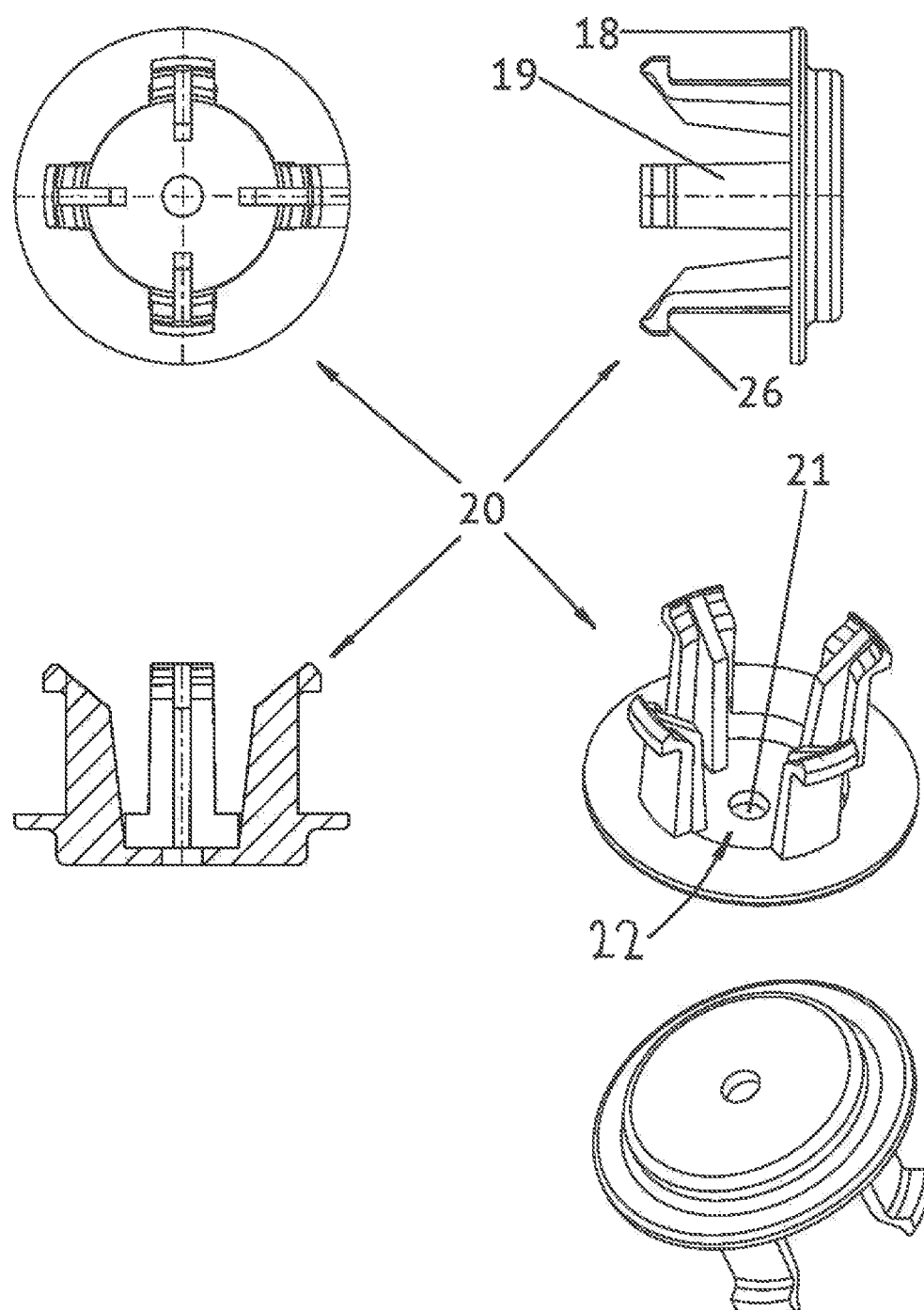


FIG 5

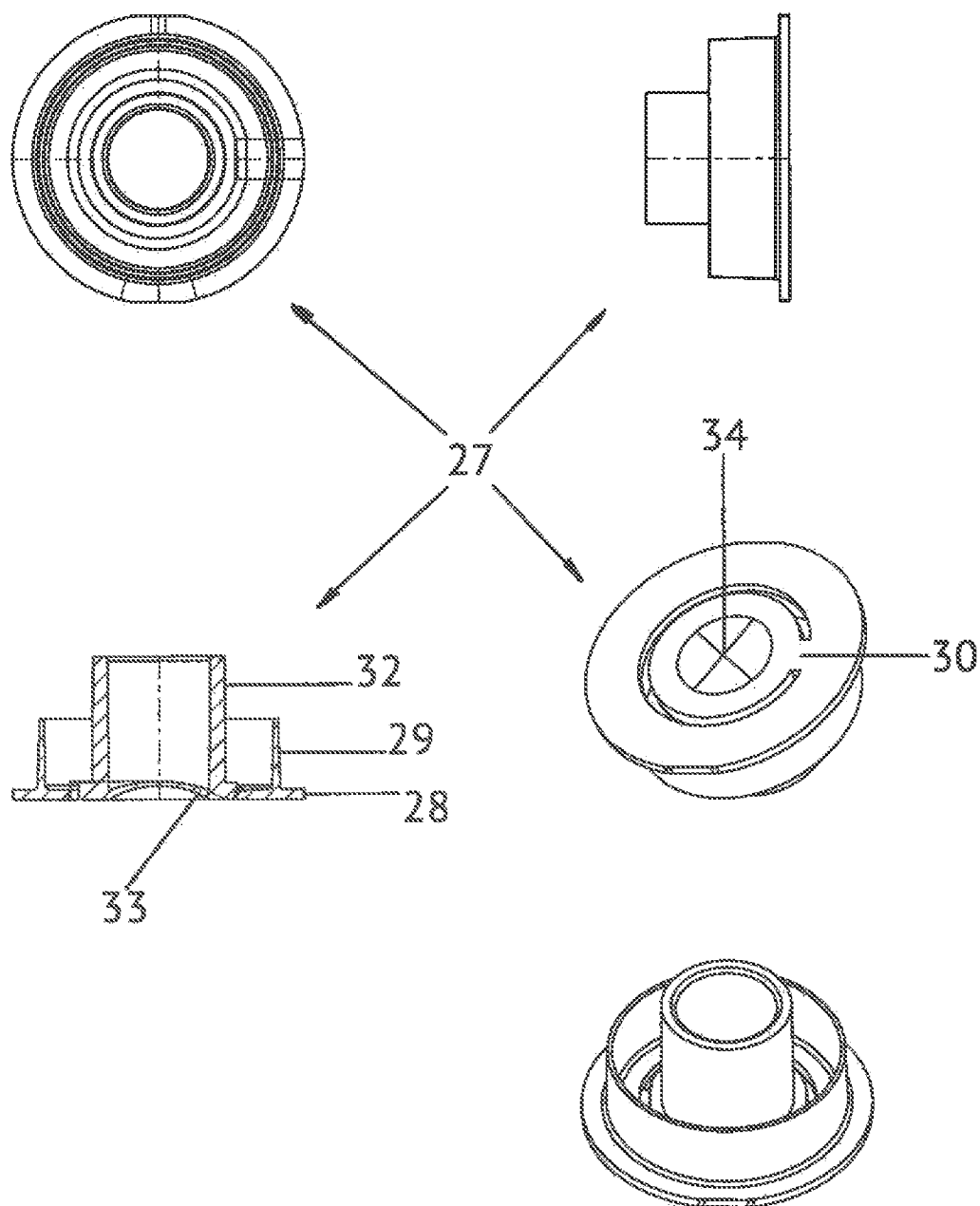


FIG 6

