



(11) **EP 4 367 037 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
18.06.2025 Bulletin 2025/25

(21) Application number: **23847855.6**

(22) Date of filing: **18.08.2023**

(51) International Patent Classification (IPC):
B65D 51/28 (2006.01) **B65D 47/06** (2006.01)
B65D 47/26 (2006.01) **B65D 25/40** (2006.01)
B65D 81/32 (2006.01)

(52) Cooperative Patent Classification (CPC):
B65D 47/08; B65D 51/28

(86) International application number:
PCT/US2023/030529

(87) International publication number:
WO 2024/039816 (22.02.2024 Gazette 2024/08)

(54) **DISPENSING CAP AND DISPENSING CONTAINER**

SPENDERKAPPE UND SPENDERBEHÄLTER

BOUCHON DE DISTRIBUTION ET CONTENANT DE DISTRIBUTION

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**

(30) Priority: **19.08.2022 US 202263399591 P**
19.08.2022 US 202263399599 P
19.08.2022 US 202263399605 P
20.12.2022 US 202263433896 P

(43) Date of publication of application:
15.05.2024 Bulletin 2024/20

(73) Proprietor: **H.J. Heinz Company Brands LLC**
Pittsburgh, Pennsylvania 15222 (US)

(72) Inventors:
• **HILTSE, Balint**
6663 NM Lent (NL)
• **MASKELL, William John**
Marlborough
Wiltshire SN8 2BA (GB)
• **SALMON, Dave Eugene**
Watford
Hertfordshire WD18 0QA (GB)

- **WATSON, Mark**
Marlborough
Wiltshire SN8 2BG (GB)
- **HANSEN, Nicholas Andrew**
Banbury
Oxfordshire OX15 4FX (GB)
- **DEVRIES, Charlotte Catherine Erik**
6717 LD Ede (NL)
- **BEEKMANS, Amy Adriana Wilhelmina**
5688 VH Oirschot (NL)
- **GÓMEZ AVÍN, Daniel**
6512 CB Nijmegen (NL)
- **PEREIRA, Inês Ribau**
6511 SZ Nijmegen (NL)
- **SCHELFHOUT, Leo Victor**
6822 HL Arnhem (NL)

(74) Representative: **Boult Wade Tennant LLP**
Salisbury Square House
8 Salisbury Square
London EC4Y 8AP (GB)

(56) References cited:
JP-A- 2010 260 595 KR-Y1- 200 480 149
US-A- 4 585 149 US-A- 4 964 541
US-A1- 2011 089 189 US-B2- 8 684 231

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

DescriptionTechnical Field

- 5 **[0001]** This disclosure relates generally to container packaging for fluids. More particularly, this disclosure relates to containers with dispensing caps.

Background

- 10 **[0002]** A wide variety of fluid packaged products are available on the market that offer an array of choices to the consumer. Such products may include, for instance, food products such as drinks, sauces, and condiments, personal care products such as body washes, lotions, and hair care products, and home care products such as cleaners. The number of products may be especially vast when products within a certain category are available in many different formulations or recipes. Products, however, are often packaged alone in a single, full-sized container. Thus, if consumers would like to try
15 or use more than one product at a time, consumers typically have to purchase multiple full-sized products or add-ins to mix with other products. The cost, as well as the need to store all the individual containers, can become burdensome to the consumer.

- [0003]** Such issues are often compounded with respect to packaged food products. Consumers desire to try many different food products, and often would like to use several different products in a single meal, but typically face the challenge of limited storage space (e.g., on a refrigerator shelf). In addition, many packaged food products are stored in
20 homes with several different individuals that may have differing food preferences.

[0004] To mitigate these issues, in some cases different substances can be packaged within a single packaged product. This is often implemented by packaging different substances in different containers that are secured and/or stored together.

- 25 **[0005]** In yet another approach, the different substances are disposed in different compartments or chambers of a single container. By one approach, each compartment of the container has a dedicated closure, and the user can open and close each compartment as desired. This approach, however, may be cumbersome to the user, and may not be optimal if it is desired to co-dispense several substances at once. This would be particularly true for fluid substances, as the fluids would be co-dispensed in separate streams instead of in a single stream of the products, which could be difficult to manage.

- 30 **[0006]** By another approach, there may be a single mixing closure that mixes fluids from different compartments of the container within the closure or as the fluids exit the closure. This approach, however, may not be ideal if it is not desired that the fluids are mixed. In one example, US Patent 8672185 discloses a dispensing cap for mixing a primary flowable substance, such as a soap, lotion, or the like, with a small dose of a secondary flowable substance, such as a fragrance. The dispensing cap includes a plurality of reservoirs containing a plurality of secondary flowable substances. Each of the
35 reservoirs is associated with a secondary piston that, when actuated, causes the secondary flowable substance to be expelled from the reservoir into a mixing chamber in the cap, where it is mixed with the primary flowable substance. Upon mixing the two are dispensed together from a dispensing end of the cap. In another example, US 8074825 discloses a container with multiple compartments for holding different materials and a closure with a fitment, where the fitment has separate bottom receptacle areas on one side and a top receptacle on the other. The separate receptacle areas are each exposed to different compartments within the container. US 8 684 231 discloses a dispensing cap comprising: a base
40 having a dispensing channel and configured to be attached to a bottle neck of a bottle, the base having a receptacle; and a cartridge (26) disposable in the receptacle of the base. US 4 964 541 discloses a dispensing cap base for removably coupling to a bottle neck of a bottle, the dispensing cap base comprising: a main body and a base piston element, the main body including: a first end; a second end comprising an ingress portion for receiving a fluid from the bottle; a dispensing channel extending from the first end to the second end for dispensing fluid from the bottle; and a guide channel, the base
45 piston element being movable between a first position and a second position along the guide channel.

[0007] The issues above are solved by the dispensing cap of appended claim 1 and the dispensing cap base of appended claim 12. Further embodiments are disclosed in the dependent claims.

50 Brief Description of the Drawings

[0008] Disclosed herein are embodiments of apparatuses, systems, and methods pertaining to a dispensing container with a dispensing cap, a dispensing cap with a cartridge, and a cartridge for a dispensing cap. This description includes drawings, wherein:

- 55 FIG. 1 is a perspective top view of a dispensing cap with a cartridge therein in accordance with some embodiments.

FIG. 2 is a perspective top view of the cap and cartridge of FIG. 1 with the cartridge removed from the cap in

accordance with some embodiments.

FIG. 3 is a perspective top view of a dispensing bottle with the cap and cartridge of FIG. 1 in accordance with some embodiments.

FIG. 4 is a perspective bottom cross sectional view of a dispensing cap in accordance with some embodiments, shown attached to a bottle.

FIG. 5 is a perspective bottom cross sectional view of an underside of a dispensing cap in accordance with some embodiments.

FIG. 6 is a perspective horizontal cross sectional view of the dispensing cap of FIG. 5 taken along line 6-6 in accordance with some embodiments.

FIG. 7 is a cross sectional view of a cartridge for the dispensing cap of FIG. 2 taken along line 7-7 in accordance with several embodiments.

FIG. 8 is a cross sectional view of the dispensing cap of FIG. 5 taken along line 8-8 in a first unactuated piston position in accordance with some embodiments.

FIG. 9 is a cross sectional view of the dispensing cap of FIG. 5 taken along line 8-8 in a second fully extended piston position in accordance with some embodiments.

FIG. 10 is a cross sectional view of the dispensing cap of FIG. 1 in use without a cartridge inserted therein, in a fully extended piston position dispensing only fluid from the bottle.

FIG. 11 is an illustration of the dispensed fluids in accordance with some embodiments.

FIG. 12 is a perspective top view of an alternative embodiment of a dispensing cap with a cartridge therein.

FIG. 13 is a side view of the dispensing cap of FIG. 12 with a cartridge therein.

FIG. 14 is a bottom perspective view of the dispensing cap of FIG. 12 with a cartridge therein.

FIG. 15 is an exploded view of the dispensing cap of FIG. 12 with a cartridge therein.

FIG. 16 is a top perspective view of the cartridge of the dispensing cap of FIG. 12.

FIG. 17 is a bottom perspective view of the cartridge of the dispensing cap of FIG. 12.

FIG. 18 is a bottom perspective view of the cartridge of the dispensing cap of FIG. 12.

FIG. 19 is an exploded view of the cartridge of the dispensing cap of FIG. 12.

FIG. 20A is a side perspective view of a valve body of the cartridge of FIG. 16.

FIG. 20B is a bottom perspective view of a valve body of the cartridge of FIG. 16.

FIG. 20C is a side perspective view of a valve body of the cartridge of FIG. 16.

FIG. 20D is a top perspective view of a valve body of the cartridge of FIG. 16.

FIG. 21A is a top perspective view of a cartridge piston element of the cartridge of FIG. 16.

FIG. 21B is a bottom perspective view of a cartridge piston element of the cartridge of FIG. 16.

FIG. 22A is a perspective view of a cartridge body of the cartridge of FIG. 16.

FIG. 22B is a perspective view of a cartridge body of the cartridge of FIG. 16.

FIG. 22C is a top perspective view of a cartridge body of the cartridge of FIG. 16.

5 FIG. 22D is a bottom perspective view of a cartridge body of the cartridge of FIG. 16.

FIG. 22E is a bottom perspective view of a cartridge body of the cartridge of FIG. 16.

10 FIG. 23 is a top perspective view of a cap base of the dispensing cap of FIG. 16.

FIG. 24 is a bottom perspective view of a cap base of the dispensing cap of FIG. 16.

FIG. 25 is a centrally taken cross-section view of a cap base of the dispensing cap of FIG. 16.

15 FIG. 26 is an exploded view of the cap base of FIG. 23.

FIG. 27A is a perspective view of a base piston element of the cap base of FIG. 23.

20 FIG. 27B is a perspective view of a base piston element of the cap base of FIG. 23.

FIG. 27C is a perspective view of a base piston element of the cap base of FIG. 23.

FIG. 28A is a perspective view of a portion of the cap base of FIG. 23.

25 FIG. 28B is a perspective view of an additional portion of the cap base of FIG. 13.

FIG. 29 is a top perspective view of an alternative embodiment of a dispensing bottle having an alternative dispensing cap with an alternative cartridge therein.

30 FIG. 30 is a portion of a centrally taken cross-section view of the dispensing bottle of FIG. 29.

FIG. 31 is a top perspective view of the dispensing cap of FIG. 29.

35 FIG. 32 is a bottom perspective view of the dispensing cap of FIG. 29.

FIG. 33 is an exploded view of the dispensing cap of FIG. 29.

FIG. 34A is a top perspective view of a cap base of the dispensing cap of FIG. 29.

40 FIG. 34B is a centrally taken cross-section of the cap base of the dispensing cap of FIG. 29.

FIG. 35A is a top perspective view of the cap base of the dispensing cap of FIG. 29 shown without a base piston element.

45 FIG. 35B is a bottom perspective view of the cap base of the dispensing cap of FIG. 29 shown without a base piston element.

FIG. 36A is a top perspective view of the cartridge of FIG. 29.

50 FIG. 36B is a bottom perspective view of the cartridge of FIG. 29.

FIG. 36C is a centrally taken cross-section view of the cartridge of FIG. 29.

55 FIG. 37A is a left side perspective view of a valve body of the cartridge of FIG. 29.

FIG. 37B is a right side perspective view of the valve body of the cartridge of FIG. 29.

FIG. 37C is a bottom perspective view of the valve body of the cartridge of FIG. 29.

FIG. 37D is a top perspective view of the valve body of the cartridge of FIG. 29.

FIG. 38A is a top perspective view of a cartridge body of the cartridge of FIG. 29.

FIG. 38B is a bottom perspective view of the cartridge body of the cartridge of FIG. 29.

FIG. 39A is a top perspective view of a cartridge piston element of the cartridge of FIG. 29.

FIG. 39B is a bottom perspective view of the cartridge piston element of the cartridge of FIG. 29.

FIG. 40A is a perspective view of a portion of the cap base of the dispensing cap of FIG. 29.

FIG. 40B is a perspective view of an additional portion of the cap base of the dispensing cap of FIG. 29.

FIG. 41A is an illustration of the dispensed fluids in accordance with some embodiments.

FIG. 41B is an illustration of the dispensed fluids in accordance with some embodiments.

[0009] Elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions and/or relative positioning of some of the elements in the figures may be exaggerated relative to other elements to help to improve understanding of various embodiments of the present disclosure. Also, common but well-understood elements that are useful or necessary in a commercially feasible embodiment may be omitted in order to facilitate a less obstructed view of these various embodiments of the present invention. Certain actions and/or steps may be described or depicted in a particular order of occurrence when such specificity with respect to sequence is not actually required. The terms and expressions used herein have the ordinary technical meaning as is accorded to such terms and expressions by persons skilled in the technical field as set forth above except where different specific meanings have otherwise been set forth herein.

[0010] Further, the following description of illustrative embodiments according to principles of the present disclosure is intended to be read in connection with the accompanying drawings, which are to be considered part of the entire written description. In the description of embodiments disclosed herein, any reference to direction or orientation is merely intended for convenience of description and is not intended in any way to limit the scope of the present invention. Relative terms such as "lower," "upper," "horizontal," "vertical," "above," "below," "up," "down," "top" and "bottom" as well as derivative thereof (e.g., "horizontally," "downwardly," "upwardly," etc.) should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These relative terms are for convenience of description only and do not require that the apparatus be constructed or operated in a particular orientation unless explicitly indicated as such. Terms such as "attached," "affixed," "connected," "coupled," "interconnected," and similar refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise. Moreover, the features and benefits of the disclosure are illustrated by reference to certain embodiments. Accordingly, the invention expressly should not be limited to such embodiments illustrating some possible non-limiting combination of features that may exist alone or in other combinations of features.

Detailed Description

[0011] Described herein are apparatuses, systems, and methods of manufacture and use pertaining to a dispensing container having a dispensing cap with a cartridge. The dispensing container and cap are useful to dispense more than a single fluid. In one illustrative approach, the dispensing cap may dispense up to two different fluids, such as, for example, two different condiments, from the dispensing container at the same time. When there are two fluids, one fluid may be contained in a main container body of the dispensing container, such as within a bottle, and another fluid may be contained in the dispensing cap, and particularly in the cartridge of the cap.

[0012] Some embodiments include a dispensing cap or closure for a dispensing container. The dispensing cap may include a cap base configured to be attached to a neck of a container, such as a bottle, a dispensing channel which fluid from the container may enter to be dispensed, and a receptacle having a cartridge disposed therein. In some configurations, a base piston element is disposed in the base, and is movable between a first position and a second position. In some embodiments this movement occurs when a primary fluid disposed in the container is forced into the cap, which causes at least a portion of the fluid to engage the base piston element, moving the base piston element towards the second position. In one illustrative embodiment, as the base piston element is moved toward the second position, it is also configured to drive a cartridge piston element disposed in the cartridge. The movement of the cartridge piston element may

thereby cause a secondary fluid disposed in the cartridge to egress from the cartridge. By one approach, the cartridge is configured to be removably attachable to the cap base, for example via corresponding threads on the cartridge and receptacle. The dispensing cap may further include a flip-top lid.

[0013] Further described herein is a cartridge for a dispensing cap. In some configurations, the cartridge includes a container, vessel, or cartridge body, a valve element, and the above-mentioned cartridge piston element. By some approaches, the valve element is coupled to an outer surface of the body on a dispensing side of the cartridge. The body, valve element, and cartridge piston element are configured to form a container defining a cavity for a fluid disposed in the cartridge. In some approaches, the container is removably attachable to a dispensing cap. In an illustrative embodiment, the valve element has a tube portion extending within the container. In such a configuration, the tube portion may include at least one outlet opening in a wall thereof. In addition, the tube portion may be movable relative to the body between a first position and a second position. For example, the first position of the tube portion may be where the at least one opening is covered by an inner wall of the body to inhibit a fluid in the container from flowing into the tube portion via the at least one outlet opening. Further, the second position may be where the fluid in the container is able to flow through the at least one outlet opening and into the tube portion. In some embodiments, attaching the cartridge to the base of the dispensing cap brings an end of the tube portion into engagement with an end of the dispensing channel of the cap base, moving the tube portion to open the at least one outlet opening.

[0014] By one approach, the cartridge includes a body removably attachable to a dispensing cap. In such a configuration, the body typically defines at least a portion of a cavity with a first fluid disposed therein, and an internal cylindrical wall of the body defines at least a portion of a central opening of the body. Attached to an outer surface of the body, in one approach, is a valve element, having a tube portion that extends within the central opening of the body. In use, the tube portion typically has a first end to receive a second fluid flowing into the tube portion from the dispensing cap and a second end through which the first and second fluids are dispensed. The tube portion also typically includes at least one outlet opening in a wall of the tube portion through which the first fluid is able to be dispensed from the cavity to join the second fluid.

[0015] In some embodiments of the cartridge, the cartridge piston element is generally disposed in the cavity of the body about the central opening of the body. In this manner, the cartridge piston is generally movable between a first position and a second position to force the first fluid toward the at least one outlet opening. In an illustrative configuration, the valve element is elastically deflectable such that the tube portion is movable along an axis of the central opening to close and open the at least one outlet opening. In one illustrative embodiment, the valve element is formed from polypropylene.

[0016] In one configuration, the cartridge disposed in the receptacle of the cap base includes a side wall, the side wall having a lower portion that is received in the receptacle and an upper portion which protrudes from the receptacle, the upper portion including one or more gripping surfaces. In some embodiments, the cartridge disposed in the receptacle of the cap base includes external threads for being threaded into the receptacle, and one or more projections on the external threads engage one or more recesses on internal threading of the receptacle to provide a user an auditory and/or tactile indication when the cartridge is positioned correctly in the receptacle.

[0017] Further described herein is a dispensing container or bottle which includes a dispensing cap. In one approach, a dispensing cap including a cartridge, such as described above, is threaded onto the bottle neck of a bottle, wherein a primary fluid is disposed in the bottle and a secondary fluid is disposed in the cartridge.

[0018] By an illustrative approach, a dispensing container includes a bottle including a primary fluid, a dispensing cap removably attached to a neck of the bottle, and a cartridge insertable into a receptacle of the dispensing cap and including a secondary fluid within a cavity of the cartridge. In some configurations, the dispensing cap includes a dispensing channel through which fluid is dispensed from the dispensing container, the channel defining at least a portion of a fluid path. Additionally, the cartridge may include at least one outlet opening which permits the secondary fluid to egress from the cavity, the at least one outlet opening positioned to direct fluid into the fluid flow path.

[0019] In some embodiments, a stream of the primary fluid and at least one stream of the secondary fluid are joined together in a fluid flow path as the primary fluid and secondary fluid are dispensed. By one approach, the streams are joined together and dispensed without substantial mixing of the primary and secondary fluids. In an illustrative embodiment, the primary and secondary fluids are different sauces or condiments, having viscosities and flow resistances typical to such products. In some configurations, the primary and secondary fluids have similar fluid properties, such as viscosity, texture, density, compressibility, surface tension, etc., whereas in other configurations, the primary and secondary fluids have dissimilar fluid properties.

[0020] The dispensing bottle may also include a movable base piston element disposed in the dispensing cap. In some configurations, the base piston element is configured to engage a movable cartridge piston element of the cartridge to force the secondary fluid toward the at least one outlet opening of the cartridge. The base piston element may be movable between a first position and a second position. In some embodiments, the dispensing cap includes one or more stops that inhibit the base piston element from moving beyond the second position. By one approach, the bottle has elastically flexible walls, and applying manual pressure to the bottle forces at least a portion of the primary fluid against the base piston element of the dispensing cap to move the base piston element, which, in turn, moves the cartridge piston element. The

movement of the cartridge piston element thereby forces the secondary fluid to exit the at least one outlet opening of the cartridge. In such a configuration, applying manual pressure to the bottle also causes the primary fluid to enter and advance along the dispensing channel of the dispensing cap to dispense the primary fluid.

[0021] In another approach, a method of dispensing a primary fluid and one or more secondary fluids together from a dispensing container uses the dispensing container described herein. The dispensing container, in some illustrative approaches, includes a dispensing cap as disclosed herein that is removably attached to the container, for example, to the neck of a flexible bottle. The method includes a step of applying pressure to the flexible bottle effective for an amount of a primary fluid disposed in the bottle to egress from the flexible bottle into the dispensing cap. A user may, for example, manually apply pressure to the bottle by squeezing the bottle.

[0022] In one configuration, a first portion of the primary fluid flows into the dispensing channel, and a second portion of the primary fluid exerts pressure on the base piston element, moving the base piston element from a first position toward a second position. In use, the movement of the base piston element may then cause a cartridge piston element in the cartridge to move, for example towards a dispensing side of the cap. This movement forces a secondary fluid disposed in the cartridge to egress through at least one outlet opening in the cartridge to join the primary fluid from the dispensing channel in a flow path where they may be dispensed from the cap together. In an illustrative configuration, they are joined together within a tube portion of a valve element of the cartridge and dispensed without substantial mixing of the primary and secondary fluids such that the fluids are each distinctly visible in the dispensed stream.

[0023] In embodiments, the method may include inserting the cartridge into the cap such that a cartridge is not already disposed therein. Accordingly, the method also may include inserting the cartridge into a receptacle of the dispensing cap prior to use. For example, a user may screw the cartridge into the dispensing cap. The methods of inserting the cartridge into the receptacle of the dispensing cap are not particularly limited, as long as the cartridge can be manually inserted and removed by a typical user without unreasonable effort, and as long as the cartridge stays securely in place after insertion and during use. For example, as an alternative, the cartridge may be mated with a remainder of the dispensing cap such as the receptacle via other mechanical connections such as, e.g., an interference fit, a snap fit, friction fit, and/or a detent or other biasing mechanism.

[0024] In some embodiments, a user typically orients the cartridge by aligning geometry of the cartridge with corresponding geometry of the receptacle to insert the cartridge into the receptacle of the cap. For example, there may be a marking, notch, or other visual indication on the cap and/or cartridge to indicate how the cartridge should be inserted or oriented. In some embodiments, a user may know the cartridge was properly inserted via some kind of indication, such as a clicking sound and/or manual or visual feedback. The indication may let a user know that the cartridge is in a correct position for dispensing fluid. For example, the indication may coincide with the one or more outlet openings in the cartridge being open and no longer blocked/sealed, so that the fluid disposed in the cavity of the cartridge may exit the outlet openings.

[0025] In some embodiments, the cartridge includes external threads for being threaded into the receptacle, wherein one or more projections or recesses on the external threads engage one or more projections or recesses on internal threading of the receptacle to provide a user an auditory and/or tactile indication when the cartridge is positioned correctly in the receptacle. The method may include threading the cartridge into the receptacle until the user receives the indication.

[0026] The method may also include threading the base of the dispensing cap onto the neck of the bottle. In some embodiments, the neck receives an ingress portion of the base whereby the primary fluid can flow through an inlet of the dispensing channel and through one or more cap base openings spaced about the inlet to move the base piston element. In some approaches, the dispensing channel defines at least a portion of a fluid flow path, and the at least one inner opening of the cartridge is positioned to direct the secondary fluid into the fluid flow path.

[0027] In certain non-limiting embodiments, the secondary fluid has a viscosity between about 7.0 Pa.s to about 25.0 Pa.s (about 7,000 to about 25,000 centipoise) or between about 7.0 Pa.s to about 20.0 Pa.s (7,000 to about 20,000 centipoise).

[0028] By one approach, the step of inserting the cartridge into the receptacle of the dispensing cap (for instance, by screwing or threading) brings the tube portion of the valve element of the cartridge into engagement with an end of the dispensing channel of the dispensing cap base, thereby moving the tube portion to open the at least one outlet opening of the cartridge. As noted above, the valve element, including the tube portion, may be formed of an elastically deflectable or otherwise flexible material effective to allow the movement to occur. In an illustrative configuration, upon inserting the cartridge into the receptacle of the dispensing cap, the flexible tube portion is pushed in the direction of the dispensing side of the cap, and a user may see the outer surface of the valve element being pushed or flexed outwards from the top of the cap. This could be a further indication to the user that the cartridge is correctly seated for dispensing the fluid.

[0029] In some embodiments, the tube portion of the cartridge is aligned with a central opening of the cartridge, and the at least one inner opening is formed in a wall of the tube portion, a first end of the tube portion receiving the primary fluid from the dispensing channel, and the tube portion having a second end containing the outlet through which the primary and secondary fluids are dispensed.

[0030] The method also may include a user removing and/or replacing the cartridge from the dispensing cap. In some

embodiments, the user may insert a different cartridge into the cap, for example if the first cartridge is substantially spent or has run out of fluid, or if the user desired to use a cartridge with a different fluid flavor and/or mouthfeel. In one configuration, the user may remove the cartridge and dispense only the fluid disposed in the bottle via the dispensing cap. In such a configuration, the fluid from the bottle is dispensed from the cap through the dispensing channel in the cap base.

[0031] The method may further include multiple users using the bottle multiple times to dispense the fluids contained therein as needed. For example, if the dispensing container is a condiment container which contains one condiment (e.g., a primary fluid) in the bottle, and another condiment (e.g., a secondary fluid) in the cartridge of the dispensing cap, the users may dispense multiple servings of both condiments during meals. In some embodiments, the users may also interchange different cartridges having different fluids in the dispensing cap or replace a cartridge in the cap with a new cartridge when the first cartridge empties.

[0032] In some embodiments, a method of manufacturing a dispensing container or bottle includes the steps of forming a flexible bottle and disposing a primary fluid therein, and forming a dispensing cap. Advantageously, it is contemplated that the dispensing caps disclosed herein can easily interface with containers or bottles that have already been designed and manufactured. For example, a bottle designed and manufactured for packaging ketchup may be provided with a conventional dispensing cap and sold as a package containing a single product (e.g., ketchup). However, that same bottle may alternatively be provided and/or used in conjunction with the manufactured dispensing cap described herein, so that a packaged bottle dispensing multiple products (e.g., ketchup and chipotle sauce) can be produced.

[0033] By one approach, forming a dispensing cap includes forming a base having a dispensing channel and a receptacle, the base being configured to be attached to a bottle neck. Forming a dispensing cap, in some configurations, further includes forming a base piston element and coupling it to the base. In this manner, the piston element is movable between a first position and a second position such that as fluid disposed in the bottle is forced toward the dispensing channel to dispense the fluid at least a portion of the fluid engages the base piston element and moves the base piston element toward the second position. The dispensing cap can also be formed to include a hinged flip-top lid.

[0034] A further step may include forming a cartridge to be disposed in the receptacle of the base. In one embodiment, the cartridge is formed with a base piston element configured to drive a cartridge piston element of the cartridge as the base piston element is moved from the first position toward the second position. By one approach, the step of forming the cartridge includes forming three components: a cartridge body, a valve element, and a cartridge piston element. The step may include, for example, disposing the valve element on a dispensing side of the cartridge body and the cartridge piston element on the side of the cartridge body opposite the dispensing side, the three components forming a container for containing a fluid. A further step may include disposing a fluid in the cartridge. In one illustrative configuration, the fluid disposed in the cartridge is a different fluid than the fluid in the bottle. In one configuration, a manufacturing step includes disposing the filled cartridge in the receptacle of the dispensing cap, and, in some embodiments, threading the dispensing cap with the filled cartridge onto the filled bottle.

[0035] In some embodiments, a method of manufacturing a cartridge for a dispensing cap includes providing a fluid, forming a cartridge container comprising a central opening and a cavity for containing the fluid, forming a cartridge piston element dimensioned to slide along the cavity of the cartridge container and force the fluid out of the cavity, and forming a valve element having a tube portion dimensioned to extend within the central opening. By some approaches, the tube portion includes at least one outlet opening in a wall thereof. In addition, the method of manufacturing also typically includes assembling a cartridge by disposing the cartridge piston element in the cavity of the cartridge container, filling the cavity with a fluid, and coupling the valve element to the container. In this manner, the tube portion is typically aligned with the central opening of the container. Alternatively, the valve element may first be coupled to the container, the cavity then filled with the fluid, and the cartridge piston element subsequently disposed in the cavity of the cartridge container.

[0036] In some embodiments, a method of manufacturing a dispensing cap includes forming a dispensing cap base, wherein the dispensing cap base includes a dispensing channel and is configured to be attached to a neck of a bottle. In some aspects, the base has a receptacle dimensioned to receive the cartridge. The method of manufacturing also may include forming a base piston element and disposing the base piston element in the dispensing cap base, where the base piston element is configured to be movable between a first position and a second position. In use, the base piston element may move in a manner such that as a fluid disposed in the bottle is forced toward the dispensing channel to dispense the fluid at least a portion of the fluid engages the base piston element and moves the base piston element toward the second position. In some configurations, the method includes disposing a cartridge, as disclosed herein, in the receptacle of the dispensing cap base. In an illustrative embodiment, the manufacturing process does not include inserting the cartridge into the cap base; rather, the cartridge remains outside of the cap base to be inserted by the user.

[0037] In some embodiments the tube portion is formed so as to be movable relative to the container between a first "closed" position wherein the at least one opening is covered by an inner wall of the container to inhibit the cartridge fluid from flowing into the tube portion via the at least one outlet opening and a second "open" position where the cartridge fluid is able to flow through the at least one outlet opening and into the tube portion. In addition, the step of disposing the cartridge in the receptacle also typically induces a movement of the tube portion into the second open position.

[0038] A variety of materials may be utilized for the elements described herein. By one approach, the valve element,

including the tube portion, is formed from a material that is suitably flexible for the above-described movement to occur. In an illustrative embodiment, the valve element is formed from polypropylene.

[0039] In some configurations, the cartridge includes a cartridge body, a valve element, and a cartridge piston element. Indeed, in one exemplary approach, these three elements are combined to form the cartridge container. In an illustrative embodiment, the cartridge body is formed as an outer cartridge cylindrical wall dimensioned to fit within the cap base, with a hollow interior forming the cavity. In some embodiments, the valve element is coupled to an outer surface of a dispensing side of the cartridge body. A dispensing end of the tube portion of the valve element typically forms a dispensing outlet of the cartridge, through which, in use, the cartridge and bottle fluids are together dispensed from the cap. In addition to the tube portion, the valve element also may be formed to include a disc portion extending from and about the tube portion at the dispensing outlet. In some embodiments, the disc portion of the valve element is coupled to a dispensing side of the cartridge body (such as by gluing, engaging corresponding geometry, and/or welding), and partially seals the cartridge on the dispensing side of the cartridge. By one approach, the above-noted inner wall of the container is formed as an inner cartridge cylindrical wall of the cartridge body, which is coupled to the dispensing side of the cartridge body. In some configurations, the inner cartridge cylindrical wall defines at least a portion of the central opening of the cartridge container.

[0040] In some embodiments, the base piston element is configured to drive the cartridge piston element disposed in the cartridge as the base piston element is moved from the first position toward the second position. The base may be formed to include one or more stops configured to inhibit the base piston element from moving beyond the second position. In an illustrative configuration, the cartridge piston element is formed with engagement members such as upstanding ribs for engaging the base piston element during the movement.

[0041] By one approach, a manufacturing step of disposing the cartridge in the receptacle brings a first end of the tube portion into engagement with an end of the dispensing channel moving the tube portion to open the at least one outlet opening. However, it will be appreciated that a manufacturing process may not include disposing the cartridge the receptacle, such that a user typically inserts the cartridge prior to use thereof.

[0042] A manufacturing method may further include adding tamper-evident features or packaging to the cartridge and/or the dispensing container. One or more cartridges, for example, may be sealed in a flow pack. In some embodiments, the cartridges may have a tamper-evident sealing liner on the dispensing side of the cartridge and the side opposite the dispensing side. A tamper-evident seal may also be disposed on the mouth of the flexible bottle. Such seals would typically need to be removed by the user prior to use.

[0043] In embodiments of any of the above methods of manufacturing, the base of the dispensing cap may be formed to include a guide channel along which at least a portion of the base piston element moves. The base may be formed so that at least a portion of the dispensing channel extends within the guide channel and may include at least one base opening through which fluid from the bottle is able to flow between the dispensing channel and the guide channel to engage the base piston element, forcing it to move.

[0044] Some methods of manufacturing may also include a step of adding seals within the cap base and/or the cartridge to prevent leakage of fluid into unintended areas. For example, the base piston element may be formed to include an inner sealing element and an outer sealing element, such as inner and outer bore seals, the inner seal element configured to engage an outer surface of the dispensing channel and the outer seal element configured to engage the guide channel. In one configuration, the base piston element is ring-shaped and the outer and inner seals may be continuous flange-like protrusions extending at an angle from the outer and inner edges of a bottle-facing side of the base piston element, respectively. Such protrusions may be formed integrally with the base piston element and formed to be effective in creating a close seal between the base piston element and the guide channel and the base piston element and the dispensing channel in use, for example, as the base piston element is forced to move via the fluid entering from the bottle. The seals function to keep any fluid entering from the bottle from flowing between the piston element and the guide channel and between the piston element and the dispensing channel.

[0045] The cartridge piston element may be similarly formed to include one or more outer and inner sealing elements to prevent fluid from leaking out or into the cavity of the cartridge. For instance, the cartridge piston element may be formed to include one or more outer sealing elements configured to contact an outer side wall of the cartridge to seal the cartridge fluid within the cavity. In one configuration, the cartridge piston element is ring-shaped and disposed about the inner cartridge cylindrical wall of the cartridge and is formed to include one or more inner sealing elements configured to contact the inner cartridge cylindrical wall to seal the first fluid within the cavity. In one illustrative embodiment, the outer and inner seals may be formed as continuous flange-like protrusions extending at an angle from the outer and inner edges of one or both of a fluid-facing side and a non-fluid-facing side of the cartridge piston element, respectively. Such protrusions may be formed integrally with the cartridge piston element, and formed to be effective in creating, in use, a close seal between the cartridge piston element and the outer side wall of the cartridge and the cartridge piston element and the inner cartridge cylindrical wall of the cartridge, for example, as the base piston element drives the cartridge piston element.

[0046] The above-mentioned sealing elements formed as protrusions in the above-described manner reduces friction of the pistons during movement, compared to an alternative embodiment in which the outer and inner walls of the ring-shaped pistons function as sealing surfaces in direct contact with the walls of the cartridge body, guide channel, or dispensing

channel.

[0047] The various seals and sealing may be formed from a variety of materials. The pistons and integral seal elements are ideally formed from materials that have good sealing capability, which may have an attribute of flexibility, elasticity, softness, and/or compressibility. Suitable examples include, e.g., silicon, rubber, low-density polyethylene, and/or high-density polyethylene. In an illustrative embodiment, the material is low-density polyethylene and/or high-density polyethylene. In yet another embodiment, the material is polypropylene.

[0048] Inclusion of sealing elements not only serves the above-mentioned functions, but also presents a clean appearance of the dispensing cap to the user. For example, when the cartridge is removed from the cap base, the outer surfaces of the cartridge and cap base are free from any leaked fluid or fluid residue.

[0049] The methods of manufacturing may also include a step of forming a flip-top lid hingedly attached to the base. In some embodiments, the flip-top lid has an interior projection and is movable between an open position and a closed position, wherein the projection blocks egress of fluid from the cartridge when in the closed position and permits egress of the fluid when in the open position. By one approach, the interior projection may be formed to include a first sealing surface configured to block egress of fluid from the dispensing channel of the base, and a second sealing surface configured to block egress of fluid from the cartridge. For example, the interior projection may have a geometry corresponding to different openings such as a wide portion that is dimensioned to provide a close fit to the dispensing outlet of the valve element so that fluid from the cartridge cannot leak from the cartridge when the lid is closed. In one embodiment, the wide portion can block the outlet openings in the tube portion of the valve element, so that the fluid in the cartridge cannot egress into the tube portion. The interior projection may additionally have a narrower portion at its terminal end that is dimensioned to sealingly contact an outlet of the dispensing channel of the cap base.

[0050] The containers, dispensing caps, and cartridges described herein may be formed, filled, and sealed in high speed, high volume, mass production operations, or in other types of operations. In one approach, a flexible container or bottle is formed by blow molding, injection molding, or other suitable methods. Typically, the dispensing cap and cartridge parts are formed by injection molding, though other methods are contemplated. In some configurations, the dispensing cap base and flip-top lid are formed in a single, integral one-piece structure, while the base piston element is formed as a separate piece. The base piston element and cap base may be assembled at the mold or at a separate station.

[0051] By a further approach, a system for dispensing fluids from a container is contemplated. The system may include one or more flexible bottles, one or more dispensing caps, and one or more cartridges for the dispensing caps described herein. In an illustrative embodiment, the system includes a flexible bottle containing a primary fluid, a dispensing cap base that can be coupled to the flexible bottle, the dispensing cap base having a receptacle or cavity for receiving a cartridge, and a cartridge containing a secondary fluid that can be removably inserted the receptacle of the dispensing cap. The system permits a user to dispense the primary fluid and secondary fluid together from the dispensing cap when the dispensing cap is coupled to the bottle and the cartridge is inserted into the cap base. It also may permit a user to dispense only a primary fluid. By one approach, the system includes several different cartridges that can be interchanged for one another within the receptacle of the dispensing cap. In some embodiments, the system includes dispensing caps and/or cartridges with different configurations to enable proper dispensing of fluids having differing fluid properties such as viscosity, texture, density, compressibility, surface tension, etc.

[0052] Turning now to the figures, FIG. 1 illustrates a dispensing cap 100 that includes a hinged flip-top lid 180, and a cartridge 105 disposed in the interior of the cap, with the flip-top lid 180 in the open configuration. The cartridge is configured to contain a fluid, such as a thixotropic fluid, gel, or other fluid. In an illustrative embodiment, the fluid is a sauce or condiment.

[0053] FIG. 1 illustrates the cartridge 105 inserted within a dispensing cap base 150, while FIG. 2 depicts the cartridge 105 outside of the cap base 150, in a position to be inserted. As shown, the cartridge 105 and cap base 150 include corresponding threads 130, 152 so that the cartridge can be screwed into and out of a secured position within the cap base 150 by a user. Advantageously, this modularity of the dispensing cap permits a user to remove and insert different cartridges into the dispensing cap, such as when a cartridge is empty, or when one or multiple users desire to use different cartridges having different fluids. As noted above, alternative embodiments may include other manners of removably inserting/affixing the cartridge in the cap base besides screwing or threading. For example, the cartridge may be mated with the cap base via other mechanical connections such as, e.g., an interference fit, a snap fit, friction fit, and/or a detent or other biasing mechanism that may click the cartridge into position.

[0054] In one configuration, the cap base 150, as shown in FIG. 2, is integrally formed to include a tubular dispensing channel 155 extending from a fluid-receiving side of the cap base 150. The dispensing channel 155 typically forms an inlet opening 162 (shown in FIGS. 4 and 5, which illustrate bottom perspective views) at the fluid-receiving side of the cap base 150 for receiving a primary fluid from a bottle. Generally, the dispensing channel 155 is axially aligned with a central opening of the cartridge 105 such that the dispensing channel 155 is received within the central opening when the cartridge is screwed into the base. While the dispensing channel and the central opening may be centrally disposed, in other configurations, the dispensing channel and central opening are offset from a central position of the dispensing cap. The dispensing channel 155 is further axially aligned with a dispensing outlet 122 on a dispensing side of the cartridge. In use,

when primary fluid from an attached bottle flows through the dispensing channel 155 of the dispensing cap 100 as the bottle is squeezed, the fluid from the bottle flows toward the dispensing outlet 122 where it is dispensed alongside a secondary fluid from the cartridge.

[0055] As shown in FIG. 2, the hinged flip-top lid 180 typically includes on its underside a projection 185 that plugs the dispensing outlet 122 to prevent fluid from flowing or leaking out of the cap when the lid 180 is in a closed position. As suggested above, the dispensing channel and central opening may be centrally disposed; accordingly, the projection 185 also may also be centrally disposed.

[0056] FIG. 3 illustrates an embodiment of a dispensing bottle 300, which includes a squeezable bottle 302 with the dispensing cap 100 attached thereto. The squeezable bottle 302 includes a container body portion 303 for containing a fluid 306, such as ketchup, mayonnaise, barbecue sauce, or another fluid, and an open neck portion 304 to which a dispensing cap can be attached. The squeezable bottle is typically formed from a flexible material so that a user may apply manual pressure to the bottle to force a fluid 306 out of the bottle. As shown in FIG. 4, the dispensing cap 100 is threaded onto the neck 304 of the squeezable bottle via internal threads 178 of the dispensing cap base, which engage external threads 379 on the neck of the bottle. While FIG. 3 shows the dispensing bottle 300 in an upright position, in some embodiments the bottle 300 is configured to be stored inverted while resting on its dispensing cap 100, when the flip-top lid 180 is closed.

[0057] To open the bottle 300 to permit the fluid to be dispensed therefrom, a user may pivot the flip-top lid 180 from a closed configuration of the cap, for example, as shown in FIG. 4, to the open configuration shown in FIG. 3. To that end, a user or consumer may apply upward force to the lid 180 pulling it away from the cap base 150. The flip-top lid 180 then pivots about a hinge to sit stably in the open configuration.

[0058] As illustrated in FIG. 3, when the flip-top lid 180 is in the open configuration, a projection 385 of the flip-top lid 380 is moved from obstructing or blocking a dispensing outlet 122 of the dispensing cap to a position away therefrom, such that the dispensing outlet 122 is unobstructed.

[0059] The dispensing cap 100 for the dispensing bottle 300 includes a dispensing cap base 150 which receives a cartridge 105. By one approach, the cartridge 105 is received in the receptacle 152, which may be a depression or cavity in the base 150 that is exposed when the flip-top lid 180 is positioned in the open configuration. As noted above, the cartridge 105 is manually insertable and removable into the cap base 150 by the user, such as by screwing the cartridge into the base. The dispensing cap and cartridge, usable with a dispensing bottle 300, will be described in further detail with reference to FIGS. 4-10.

[0060] FIG. 4 illustrates a dispensing cap 100 in accordance with some embodiments. The dispensing cap is shown attached to a neck 304 of a bottle 302, and a cartridge 105 is shown inserted into a dispensing cap base 150. The dispensing cap base 150 has an outer cylindrical housing 172 with a hollow interior formed by an outer housing cylindrical wall 173, and an inner cylindrical housing 174 disposed in the interior of the outer cylindrical housing along a central axis of the outer cylindrical housing, the inner cylindrical housing 174 formed by an inner housing cylindrical wall 175 running substantially parallel to the outer housing cylindrical wall 173. In one illustrative configuration, the inner housing cylindrical wall 175 is connected to the outer housing cylindrical wall 173 by an annular wall 176, which may extend perpendicular to the inner and outer housing cylindrical walls. In the illustrated embodiment, the annular wall 176 forms a partial floor or bottom to a cartridge-receiving receptacle 152 of the cap base, and has a stepped configuration, for example, an outer step adjacent the outer housing cylindrical wall 173, and an inner step adjacent the inner housing cylindrical wall 175. The inner step forms a portion of an annular slot 168 of the cap base for receiving a neck 304 of a bottle. The slot 168 is formed by the inner step, a lengthwise portion of the inner housing cylindrical wall 175, and an annular wall 181 which extends perpendicular from the inner step and around the inner housing cylindrical wall 175. In the illustrated embodiment, the slot includes internal threads 178 disposed on an inward-facing surface of the annular wall 181 for screwing external threads 379 of a bottle so that the bottle can be securely attached to the cap.

[0061] Inserting and securing the bottle neck 304 in the slot 168 causes the container body of an attached bottle to be in fluid communication with the interior of the inner cylindrical housing 174 of the dispensing cap base 150. Specifically, the inner cylindrical housing 174 is dimensioned to tightly fit within the neck of a bottle, an outer surface of the inner housing cylindrical wall 175 sealingly contacting an interior surface of the neck, inhibiting fluid from the bottle from flowing between the inner housing cylindrical wall 175 and the neck 304. As such, the fluid disposed in the bottle is directed into the inner cylindrical housing 174 of the dispensing cap during dispensing.

[0062] The flow of fluid between the bottle and the inner cylindrical housing 174 is partially obstructed by a set of retaining or strengthening ribs or a lateral wall 186 (FIG. 4) covering the inner cylindrical housing. By one approach, the ribs or lateral wall 186 extends inwardly at a terminal end of the inner housing cylindrical wall 175 and generally perpendicular thereto. The lateral wall 186, in the illustrated embodiment, includes a central opening, forming a dispensing channel inlet 162, for permitting fluid to flow directly from the bottle into a tubular dispensing channel 155 that extends along a central axis of the inner cylindrical housing, and, generally, through a substantial lengthwise portion of the dispensing cap 100. By one approach, the tubular dispensing channel 155 is integral with the lateral wall 186 or ribs. In some embodiments, the outer housing cylindrical wall 173, inner housing cylindrical wall 175, annular wall 176, annular wall 181 with threads, and

dispensing channel 155 are all integrally formed, as well as, in some embodiments, the flip-top lid 180. Such components may be formed from a food-grade plastic or polymer such as polypropylene (PP) and/or high-density polyethylene (HDPE). In some configurations, different components may be formed of different materials.

[0063] In use, a primary fluid from the bottle that flows into the dispensing channel 155 is dispensed from the cap at the opening 122. In some configurations, such as when a filled cartridge is disposed within the base, the primary fluid will be dispensed along with a secondary fluid from the cartridge. The dispensing channel 155, thus, is configured so that a certain amount of primary fluid from the bottle is dispensed. In some configurations, the dispensing channel 155 may have a flow restrictor 157 at one or both ends of the dispensing channel 155 to limit the flow of the primary fluid out of the dispensing channel 155 into a tube portion of the cartridge (described in more detail below). Limiting the flow of the primary fluid from the bottle ensures that there is sufficient room at the exit for the secondary fluid from the cartridge to join the stream of primary fluid and maintain good flow as the fluids are dispensed. In the illustrated embodiment, the flow restrictor 157 is located at an outlet end of the dispensing channel 155. Such a flow restrictor may include an opening, such as a circular opening, having a diameter of about 0.5 to about 3.0 mm. In an illustrative embodiment, the diameter is about 2.0 mm. In one embodiment, the diameter is about 1.8 mm. It is noted that a larger diameter, such as greater than 1.8 mm, can advantageously lessen the force required to dispense the fluid. For thicker fluids, particularly, typically a wider diameter or larger access may be necessary so that less force is required to dispense the fluid, such as a diameter beyond 3.0 mm.