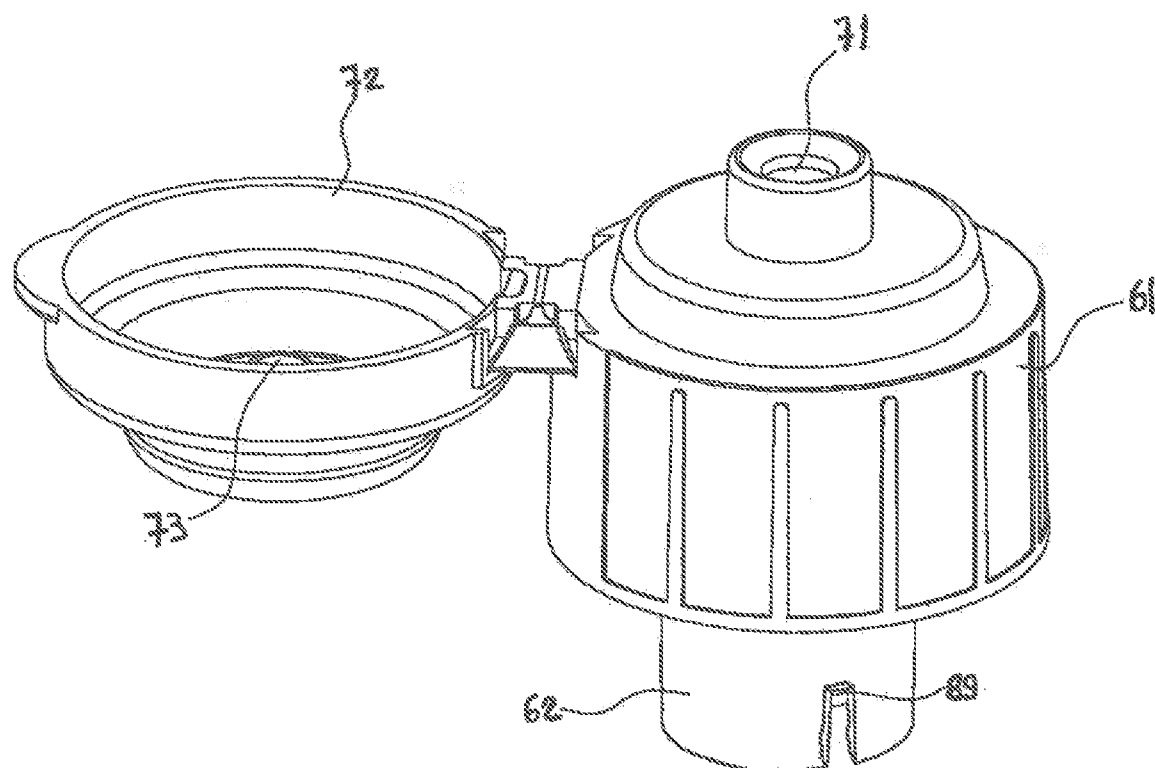


Figure 1

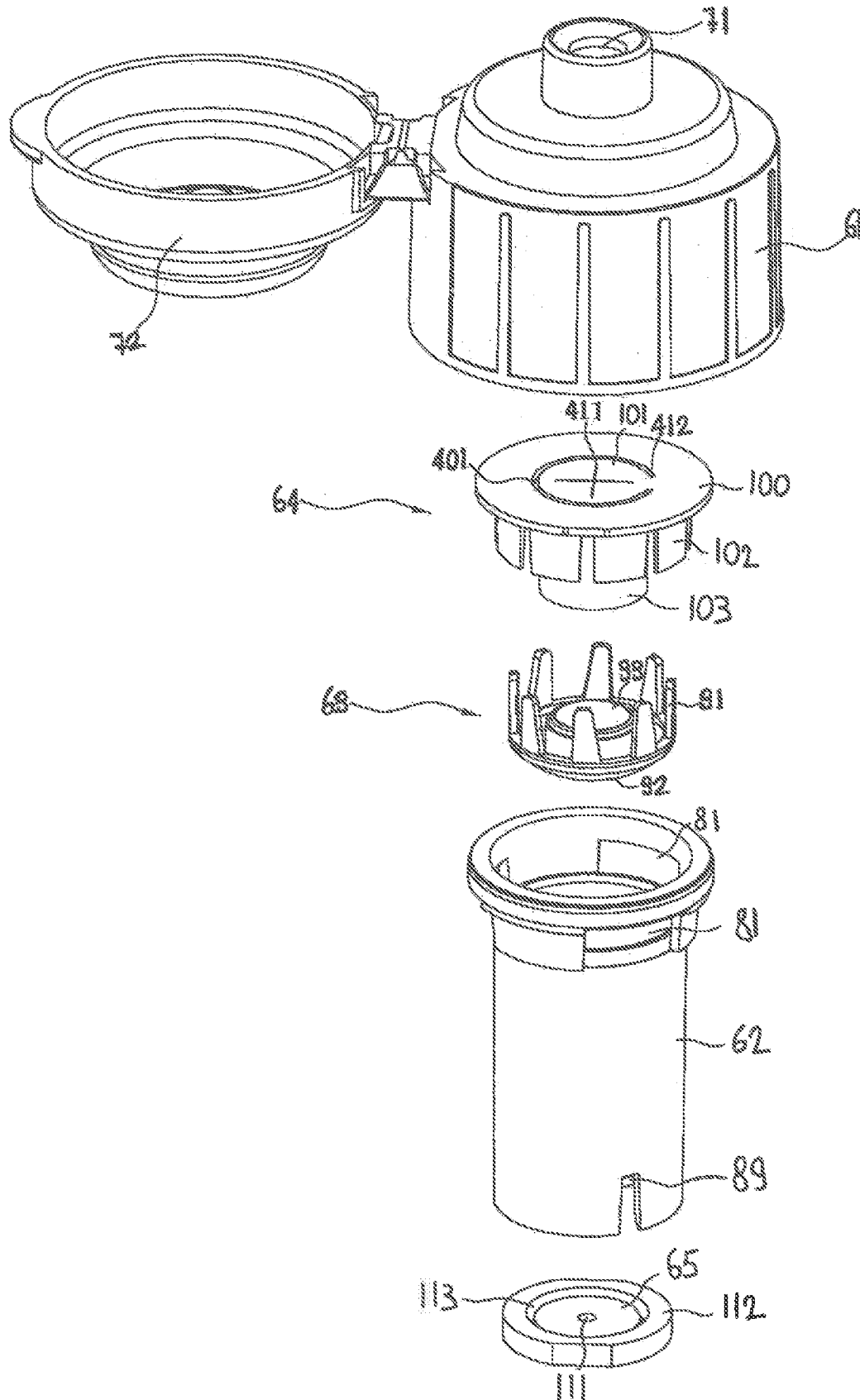