[0064] As illustrated in FIG. 4, the lateral wall 186 further includes cap base openings 167 disposed about the dispensing channel inlet 162. As shown in FIG. 5, there may, for example, be four cap base openings 167. In use, when the bottle is squeezed by the user, fluid from the bottle is forced toward the dispensing channel 155 to ultimately be dispensed from the dispensing cap 100, as noted above. Further, a portion of fluid from the bottle takes a different fluid path through the cap base openings 167 to engage a portion of a base piston element 165 disposed in the interior of the inner cylindrical housing 174. The force of the fluid on the base piston element 165 causes the base piston element 165 to movably slide between a first unactuated position, in which an end of the base piston element 165 is disposed close to the lateral wall 186 covering the inner cylindrical housing 174 (as shown in FIG. 8), and a second position (as shown in FIG. 9). In movement, the base piston element 165 slides away from the lateral wall 186 toward the dispensing outlet.

[0065] The base piston element 165 includes a first cylindrical portion 182 which, in the unactuated position, is disposed within the interior of the inner cylindrical housing 174, and a second flange portion 183 which is in large part disposed outwardly with respect to the inner cylindrical housing 174. The first cylindrical portion 182 of the base piston element 165 includes a piston cylindrical wall 184 with a slightly smaller diameter than the diameter of the inner housing cylindrical wall 175 of the cap base 150. Thus, as the base piston element 165 moves, the inner housing cylindrical wall 175 of the cap base functions, in part, as a portion of a guide channel 160 for the base piston element 165. An upper end of the piston cylindrical wall 184 of the base piston element 165 additionally includes a piston floor or lateral wall 187 continuously extending inwardly therefrom and generally perpendicular thereto. The piston floor 187 is ring-shaped, with an opening in the center so that the first cylindrical portion 182 of the base piston element can be disposed about the dispensing channel 155 extending therethrough. In one configuration, the piston floor 187 both covers the top of the base piston element 165 and serves as a surface that a primary fluid from the bottle can press against to move the base piston element 165.

[0066] Specifically, in use, a portion of the primary fluid from the bottle is forced against the piston floor 187 of the base piston element 165, which causes the base piston element 165 to be pushed in a direction away from the lateral wall 186 of the cap base 150 along a central lengthwise axis of the dispensing cap. Typically, the ring-shaped first cylindrical portion 182 of the base piston element sealably slides along the guide channel 160 and the dispensing channel 155, to prevent leakage of the primary fluid between the base piston element 165 and the guide channel 160 and between the base piston element 165 and the dispensing channel 155. This can be accomplished, in part, by configuring a close fit between the piston cylindrical wall 184 of the piston and the inner housing cylindrical wall 175 of the cap base 150, and between the central opening of the piston floor 187 of the base piston element 165 and the dispensing channel 155. In addition to the fit of the elements, the geometry of the elements, the materials forming the elements and/or the types of fluids within the dispensing bottle and cap also may be relevant to ensuring no or minimal leakage between the elements. To that end, the materials, geometry, and/or sizing of elements may be adjusted depending on the materials being packaged and dispensed.

[0067] However, to mitigate friction as the piston moves, one or more sealing elements, such as inner and outer bore seals may instead extend from the first cylindrical portion 182. For example, an inner seal element 170 may be configured to engage an outer surface of the dispensing channel 155 and an outer seal element 171 may be configured to engage the inner housing cylindrical wall 175. As illustrated in FIG. 4, the outer and inner seals 170, 171 may be continuous flange-like protrusions. In one illustrative approach, the outer and inner seals extend at an oblique angle from the outer and inner edges of the piston floor 187 of the base piston element 165, respectively. In some configurations, only the sealing elements 170, 171 extending from the first cylindrical portion 182 of the base piston element 165 engage the adjacent surfaces of the inner housing cylindrical wall 175 and dispensing channel 155, which both reduces friction during movement of the piston 165 yet provides sufficient sealing to prevent leakage in unintended areas.

[0068] A variety of materials may be utilized for the base piston element 165 and the seal elements 170, 171. In one

illustrative embodiment, the base piston element and the seal elements are integrally formed from materials that have good sealing capability, which may, for example, have an attribute of flexibility, elasticity, softness, and/or compressibility. Suitable examples include low-density polyethylene or high-density polyethylene. In one embodiment, the material is polypropylene.

[0069] As noted above, the guide channel 160 is at least partially defined by the inner housing cylindrical wall 175 of the cap base 150. However, the inner housing cylindrical wall 175 can be described as terminating in several guide channel posts 161 which extend lengthwise from a bottom edge of the inner housing cylindrical wall 175 opposite the lateral wall 186. In the illustrated embodiment (shown, for example, in FIG. 6), there are four such posts 161, though other amounts of posts, such as two, three, or more are possible. The posts 161 are configured such that the base piston element 165 can slide along the posts during movement of the piston. In an illustrative configuration, each post terminates in a stop 177 for the base piston element 165 (see, e.g., FIGS. 4 and 8). As shown in FIG. 4, the stop 177 is a small ledge extending inward from the guide channel post 161. In this manner, the stop 177 limits the base piston element 165 from moving beyond a final position.

[0070] In the illustrated embodiment, the movement of the base piston element 165 is configured to be limited by the stops 177 after at least a portion of the first cylindrical portion 182 of the base piston element moves beyond the stops, as shown in FIG. 9. To this end, the piston cylindrical wall 184 of the first cylindrical portion 182 of the base piston element includes lengthwise cut-outs 163 (see, e.g., FIG. 4) corresponding to each of the guide channel posts 161 such that, in operation, when the first cylindrical portion 182 of the base piston element moves through the guide channel 160, the cut-outs allow a leading portion of the first cylindrical portion 182 of the base piston element to pass beyond the stops 177 until the tops of the cut-outs 163 in the piston cylindrical wall 184 engage, or get "caught" on the geometry, such as the ledges, of the stop 177.

[0071] As suggested above, the base piston element 165 includes a second flange portion 183 in addition to the first cylindrical portion 182. As shown in FIG. 4, in the spaces between each of the guide channel posts 161, corresponding lateral walls 164 extend outward from the bottom edge of the first cylindrical portion 182. In one illustrative approach, the lateral walls 164 extend outward and generally perpendicular to the bottom edge of the first cylindrical portion 182. Past the guide channel, the lateral walls 164 are integrally joined into a continuous annular second flange portion 183 that extends about the guide channel posts 161. When the base piston element 165 is moved, the second flange portion 183 of the base piston element advances downward to engage and drive a cartridge piston element 145 of the cartridge 105, the downward strike, as described above, limited only by engagement of the first cylindrical portion 182 with the stops 177.

[0072] As illustrated in FIG. 4, the dispensing cap 100 in use has a cartridge 105 received within a receptacle 152 of the cap base 150. By some configurations, the receptacle 152 is defined at least in part by the outer housing cylindrical wall 173 and annular wall 176 of the cap base. In the shown embodiment, the cartridge 105 includes external threads 130 and the receptacle 152 includes internal threads 153 for mating the cartridge with the receptacle. The cartridge, as noted above, is advantageously manually insertable and removable by the user.

[0073] In the illustrated embodiment, the cartridge 105 includes a main body 110, a valve element 138 coupled to the body 110 on a dispensing side of the cartridge (i.e., the side of the cartridge disposed adjacent the dispensing outlet 122), and a cartridge piston element 145 disposed on a side of the cartridge opposite the dispensing side. The body 110, valve element 138, and cartridge piston element 145 define an interior cavity 115 or container for containing a fluid 120 disposed in the cartridge.

[0074] Specifically, the main body 110 of the cartridge is formed in part by an outer cartridge cylindrical wall 111 dimensioned to fit within the dispensing cap base 150, having a hollow interior forming a portion of the cavity 115. While the outer cartridge cylindrical wall 111 forms a side wall to the cartridge, the body 110 also includes a top portion 112 extending from the top edge of the outer cartridge cylindrical wall 111 forming a partial cover to the "top" (dispensing side) of the cartridge.

[0075] The main body 110 also includes an inner cartridge cylindrical wall 127 centered in the interior of the cartridge and extending lengthwise therethrough, and generally parallel to the outer cartridge cylindrical wall 111. The inner cartridge cylindrical wall 127 is sized so that the dispensing channel 155 of the dispensing cap base 150 can fit snugly within the inner cartridge cylindrical wall 127, as illustrated in FIG. 4. At the dispensing side of the cartridge, several radial spoke-like connecting members 113 branch out from the inner cartridge cylindrical wall 127, connecting the inner cartridge cylindrical wall to the top portion 112 of the cartridge body (illustrated most clearly in FIG. 7). For example, there may be two, three, four, or more such members. The illustrated embodiments, for instance, include two sets of opposing connecting members 113 extending from the inner cartridge cylindrical wall 127 to the top portion 112 of the body 110, though only two of the four connecting members 113 are shown in the cross sectional views of FIGS. 4 and 7. In this manner, fluid within the cartridge can easily flow around the spokes or connecting members 113.

[0076] The inner cartridge cylindrical wall 127, connecting members 113, outer cartridge cylindrical wall 111, and top portion 112 may be formed integrally as the main body 110 of the cartridge, and may be formed from a food-grade plastic or polymer material such as polypropylene. Use of polypropylene for the cartridge body 110 or a portion thereof can permit the cartridge body to be configured to have a lower opacity or to be substantially transparent. This can allow a user to see how

much fluid remains in the cartridge. In such an embodiment, at least a portion of the cap base 150 (such as the outer housing cylindrical wall 173) may also have a lower opacity or be substantially transparent, so that the user can see through the cap base to see how much fluid remains in the cartridge while dispensing. In another embodiment, the cartridge body lacks transparency and is formed from high-density polyethylene. Use of high-density polyethylene can contribute to the sealing of the cartridge.

[0077] As mentioned above, the top portion 112 of the cartridge body 110 only partially covers the top of the cartridge 105. In one illustrative embodiment, the top portion 112 includes a circular opening in its center which is interrupted only by the radial connecting members 113. By some approaches, a valve element 138 is disposed on the top of the cartridge 105 to cover the circular opening. Specifically, the valve element 138 may be coupled to the top portion 112 of the body 110 and include a disc portion 139 which substantially covers the circular opening. An open dispensing outlet 122 is typically formed, at least in part, by an opening at the center of the disc portion 139 of the valve element. Further, the valve element 138 may be coupled to the top portion 112 of the body 110 in any suitable manner, for example by corresponding geometry, gluing, and/or welding. In other embodiments, portions of the valve element 138 may be mated with a remainder of the dispensing cap via other mechanical connections such as, e.g., an interference fit, a snap fit, friction fit, and/or a detent or other biasing mechanism.

[0078] The embodiment illustrated in FIG. 4 illustrates a further tube portion 140 of the valve element 138 extending inwardly into the cartridge from the disc portion 139 at the dispensing outlet 122. In such a configuration, the tube portion 140 typically has a first end configured to receive the fluid from the bottle flowing into the tube portion 140 from the dispensing channel 155 of the cap base 150 and a second end through which the first and second fluids are dispensed. In another aspect, the second end can alternatively be described as forming the dispensing outlet 122 of the cartridge.

[0079] In one configuration, the disc portion 139 may be angled or flexed downwardly towards the cartridge, such that the dispensing outlet 122 and tube portion 140 are disposed at least partially lower than an outer edge or outer portion of the disc portion. As illustrated in FIGS. 4 and 7, the disc portion 139 has a funneled configuration with the dispensing outlet 122 and tube portion 140 at its center. In yet other embodiments, other configurations of the disc portion 139 may be incorporated therein.

[0080] In some approaches, the tube portion 140 of the valve element 138 extends, at least partly, within an interior formed by the inner cartridge cylindrical wall 127 of the cartridge body 110. In some examples, the tube portion 140 has a diameter slightly smaller than the diameter of the inner cartridge cylindrical wall 127 to achieve a close fit, such as an interference fit. The tube portion 140 and inner cartridge cylindrical wall 127 together form a central through opening 125 running through a central lengthwise axis of the cartridge. On the dispensing side of the cartridge, the central through opening 125 terminates at the dispensing outlet 122. On the side opposite the dispensing side, the central through opening 125, via the inner cartridge cylindrical wall 127, is configured to receive the dispensing channel 155 of the cap base 150.

[0081] As noted above, the tube portion 140 of the valve element 138 typically includes at least one outlet opening 135 in the tubular wall thereof. In use, the outlet opening 135 is configured to permit fluid 120 from the cavity 115 of the cartridge to flow therethrough into the exit or tube portion 140 of the valve element. In one illustrative embodiment, there are two opposing outlet openings 135 on the tubular wall of the tube portion 140. In other embodiments, there may be one outlet opening, three outlet openings, four outlet openings, or more. In some embodiments, the outlet 135 openings may be selected or disposed in a particular arrangement to create a particular pattern in the combined stream.

[0082] Varying the number and size of the openings has a salient effect on the appearance or aesthetic of the combined stream of fluids when they are dispensed. For example, two outlet openings 135 in the wall of the tube portion may achieve a desirable aesthetic in that the cartridge fluid is dispensed as two stripes disposed on the bottle or primary fluid, as depicted in FIG. 11. In an embodiment with two outlet openings, the openings could each have a width and length or diameter of, for instance, between 0.5 and 3.5 mm. The outlet openings 135 may be generally circular or square or may have a rectangular shape. For example, an outlet opening may have a width of 2.0 mm and a length of 2.0 mm or have a width of 0.5 and a length of 3.0 mm. Other geometrical shapes of the openings are also contemplated.

[0083] In one exemplary embodiment, the cartridge may have multiple configurations such as a storage and a use configuration. For example, FIGS. 7 and 8 illustrate a cartridge that is configured with a mechanism to convert the cartridge from a "closed" configuration (in which the outlet openings 135 of the tube portion 140 are blocked and cartridge fluid 120 cannot egress from the cavity 115 of the cartridge) to an "open" configuration after being inserted into a dispensing cap base 150 (in which the outlet openings 135 are not blocked and cartridge fluid 120 can egress from the cavity 115). Specifically, the valve element 138 of the cartridge 105, in some illustrative configurations, is movable relative to the cartridge body 110. More particularly, the valve element 139 may be movable between a first position where the outlet openings 135 are covered by an inner wall 127 of the body 110 to inhibit a fluid in the cavity 115 from flowing into the tube portion 140 via the outlet openings 135 and a second position in which the fluid in the cavity 115 is able to flow through the outlet openings 135 and into the tube portion 140.

[0084] With respect to the "closed" configuration of the cartridge 105, FIG. 7 illustrates a cartridge 105 that is not inserted into a dispensing cap base 150. Advantageously, when the cartridge is not inserted into the dispensing cap base 150, the outlet openings 135 in the tube portion 140 of the cartridge are blocked by an inner wall of the cartridge 105. This inhibits

cartridge fluid from leaking out of the cartridge 105 when the cartridge 105 is not inserted into the cap base 150. Specifically, in the closed configuration, the outlet openings 135 are covered by the inner cartridge cylindrical wall 127 of the cartridge 105. The "closed" configuration may be particularly useful for shipment and storage of the cartridge 105, and especially relevant to approaches where the cartridge 105 is shipped and stored separate from a remainder of the dispensing cap 100.

[0085] When the cartridge 105 is then inserted into the dispensing cap base 150, as shown in FIG. 8, the cartridge 105 may then be reconfigured into a ready position, which might include an open or nearly open configuration. In one illustrative embodiment, the cartridge 105 is in the open configuration and coupled to the cap base 150, an end of the tube portion 140 is brought into forceful engagement with a leading end of the dispensing channel 155 of the cap base 150. Contact with the dispensing channel 155 forces the tube portion 140 of the valve element 138 to be driven upwards along an axis of the central opening 125, which moves the outlet openings 135 in the wall of the tube portion 140 upward and away from the inner cartridge cylindrical wall 127 so they are no longer blocked by the wall 127. This is possible because the valve element 138, including both the disc portion 139 and the tube portion 140, is typically made of a material that can move, deflect, and/or flex in the above-described manner. For example, the valve element may be formed from polypropylene and high-density polyethylene (HDPE) among other optional materials.

[0086] As noted above, the movement, deflection, and/or flexing of the valve element 138 upon insertion of the cartridge 105 into the cap base 150 may be visible to the user, as the disc portion 139 of the valve element, and the dispensing outlet 122 formed by an end of the tube portion 140, are also driven upwards. For example, though the disc portion 139 is angled or flexed downwards in a funneled configuration in the closed position, as shown in FIG. 7, in the open position the disc portion 139 may be pushed upwards so it is substantially less funneled, and nearly level with the dispensing outlet 122, as shown in FIG. 8. The visible movement of the valve element may be an indication to the user that the cartridge 105 has been properly inserted for use.

[0087] It should be appreciated that in the open configuration of some embodiments, cartridge fluids having certain thicker viscosities or slower flow rates, for example, certain condiments, will not readily flow through or leak out of the outlet openings 135 until manual pressure is applied to the flexible bottle and the cartridge piston element 145 is driven to force the cartridge fluid 120 out of the cartridge cavity 115.

[0088] Advantageously, the flexibility of the valve element 138 permits that the outlet openings 135 are recloseable after the cartridge 105 is removed from the dispensing cap base 150. That is, the cartridge 105 returns to the closed configuration after the cartridge 105 is removed. The valve element 138 may, for example, be molded to be biased toward the closed position. For instance, as shown in FIG. 7, in the closed configuration the disc portion 139 may be molded to be angled or flexed downward, holding the tube portion 140 in a position blocked by inner cartridge cylindrical wall 127. When the cartridge 105 is then inserted into the dispensing cap base, the tube portion 140 and disc portion 139 are forced upwards from contact with the dispensing channel 155. After the cartridge 105 is unscrewed from the cap base 150 and the dispensing channel 155 is no longer straining or applying force to the tube portion 140 and disc portion 139 upwards in the open configuration, the tube portion 140 and disc portion 139 are released from the biased position, with the disc portion 139 "remembering" and returning to its stable, angled position and forcing the tube portion 140 back downward into the cartridge 105 to its original position in which the outlet openings 135 are once again covered by the inner cartridge cylindrical wall 127 of the cartridge body 110.

[0089] Generally, the closed configuration of the cartridges permits that the cartridges can be manufactured, shipped, sold, handled, and stored separately from the dispensing cap base without leaking fluid from the cavity 115 of the cartridge 105 into the tube portion 140 of the cartridge 105. Leaking cartridge fluid into the tube portion 140 of the cartridge 105 could inhibit the correct flow of the cartridge fluid and bottle fluid from the dispensing cap after the cartridge 105 is inserted into the cap base 150.

[0090] Further, the reclosability of the cartridge after use limits exposure of the cartridge fluid to external contamination, preserving the taste and freshness of the contents thereof, and prevents any accidental leaking of the cartridge contents (for example, of the sauce itself, or a separated serum of the sauce). This is particularly helpful if the cartridge is stored and handled by the user apart from the dispensing cap after use. The reclosability also may preclude the need to provide a full cover or plug for the dispensing outlet of the cartridge. For example, after a user removes a tamper-evident seal from the cartridge, and uses the cartridge in the dispensing cap, a user may then wish to remove the cartridge from the cap and store the cartridge separately from the cap (for instance, if the user possesses multiple cartridges for the cap). The "closed" configuration of the cartridge when the cartridge is not inserted into the dispensing cap permits the cartridge to be kept fresh and stored separately from the cap base. In other words, the cartridge can be stored and re-used after an initial use, instead of being disposed of, and without requiring a lid for the cartridge.

[0091] In some configurations, as mentioned above, the valve element 138 may be formed from polypropylene (PP), low-density polyethylene (LDPE), and/or high-density polyethylene (HDPE). In addition to permitting the required flexing, forming the valve element from polypropylene may permit the valve element to be substantially transparent (or to have a lower opacity), allowing the user to see the fluid in the cartridge. In other configurations, the valve element 138, or at least a portion thereof, is configured to not be substantially transparent (or have a higher opacity). This may inhibit a user from

seeing residue of fluid that may form on portions of the valve element 138.

[0092] The cartridge piston element 145, as noted above, is typically disposed on the non-dispensing side of the cartridge 105. For example, the cartridge piston element 145 may be disposed on the non-dispensing side formed by the outer cartridge cylindrical wall 111 of the cartridge body 110. In the embodiment shown in FIG. 4, the cartridge piston element 145 may be described as including a cylindrical wall dimensioned and configured to fit within and slide sealably along the outer cartridge cylindrical wall 111. The cartridge piston element 145 also may include a ring-shaped portion extending laterally from the cylindrical wall so as to cover or seal the cartridge cavity 115 at the non-dispensing side of the cartridge.

[0093] In one approach, the cartridge piston element 145 has a central hole dimensioned so that the cartridge piston element 145 can be disposed sealingly about the inner cartridge cylindrical wall 127 of the cartridge body 110. In the embodiment of FIG. 4, the ring-shaped portion of the cartridge piston element 145 has a stepped configuration to correspond to elements of the cap base 150. For instance, an annular inner step portion 142 of the cartridge piston element 145 may be angled to provide allowance for the stops 177 of the dispensing cap base 150. An annular outer step portion 143 of the cartridge piston element 145, in one approach, is aligned with the second flange portion 183 of the base piston element 165. In use, when the base piston element strikes downward toward the cartridge 105, the second flange portion 183 may contact engagement members 146 disposed on an outer surface of the annular outer step portion 143. As illustrated in FIG. 6, which depicts a horizontal cross sectional view of the dispensing cap 100, these engagement members 146 may take the form of upstanding extensions or ribs extending outwards from the outer surface of the cartridge piston element 145. For example, as shown, there may be eight ribs equally spaced from one another around the annular outer step portion 143 of the cartridge piston element. The number of ribs or engagement members may be any suitable amount, and in an alternative embodiment there may be no engagement members. For example, the second flange portion 183 of the base piston element may directly contact the outer surface of the cartridge piston element 145.

[0094] Corresponding or similar diameters of the ring-shaped portion of the cartridge piston element 145 and the ring-shaped second flange portion 183 of the base piston element 165 may help to provide an equally distributed transfer of force from the base piston element 165 to the cartridge piston element 145 during movement of the piston elements 145, 165. For example, in one illustrative embodiment, the second flange portion 183 and the ring-shaped portion of the cartridge piston element 145 extend to the same (or approximately the same) radius from the center of the dispensing cap 100. Equally spaced engagement members 146, as described above, may also distribute the force. Such configurations lessen the amount of force needed to be provided by the user to dispense the fluids.

[0095] Similar to the base piston element 165, the cartridge piston element 145 may be formed to include one or more outer and inner sealing elements to prevent fluid from leaking out or into the cavity of the cartridge. For instance, as illustrated in FIG. 7, the cartridge piston element 145 may be formed to include one or more outer annular sealing elements 147. In one approach, the sealing elements 147 may be configured to contact the outer cartridge cylindrical wall 111 of the cartridge 105 to seal the cartridge fluid within the cavity 115. In addition, the cartridge piston element 145 also may include one or more inner annular sealing elements 149 configured to contact the inner cartridge cylindrical wall 127 to seal the cartridge fluid within the cavity 115. In the illustrated configuration, two outer seals 147 are formed as continuous flange-like protrusions extending from the cylindrical wall of the cartridge piston element 145 and contacting the outer cartridge cylindrical wall 111 of the cartridge at an angle. The outer seals 147 are present at both a fluid-facing side and a non fluid-facing side of the cartridge piston element 145. The illustrated configuration also includes one inner sealing element 149 configured as a continuous flange-like protrusion extending from the ring-shaped portion of the cartridge piston element adjacent the central hole. By one approach, the inner sealing element 149 sealingly engages the inner cartridge cylindrical wall 127 of the cartridge body 110. Such protrusions would typically be formed integrally with the cartridge piston element 145, and formed to be effective in creating, in use, a close seal between the cartridge piston element 145 and the outer wall 111 of the cartridge and the cartridge piston element 145 and the inner cartridge cylindrical wall 127 of the cartridge 105, for example, as the base piston element 165 drives the cartridge piston element 145.

[0096] As previously noted, the above-mentioned sealing elements 147, 149 formed as protrusions in the above-described manner reduces friction of the cartridge piston element 145 during movement of the piston 145, compared to an alternative embodiment in which the outer and inner walls of the cartridge piston element 145 function as sealing surfaces in direct contact with the walls of the cartridge body 110.

[0097] By some approaches, the cartridge piston element 145 and the integral seal elements 147, 149 are formed from food-grade plastic or polymer materials that have good sealing capability, which may have an attribute of flexibility, elasticity softness, and/or compressibility. Suitable examples include low-density polyethylene or high-density polyethylene. By one approach, the material is polypropylene.

[0098] FIG. 8 illustrates the pistons 145, 165 of a dispensing cap in an "unactuated," stable, or resting first position, while FIG. 9 illustrates the pistons 145, 165 in a second "fully extended" or biased position. Together, the figures illustrate how the base piston element 165 and cartridge piston element 145 jointly move between the first position and the second position to dispense the two fluids together from the cap 100.

[0099] For instance, in FIG. 8, the first cylindrical portion 182 of the base piston element 165 is disposed against or close

to the lateral wall 186 of the inner cylindrical housing 174 of the cap base 150, while the second flange portion 183 of the base piston element 165 is disposed against or close to the annular wall 176 of the cap base. The second flange portion 183 may also be in contact with the engagement members 146 of the cartridge piston element 145, or disposed close to the engagement members 146 without contact. In the unactuated position, a bottom edge of the cylindrical wall of the cartridge piston element 145 is aligned with or close to a bottom edge of the outer cartridge cylindrical wall 111 of the cartridge body. In other words, the cartridge piston element 145 is typically disposed at a farthest possible point in the cartridge body 110 from the dispensing side of the cartridge 105.

[0100] When a user squeezes a flexible bottle that is attached to the dispensing cap of FIG. 8, a primary fluid 306 from the bottle and a secondary fluid 120 from the cartridge 105 are dispensed together from the cap 100 via the following mechanism. First, a portion of the primary fluid 306 from the bottle passes through the base openings 167 (shown in FIG. 4) in the lateral wall 186 of the inner cylindrical housing 174. The force of the fluid 306 on the piston floor 187 of the base piston element 165 causes the entire base piston element 165 to be driven in the direction of the cartridge 105. As it moves, the base piston element 165 remains on a central axis in the cap 100 due to being configured such that at least a portion of the base piston element 165 is always in contact with the guide channel 160.

[0101] As the base piston element 165 moves, the second flange portion 183 of the base piston element 165 is moved into forceful engagement with the engaging members 146 of the cartridge piston element 145, thereby moving the cartridge piston element 145 within the body of the cartridge 105 in the direction of the dispensing side. The movement of the pistons 145, 165 is limited, in part, by the amount of fluid that is disposed in the cartridge 105. For example, if the cartridge is full of fluid, the cartridge piston element 145 traverses only a short distance in the cartridge to dispense the fluid 120, as the cartridge piston element 145 quickly contacts and meets resistance from the fluid. The force from the cartridge piston element exerts pressure on the fluid, which is relieved as fluid is forced out the cavity 115 through the outlet openings 135 in the tube portion 140 of the valve element 138. As fluid is forced out of the cavity 115, the level of fluid 120 in the cavity 115 recedes, and the cartridge piston element 145 can move further into the cartridge to continue to press the fluid. As the cartridge empties, the cartridge piston element traverses a substantial distance within the cartridge in order to contact and apply pressure to the receding fluid so that the fluid can be forced out of the cavity 115.

[0102] During dispensing, to the extent the user is exerting a continuous pressure on the bottle, the movement of the pistons is typically correspondingly continuous. That is, as the user continues to squeeze the bottle, and cartridge fluid 120 is ejected from the cavity 115 to be dispensed, the level of the fluid in the cartridge recedes, which causes the cartridge piston element 145 to move further into the cartridge and maintain pressure on the receding fluid. This results in a smooth, continuous dispensing of the fluid from the cartridge as the bottle is squeezed. Further, when the user stops squeezing the bottle, the pressure exerted on the pistons 145, 165 and fluids is immediately halted, which results in an abrupt stop to the dispensing. That is, the pistons 145, 165 return to their initial, unactuated position.

[0103] FIG. 9 illustrates the base piston element 165 and cartridge piston element 145 in a fully extended position. The fully extended position, in which the cartridge piston element 145 has been driven to the dispensing side of the cartridge, occurs only when there is less than a very small amount of cartridge fluid left in the cartridge. Further, as shown in FIG. 9, the fully extended position of the cartridge piston element 145 is also dependent on the stops 177 of the cap base 150. As the base piston element 165 is caught on the stops 177, the base piston element 165 and cartridge piston element 145 are consequently limited from moving further in the direction of the dispensing side of the cap. This prevents the cartridge piston element 145 from exerting too much pressure on the top structures of the cartridge (such as the top portion 112 of the cartridge body 110 or the valve element 138).

[0104] FIG. 9 also illustrates the general movement of the fluids 120, 306 during dispensing via arrows. When cartridge fluid 120 is forced out of the cavity 115 of the cartridge via the outlet openings 135 in the tube portion 140 of the valve element 138, the streams of the cartridge fluid 120 egressing the outlet openings 135 are joined with a stream of fluid 306 from the bottle which enters the exit chute or tube portion 140 from the dispensing channel 155. When the user squeezes the bottle, the fluid from the bottle 306 not only presses against and pushes the base piston element 165, but, as noted above, a portion of fluid from the bottle 306 also travels through the dispensing channel 155 to ultimately be dispensed from the cap. In an illustrative embodiment, the streams of cartridge fluid are joined to the stream of fluid from the bottle in the tube portion 140, creating a single stream of the fluids that is dispensed from the cap 100. The fluids are substantially unmixed as they are joined together. That is, each of the fluids maintains its integrity and is separately visible in the stream. For instance, the fluids 120, 306 may adhere onto one another. In this manner, the fluids are dispensed together from the tube portion 140 through the dispensing outlet 122 of the cartridge 105.

[0105] The lack of mixing of the fluids creates an aesthetic effect in the dispensed product in which the streams of the cartridge fluid 120 maintain their integrity from the bottle fluid, typically appearing as stripes disposed on the bottle fluid 306, as shown in FIG. 11. This aesthetic effect can be particularly striking if the cartridge fluid and bottle fluid are different colors. For example, the bottle fluid may be mayonnaise and the cartridge fluid may be chipotle sauce. The aesthetic effect may also be influenced by the rheological properties of the two different fluids. For instance, the two fluids may have a certain viscosity or texture relative to one another so that both fluids are visible or distinct in the dispensed stream.

[0106] For the cartridge fluid and bottle fluid to adhere to one another in the above-described manner, it is contemplated

that the fluids have certain viscosities or flow resistances that allow the fluids to remain substantially discrete from one another and unmixed as they are dispensed joined together as a single stream of fluid. For example, in some embodiments the fluids may have viscosities ranging from about 5.0 Pa.s to about 70.0 Pa.s (5,000 centipoise to about 70,000 centipoise). In some embodiments the fluids may have viscosities ranging from about 9.0 Pa.s to about 50.0 Pa.s (about 9,000 centipoise to about 50,000 centipoise). By one approach, the fluids may have viscosities ranging from about 12.0 Pa.s to about 45.0 Pa.s (about 12,000 centipoise to about 45,000 centipoise). In another approach, the fluids may have viscosities ranging from about 9.0 Pa.s to about 25.0 Pa.s (about 9,000 centipoise to about 25,000 centipoise), from about 10.0 Pa.s to about 20.0 Pa.s (about 10,000 to about 20,000 centipoise), from about 13.0 Pa.s to about 15.0 Pa.s (about 13,000 to about 15,000 centipoise), or from about 12.0 Pa.s to about 19.0 Pa.s (about 12,000 to about 19,000 centipoise). The viscosity measurements described herein may be determined, for example, by a Brookfield Viscometer (for example, an RV DV-II) using Spindle 6, at 12 rpm, at 20-22°C, for 30 seconds.

[0107] The fluids having viscosities in the above-noted ranges serve other purposes as well. If the viscosities of the fluids are too low, the cartridge fluid could leak out of the outlet openings 135 or the bottle fluid could leak out of the bottle without the user squeezing the bottle. The fluids must be viscous enough to remain contained when not being dispensed. In addition, a cartridge fluid should be viscous enough so that it provides sufficient resistance to the movement of the cartridge piston element so that it is not forced to flow out of the cavity too quickly.

[0108] On the other hand, fluids with higher viscosities may exhibit too much flow resistance. This may be undesirable since it could require the user to apply more force to the bottle in order for the pistons to move and dispense the fluids. Further, larger openings and channels throughout the cap may be required to ease the flow of a fluid with a higher viscosity.

[0109] By one approach, both the primary fluid in the bottle and the secondary fluid in the cartridge can have a similar viscosity. By another illustrative approach, the secondary fluid has a lower viscosity and flow resistance compared to the primary fluid, to compensate for the fact that more force may be required for fluid in the cartridge to be ejected from the cartridge. In some embodiments of the dispensing cap, the secondary fluid can have a viscosity ranging from about 7.0 Pa.s to about 25.0 Pa.s (about 7,000 centipoise to about 25,000 centipoise), and/or the primary fluid can have a viscosity ranging from about 10. Pa.s to about 70.0 Pa.s (about 10,000 to about 70,000 centipoise). By some approaches, the secondary fluid can have a viscosity ranging from about 8.0 Pa.s to about 20.0 Pa.s (about 8,000 centipoise to about 20,000 centipoise), from about 10.0 Pa.s to about 17.0 Pa.s (about 10,000 centipoise to about 17,000 centipoise), or from about 12.0 Pa.s to about 16.0 Pa.s (about 12,000 centipoise to about 16,000 centipoise), and/or the primary fluid can have a viscosity ranging from about 12.0 Pa.s to about 45.0 Pa.s (about 12,000 centipoise to about 45,000 centipoise), from about 15.0 Pa.s to about 30.0 Pa.s (about 15,000 centipoise to about 30,000 centipoise), or from about 17.0 Pa.s to about 25.0 Pa.s (about 17,000 centipoise to about 25,000 centipoise). In one configuration, the secondary fluid has a viscosity ranging from about 12.5 Pa.s to about 15.5 Pa.s (about 12,500 centipoise to about 15,500 centipoise) and the primary fluid has a viscosity ranging from about 17.0 Pa.s to about 19.0 Pa.s (17,000 centipoise to about 19,000 centipoise).

[0110] In an illustrative configuration, the dispensing container may be configured such that the joint dispensing of the bottle and cartridge fluids can occur for a certain amount of dispensing before one or both of the fluids run out. To achieve this, for example, the cartridge may be a certain size relative to the size of the bottle, and/or the amount of fluid in the cartridge may be proportioned relative to the amount of condiment in the bottle.

[0111] In some configurations, a bottle is sized to have a larger volume than the cartridge and will contain more fluid than the cartridge contains. As such, by one approach it is advantageous to configure the dispensing cap to dispense a smaller amount of cartridge fluid relative to the bottle fluid, so that a single cartridge can be used for at least a certain proportion of the bottle's life. This may be done, for example, by varying the size and proportions of the outlet openings 135 in the cartridge. Other openings in the cap may also be varied. For example, the dispensing end of the dispensing channel 155 may have a flow restrictor 157 at the dispensing end of the dispensing channel 155. In this manner, the bottle fluids and cartridge fluids can be dispensed together in a specific ratio.

[0112] In one embodiment, a dispensing cap and bottle may be configured so that approximately only one cartridge is needed per bottle; that is, when dispensed, the cartridge and the bottle are emptied at about the same time. In another embodiment, approximately only two cartridges are needed per bottle; that is, when dispensed, a single cartridge may be emptied when only about half of the bottle is emptied, so the user must then remove the cartridge and insert a second cartridge to use with the second half of the bottle. In different embodiments, three or more cartridges may be required. It is contemplated, however, that three or less cartridges, and in an illustrative embodiment, at most two cartridges, would be required per bottle. Such an approach would reduce waste as well as be more convenient to the user. However, it is noted that the amount of cartridge fluid used per bottle fluid may, to some extent, vary based on the squeeze force applied by the user to the bottle. In addition, the size of bottles may vary, which may require a different approximate number of cartridges per bottle. For instance, for some larger sized bottles, four or more cartridges would be required per bottle.

[0113] By one approach, the secondary cartridge fluid is dispensed in an amount of about 8 to 12% by volume of the primary bottle fluid that is dispensed. In another approach, the secondary cartridge fluid is dispensed in an amount of up to about 50% by volume of the primary bottle fluid that is dispensed. In some embodiments, the secondary fluid and primary fluid are dispensed in a ratio of about 0.5:10 to about 5:10. In an illustrative configuration, the ratio is 1:9, and, in another

approach, 1:10. In yet another approach, the ratio is about 2:8 or even 1:1. Varying the size of the outlet openings 135 of the cartridge relative to the flow regulator 157 of the dispensing channel 155 of the cap base 150 can be effective to achieve the right ratio. For instance, by one approach two outlet openings 135 each measuring about 2.0 mm by about 2.0 mm and a flow regulator of the dispensing channel measuring about 1.8 to 2.0 mm is effective to permit the secondary cartridge fluid to be dispensed in an amount of about 8 to 12% by volume of the primary bottle fluid that is dispensed. Such dimensions may be particularly advantageous when the secondary cartridge fluid has a viscosity ranging from about 12.5 Pa.s to about 15.5 Pa.s (about 12,500 to about 15,500 centipoise) and the primary bottle fluid has a viscosity ranging from about 17.0 Pa.s to about 19.0 Pa.s (17,000 centipoise to about 19,000 centipoise). Generally, it is contemplated that the diameter of the flow regulator 157 must be small enough relative to the diameter of the tube portion 140 or the dispensing outlet 122 of the cartridge to permit the streams of the bottle fluid and cartridge fluid to be properly joined and dispensed together in a continuous manner. For instance, if the flow regulator 157 is too large (for example, more than about 4.0 mm wide, relative to a tube portion 140 or a dispensing outlet 122 having a diameter of about 5.0 mm), the cartridge fluid may be substantially blocked or inhibited from joining the bottle fluid within the tube portion 140.

[0114] In a further embodiment, a bottle may have a capacity of about 250 mL to about 1000 mL for containing the primary fluid disposed in the bottle. In some configurations, the cartridge may have a capacity of about 10 ml to about 50 ml, or about 15ml to about 35ml for containing the secondary fluid disposed in the cartridge. Cartridges and bottles having capacities outside of these ranges may also be configured.

[0115] As noted above, in some embodiments a user may also interchange cartridges containing different fluids in the same dispensing cap and with the same bottle. Advantageously, the user can then use multiple combinations of fluids. For example, a user may be provided with a bottle filled with a first condiment such as ketchup, a dispensing cap, and two, three, or more cartridges filled with different condiments. As desired, the user can interchange the cartridges in the dispensing cap to enjoy different flavor combinations, for example ketchup and a chipotle sauce, or ketchup and a sweet chili sauce. It is contemplated that in one embodiment the different condiments in different cartridges have similar fluid properties, such as similar viscosity, texture, density, and/or compressibility, so that similarly configured cartridges can be manufactured for each condiment. To the extent the fluid properties of the different condiments in different cartridges vary, the cartridge configurations for such condiments may need to be adjusted and customized so that different cartridge condiments dispense in the desired manner. For example, the dimensions of the outlet openings 135 and/or the size of the tube portion 140 and dispensing outlet 122 may have to be adjusted.

[0116] By one approach, different cartridges 105 containing fluids with differing fluid properties must be used with differently configured dispensing cap bases 150 so that optimal dispensing can occur. For example, modifications to the cap bases 150 depending on the viscosities or textures of the fluids may include varying the size of the flow restrictor 157 of the dispensing channel 155 or the diameter of the dispensing channel 155 or varying the dimensions of the base piston element 165. For instance, in one embodiment the diameter of the dispensing channel 155 may be about 4.0 mm to about 6.0 mm, and by one approach, about 5.0 mm. For bottle fluids with higher viscosities (for example, mayonnaise), the diameter of the dispensing channel 155 may be larger.

[0117] In yet a further approach, a user may choose to remove the cartridge altogether and only dispense the primary fluid from the bottle. As such, it is advantageous that in some embodiments the dispensing cap base 150 is configured so that it can dispense fluid without a cartridge 105 inserted therein. This is useful to give the user the option to only dispense the fluid disposed in the bottle. FIG. 10 illustrates how a dispensing cap base 150 attached to a neck of a bottle is usable without a cartridge inserted therein. Upon squeezing the bottle, fluid from the bottle is forced into the dispensing channel 155 and is dispensed from the dispensing cap 100 directly therefrom. Notably, in this configuration a portion of the bottle fluid still forces the base piston element 165 to move, though, of course, the movement of the base piston element 165 does not serve a function without the cartridge.

[0118] When not in use, the dispensing cap may be covered by the flip-top lid 180, as illustrated in FIG. 4, to maintain freshness or prevent contamination or leakage of the product. As noted above, the flip-top lid has an interior projection 185 and is movable between an open position and a closed position, wherein the projection 185 blocks egress of fluid from the cap when in the open position, and permits egress of the fluid when in the closed position. FIG. 4 illustrates the flip-top lid in the closed position, with the interior projection 185 inserted into the dispensing outlet 122 of the cartridge and extending into the tube portion 140 of the valve element 138. In the illustrated embodiment, the interior projection 185 includes a first sealing surface configured to block egress of fluid from the dispensing channel 155 of the cap base 150, and a second sealing surface configured to block egress of fluid from the cartridge. The interior projection 185 has a wide portion that is dimensioned to provide a sealing fit to the dispensing outlet 122 so that fluid from the cartridge cannot leak from the cartridge when the lid is closed. In one embodiment, the wide portion can block the outlet openings 135 in the tube portion 140 of the valve element 138, so that the fluid 120 disposed in the cartridge cavity 115 cannot egress into the tube portion 140. The interior projection, as illustrated, additionally has a narrower portion at its terminal end that is dimensioned to sealingly contact the outlet of the dispensing channel 155. The lid 180 and interior projection 185 are configured to sealingly contact the outlet of the dispensing channel 155 even if the cartridge is not inserted into the cap base 150.

Example 1.

[0119] In one non-limiting example, a dispensing cap, cartridge, and dispensing bottle are formed in accordance with the approximate measurements indicated in Table 1.

Table 1

Parameter	Approximate Measurement
Viscosity of bottle fluid (Tomato Ketchup)	17.380 Pa.s (17,830 centipoise)
Viscosity of cartridge fluid (Salad Cream)	13.790 Pa.s (13,790 centipoise)
Number of outlet openings in cartridge	2
Dimensions of each outlet opening	2.0x2.0 mm
Inner diameter of tube portion of cartridge	4.9 mm
Diameter of flow regulator of cap base dispensing channel	2.0 mm
Inner diameter of cap base dispensing channel	5.0 mm
Inner length of cap base dispensing channel	34.7 mm
Diameter of ring-shaped portion of cartridge piston element	43.1 mm
Diameter of flange portion of base piston element	42.1 mm
Diameter of first cylindrical portion of base piston element	21.4 mm
Cap dimensions	Radius: 55 mm Length: 215.6 mm
Volume of fluid in bottle	500 mL
Volume of fluid in cartridge	25 mL

[0120] In use, the dispensing bottle described above may dispense a consistent single stream of two fluids from the bottle when the user squeezes the bottle. The fluids may then be joined together in a substantially unmixed manner, similar to the dispensed stream illustrated in FIG. 11.

[0121] FIGS. 12-28B illustrate an alternative embodiment of a dispensing cap 400 and portions thereof. Dispensing cap 400 has a similar configuration and dispensing mechanism to the dispensing cap embodiments described in the foregoing. Accordingly, it is noted that elements of the embodiments illustrated in FIGS. 12-28B that are substantially the same as or correspond to elements of the embodiments illustrated in FIGS. 1-11, with any differences noted, are numbered to reflect that correspondence, with the only difference in numbering being the first digit of the reference numeral. For example, reference numerals 135 and 635 correspond to the cartridge outlet opening in different embodiments, and reference numerals 127 and 627 correspond to the inner cartridge cylindrical wall in different embodiments. As such, the description of elements described in the foregoing also serves to describe any corresponding elements in FIGS. 12-28B, with any differences being noted and highlighted below.

[0122] Like the above-described embodiments, dispensing cap 400 includes a cartridge 605 that is received in a dispensing cap base 550. The dispensing cap base 550 includes a hinged lid 580 that, in a closed position, causes the cartridge 605 to be entirely enclosed within the cap base 550 and blocks any fluid from being dispensed from a dispensing outlet 622 of the cartridge 605. In an open position of the hinged lid 580, as illustrated in FIG. 12, the top of the cartridge 605 is uncovered, exposing the dispensing outlet 622 and permitting dispensing of fluid from the dispensing cap 400.

[0123] As illustrated in FIG 12, in one illustrative embodiment, when the hinged lid 580 is in the open position and the cartridge 605 is fully seated into the base, an upper side portion 621 of the cartridge 605 is also exposed. That is, when the cartridge 605 is inserted into the cap base 550, a portion of the cartridge 605 protrudes out from the cap base 550. The exposed, protruding portion 621 of the cartridge 605 allows a user to grip the cartridge when inserting the cartridge 605 into the cap base 550 or when removing the cartridge 605 from the cap base 550.

[0124] In the illustrated embodiment, the exposed portion 621 of the cartridge 605 also includes gripping 607 to facilitate a user's grip on the cartridge when inserting or removing the cartridge 605. As illustrated, the gripping 607 may take the form of ribbing or other texture on the exposed portion 621 of the cartridge 605. There may be several gripping surfaces or portions of gripping 607 spaced along the exposed portion of the cartridge 605. For instance, there may be two, three, four, five, or more portions of gripping 607.