Figure 8

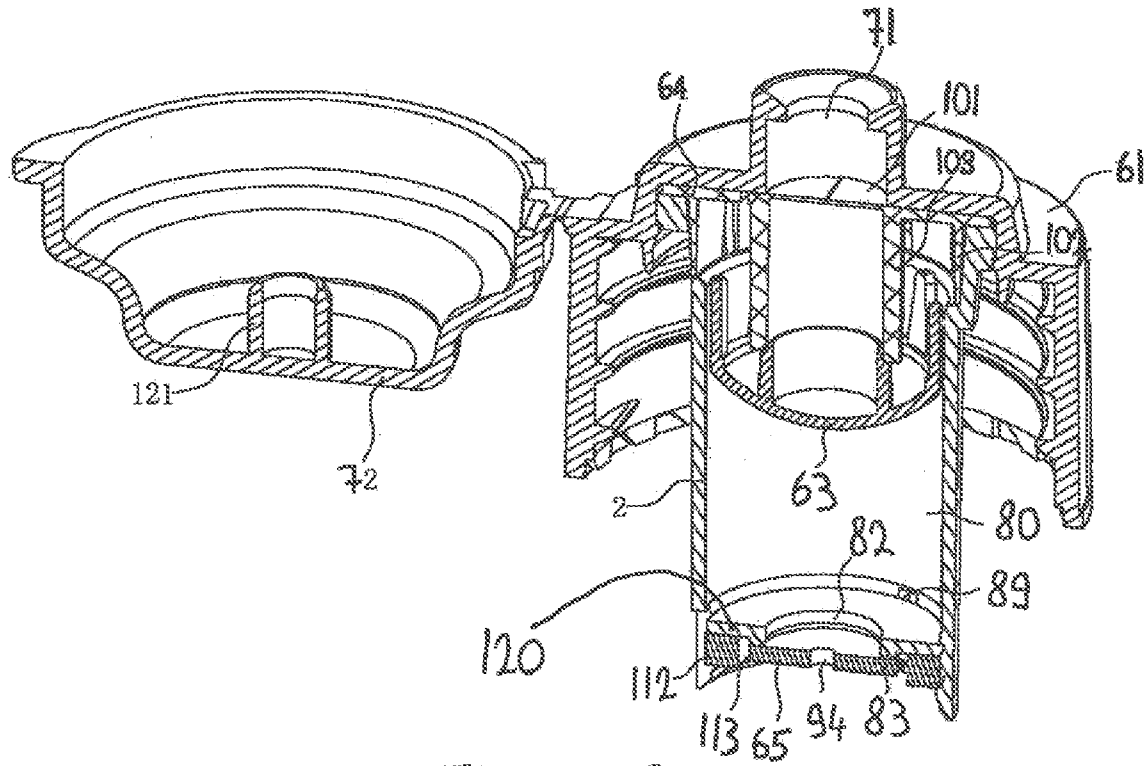


Figure 9

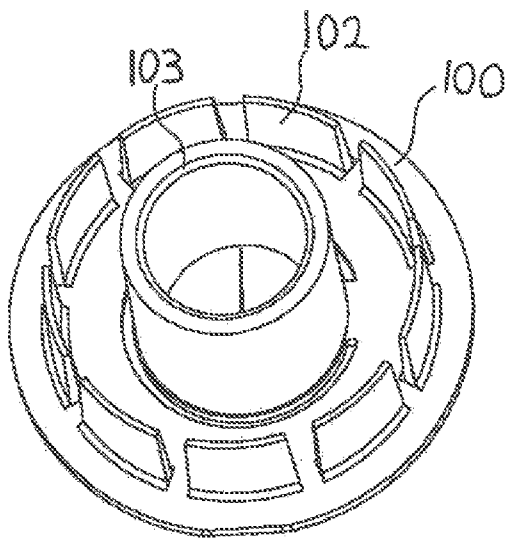