[0125] The cap base 550 may also include a continuous gripping portion 508 disposed outwardly on a side wall of the cap

base 550. As shown in FIG. 12, the continuous gripping portion 508 is disposed at an end of the cap base 550 that is configured to be threaded onto a neck of a bottle. The continuous gripping portion 508 facilitates a user's gripping and turning of the dispensing cap 400 or cap base 550 when the dispensing cap 400 or cap base 550 is threaded onto or unthreaded from a neck of a bottle. The gripping portion 508 also may assist with retaining or grasping of the cap base 550 when the cartridge 605 is moved relative thereto.

[0126] As illustrated, the exposed portion 621 of the cartridge 605 can also include various indicia to facilitate a user's use of the dispensing cap 605 by indicating intended use thereof. The indicia, for example, can include instructions to the user. For instance, the instructions can indicate how to insert or remove the cartridge 605 from the cap base 550. For example, FIGS. 12 and 13 illustrate a downwardly pointing arrow 614 to indicate to the user the direction the cartridge is to be inserted into the cap base 550. There may be more than one of such arrows 614 spaced around the exposed portion 621 of the cartridge so that the user can see the instructions from multiple angles. As shown, the dispensing cap base 550 may also have a corresponding upwardly pointing arrow 509 which indicates the orientation of the cap base 550 when inserting the cartridge 605.

[0127] The illustrated embodiment also includes indicia 616 to indicate to the user a direction to rotate the cartridge 605 in order to thread the cartridge 605 into the cap base 550. For instance, one or more arrows 616 may be spaced along the exposed portion 621 of the cartridge 605 to indicate the direction of rotation. By another approach, one or more arrows may indicate a first direction for screwing the cartridge 605 into the cap base 550 and one or more different arrows may indicate a second, opposite, direction for unscrewing the cartridge 605 from the cap base 550.

[0128] It is noted that the above-described indicia are non-limiting, and many different forms of indicia for instructing the user are contemplated. For instance, there may simply be verbal instructions or there may be verbal instructions accompanied by nonverbal indicia (such as arrows) or there may simply be nonverbal indicia.

[0129] When inserting a cartridge 605 into a cap base 550, the user may also experience an indication that the cartridge 605 has been properly inserted. For instance, the user may experience a tactile or auditory indication when the cartridge 605 has been threaded sufficiently into the cap base 550 and/or is properly aligned. For instance, there may be a detent mechanism. In this case, a main cartridge body 610 of cartridge 605, as shown in FIGS. 22A-B, includes one or more bumps or protrusions 618 on threading 630 disposed externally on the main cartridge body 610. When the cartridge 605 is being threaded into the cap base 550, the protrusions 618 may bump against corresponding indentations or recesses 519a, 519b on the threading 552 disposed internally in the cap base 550 (as illustrated in FIGS. 28A-28B), which produces a sound (such as a clicking sound) and/or tactile indication that the cartridge is in place. In other configurations, the location of the bumps or protrusions may be reversed such that they are disposed on the base instead of the cartridge (with the recesses on the cartridge). By one approach, there may be two protrusions 618 on the cartridge and four indentations 519a, 519b on the threading 552 in the cap base 550.

[0130] As illustrated in FIG. 15, the dispensing cap 400 includes a cap base 550 that has a main cap base body or outer cylindrical housing 572 and a base piston element 565 disposed therein. The cartridge 605 generally includes a main cartridge body 610, a cartridge piston element 645, and a valve element 638. When the dispensing cap 400 is assembled with the cartridge 605 received within the housing 572 of the cap base 550, all of the components 572, 565, 610, 645, and 638 are generally centrally aligned along central longitudinal axis 30.

[0131] FIGS. 16-19 illustrate the cartridge 605 on its own apart from a cap base 550 of a dispensing cap 400. The cartridge 605 is similar to cartridge 105 described above, having a main cartridge body 610 formed in part by a cylindrical wall, a valve element 638 substantially covering a top side of the cartridge 605, and a cartridge piston element 645 substantially covering a bottom side of the cartridge 605. As illustrated in FIGS. 20A-D, 21A-21B, and 22A-22E, the valve element 638, cartridge piston element 645, and main cartridge body 610 are substantially similar to the valve element 138, cartridge piston element 145, and main cartridge body 110 of cartridge 105 and, in use, function in a likewise manner.

[0132] FIGS. 23-26 illustrate views of a cap base 550 of dispensing cap 400, which is similar to the cap base 150 of dispensing cap 100. As illustrated in FIG. 24, the base openings 567 of the inner cylindrical housing 574 of the cap base 550 have a different configuration compared to the base openings 167 of the cap base 150. Specifically, there are four groupings of two ribs or spokes 566 connecting the top of the dispensing channel 555 to the inner cylindrical housing 574, and base openings 567 are disposed between the ribs 566 in each grouping and between each grouping of ribs 566. The larger quantity of base openings 567 in the cap base 550 permits fluid from a bottle to flow into the inner cylindrical housing 574 of the cap base 550 to move the base piston element 565, while the groupings of multiple ribs 566 strengthen the connection between the dispensing channel 555 and the inner cylindrical housing 574.

[0133] The cap base 550, like cap base 150, includes a dispensing channel 555 that permits fluid from a bottle to flow through a portion of the dispensing cap 400 when the bottle is squeezed to ultimately be dispensed. The cap base 550, like cap base 150, also includes a base piston element 565 that, in use of the dispensing cap 400, advantageously transfers the force of the bottle fluid being squeezed from the bottle to drive the cartridge piston element 645 of the cartridge 605 to dispense a cartridge fluid from the cartridge 605, without the bottle fluid ever needing to contact the cartridge piston element 645. In this manner, the exposed outer surface of the cartridge piston element 645 is kept clean during use of the dispensing cap 400, and there is substantially no mess or residue from the bottle fluid that a user needs to clean at the

interface between the cap base 550 and the cartridge 605 when the cartridge 605 is removed from the cap base 550 after use.

[0134] FIGS. 27A-27C illustrate several views of base piston element 565. Like base piston element 165, base piston element 565 includes a first cylindrical portion 582 and a second flange portion 583. In use, fluid squeezed from the bottle engages a lateral piston floor 587 of the first cylindrical portion 582 to move the base piston element 565 from a first position in the dispensing cap 400 toward a second position. The second flange portion 583 engages and moves the cartridge piston element 645, which forces cartridge fluid out from the cartridge 605. When squeezing the bottle, the distance and speed the base piston element 565 travels is limited by the amount of fluid remaining in the cartridge 605. For instance, if the cartridge 605 is nearly empty, when the bottle is squeezed, the pressure of the bottle fluid on the piston floor 587 causes the base piston element 565 to traverse a substantial distance within the dispensing cap 400 to drive the cartridge piston element 645 to force out the remaining cartridge fluid. The base piston element 565 is also limited in its movement by stops 577 along guide channel posts 561 on the cap base 550 (as illustrated in FIGS. 23 and 25). Like the base piston element 165 of dispensing cap 100, base piston element 565 includes lengthwise cut-outs 563 corresponding to the guide channel posts 561 such that, in use, when the first cylindrical portion 582 of the base piston element 565 moves through the dispensing cap 400, the cut-outs 563 allow a leading portion of the first cylindrical portion 582 of the base piston element 565 to pass beyond the stops 577 until the tops of the cut-outs 563 are stopped by the geometry, such as ledges, of the stops 577. As illustrated in FIGS. 27B and 27C, the tops of the cut-outs 563 in dispensing cap 400 may include projections 589 that get "caught on" or abut the stops 577.

[0135] FIGS. 29-40B illustrate a further embodiment of a dispensing container 1000, a dispensing cap 700, and portions thereof. Dispensing container 1000 and dispensing cap 700 have a similar configuration and dispensing mechanism to the dispensing container and dispensing cap embodiments described in the foregoing. Accordingly, it is noted that elements of the embodiments illustrated in FIGS. 29-40B that are substantially the same as or correspond to elements of the embodiments illustrated in FIGS. 1-28B, with any differences noted, are numbered to reflect that correspondence, with the only difference in numbering being the first digit of the reference numeral. For example, reference numerals 135 and 935 correspond to the cartridge outlet opening in different embodiments, and reference numerals 127 and 927 correspond to the inner cartridge cylindrical wall in different embodiments. As such, the description of elements described in the foregoing also serves to describe any corresponding elements in FIGS. 29-40B, with any differences being noted and highlighted below.

[0136] With reference to FIGS. 29-33, the dispensing bottle 1000 includes a dispensing cap 700 and a flexible bottle 1002 that can be squeezed to dispense fluid therefrom. While the bottle 1002 contains a primary fluid, the dispensing cap 700 having a cartridge, capsule, or pod 905 containing a secondary fluid may be threaded to a neck 1004 of the bottle 1002 so that the primary and secondary fluids are dispensed together from the dispensing bottle 1000 via a dispensing outlet 922 of the dispensing cap 700 in the manner described above. In some embodiments, a conventional dispensing cap (not shown) which dispenses only the primary fluid from the bottle 1002 may be removed from the flexible bottle 1002 and replaced with the dispensing cap 700.

[0137] The dispensing bottle 1000 including the flexible bottle 1002 and dispensing cap 700 may have a combined geometry that permits the dispensing bottle 1000 to stand inverted while resting on its cap 700 when the cap 700 is closed via a hinged flip-top lid 880. The hinged flip-top lid 880, in some embodiments, may have a buckle element 880a extending downward from an outer side edge of the lid 880 having a protrusion 880b that mates with or clicks into a recess or notch 880c on a corresponding side surface of the cap base 850 for secure closure. A user may engage the buckle element 880a to open and close the lid 880. The opening force to open the lid 880 may, for example, be about 7-15 N. By one approach, the buckle element 880a includes a tab of material with the protrusion 880b including an inwardly extending lip or flange. The protrusion 880b is configured to engage geometry on the base to provide a secure closure for the closure cap. While the corresponding geometry may include a recess or notch 880c, it also may include a corresponding geometry such as an offset lip or flange that extends outward from the base.

[0138] The primary and secondary fluids, in illustrative embodiments, may be thixotropic fluids. In some embodiments, the fluids may be an edible product such as, for example, a sauce, condiment, dressing, or beverage. In certain embodiments, the fluids may be an emulsion, gel, paste, or puree. However, it is contemplated that the primary fluid and the secondary fluid may include non-food products. For instance, in some embodiments the fluids are health, body, hair, or cosmetic products, for example, shampoos, conditioners, lotions, soaps, body washes, serums, etc. In some embodiments, the first and second fluids may be characterized by certain rheological properties, as described in further detail below. For instance, the fluids may have certain viscosities, hardness, stringiness, yield stress, adhesive force, specific heat, thermal conductivity, etc. and may have Newtonian or non-Newtonian properties.

[0139] The dispensing cap 700 is configured and functions similarly to the above-described caps 100, 400. As illustrated in FIGS. 30-33, the dispensing cap 700 includes a cap base 850 that has a main base body or outer cylindrical housing 872 and a base piston element 865 disposed therein. The cartridge 905 generally includes a main cartridge body 910, a cartridge piston element 945, and a valve body 938. When the dispensing cap 700 is assembled with the cartridge 905 seated within the outer housing 872 of the cap base 850, all of the components 872, 865, 910, 945, and 938 are generally

aligned about a central longitudinal axis Y.

[0140] More specifically, with reference to FIGS. 30 and 34A-35B, in some embodiments the dispensing cap base 850 includes internal threading 878 corresponding to external threading 1079 on the neck 1004 of the bottle 1002 for coupling the dispensing cap base 850 to the bottle 1002. The dispensing cap base 850 is also configured to receive the cartridge 905. By one approach, the cartridge 905 is received in a receptacle 852 (see, e.g., FIG. 34A) of the dispensing cap base 850, which may be a depression or cavity in the base 850 that is exposed when the flip-top lid 880 is positioned in an open configuration. The cartridge 905 is manually insertable and removable into the cap base 850 by the user, such as by screwing the cartridge 905 into the base 850. For instance, the cartridge 905 may include external threading 930 that engages internal threading 852a of the cap base 850.

[0141] Like caps 100, 400, the outer housing 872 of the cap base 850 has a generally hollow interior and an inner cylindrical housing 874 disposed centrally in the interior of the outer housing 872. In one illustrative configuration, the inner housing 874 is generally hollow and connected to the outer housing 872 by an annular floor 876 (see FIG. 30), which may extend perpendicular to the inner and outer housings 874, 872. In the illustrated embodiment, the annular floor 876 forms a partial floor or bottom to the cartridge-receiving receptacle 852 of the cap base, and has a stepped configuration, for example, an outer step 876a adjacent the outer cylindrical housing 872, and an inner step 876b adjacent the inner housing 874. The inner step 876b forms a portion of an annular slot 868 of the cap base 850 for receiving the neck 1004 of the bottle 1002. The slot 868 is formed by the inner step 876b, a lengthwise portion of the inner cylindrical housing 874, and an annular wall 881 which extends perpendicular from the inner step 876b and about the inner cylindrical housing 874. In the illustrated embodiment, the slot 868 includes the internal threading 878 disposed on an inward-facing surface of the annular wall 881 for engaging corresponding external threading 1079 of the bottle 1002 so that the bottle 1002 can be securely attached to the cap 700.

[0142] At least a portion of the inner housing 874 is received by the neck 1004 of the bottle 1002 when the cap base 850 is threaded onto the neck 1004, bringing the interior of the bottle 1002 into fluid communication with an ingress portion 891 of the cap base 850 disposed adjacent a top end of the inner housing 874. The base piston element 865 is disposed radially inward of the inner housing 874. The inner housing 874 serves in part as a guide channel 860 for movement of the base piston element 865. A tubular dispensing channel 855 of the cap base 850 is disposed radially inward of the base piston element 865 along the central axis Y of the dispensing cap 700. Specifically, the dispensing channel 855 extends through a central opening of the base piston element 865, which has an annular configuration. The dispensing channel 855 extends from the ingress portion 891 of the cap base 850 and lengthwise through a substantial portion of the cap base 850 towards a dispensing side of the cap base 850. Specifically, the dispensing channel 855 defines an inlet opening 862 at the ingress portion 891 of the cap base 850 for receiving the primary fluid from the bottle 1002 and an outlet opening 857 at a distal end portion 855a of the dispensing channel 855. The distal end portion 855a of the dispensing channel 855 containing the outlet opening 857 is positioned to engage the cartridge 905. In particular, in the illustrated approach, the end portion 855a of the dispensing channel 855 is received within an inner cartridge cylindrical wall 927 of the cartridge 905. In use, the outlet opening 857 communicates the primary fluid into a dispensing chamber or tubular portion 940 of the cartridge 905. In the dispensing chamber 940, the primary fluid is joined with the secondary fluid from the cartridge 905 and dispensed from the dispensing cap 700 through the dispensing outlet 922.

[0143] Referring to FIGS. 30 and 35A-B, the primary fluid from the bottle 1002 flows towards the ingress portion 891 of the cap base 850 when pressure is applied to the bottle 1002 to dispense the fluid. The ingress portion 891, as noted above, includes the inlet 862 to the dispensing channel 855. The ingress portion 891 further includes a set of supporting or connecting spokes 866a partially covering the inner housing 874. The spokes 866a support and connect the dispensing channel 855 to the inner housing 874. Specifically, in some embodiments, the spokes 866a are formed integrally with the dispensing channel 855 and the inner housing 874, with the spokes extending radially outward from the inlet opening 862 of the dispensing channel 855. By one approach, there are four spokes 866a equally spaced about the dispensing channel inlet opening 862, connecting the dispensing channel 855 to the inner cylindrical housing 874. In other approaches there may be a different number of spokes, for example three, five, six, or eight. The number and configuration of the spokes 866a should be selected so that the structure can withstand repeated pressure from the primary fluid during use. In addition, the spokes 866a are selected to protect the cap against breakage (e.g., when it is dropped).

[0144] The ingress portion 891 further includes cap base openings 867 disposed between the spokes 866a which, in use, permit passage of the primary fluid into the inner housing 874 when pressure is applied to the bottle 1002. In an illustrative approach, there are four equally sized openings 867 defined between each of the four spokes 866a, though other numbers of openings are possible. The number and size of the cap base openings 867 may be selected, at least in part, so that a sufficient amount of the primary fluid passes into the inner cylindrical housing 874 to pressurize and move base piston element 865 when the bottle 1002 is squeezed so that the base piston element 865 can engage and move the cartridge piston element 945.

[0145] By one approach, a top annular edge 874a of the inner cylindrical housing 874 may be punctuated by recesses or grooves 867a disposed adjacent to the cap base openings 867 and between the spokes 866a. For instance, there may be four grooves 867a adjacent to the four cap base openings 867 and between the four spokes 866a. The grooves 867a may

be formed in part by one or more bevels or chamfers of the top edge 874a of the inner housing 874 and may strengthen and reinforce the ingress portion 891 to prevent it from breaking.

[0146] In some embodiments, the outer housing 872, inner housing 874, annular floor 876, annular wall 881, and dispensing channel 855 are all integrally formed, as well as, in some embodiments, the flip-top lid 880. Such components may be formed from a food-grade plastic or polymer such as polypropylene (PP) and/or high-density polyethylene (HDPE). In an illustrative embodiment, the material is polypropylene. In some configurations, different components may be formed of different materials.

[0147] In use, when the bottle 1002 is squeezed, the primary fluid from the bottle simultaneously passes through the ingress portion 891 via two different routes. In a first route, a portion of the primary fluid flows into the dispensing channel 855 to ultimately be dispensed from the dispensing cap 700. In a second route, a portion of the primary fluid flows through the cap base openings 867 to engage the base piston element 865 within the inner housing 874.

[0148] In the first route, a portion of the primary fluid flows into the dispensing channel 855 through the inlet opening 862 at the ingress portion 891 of the cap base 860 and out the outlet opening 857 positioned at a distal end 855a of the dispensing channel 855. As explained above, in some approaches, the outlet opening 857 then communicates the fluid into a dispensing chamber or tubular portion 940 of the cartridge 905. In the dispensing chamber 940, the first fluid is joined with the second fluid from the cartridge 905 and dispensed from the dispensing cap 700 through the dispensing outlet 922. In some approaches, the dispensing channel 855 is configured so that a certain amount of the primary fluid is dispensed, for example, relative to the secondary fluid. In addition, the dispensing channel 855 may be configured so that the primary fluid has a desirable flow (e.g., amount and speed) from the dispensing channel 855 relative to the squeeze force. For instance, it should not require too much squeeze force to move the fluid through the dispensing channel 855 and into the tubular portion 940 of the cartridge 905. In addition, limiting the flow of the primary fluid from the dispensing channel 855 ensures that there is sufficient room in the tubular portion 940 for the secondary fluid from the cartridge to join the stream of primary fluid and maintain a desirable joint flow and/or pattern as the fluids are dispensed. In some configurations, achieving an appropriate balance between these factors depends on both the configuration of the dispensing channel 855 and the rheological characteristics of the fluids. In some illustrative embodiments, for example, the size and shape of the outlet opening 857 of the dispensing channel 855 is selected. For instance, in particular embodiments, the outlet opening 857 is circular and, for instance, may have a diameter of about 0.5 to about 3.0 mm, depending on the characteristics of the fluid. In some approaches, the diameter is between about 1.8 mm to about 3.0mm, or about 2.4mm to 2.8mm. In an illustrative embodiment, the diameter is about 2.6mm. It is noted that a larger diameter, such as a diameter greater than 1.8 mm, can advantageously lessen the force required to dispense the primary fluid. For thicker fluids in particular, typically a larger diameter or larger access may be necessary so that less force is required to dispense the primary fluid, such as a diameter beyond 3.0mm (e.g., 3.0mm to 4.0mm).

[0149] The outlet opening 857 may have a smaller diameter than the rest of the dispensing channel 855. For instance, the dispensing channel 855, in exemplary embodiments may have an inner diameter about 4 mm to about 6 mm, and in some embodiments about 4.4 mm to about 5 mm. The inner diameter of the dispensing channel may have a uniform or tapered diameter. For instance, in some approaches, the inner diameter may be tapered and wider at the portion of the channel 855 closer to the bottle. In certain non-limiting approaches, the length of the dispensing channel 855 may be about 30 mm to about 40 mm. The dispensing channel has a length sized to extend from the ingress portion 891 to the tube portion 940 of the cartridge 905.

[0150] In the second route, a portion of the primary fluid passes through the cap base openings 867 towards the base piston element 865 retained within the inner housing 874. Specifically, and with reference to FIGS. 30 and 34A-35B, the pressurized fluid exerts a force on a lateral piston floor 887 of the base piston element 865 to drive the base piston element 865 along the guide channel 860 away from the ingress portion 891 of the cap base 850 and towards the cartridge 905. In this manner, the cap base 850, like cap bases 150 and 550, advantageously utilizes the base piston element 865 to transfer the force of the primary fluid being squeezed from the bottle 1002 to drive the cartridge piston element 945 of the cartridge 905 to dispense a cartridge fluid from the cartridge 905, without the primary fluid ever needing to contact the cartridge piston element 945. As such, the outer surface of the cartridge piston element 945 is kept clean during use of the dispensing cap 700, and there is substantially no mess or residue from the bottle fluid that a user needs to clean at the interface between the cap base 850 and the cartridge 905 when the cartridge 905 is removed from the cap base 850 after use. In addition, the primary fluid that passes into the inner housing 874 to move the base piston element 865 does not enter other portions of the cap base 850 (keeping the rest of the cap base 850 free from residue) and, in some approaches, springs back into the bottle 1002.

[0151] The base piston element 865 is substantially the same as the above-described base piston elements 165 and 565. For instance, the base piston element 865 includes a first cylindrical portion 882 and a second annular flange portion 883 extending in large part radially outward from an end of the first cylindrical portion 882. In use, primary fluid squeezed from the bottle engages the lateral piston floor 887 of the first cylindrical portion 882 to move the base piston element 865 from a first position in the dispensing cap 700 toward a second position. The second flange portion 883 engages and moves the cartridge piston element 945, which forces the secondary fluid disposed in the cartridge 905 to pass out of the

cartridge 905. It is noted that the base piston element 865 should be configured so that there is not too much resistance between the base piston element 865 and the guide channel 860 so that there is easy initiation of movement of the base piston element 865 when the bottle 1002 is squeezed and the base piston element 865 is engaged by the pressurized primary fluid.

[0152] When squeezing the bottle 1002, the distance and speed the base piston element 865 travels is limited by the amount of fluid remaining in the cartridge 905, as described in the foregoing. For instance, if the cartridge 905 is nearly empty, when the bottle is squeezed, the pressure of the bottle fluid on the piston floor 887 causes the base piston element 865 to traverse a substantial distance along the central axis Y of the dispensing cap 700 to drive the cartridge piston element 845 to force out the remaining secondary fluid in the cartridge 905. The base piston element 865 is also limited in its movement by stops or piston retention clips 877 along guide channel posts 861 on the cap base 850. Like the base piston element 165 of dispensing cap 100, base piston element 865 includes lengthwise cut-outs 863 corresponding to the guide channel posts 861 such that, in use, when the first cylindrical portion 882 of the base piston element 565 moves through the dispensing cap 700, the cut-outs 863 allow a leading portion of the first cylindrical portion 882 of the base piston element 565 to pass beyond the stops 877 until the tops of the cut-outs 863 are stopped by corresponding geometry, such as ledges, of the stops 877. Since the stops 877 limit the movement of the base piston element 865 beyond a final position, movement of the cartridge piston element 945 is also thereby limited. In some approaches, this may be advantageous so that the cartridge piston element 945 is not moved to contact and induce wear on other portions of the cartridge 905 (e.g., the valve element 938).