Figure 10

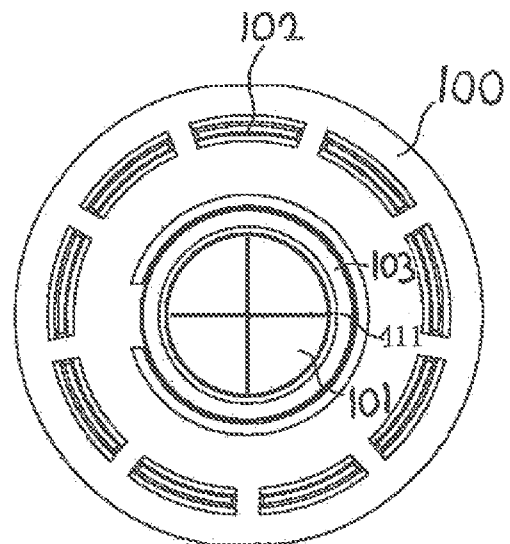


Figure 11

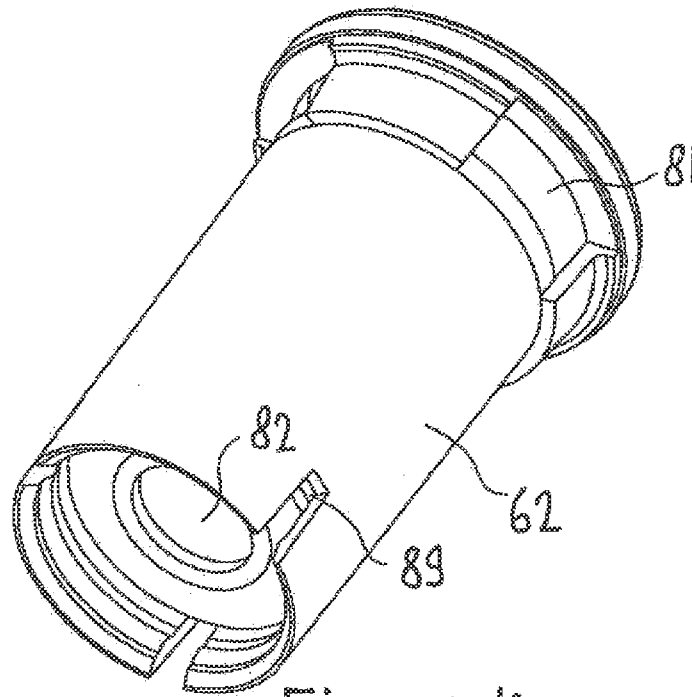


Figure 12

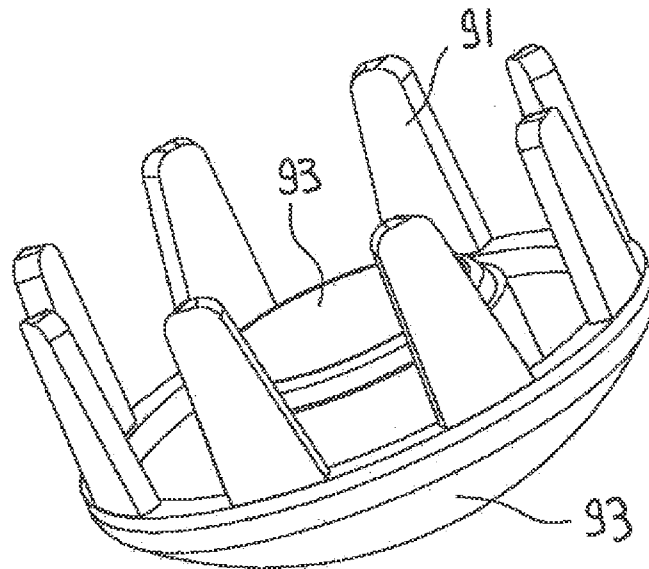
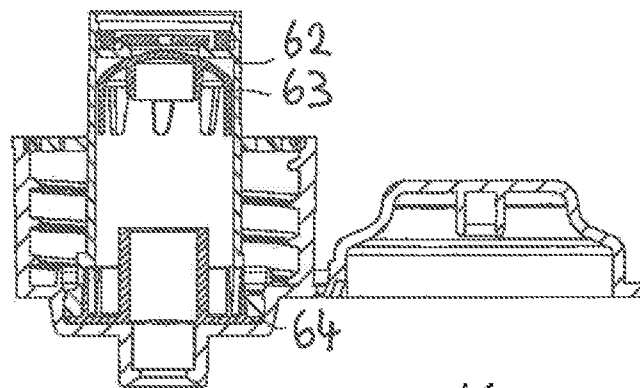