[0153] Like base piston elements 165 and 565, the base piston element 865 is configured to slide sealably along the guide channel 860 and the dispensing channel 155 to prevent leakage of the primary fluid from the bottle between the base piston element 865 and the guide channel 860 and between the base piston element 865 and the dispensing channel 855.

[0154] This can be accomplished, in part, by configuring a close fit between the first cylindrical portion 882 of the base piston element 865 and the guide channel 860 and between the piston floor 887 (which has an annular shape) and the dispensing channel 855. In addition to the fit of the elements, the geometry of the elements, the materials forming the elements and/or the types of fluids within the dispensing bottle and cap also may be relevant to ensuring no or minimal leakage between the elements. To that end, the materials, geometry, and/or sizing of elements may be adjusted depending on the materials being packaged and dispensed.

[0155] By one approach, one or more sealing elements, such as inner and outer bore seals may extend from the first cylindrical portion 882 of the base piston element 865. For example, an inner seal element 870 may be configured to engage an outer surface of the dispensing channel 855 and an outer seal element 871 may be configured to engage the guide channel 860. In one configuration, the outer and inner seals 870, 871 may be continuous flange-like protrusions. In one illustrative approach, the outer and inner seals 870, 871 extend at an oblique angle from the outer and inner edges of the piston floor 887 of the base piston element 865, respectively. In some configurations, only the sealing elements 870, 871 extending from the first cylindrical portion 882 of the base piston element 865 engage the adjacent surfaces of the guide channel 860 and dispensing channel 855, which both reduces friction during movement of the base piston element 865 yet provides sufficient sealing to prevent leakage in unintended areas.

[0156] A variety of materials may be utilized for the base piston element 865 including the seal elements 870, 871. In one illustrative embodiment, these elements are integrally formed from materials that have good sealing capability, which may, for example, have an attribute of flexibility, elasticity, softness, and/or compressibility. Suitable examples include low-density polyethylene, high-density polyethylene or polypropylene. In one embodiment, the material is low-density polyethylene. By one approach, the material of the base piston element 865 is low-density polyethylene while the rest of the cap base 850 is polypropylene. In another approach, the base piston element 865 and the rest of the cap base 850 is the same material (for example, in embodiments in which recyclability of the entire cap is desirable). For example, the entire cap base 850 including the base piston element 865 may be polypropylene. In some configurations, the base piston element 865 is not removable from the cap base 850 during typical use of the product and is always retained within the guide channel 860.

[0157] FIGS. 36A-36C illustrate the cartridge 905 on its own apart from a cap base 850 of a dispensing cap 700. The cartridge 905 is configured and functions similarly to cartridges 105 and 605 described above, having a main cartridge body 910 formed in part by a cylindrical wall, a valve body or valve element 938 substantially covering a top side of the cartridge 905, and a cartridge piston element 945 substantially covering a bottom side of the cartridge 905 opposite the valve element 938. The body 910, valve element 938, and cartridge piston element 145 define an interior cavity 915 or container for containing a fluid disposed in the cartridge. Since the cartridge 905 includes a similar configuration and functionality to cartridge 105, 605, the description of cartridges 105, 605 is incorporated by reference herein with the below discussion focusing on the differences between cartridge 905 and the previous cartridges 105, 605.

[0158] With reference to FIGS. 36C and 37A-37D, the cartridge body 910 includes a top portion 912 which partially covers a dispensing side of the cartridge 905. The valve element 938 is in part seated on or over the top portion 912 of the cartridge body 910 and provides additional cover to the dispensing side of the cartridge. The valve element 938 may be disposed on or over the top portion 912 of the body 910 in any suitable manner, for example by corresponding geometry,

gluing, and/or welding. In other embodiments, portions of the valve element 938 may be mated with the cartridge 905 via other mechanical connections such as, e.g., an interference fit, a snap fit, friction fit, and/or a detent or other biasing mechanism.

[0159] In the illustrated embodiment, the valve element 938 is coupled to the top portion 912 of the body 910 and includes an annular disc portion 939 which covers the entire dispensing side of the cartridge 905 with the exception of the open dispensing outlet 922. The dispensing outlet 922 is typically formed, at least in part, by an opening at the center of the disc portion 939 of the valve element 938. In the illustrated embodiment, the valve element 938 includes an annular angled upstanding rim portion 939a extending continuously about the disc portion 939. The angled rim portion 939a may be coupled to the top portion 912 of the cartridge body 910 at a corresponding annular angled surface 912a adjacent a perimeter of the top portion 912. In some embodiments, the angled surface 912a is angled radially inwardly and downwardly towards the cavity 915 and, in some approaches, terminates in an annular step 912b of the top portion 912 that may also support the angled rim portion 939a. In the illustrated embodiment, the angled rim portion 939a may be coupled to the angled surface 912a of the cartridge body 910 in any suitable manner, for example by gluing or welding.

[0160] Like valve elements 138 and 638 described above, valve element 938 includes a further tube portion or dispensing chamber 940 extending inwardly into the cartridge 905 from the disc portion 939 at the dispensing outlet 922. In such a configuration, the tube portion 940 has a first end configured to receive the primary fluid from the bottle flowing into the tube portion 940 from the dispensing channel 855 of the cap base 850 and a second end that defines the dispensing outlet 922 through which the first and second fluids are dispensed. The dispensing outlet 922 may be formed by a portion of the tube portion 940 that upwardly protrudes relative to an adjacent portion of the disc portion 939. The tube portion 940, including the dispensing outlet 922, may have a uniform internal diameter. In some embodiments, the dispensing outlet 922 may have a slightly expanded diameter or access than the remainder of the tube portion 940.

[0161] The tube portion 940, including the dispensing outlet 922, in illustrative embodiments, may have a length of about 5 mm to about 12 mm. In some embodiments, for example, the length may be about 6 mm to about 10 mm, or about 7 mm to about 9 mm. The inner diameter of the tube portion 940, in illustrative embodiments, may be about 4 mm to about 7 mm. In some embodiments, for example, the diameter may be about 4.5 mm to about 5.5 mm.

[0162] In one configuration, a central portion of the disc portion 939 may be angled or flexed downwardly towards the interior of the cartridge body 910, such that the dispensing outlet 922 and tube portion 940 are disposed lower than an outer edge or outer portion of the disc portion 939. Thus, like valve elements 138 and 638, the disc portion 939 of valve element 938 has a funneled or conical configuration with the dispensing outlet 922 and tube portion 940 at its center. The disc portion 939 differs from the above-described disc portions 139 and 639 in the shape of the funnel. While disc portions 139 and 639 have a substantially angular or linear funnel cross-section, the funnel of disc portion 9 is curved into a substantially S shape (as shown in FIG. 36C).

[0163] Like valve elements 138 and 638, in some approaches, the tube portion 940 of valve element 938 extends, at least partly, within an interior of the cartridge body 910. The tube portion 940 specifically may be configured to extend within a centrally disposed inner cylindrical wall 927 of the cartridge body 910. In some examples, the tube portion 940 has a diameter slightly smaller than the diameter of the inner cartridge cylindrical wall 927 to achieve a close fit, such as an interference fit. The tube portion 940 and inner cartridge cylindrical wall 927 together form a central opening running through a central lengthwise axis of the cartridge. On the dispensing side of the cartridge, the central opening terminates at the dispensing outlet 922. On the side opposite the dispensing side, the central opening, via the inner cartridge cylindrical wall 927, is configured to receive the dispensing channel 855 of the cap base 850.

[0164] Like valve elements 138 and 638, the tube portion 940 of the valve element 938 typically includes at least one outlet opening 935 in the tubular wall thereof. In use, the outlet openings 935 are configured to permit the secondary fluid from within the cavity 915 of the cartridge 905 to flow therethrough into the dispensing chamber or tube portion 940 of the valve element 938. In the illustrated embodiment, there are four outlet openings 935 equally spaced about the tubular wall of the tube portion 140. Specifically, there are two opposing pairs of outlet openings 935. In the illustrated approach, each opening 935 has a circular shape and has a diameter of between about 2mm to about 4mm, about 2.5mm to about 3.5mm, or between about 3mm to about 3.3mm. For instance, the diameter may be about 3.1mm. For certain fluids, such as certain sauces or emulsions, the combination of four circular outlet openings 935 having a diameter in these ranges and the dispensing channel outlet 857 having a diameter between about 1.5mm to about 3.0mm, or about 2.4mm to about 2.8mm, results in optimal functioning of the dispensing cap 700. Such a configuration, for example, may lead to a desirable dosing of the secondary fluid, a desirable proportioning of the primary and secondary fluids (described further below), a desirable pattern in the dispensed fluids, a lessened squeeze force or dosing force required to dispense the fluids, and/or prevention of unintended leaking of secondary fluid into the tube portion 940 when pressure is not applied. Specifically, for instance, the openings 935 may be configured with a sufficient cross-sectional area to increase the flow of the secondary fluid from the cavity 915 and thereby reduce resistance of the secondary fluid against the cartridge piston element 945 so that less squeeze force is required to dispense the product. In certain embodiments, there may be a suitable amount of both the primary and secondary fluid dispensed at a squeeze force of 100 N or less, a squeeze force of 90 N or less, a squeeze force of 85 N or less, a squeeze force of 80 N or less, or a squeeze force of 75 N or less. In an illustrative configuration, the outlet

openings 935 may have a diameter of about 3.1 mm and the dispensing channel outlet 857 may have a diameter of about 2.6 mm.

[0165] In some configurations, the outlet openings 935 may have a total combined area. For instance, in embodiments, the total combined area may be about 6 mm² to about 40 mm². In other illustrative approaches, the total combined area may be about 8 mm² to about 35 mm², about 8 mm² to about 35 mm², or about 12 mm² to about 32 mm².

[0166] In some approaches, each outlet opening 935 may have a certain area. For instance, in some approaches, the area may be between about 3 mm² to about 15 mm². In some embodiments, the area may be between about 4 mm² to about 10 mm² or about 6 mm² to about 8 mm². In embodiments, there may be different amounts, shapes, and sizes of outlet openings 935, which may depend on the viscosity, yield stress, or other rheological properties of the fluids. For instance, some embodiments may have one outlet opening, some embodiments may have two outlet openings, some embodiments may have three outlet openings, some embodiments may have four outlet openings, and some embodiments may have four or more outlet openings. Exemplary shapes of the outlet openings include circular, square, rectangular, oval, etc. In certain embodiments, a plurality of outlet openings may have different shapes, or a pattern of different shapes (e.g., rectangle, oval, rectangle, oval). In some embodiments, the outlet openings 935 may be selected or disposed in a particular arrangement to create a particular pattern in the combined stream. For instance, the above-described configuration may approximate to a swirl-like pattern when the fluids are dispensed, as illustrated in FIGS. 41A and 41B. While the illustrated embodiment includes the outlet openings 935 aligned along the same horizontal plane relative to the central longitudinal axis Y, other configurations may include the outlet openings 935 offset from one another and at different positions along the length of the tube portion 940.

[0167] Like the earlier embodiments, the properties of the fluids and the configuration of the dispensing cap 700 prevents substantial mixing of the fluid during dispensing in the sense that the integrity and appearance of two different sauces is maintained and clearly visible in the resulting dispensed pattern. As noted above, this may provide a desirable aesthetic effect, particularly to the extent the two fluids are different colors. The aesthetic effect may be influenced by the rheological properties of the two different fluids. For instance, the two fluids may have a certain viscosity or texture relative to one another so that both fluids are visible or distinct in the dispensed stream.

[0168] As noted above, the cartridge 905 functions in the dispensing cap 700 in the same manner as described above with respect to cartridge 105 and 605. For instance, in one exemplary embodiment, the cartridge 905 may have multiple configurations such as a storage and a use configuration. For example, FIGS. 36A-36C illustrate a cartridge in a "closed" configuration (in which the outlet openings 935 of the tube portion 940 are blocked and the secondary fluid cannot egress from the cavity 915 of the cartridge 905). This occurs when the cartridge 905 is not inserted into the cap base 850. FIG. 30, however, illustrates the cartridge 905 in an "open" configuration after being inserted into the cap base 850. In this configuration, the outlet openings 935 are not blocked and cartridge fluid can egress from the cavity 915 when the pistons 865, 945 are pressurized. Specifically, the valve element 938 of the cartridge 905, in some illustrative configurations, is movable relative to the cartridge body 910. More particularly, the valve element 938 may be movable between a first position where the outlet openings 935 are covered by the inner cylindrical wall 927 of the cartridge body 910 to inhibit the secondary fluid in the cavity 915 from flowing into the tube portion 940 via the outlet openings 935 and a second position in which the outlet openings 935 are no longer blocked by the inner cylindrical wall 927 and the secondary fluid in the cavity 915 is able to flow through the outlet openings 935 into the tube portion 940.

[0169] With respect to the "closed" configuration of the cartridge 905, FIG. 36C illustrates a cartridge 905 that is not inserted into a dispensing cap base 850. Advantageously, when the cartridge is not inserted into the dispensing cap base 850, the outlet openings 935 in the tube portion 940 of the cartridge 905 are blocked by an inner wall of the cartridge 905. This inhibits cartridge fluid from leaking out of the cartridge 905 when the cartridge 905 is not inserted into the cap base 850. Specifically, in the closed configuration, the outlet openings 935 are covered by the inner cartridge cylindrical wall 927 of the cartridge 905. The "closed" configuration may be particularly useful for shipment and storage of the cartridge 905, and especially relevant to approaches where the cartridge 905 is shipped and stored separate from a remainder of the dispensing cap 700.

[0170] When the cartridge 905 is then inserted into the dispensing cap base 850, as shown in FIG. 30, the cartridge 905 may then be reconfigured into a ready position, which might include an open or nearly open configuration. In one illustrative embodiment, the cartridge 905 is in the open configuration and coupled to the cap base 850, an end of the tube portion 940 is brought into forceful engagement with a leading end 855a of the dispensing channel 855 of the cap base 850. Contact with the dispensing channel 855 forces the tube portion 940 of the valve element 938 to be driven upwards along a central axis of the cartridge 905, which moves the outlet openings 935 of tube portion 940 upward and away from the inner cartridge cylindrical wall 927 so they are no longer blocked by the wall 927. This is possible because the valve element 938, including both the disc portion 939 and the tube portion 940, is typically made of a material that can move, deflect, and/or flex in the above-described manner. For example, the valve element 938 may be formed from polypropylene and high-density polyethylene (HDPE) among other optional materials. In an illustrative embodiment, the valve element 938 is formed from polypropylene. By one approach, both the valve element 938 and the main cartridge body 910 are formed from polypropylene, which may provide sufficient resilience or flexibility to prevent cracking during use. In addition to permitting

the required flexing, forming the valve element 938 and/or the main cartridge body 910 from polypropylene may permit these elements to be substantially transparent or translucent (or to have a lower opacity), allowing the user to see the fluid in the cartridge. In other configurations, these elements, or at least a portion thereof, are configured to not be substantially transparent (or to have a higher opacity). This may inhibit a user from seeing residue of fluid that may form on portions of the valve element 938.

[0171] As noted above, the movement, deflection, and/or flexing of the valve element 938 upon insertion of the cartridge 905 into the cap base 850 may be visible to the user, as the disc portion 939 of the valve element and the dispensing outlet 922 formed by an end of the tube portion 940 are also driven upwards. For example, though the disc portion 939 is flexed downwards in a funneled configuration in the closed position, as shown in FIG. 36C, in the open position the disc portion 939 may be pushed upwards so it is substantially less funneled, with the dispensing outlet 922 nearly level with an outer periphery of the disc portion 939, as shown in FIG. 30. The visible movement of the valve element 939 may be an indication to the user that the cartridge 905 has been properly inserted for use.

[0172] It should be appreciated that in the open configuration of some embodiments, secondary fluids in the cartridge 905 having certain thicker viscosities, slower flow rates, higher yield stress, or other rheological properties, for example, certain condiments, will not readily flow through or leak out of the outlet openings 935 until manual pressure is applied to the flexible bottle 1002 and the cartridge piston element 945 is driven to force the cartridge fluid out of the cartridge cavity 915.

[0173] Advantageously, the flexibility of the valve element 938 permits that the outlet openings 935 are recloseable after the cartridge 905 is removed from the dispensing cap base 850. That is, the cartridge 905 returns to the closed configuration after the cartridge 905 is removed. The valve element 938 may, for example, be molded to be biased toward the closed position. For instance, as shown in FIG. 36C, in the closed configuration the disc portion 939 may be molded to be angled or flexed downward, holding the tube portion 940 in a position blocked by inner cartridge cylindrical wall 927. When the cartridge 905 is then inserted into the dispensing cap base 850, the tube portion 940 and disc portion 939 are forced upwards from contact with the dispensing channel 855. After the cartridge 905 is unscrewed from the cap base 850 and the dispensing channel 955 is no longer straining or applying force to the tube portion 940 and disc portion 939 upwards in the open configuration, the tube portion 940 and disc portion 939 are released from the biased position, with the disc portion 939 "remembering" and returning to its stable, angled position and forcing the tube portion 940 back downward into the cartridge 905 to its original position in which the outlet openings 935 are once again covered by the inner cartridge cylindrical wall 927 of the cartridge body 910.

[0174] As described above for cartridges 105 and 605, the closed configuration of the cartridges 905 permits that the cartridges can be manufactured, shipped, sold, handled, and stored separately from the dispensing cap base without leaking fluid from the cavity 915 of the cartridge 905 into the tube portion 940 of the cartridge 905.

[0175] Further, the reclosability of the cartridge 905 after use limits exposure of the cartridge fluid to external contamination, preserving the taste and freshness of the contents thereof, and prevents any accidental leaking of the cartridge contents (for example, of the sauce itself, or a separated serum of the sauce). This is particularly helpful if the cartridge is stored and handled by the user apart from the dispensing cap after use. The reclosability also may preclude the need to provide a full cover or plug for the dispensing outlet of the cartridge. For example, after a user removes a tamper-evident seal from the cartridge, and uses the cartridge in the dispensing cap, a user may then wish to remove the cartridge from the cap and store the cartridge separately from the cap (for instance, if the user possesses multiple cartridges for the cap). The "closed" configuration of the cartridge when the cartridge is not inserted into the dispensing cap permits the cartridge to be kept fresh and stored separately from the cap base. In other words, the cartridge can be stored and re-used after an initial use, instead of being disposed of, and without requiring a lid for the cartridge.

[0176] The cartridge piston element 945, shown in FIGS. 39A and 39B, is typically disposed on the non-dispensing side of the cartridge 905. The cartridge piston element 945 is substantially the same as the cartridge piston elements 145, 645 described above, and functions in the same manner. Thus, the above descriptions of cartridge piston elements 145 and 645 are incorporated by reference herein for cartridge piston element 945. However, it is noted that, by one approach, cartridge piston element 945, including integral seal elements 947, 949, are formed from low-density polyethylene. In one configuration, the cartridge piston element 945 is formed from low-density polyethylene and the other elements of the cartridge 905 (the valve element 938 and the main cartridge body 910) are formed from polypropylene. In another embodiment, the cartridge piston element 945, the valve element 938, and the main cartridge body 910 are all formed from polypropylene, which may be useful for allowing recyclability of the entire cartridge after use. Other food-grade plastic or polymer materials may be used for the cartridge piston element 945, for example those that have good sealing capability yet are also able to slide along the main cartridge body 910.

[0177] In some approaches, the cartridge piston element 945 may not be removable or may be difficult to remove by a consumer during typical use of the product such that the consumer cannot open or close the cartridge 905. In other embodiments, the cartridge piston element 945 may be removable from the main cartridge body 910 by the consumer and subsequently recoupled. In this approach, a cartridge 905 may be cleaned and/or refilled by the consumer.

[0178] The dispensing cap 700 functions in the same way described above with respect to dispensing caps 100 and 400 and illustrated in FIGS. 8 and 9. Specifically, FIGS. 8 and 9 illustrate how the base piston element and cartridge piston

element jointly move between a first unactuated position and a second position to jointly dispense the primary fluid from the bottle and the secondary fluid from the cartridge from the dispensing cap without substantial mixing of the fluids, (that is, each of the fluids maintains its integrity and is separately visible in the stream).

[0179] With reference to FIG. 31, like dispensing cap 400, dispensing cap 700 may be configured such that an upper side portion 921 of the cartridge 905 is exposed when the cartridge 905 is fully seated into the cap base 850 when the hinged lid 880 is in the open position. That is, when the cartridge 905 is inserted into the cap base 850, the upper side portion 921 of the cartridge 905 protrudes out from the cap base 850. The exposed upper side portion 921 of the cartridge 905 allows a user to grip the cartridge 905 when inserting the cartridge 905 into the cap base 850 or when removing the cartridge 905 from the cap base 850.

[0180] The cartridge 905 and the cap base 850 of dispensing cap 700 may also include gripping portions comprising ribbing or texture as described above with respect to dispensing cap 400. For instance, though not shown, the cartridge 905 may have one or more gripping surfaces similar to gripping surfaces 607 spaced along the exposed upper side portion 921 of the cartridge 905 to facilitate a user's grip on the cartridge when inserting or removing the cartridge 605. The cap base 850 may also include a continuous gripping portion 808 disposed outwardly on a side wall of the cap base 850, for instance adjacent the end of the cap base 850 configured to be threaded onto a neck of a bottle. The continuous gripping portion 808 facilitates a user's gripping and turning of the dispensing cap 700 or cap base 850 when the dispensing cap 700 or cap base 850 is threaded onto or unthreaded from a neck of a bottle. The gripping portion 808 also may assist with retaining or grasping of the cap base 850 when the cartridge 905 is moved relative thereto.

[0181] As illustrated, the dispensing cap 700 may include the various indicia described above with respect to dispensing cap 400 to facilitate a user's use of the dispensing cap 605 by indicating instructions for use, such as indicia that indicate how to insert or remove the cartridge 905 from the cap base 850. For instance, arrows 916, 914, and/or 809 may be present on the cartridge 905 (for example the exposed top side portion 921) and/or on the cap base 850, as described above to indicate an orientation for insertion or direction of rotation for threading the cartridge 905 into the cap base 850. Such indicia are non-limiting, and many different forms of indicia for instructing the user are contemplated. For instance, there may simply be verbal instructions or there may be verbal instructions accompanied by nonverbal indicia (such as arrows) or there may simply be nonverbal indicia.