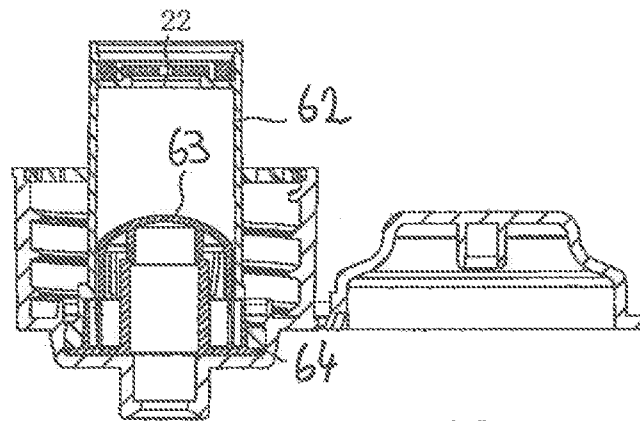
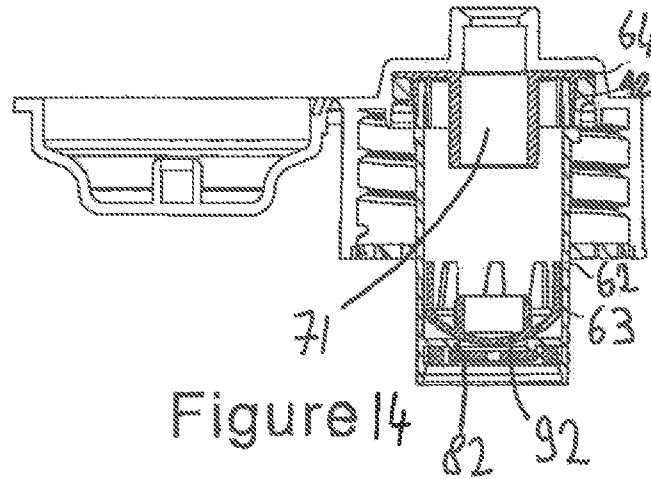


Figure 13



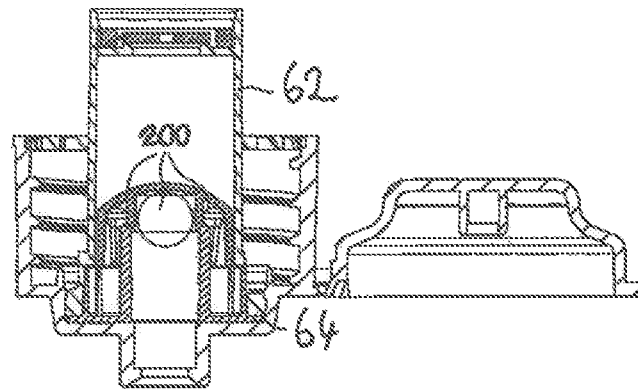


Figure 17

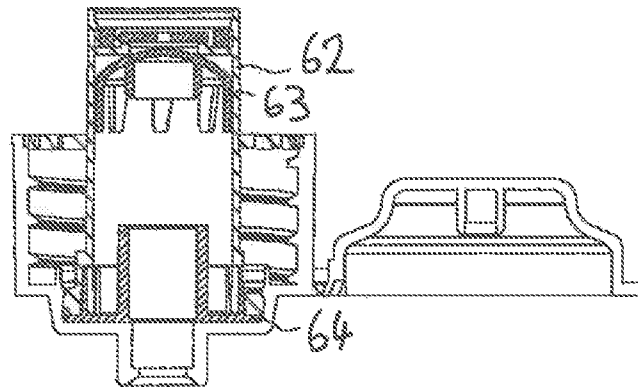


Figure 18