[0182] Like dispensing cap 400, dispensing cap 700 may be configured to present to the user an indication that the cartridge 905 has been properly inserted into the cap base 850. For instance, the user may experience a tactile or auditory indication when the cartridge 905 has been threaded sufficiently into the cap base 850 and/or is properly aligned. In this case, the main cartridge body 910 of cartridge 905, as shown in FIG. 36A, includes one or more bumps or protrusions 918 on the external threading 930. When the cartridge 905 is threaded into the cap base 850, the protrusions 918 engage or bump against corresponding indentations or recesses 819a, 819b on the threading 852a disposed internally in the cap base 850 (as illustrated in FIGS. 40A-40B), which produces a sound (such as a clicking sound) and/or tactile indication that the cartridge 905 is correctly seated. In other configurations, the location of the bumps or protrusions 918 may be reversed such that they are disposed on the base 850 instead of the cartridge 905, with corresponding indentations on the cartridge 905. By one approach, there may be two protrusions 918 on the cartridge 905 and two indentations 819a, 819b on the threading 852 in the cap base 850.

[0183] By some approaches, the dispensing cap 700 is configured to prevent leakage during use and storage of the product. For instance, as described above, the cartridge 905, when not inserted into the cap base 850, has a closed configuration in which the outlet openings 935 are covered by the inner cylindrical wall 927 of the cartridge 905 to prevent fluid leakage from the cartridge cavity 915. In addition, this closed configuration may be an air tight configuration in some approaches. To the extent a cartridge 905 is inserted into the cap base 860, and the cartridge 905 is in the open configuration (as described above), the central protrusion 885 of the hinged flip-top lid 880 can plug the dispensing outlet 922 to prevent leakage of fluid from the cartridge 905 when the flip-top lid 880 is closed. This may also be an air tight configuration in certain approaches. The dispensing cap 700 may also be configured so that there is suitable spring back of the fluid products into the bottle 1002 and cartridge cavity 915 after dispensing to minimize product contamination at the various orifices/nozzles of the dispensing cap 700 (e.g., the dispensing outlet 922, the cartridge outlet openings 935, the dispensing channel outlet 857, etc.) or in portions of the dispensing cap base 850 that interface with the cartridge 905.

[0184] In certain embodiments, the secondary fluid in the cartridge is also configured to have rheological characteristics that prevent leakage or egress of the secondary fluid from the outlet openings 935 and into the tube portion 940 when the cartridge 905 is in the open configuration (i.e., inserted into the cap base 850) unless the dispensing cap 700 is actuated by squeezing the bottle 1002. For instance, as described further below, the secondary fluid in the cartridge 905 may have a certain viscosity, yield stress, or texture. In addition, in cases where the fluid is an emulsion in particular, the emulsion may be suitably stable to prevent syneresis and leakage of a more fluid portion of the fluid (e.g., a separated oil component). Moreover, the combination of the rheological characteristics of the fluid with the size and shape of the outlet openings 935 may also contribute to a lack of leakage of the secondary fluid through the outlet openings 935 in the open configuration.

[0185] Further, the illustrated configuration of the cap base 850 and the cartridge 950 prevents leakage in the threading areas at the interfaces between the bottle 1002, the cap base 850, and the cartridge 950.

[0186] In some approaches, and as described above, the primary fluid and the secondary fluid are dispensed from the dispensing cap 700 without substantial mixing of the fluids such that each fluid is visible in the dispensed pattern. However, the amount of mixing of the fluids, or the pattern that is formed, may depend in part on the squeeze force applied to the bottle 1002. For instance, a larger squeeze force may result in more turbulence and mixing of the fluids as the fluids are being dispensed, and could change the relative proportion, pattern, or appearance of the primary fluid and secondary fluid as they are dispensed.

[0187] As noted above, the rheological properties of the fluids disposed in the bottle and the cartridge affect the proper functioning of the dispensing cap 700. For instance, depending on certain rheological properties such as viscosity, thickness, yield stress, texture, emulsion stability, stringiness, hardness, etc., the fluids may exhibit more or less resistance to flow and require more or less squeeze force to achieve a desired result. In some approaches, the fluids are formulated with rheological characteristics to achieve certain results, such as yield stress to determine acceptable squeeze force of the fluids during dispensing, an acceptable ratio and pattern of the fluids when dispensed, and prevention of unintended leaking of the fluids.

[0188] For example, in some embodiments the primary and secondary fluids may have certain viscosities. In the illustrated embodiment, the viscosities of the fluids may range from about 7.0 Pa.s to about 30.0 Pa.s (about 7,000 centipoise to about 30,000 centipoise). In other embodiments, the viscosities of the fluids may range from about 5.0 Pa.s to about 70.0 Pa.s (about 5,000 centipoise to about 70,000 centipoise), about 6.0 Pa.s to about 50.0 Pa.s (about 6,000 centipoise to about 50,000 centipoise), or about 6.0 Pa.s to about 45.0 Pa.s (about 6,000 centipoise to about 45,000 centipoise). The viscosity measurements described herein may be determined, for example, by a Brookfield Viscometer (for example, an RV DV-II) using Spindle 6, at 12 rpm, at 20-22°C, for 30 seconds.

[0189] The viscosity of the fluid is significant because too low viscosities of the fluids could lead to the secondary fluid leaking out of the cartridge outlet openings 935 or the primary fluid leaking out of the bottle without the user squeezing the bottle. That is, the fluids must be viscous enough to remain contained when not being dispensed. In addition, a secondary fluid in the cartridge should be viscous enough so that it provides sufficient resistance to the movement of the cartridge piston element so that it is not forced to flow out of the cavity too quickly.

[0190] On the other hand, fluids with higher viscosities may exhibit too much flow resistance. This may be undesirable since it could require the user to apply more force to the bottle in order for the pistons 865, 945 to move and dispense the fluids. In some approaches, larger openings and channels throughout the dispensing cap 700 may be required to ease the flow of a fluid with a higher viscosity.

[0191] By one approach, both the primary fluid in the bottle and the secondary fluid in the cartridge can have a similar viscosity. By another illustrative approach, the secondary fluid has a lower viscosity compared to the primary fluid, to compensate for the fact that more force may be required for fluid in the cartridge to be ejected from the cartridge. In the illustrated embodiment of dispensing cap 700, the secondary fluid may have a viscosity ranging from about 5.0 Pa.s to about 25.0 Pa.s (about 5,000 centipoise to about 25,000 centipoise) or about 7.0 Pa.s to about 20.0 Pa.s (about 7,000 centipoise to about 20,000 centipoise), and/or the primary fluid can have a viscosity ranging from about 10.0 Pa.s to about 70.0 Pa.s (about 10,000 to about 70,000 centipoise). By some approaches, the secondary fluid can have a viscosity ranging from about 8.0 Pa.s to about 20.0 Pa.s (about 8,000 centipoise to about 20,000 centipoise), from about 10.0 Pa.s to about 17.0 Pa.s (about 10,000 centipoise to about 17,000 centipoise), or from about 12.0 Pa.s to about 16.0 Pa.s (about 12,000 centipoise to about 16,000 centipoise), and/or the primary fluid can have a viscosity ranging from about 12.0 Pa.s to about 45.0 Pa.s (about 12,000 centipoise to about 45,000 centipoise), from about 15.0 Pa.s to about 30.0 Pa.s (about 15,000 centipoise to about 30,000 centipoise), from about 15.0 Pa.s to about 25.0 Pa.s (about 15,000 centipoise to about 25,000 centipoise), from about 15.0 Pa.s to about 20.0 Pa.s (about 15,000 centipoise to about 20,000 centipoise), or from about 17.0 Pa.s to about 19.0 Pa.s (about 17,000 centipoise to about 19,000 centipoise).

[0192] The fluids may also be formulated to have certain yield stresses at different temperatures to ensure optimal dispensing at refrigerated temperatures or ambient temperatures. For instance, in dispensing cap 700, the primary fluid may have a yield stress at 25°C ranging from about 1,500 Pa.s to about 2,000 Pa.s and a yield stress at 4°C ranging from about 1,750 Pa.s to about 2,250 Pa.s. In other embodiments, the primary fluid may have a yield stress at 25°C ranging from about 1,500 Pa.s to about 2,500 Pa.s. In certain embodiments, the secondary fluid may have a lower yield stress than that of the primary fluid to ensure proper flow of the secondary fluid through the cartridge outlet openings 935 of the cartridge 905. For instance, the secondary fluid may have a yield stress at 25°C ranging from about 50 Pa.s to about 300 Pa.s and a yield stress at 4°C ranging from about 40 Pa.s to about 350 Pa.s.

[0193] The yield stress measurements described herein are measured by determining the stress at which the viscosity peak is observed. Prior to the viscosity peak, the material is undergoing elastic deformation where the sample stretches and the peak in viscosity represents the point at which the elastic structure breaks down (or "yields") and the material starts to flow. The tests are performed by considering a logarithmic shear stress curve from 0 to 100 Pa for 100s. An Anton Paar rheometer (MCR 302e) was used to measure the rheology of the samples, with a parallel plate used as geometry.

[0194] In some approaches, the fluids may be formulated to have other characteristics. For instance, for dispensing cap 700, a hardness of the primary fluid may be about 245.2 N to about 441.3 N (about 25 kgf to about 45 kgf), a stringiness

length may be about 15 mm to about 25 mm, and/or an adhesive force may be about 25 g to about 45 g. A hardness of the secondary fluid may be about 98.1 N to about 392.3 N (about 10 kgf to about 40 kgf), a stringiness length may be about 10 mm to about 35 mm, and/or an adhesive force may be about 5 g to about 25 g. In another embodiment a hardness of the primary fluid may be about 490.3 N to about 882.6 N (about 50 kgf to about 90 kgf), a stringiness length may be about 5 to about 20 mm, and/or an adhesive force may be about 35 g to about 65 g.

[0195] In some non-limiting approaches, both the primary fluid and secondary fluid may be sauces or condiments. The primary fluid and secondary fluid may be selected as complementary flavors. In embodiments, the sauces may have a generally smooth or puree consistency. The primary and secondary fluids may, for example, be a tomato-based sauce, a mustard-based sauce, an emulsion, or may have a different base. In some approaches, the fluids in the bottle and/or cartridge do not contain any artificial colors, artificial flavors, or preservatives. As noted above, however, the fluids are not limited to edible products and, in other illustrative embodiments, may be health or beauty products (e.g., soaps, lotions, serums, hair products, etc.).

[0196] In one non-limiting embodiment, the secondary fluid disposed in the cartridge 905 is an emulsion, for example an oil-in-water emulsion. In some approaches, the secondary fluid is an edible emulsion. In certain embodiments, an emulsion suitable for use in the cartridge may include oil, water, an emulsifier, an acidic component, sugar, salt, and additional flavoring components. A further thickening agent may also be included, or the emulsifier may serve both thickening and emulsifying functions.

[0197] As used herein, the term "oil" means oils that are liquid at room temperature (22°C) and at atmospheric pressure (760 mmHg). Exemplary oils for the dressings generally include vegetable oil. Suitable vegetable oils include but are not limited to rapeseed, corn, sesame, canola, olive, palm, sunflower seed, safflower, cottonseed, and soybean oil, and combinations thereof.

[0198] By one approach, the emulsion contains from about 10% to about 40% oil by weight of the emulsion. In another approach, the emulsion may contain from about 10% to about 30% oil, or about 20% to about 30% oil by weight of the emulsion. In certain non-limiting embodiments, the emulsion may contain about 40% to about 75% water. In some examples, increasing the amount of oil may increase the stability of the emulsion and thus prevent the oil from separating out of the product. Separation of the oil could compromise the taste, texture, and aesthetic effect of the product when it is dispensed along with the sauce from the bottle, as well as result in unintended leakage of the product from the cartridge outlet openings 935. However, increased amounts of oil can result in an emulsion that is too thick and/or resistant to flow for proper dispensing. In certain embodiments, thus, an emulsion for use in the cartridge 905 is formulated to have a viscosity and/or yield stress that is low enough to not hinder flow but also does not result in oil separation or unintended leakage of the emulsion.

[0199] The emulsion, in some approaches, includes one or more emulsifiers or emulsifying agents. The emulsifiers allow the oil phase to be blended into the water or aqueous phase ingredients to form an oil-in-water emulsion. The amount of emulsifier contributes to the stability of the emulsion and the viscosity of the product. In certain non-vegan formulations, egg yolk may be used as the emulsifying agent. For instance, a heat stable egg yolk may be used in an amount of about 0.5% to about 5% or about 1% to about 3% by weight of the emulsion. In a vegan emulsion, an amount of vegetable protein and/or vegetable fiber may instead be used for an emulsifying effect. For instance, in an emulsion with both vegetable protein and plant fiber, the vegetable protein may be present in an amount of about 0.4% to about 1% and the plant fiber may be present in an amount of about 0.5% to about 5% or about 1% to about 3% by weight of the emulsion. Other conventional emulsifiers known in the art may also be used in different embodiments, for example lecithin, whey protein, soy lecithin, agar, albumin, alginate, casein, glycerol monostearate, polysorbate, polyglycerol ester, sugar ester, sorbitan ester, modified starch, and combinations thereof.

[0200] In an exemplary embodiment, only plant fiber is used as an emulsifying agent. Advantageously, the plant fiber also serves as a thickening agent and can contribute to attaining a certain viscosity in the emulsion. The plant fiber may be a fiber from a fruit or vegetable, and, in an illustrative embodiment, is citrus fiber. The plant fiber may be present in an amount of about 0.5% to about 5% or about 1% to about 3% by weight of the emulsion. By one advantageous approach, the plant fiber is present in an amount of about 1.5% to about 3%, about 2% to about 3%, or about 2% to about 2.5% by weight of the emulsion. These amounts of the plant fiber may prevent or mitigate any breaking of the emulsion, e.g., oil separation, while permitting a sufficiently low viscosity and/or yield stress to permit adequate flow and squeeze force during dispensing.

[0201] In some embodiments, other thickening agents may be employed, such as starches, cellulose derivatives, polysaccharides, gums, gum derivatives, polyols, and combinations thereof. By some approaches, the thickening agents may be included in an amount of about 1% to about 10% by weight of the emulsion.

[0202] One or more acidic components may also be included in the emulsion which can contribute to the microbial stability of the emulsion. The acidic component may include one or more edible acids (i.e., food grade acids). The acidic component may include, for example, citric acid, sorbic acid, phosphoric acid, lactic acid, acetic acid, and combinations thereof. In some aspects, the acidic component may comprise vinegar and/or lemon juice concentrate. Exemplary vinegars include white vinegar, balsamic vinegar, apple cider vinegar, red wine vinegar, white wine vinegar, malt vinegar, and rice vinegar. In addition to contributing to microbial stability, the acidic components may also impart a desirable flavor to

the emulsions. In some embodiments, the acidic components are included in an amount of about 3% to about 9% by weight of the emulsion, in some embodiments, about 4% to about 7.5% by weight of the emulsion.

[0203] In some embodiments, sugar or other sweeteners may be included in the emulsion to impart a level of sweetness to the product. In approaches that include sugar, for example, the sugar may be present in an amount of about 2% to 5% by weight of the emulsion.

[0204] The emulsions may further include salt (e.g., sodium chloride) in an amount ranging from about 1% to about 4% or about 1% to about 2.5% by weight of the emulsion.

[0205] One or more additional flavoring components may also be employed in the emulsions to augment and/or alter the flavor thereof. Flavors may include a wide variety of herbs, spices, and natural or artificial flavors. Exemplary herbs and spices may include pepper, garlic powder, chili powder, onion powder, parsley, oregano, basil, chives, mustard, coriander, curry, cloves, rosemary, chervil, anise, cilantro, horseradish, fennel, allspice, nutmeg, paprika, thyme, tarragon, turmeric, dill, sage, saffron, marjoram, mint, cayenne pepper, chipotle, cinnamon, ginger, wasabi, capsicum, or the like. Exemplary flavors may include natural onion flavors, natural ranch flavor, natural garlic flavor, lemon juice flavor, lime juice flavor, soy sauce, truffle flavor, malt barley extract, vegetable flavors, fruit flavors, beta carotene, and the like. The amount of flavor added to the emulsions may depend on the intensity of the flavor desired. In some aspects, the additional flavoring ingredients may be present in a combined amount ranging from about 1 percent to about 20 percent or in some aspects from about 1 percent to about 10 percent, by weight of the emulsion.

[0206] By one approach, the secondary fluid for use in the cartridge may be an emulsion having the ingredients provided in Table 2.

Table 2

Emulsion Ingredients (full recipe)	% by weight
Water	42-71
Oil	20-30
Acids	4-7.5
Sugar	2-5
Salt	1-2.5
Plant fiber	1-3
Additional flavoring ingredients	1-10

[0207] In another approach, the secondary fluid for use in the cartridge may be an emulsion formed from a base recipe provided in Table 3.

Table 3

Emulsion Ingredients (base recipe)	% by weight
Water	51-71.6
Oil	20-30
Acids	4-7.5
Sugar	2-5
Salt	1-2.5
Vegetable protein	0.4-1
Plant fiber	1-3

[0208] Further flavoring ingredients may be added to the base recipe in Table 2. For instance, in one non-limiting approach the final emulsion includes the above base recipe ingredients in an amount of about 90% to about 99% by weight of the final emulsion and additional flavoring ingredients in an amount of about 1% to about 10% by weight of the final emulsion.

[0209] An exemplary egg yolk-based emulsion may be formed from a base recipe provided in Table 4.

EP 4 367 037 B1

Table 4

Emulsion Ingredients (base recipe)	% by weight
Water	44-68
Oil	20-30
Acids	4-7.5
Sugar	2-5
Salt	1-2.5
Egg yolk	1-3
Starch	4-8

[0210] Further flavoring ingredients may be added to the base recipe. For instance, in one non-limiting approach the final emulsion includes the above base recipe ingredients in an amount of about 90% to about 99% by weight of the final emulsion and additional flavoring ingredients in an amount of about 1% to about 10% by weight of the final emulsion.

Example 2.

[0211] A study was conducted to determine the squeeze force required to push an emulsion out of a cartridge relative to different configurations of the cartridge outlet openings 935 (in the tube portion of the valve element) and to different base recipes. The tested configurations for the cartridge outlet openings are provided in Table 5. There were two openings in each configuration.

Table 5

Nozzle 1	3 x 2mm, rectangle
Nozzle 2	4.5 x 2mm, oval
Nozzle 3	3.2 mm, round
Nozzle 4	3.85 x 2.2 mm, oval

[0212] The different base recipes that were tested with each of the above cartridge configurations are provided in Table 6.

Table 6

Recipe 25c (vegan)	Recipe 36c (vegan)	Recipe 1b (egg-based)
25-30% oil 0.3-1% vegetable protein 1-2% plant fiber 50.9% to 60.7% water 4.2% to 7.6% acids 2% to 5% sugar 1% to 2.5% salt	25-30% oil 2.3-3% plant fiber 51.9% to 60.3% water 4.2% to 7.6% acids 2% to 5% sugar 1% to 2.5% salt	15-20% oil 0.5-1.5% egg yolk 4-5% starch 43.9% to 67.8% water 4.2% to 7.6% acids 2% to 5% sugar 1% to 2.5% salt

[0213] Table 7 indicates the squeeze force that was necessary to dispense the different base recipes out of the different nozzle configurations of the cartridge.

Table 7

	Recipe 25c (vegan)	Recipe 36c (vegan)	Recipe 1b (egg-based)
Nozzle 1	24.5 N	66.9 N	18.5 N
Nozzle 2	23 N	61 N	15.8 N

(continued)

	Recipe 25c (vegan)	Recipe 36c (vegan)	Recipe 1b (egg-based)
Nozzle 3	21.1 N	53.2 N	15.2 N
Nozzle 4	19.9 N	53.5 N	14.2 N

[0214] As shown in Table 7, the different base recipes having different rheological characteristics resulted in considerable differences in required squeeze force.

[0215] It was further observed that recipe 36c was very thick, resulting in a high squeeze force. Recipes 25c and 1b resulted in a lower squeeze force but were thinner. This could cause the emulsions to leak out of the cartridge when the cartridge is positioned upside down and/or not form a desired pattern in combination with the primary fluid due to being too liquid.

Example 3.

[0216] An emulsion with the ingredients listed in Table 8 was prepared and disposed in cartridge 905. The emulsion had a viscosity between about 7.0 Pa.s to about 20.0 Pa.s (about 7,000 centipoise to about 20,000 centipoise).

Table 8

Recipe 32c (vegan)
20%-30% oil
1-3% plant fiber
58.4% to 65.8% water
4.2% to 7.6% acids
2% to 5% sugar
1% to 2.5% salt

[0217] The cartridge 905 was installed in a dispensing cap base 850 coupled to a bottle containing a condiment (viscosity about 17.0 Pa.s to about 18.0 Pa.s (about 17,000 to 18,000 centipoise)). The cartridge 905 included four circular cartridge outlet openings 935 each having a diameter of about 3.1mm. The dispensing cap base 850 included a dispensing channel outlet 857 having a diameter of about 2.6mm. In use, the condiment and the emulsion were jointly dispensed from the dispensing cap 900 with the two sauces clearly visible in the dispensed product. The condiment and the emulsion were dispensed in a suitable ratio with an acceptable squeeze force applied to the bottle.

Example 4.

[0218] Cartridges having outlet openings with different configurations (e.g., differing size, shape, and/or number of openings) were paired with dispensing caps having dispensing channel outlet openings with differing dimensions. The dispensing bottle was provided with 500 mL of ketchup (viscosity about 17.0 Pa.s to about 18.0 Pa.s (about 17,000 to 18,000 centipoise)). The cartridge was provided with 25g of the emulsion provided in Example 3. The different combinations were tested to determine that both the bottle sauce and the cartridge sauce were present in the dispensed product, the dosing force required to dispense the product, whether spring back occurred, and the cleanliness of the cap after dispensing (e.g., at the interfacing surfaces of the cartridge and cap base). The results are provided in Table 9.

EP 4 367 037 B1

Table 9

Test	Cap Base Sample; dispensing channel outlet diameter (mm)	Cartridge Sample; cartridge opening diameter/ dimensions (mm); cartridge opening shape	Cartridge Opening Area (mm ²)	Number of Cartridge Openings	Dosing Force (N)	Mass (g)	Spring back	Comments
T1	B1; 1.6	C1; 3x2; rectangle	6.0	2	102.9	35.9	Yes	Both fluids present. The cap was clean after testing. Immediate spring back.
T2	B2; 2.0	C2; 3.1; round	7.5	2	79.46	38.49	No	Both fluids present. The cap was a little unclean after testing. Spring back only when top up.
T3	B2; 2.0	C3; 3.4; round	9.1	2	102.6	38.5	No	Both fluids present. The cap was a little unclean after testing. Spring back only when top up.
T4	B2; 2.0	C4; 3.1; round	7.5	3	108.0	35.3	No	Both fluids present. The cap was a little unclean after testing. Spring back only when top up.
T5	B2; 2.0	C5; 3.1; round	7.5	4	81.57	36.26	No	A lot of each fluid. The cap was a little unclean after testing. Spring back only when top up.
T6	B3; 2.6	C2; 3.1; round	7.5	2	67.94	38.8	Yes	Both fluids present. The cap was clean after testing. Spring bring after about 10 seconds.
T7	B3; 2.6	C3; 3.4; round	9.1	2	64.06	35.7	No	Both fluids present. The cap was clean after testing. Spring back only when top up.