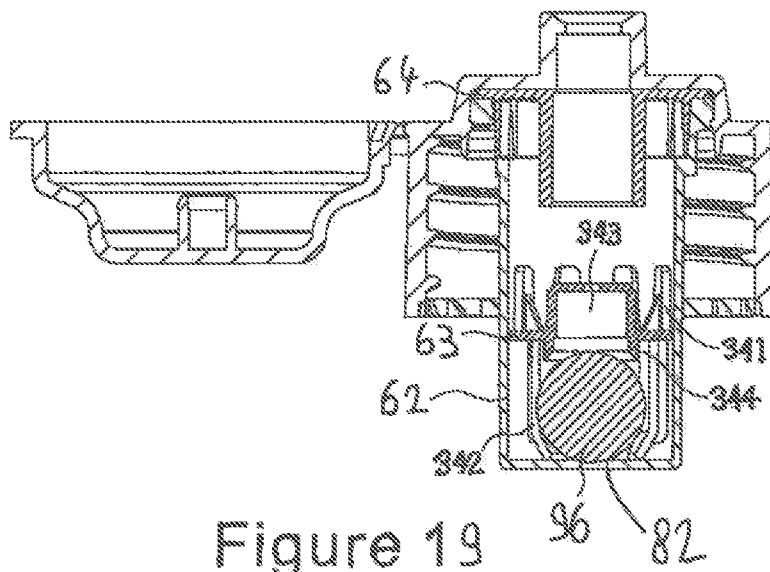


Figure 19

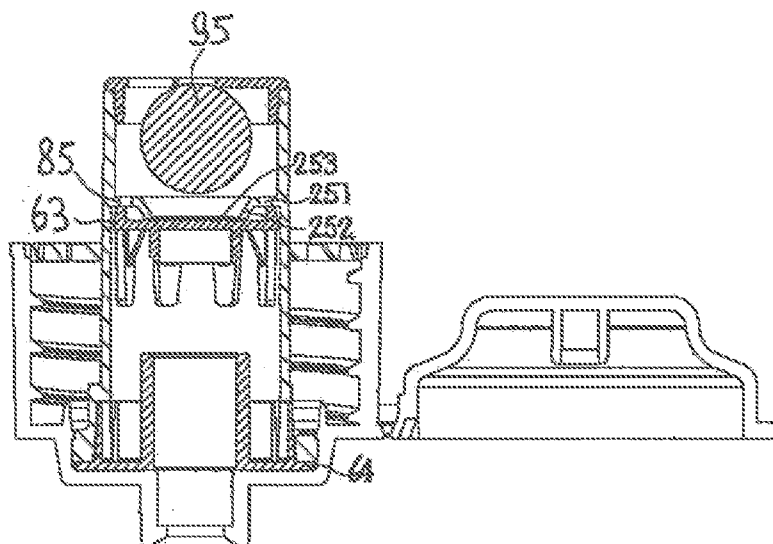


Figure 20

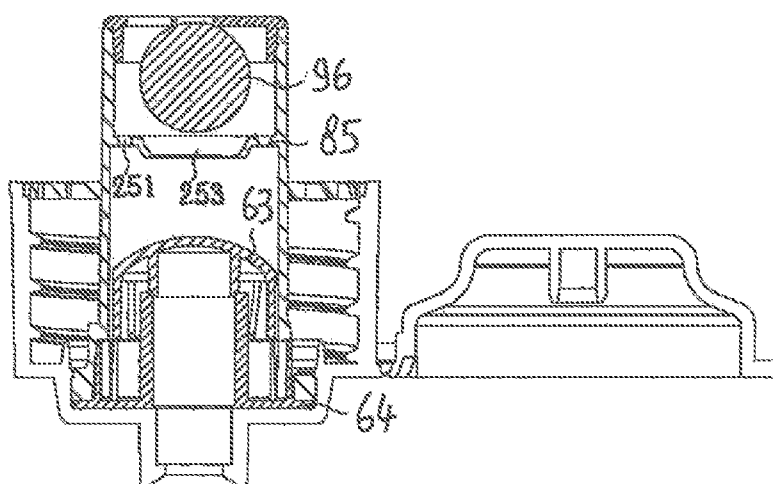


Figure 21