EP 4 367 037 B1

(continued)

Test	Cap Base Sample; dispensing channel outlet diameter (mm)	Cartridge Sample; cartridge opening diameter/ dimensions (mm); cartridge opening shape	Cartridge Opening Area (mm ²)	Number of Cartridge Openings	Dosing Force (N)	Mass (g)	Spring back	Comments
T8	B3; 2.6	C5; 3.1; round	7.5	4	71.53	36.82	Yes	Both fluids present. The cap was clean after testing. Spring back immediately.
T9	B4; 3.0	C2; 3.1; round	7.5	2	74.76	35.1	Yes	Both fluids present. The cap was a little unclean after testing. Spring back occurred after a few seconds.
T10	B4; 3.0	C3; 3.4; round	9.1	2	67.84	37.5	No	Both fluids were present. The cap was clean after testing. Spring back only when top up.
T11	B4; 3.0	C4; 3.1; round	7.5	3	65.9	40.08	No	The cartridge emulsion was not present or visible. The cap was a little unclean after testing. Spring back only when top up.
T12	B4; 3.0	C5; 3.1; round	7.5	4	69.96	40.75	Yes	The cartridge emulsion was present or visible in a very small amount. The cap was a little unclean after testing. Spring back only when top up.

[0219] In certain approaches, the dispensing bottle 1000 may be configured such that the joint dispensing of the primary and secondary fluids can occur for a certain amount of dispensing before one or both of the fluids run out. To achieve this, for example, the cartridge 905 may be a certain size relative to the size of the flexible bottle 1002, and/or the amount of fluid in the cartridge 905 may be proportioned relative to the amount of condiment in the bottle 1002.

[0220] In some configurations, a bottle 1002 is sized to have a larger volume than the cartridge 905 and will contain more fluid than the cartridge 905 contains. As such, by one approach it is advantageous to configure the dispensing cap 700 to dispense a smaller amount of secondary fluid relative to the primary fluid, so that a single cartridge can be used for at least a

certain proportion of the bottle's life. This may be done, for example, by varying the size and proportions of the outlet openings 935 in the cartridge or the outlet 857 of the dispensing channel 855. In this manner, the primary and secondary fluids can be dispensed together in a specific ratio.

[0221] In one embodiment, a dispensing cap 700 and bottle 1002 may be configured so that approximately only two cartridges 905 are needed per bottle 1002; that is, when dispensed, a single cartridge may be emptied when only about half of the bottle is emptied, so the user must then remove the cartridge and insert a second cartridge to use with the second half of the bottle. In different embodiments, only one cartridge may be required, or three or more cartridges may be required. It is contemplated, however, that three or less cartridges, and in an illustrative embodiment, at most two cartridges, would be required per bottle. Such an approach would reduce waste as well as be more convenient to the user. However, it is noted that the amount of cartridge fluid used per bottle fluid may, to some extent, vary based on the squeeze force applied by the user to the bottle. In addition, the size of bottles may vary, which may require a different approximate number of cartridges per bottle. For instance, for some larger sized bottles, four or more cartridges would be required per bottle.

[0222] By one approach, the secondary cartridge fluid is dispensed in an amount of about 8 to 12% by volume of the primary bottle fluid that is dispensed. In another approach, the secondary fluid is dispensed in an amount of up to about 50% by volume of the primary fluid that is dispensed. In some embodiments, the secondary fluid and primary fluid are dispensed in a ratio of about 0.5:10 to about 5:10, or about 1:10 to about 1:8. In an illustrative configuration, the ratio is 1:9, and, in another approach, 1:10. In yet another approach, the ratio is about 2:8 or even 1:1. In embodiments, these amounts are achieved with a squeeze force of 100 N or less, a squeeze force of 90 N or less, a squeeze force of 85 N or less, a squeeze force of 80 or less, or a squeeze force of 75 N or less. Varying the size of the outlet openings 935 of the cartridge relative to the outlet opening 857 of the dispensing channel 855 of the cap base 850 can be effective to achieve the right ratio. For instance, in the illustrated approach, four circular outlet openings 935 having a diameter of between about 3 mm to about 3.3 mm, and a dispensing channel outlet opening 857 having a diameter between about 2.4 mm to 2.8 mm may, for certain fluids, permit the secondary fluid to be dispensed in an amount of about 8 to 12% by volume of the primary fluid that is dispensed. Such dimensions may be particularly advantageous, for example, when the secondary cartridge fluid has a viscosity ranging from about 7.0 Pa.s to about 20.0 Pa.s (about 7,000 to about 20,000 centipoise) and the primary bottle fluid has a viscosity ranging from about 15.0 Pa.s to about 25.0 Pa.s (15,000 centipoise to about 25,000 centipoise).

[0223] In a further embodiment, a bottle may have a capacity of about 250 mL to about 1000 mL for containing the primary fluid disposed in the bottle. In some configurations, the cartridge may have a capacity of about 10 ml to about 50 ml, or about 15ml to about 35ml for containing the secondary fluid disposed in the cartridge. For instance, in an illustrative configuration the bottle includes about 500 mL of product and the cartridge includes about 25 mL of product. Cartridges and bottles having capacities outside of these ranges may also be configured.

[0224] In embodiments, the dispensing cap base is configured to be re-usable by the user. For instance, a single dispensing cap base may be sufficiently durable and/or hygienic in use that it may be used with a number of different cartridges and/or bottles over time. For instance, the dispensing cap base may be used to dispense approximately two or more full cartridges, three or more full cartridges, five or more cartridges, or ten or more cartridges. In some embodiments, the dispensing cap base may be continually re-usable to the extent it is periodically cleaned. For instance, the user may remove the dispensing cap base from a bottle and clean the dispensing cap base with water and/or soap.

[0225] As described above, in some embodiments a user may also interchange cartridges containing different fluids in the same dispensing cap and with the same bottle. Advantageously, the user can then use multiple combinations of fluids. For example, a user may be provided with a bottle filled with a first condiment such as ketchup, a dispensing cap, and two, three, or more cartridges filled with different condiments. As desired, the user can interchange the cartridges in the dispensing cap to enjoy different flavor combinations, for example ketchup and a garlic sauce. It is contemplated that in one embodiment the different condiments in different cartridges have similar fluid properties, such as similar viscosity, texture, yield stress, density, and/or compressibility, or formulated with similar ingredients (e.g., plant fiber) so that similarly configured cartridges can be manufactured for each condiment. To the extent the fluid properties of the different condiments in different cartridges may vary more widely, the cartridge configurations for such condiments may need to be adjusted and customized so that different cartridge condiments dispense in the desired manner. For example, the dimensions of the outlet openings 935 and/or the size of the tube portion 940 of the valve element may need to be adjusted. In addition, the size of the outlet openings 935, the size of the tube portion 940 of the valve element, the diameter of the dispensing channel outlet 857, and/or the viscosity or other rheological properties of the cartridge fluid may depend on the rheological properties of the bottle fluid.

[0226] In yet a further approach, a user may choose to remove the cartridge 905 altogether from the cap base 850 and only dispense the primary fluid from the bottle 1002. As such, it is advantageous that in some embodiments the dispensing cap base 850 is configured so that it can dispense fluid without a cartridge 905 inserted therein. This function occurs in the same manner described above with respect to dispensing cap 100 and as illustrated in FIG. 10, with the fluid from the bottle being dispensed directly from the dispensing channel 955.

[0227] A dispensing system for dispensing two fluids together without substantial mixing of the fluids is contemplated. The system includes a bottle or container having a primary fluid, a dispensing cap base including a hinged flip-top lid, and

one or more cartridges each having the same or different secondary fluids for use with the dispensing cap base and the bottle. The dispensing cap base is couplable to a neck of the bottle and each cartridge is insertable into the dispensing cap base. The bottle, dispensing cap base, and cartridges, may be configured according to any of the above-described embodiments, and, when coupled together, may permit the primary fluid and secondary fluid to be dispensed together from the dispensing outlet 922 on the cartridge 905 as described in the foregoing. The cartridges are removable from the cap base such that a different cartridge may be inserted therein, for example, in case a user would like to use a different product or if the first cartridge runs out of product. In some embodiments, the bottle includes its own cap that is removable so that the dispensing cap base can be coupled to the bottle.

[0228] The dispensing cap 700, including the dispensing cap base 850 and the cartridge 905 may be manufactured in the manners described above with respect to dispensing caps 100 and 400. In one approach, a method of manufacturing the cartridge 905 specifically includes providing a fluid, forming a cartridge main body that includes a central opening and a cavity for containing the fluid, forming a cartridge piston element dimensioned to slide along the cavity of the cartridge container and force the fluid out of the cavity, and forming a valve element having a tube portion dimensioned to extend within the central opening. By some approaches, the tube portion includes at least one outlet opening in a wall thereof so that the fluid can egress from the cavity into the tube portion during use, and in some approaches, four outlet openings. In addition, the method of manufacturing also typically includes assembling a cartridge by coupling the valve element to an open end of the cartridge main body (for instance, via welding), filling the cavity of the cartridge main body with the fluid, and seating the cartridge piston element within the cartridge main body at an opposite end of the cartridge main body from the valve element to close and seal the cavity. In some approaches, filler-heads are used to fill the cavity with the fluid, and the cavity is filled to an extent that there is no air entrapment once the cartridge piston element is seated. The manufacturing method may further include adding tamper-evident features or packaging to the cartridge. One or more cartridges, for example, may be sealed in a flow pack. In some embodiments, the cartridges may have a tamper-evident sealing liner on the dispensing side of the cartridge and/or the side opposite the dispensing side. In one approach, a top seal or sealing liner is applied to the cartridges after they are filled. The cartridges may be individually packed, for example, each in a small box (e.g., a cardboard or paperboard box).

[0229] In one approach, a method of manufacturing a dispensing bottle includes disposing a primary fluid in a bottle and forming a dispensing cap, the dispensing cap including a base, a base piston element, and a cartridge. In some embodiments, the base is formed to include a dispensing channel and configured to be attached to a bottle neck, the base further having a receptacle. In one approach, the base piston element is coupled to the base and movable between a first position and a second position such that as fluid disposed in the bottle is forced toward the dispensing channel to dispense the fluid at least a portion of the fluid engages the base piston element and moves the base piston element toward the second position. In certain configurations, the manufacturing process includes forming a cartridge to be disposed in the receptacle of the base, the cartridge including a cartridge piston element configured to be driven by the base piston element as the base piston element is moved from the first position toward the second position. In some embodiments, the process includes disposing a secondary fluid in the cartridge. By one approach, the process also includes disposing the cartridge in the receptacle of the dispensing cap. A further step may also include threading the dispensing cap with the filled cartridge onto the filled bottle.

[0230] In certain approaches, a method of manufacturing a dispensing cap may include providing a first fluid, forming a cartridge container for containing the first fluid, forming a cartridge piston element dimensions to slide along the cavity of the cartridge container and force the first fluid out of the cavity, and forming a valve element having a tube portion dimensioned to extend within the central opening, the tube portion including at least one outlet opening in a wall thereof. In illustrative embodiments, the cartridge container includes a central opening defined by an inner cylindrical wall. The method further includes, in some embodiments, assembling a cartridge by coupling the valve element to the container, filling the cavity with the first fluid, and disposing the cartridge piston element in the cavity of the cartridge container, the tube portion extending within the central opening of the container. In some embodiments, the valve element may be welded to the container. The method may further include forming a dispensing cap base, the dispensing cap base including a dispensing channel and being configured to be attached to a neck of a bottle, the base further having a receptacle dimensioned to receive the cartridge. An additional step, in certain embodiments, includes forming a base piston element and disposing the base piston element in the dispensing cap base, the base piston element configured to be movable between a first position and a second position within the dispensing cap base. The base piston element may be sized and positioned within the cap base to engage the cartridge piston element when the cartridge is inserted into the receptacle.

[0231] In some embodiments, the method may include that the cartridge container, valve element, and dispensing cap base are formed from polypropylene and the base piston element and cartridge piston element are formed from polypropylene, low-density polyethylene, high-density polyethylene, or combinations thereof. By one approach, the base piston element has an annular configuration and is formed to comprise a first cylindrical portion that slides along the guide channel and a second flange portion extending radially outward of the cylindrical portion and positioned to engage the cartridge piston element when the cartridge is received in the cap base. The method may further include that the dispensing channel extends through the guide channel, and in some examples, the base piston element is disposed about

the dispensing channel. By some approaches, the base is formed to include at least one base opening through which the second fluid is able to flow between the dispensing channel and the guide channel to engage the base piston element.

[0232] In certain embodiments, the method of manufacturing the dispensing cap may include configuring the tube portion to be elastically deflectable relative to the container between a first tube portion where the at least one outlet opening is covered by the internal cylindrical wall of the container to inhibit the first fluid from flowing into the tube portion via the at least one outlet opening and a second tube position where the first fluid is able to flow through the at least one outlet opening and into the tube portion, such that when the cartridge is received in the receptacle of the base the tube portion is moved into the second tube position. In some configurations, the method may include disposing the cartridge in the receptacle of the dispensing cap base, the step of disposing the cartridge in the receptacle bringing a first end of the tube portion into engagement with an end of the dispensing channel moving the tube portion to open the at least one outlet opening, permitting the first fluid to egress from the cavity. In some approaches, the first fluid (in the cartridge) has a viscosity between about 7.0 Pa.s to about 20.0 Pa.s (about 7,000 centipoise to about 20,000 centipoise).

[0233] In some configurations, the method may include forming the base piston element such that the base piston element drives the cartridge piston element disposed in the cartridge as the base piston element is moved from the first position toward the second position. The method may also include forming the base piston element to include an inner bore seal and an outer seal, the inner seal configured to engage an outer surface of the dispensing channel and the outer seal configured to engage the guide channel. In some configurations, the method further includes forming the base to include a stop configured to inhibit the base piston element from moving beyond the second position. The base may be formed to include a flip-top lid to be hinged attached to the base, the flip-top lid having an interior projection that is movable between a first position and a second position, wherein the projection blocks egress of fluid from the cartridge when in the first position and permits egress of the fluid when in the second position.

[0234] In some embodiments, the method of manufacturing a dispensing cap also includes disposing the cartridge piston element about the inner cylindrical wall of the cartridge. By some approaches, the method may include forming one or more inner sealing elements of the cartridge piston element configured to contact the inner cylindrical wall to seal the first fluid within the cavity. The method may also include forming one or more outer sealing elements of the cartridge piston element configured to contact an outer wall of the container to seal the first fluid within the cavity.

[0235] Those skilled in the art will recognize that a wide variety of modifications, alterations, and combinations can also be made with respect to the above-described embodiments without departing from the scope of the appended claims, and that such modifications, alterations, and combinations are to be viewed as being within the ambit of the inventive concept.

Claims

1. A dispensing cap (100) comprising:

a base (150) having a dispensing channel (155) and configured to be attached to a bottle neck (304) of a bottle (302), the base (150) having a receptacle (152);
 a base piston element (165) disposed in the base (150) and movable between a first position and a second position such that as fluid disposed in the bottle (302) is forced toward the dispensing channel (155) to dispense the fluid at least a portion of the fluid engages the base piston element (165) and moves the base piston element (165) toward the second position; and
 a cartridge (105) disposable in the receptacle (152) of the base (150), wherein the base piston element (165) is configured to drive a cartridge piston element (145) of the cartridge (105) as the base piston element (165) is moved from the first position toward the second position.

2. The dispensing cap (100) of claim 1 wherein the base (150) includes a guide channel (160) along which at least a portion of the base piston element (165) moves and the dispensing channel (155) extends within the guide channel (160).

3. The dispensing cap (100) of claim 1 wherein the cartridge (105) comprises a container (115) and a valve element (138) coupled to an outer surface of the container (115), the valve element (138) having a tube portion (140) extending within the container (115), the tube portion (140) including at least one outlet opening (135) in a wall thereof, the tube portion (140) being movable relative to the container (115) between a first position where the at least one outlet opening (135) is covered by an inner wall (127) of the container (115) to inhibit a fluid in the container (115) from flowing into the tube portion (140) via the at least one outlet opening (135) and a second position in which the fluid in the container (115) is able to flow through the at least one outlet opening (135) and into the tube portion (140).

4. The dispensing cap (100) of claim 3 configured such that attaching the cartridge (105) to the base (150) of the

dispensing cap (100) brings an end of the tube portion (140) into engagement with an end of the dispensing channel (155) of the base (150), moving the tube portion (140) to open the at least one outlet opening (135).

5 5. The dispensing cap (100) of claim 3, wherein the tube portion (140) includes four of the at least one outlet openings (135).

6. The dispensing cap (100) of claim 3, wherein the fluid in the container (115) of the cartridge (105) has a viscosity ranging from about 7.0 Pa.s to about 20.0 Pa.s (7,000 centipoise to about 20,000 centipoise).

10 7. The dispensing cap (100) of claim 3, wherein the dispensing channel (155) is in fluid communication with the tube portion (140) via an outlet orifice (157) of the dispensing channel (155) when the cartridge (105) is attached to the base (150).

15 8. The dispensing cap (100) of claim 7, wherein the outlet orifice (157) has a diameter of about 1.5 mm to about 3.0 mm and the tube portion (140) includes four of the at least one outlet openings (135), each having a diameter between about 2.5 mm to about 3.5 mm.

20 9. The dispensing cap (100) of claim 1, comprising a flip-top lid (180) hingedly attached to the base (150), wherein the flip-top lid (180) includes an interior projection (185) comprising a first sealing surface configured to block egress of fluid from the dispensing channel (155) of the base (150), and a second sealing surface configured to block egress of fluid through the at least one outlet opening (135) of the cartridge (105).

25 10. The dispensing cap (100) of claim 1 wherein the cartridge (105) disposable in the receptacle (152) of the base (150) includes external threads (130) for being threaded into the receptacle (152), wherein one or more projections (618) on the external threads (130) engage one or more recesses (519a, 519b) on internal threading (552) of the receptacle (152) to provide a user an auditory and/or tactile indication when the cartridge (105) is positioned correctly in the receptacle (152).

30 11. The dispensing cap of claim 1 or claim 10 wherein the cartridge (105) is disposed in the receptacle (152) of the base (150).

35 12. A container (300) comprising the dispensing cap (100) of claim 1 or claim 11 threaded onto the bottle neck (304) of a bottle (302) wherein a primary fluid is disposed in the bottle (302) and a secondary fluid is disposed in the cartridge (105).

13. A dispensing cap base (850) for removably coupling to a bottle neck (1004) of a bottle (1002), the dispensing cap base (850) comprising:

40 a main body (872) and a base piston element (865),
the main body (872) including:

45 a first end comprising a receptacle (852) for receiving a cartridge (905);
a second end comprising an ingress portion (891) for receiving a fluid from the bottle (1002);
a dispensing channel (855) extending from the first end to the second end for dispensing fluid from the bottle (1002); and
a guide channel (860) disposed about the dispensing channel (855), the base piston element (865) being movable between a first position and a second position along the guide channel (860) to engage the cartridge (905) when fluid from the bottle (1002) is received in the ingress portion (891).

50 14. The dispensing cap base (850) of claim 13 wherein the ingress portion (891) includes at least one cap base opening (867) through which fluid is able to flow between the dispensing channel (855) and the guide channel (860) to engage the base piston element (865).

55 15. The dispensing cap base (850) of claim 13 wherein either:

the base piston element (865) has an annular configuration and includes an inner seal (870) and an outer seal (871), the inner seal (870) engaging an outer surface of the dispensing channel (855) and the outer seal (871) engaging the guide channel (860); or

the base piston element (865) has an annular configuration and is disposed about the dispensing channel (855), the base piston element (865) including a cylindrical portion (882) disposed radially inward of the guide channel (860) and a flange portion (883) disposed substantially radially outward of the guide channel (860) at one end of the cylindrical portion (882) for engaging a cartridge (905) received in the receptacle (852).

Patentansprüche

1. Abgabekappe (100), umfassend:

eine Basis (150), welche einen Abgabekanal (155) aufweist und dazu eingerichtet ist, an einem Flaschenhals (304) einer Flasche (302) angebracht zu sein, wobei die Basis (150) eine Aufnahme (152) aufweist; ein Basis-Kolbenelement (165), welches in der Basis (150) angeordnet und zwischen einer ersten Position und einer zweiten Position bewegbar ist, so dass wenn in der Flasche (302) angeordnetes Fluid in Richtung des Abgabekanals (155) gedrängt wird, um das Fluid abzugeben, wenigstens ein Teil des Fluids mit dem Basis-Kolbenelement (165) eingreift und das Basis-Kolbenelement (165) in Richtung der zweiten Position bewegt; und eine Kartusche (105), welche in der Aufnahme (152) der Basis (150) anordenbar ist, wobei das Basis-Kolbenelement (165) dazu eingerichtet ist, ein Kartuschen-Kolbenelement (145) der Kartusche (105) anzutreiben, wenn das Basis-Kolbenelement (165) von der ersten Position in Richtung der zweiten Position bewegt wird.

2. Abgabekappe (100) nach Anspruch 1, wobei die Basis (150) einen Führungskanal (160) umfasst, entlang welchem sich wenigstens ein Abschnitt des Basis-Kolbenelements (165) bewegt, und sich der Abgabekanal (155) innerhalb des Führungskanals (160) erstreckt.

3. Abgabekappe (100) nach Anspruch 1, wobei die Kartusche (105) einen Behälter (115) und ein Ventilelement (138) umfasst, welches an eine äußere Fläche des Behälters (115) gekoppelt ist, wobei das Ventilelement (138) einen Rohrabschnitt (140) aufweist, welcher sich innerhalb des Behälters (115) erstreckt, wobei der Rohrabschnitt (140) wenigstens eine Auslassöffnung (135) in einer Wand davon umfasst, wobei der Rohrabschnitt (140) relativ zu dem Behälter (115) zwischen einer ersten Position, in welcher die wenigstens eine Auslassöffnung (135) durch eine innere Wand (127) des Behälters (115) bedeckt ist, um ein Fluid in dem Behälter (115) daran zu hindern, in den Rohrabschnitt (140) mittels der wenigstens einen Auslassöffnung (135) zu strömen, und einer zweiten Position bewegbar ist, in welcher das Fluid in dem Behälter (115) in der Lage ist, durch die wenigstens eine Auslassöffnung (135) und in den Rohrabschnitt (140) zu strömen.

4. Abgabekappe (100) nach Anspruch 3, welche derart eingerichtet ist, dass ein Anbringen der Kartusche (105) an der Basis (150) der Abgabekappe (100) ein Ende des Rohrabschnitts (140) in Eingriff mit einem Ende des Abgabekanals (155) der Basis (150) bringt, wobei der Rohrabschnitt (140) bewegt wird, um die wenigstens eine Auslassöffnung (135) zu öffnen.

5. Abgabekappe (100) nach Anspruch 3, wobei der Rohrabschnitt (140) vier der wenigstens einen Auslassöffnungen (135) umfasst.

6. Abgabekappe (100) nach Anspruch 3, wobei das Fluid in dem Behälter (115) der Kartusche (105) eine Viskosität aufweist, welche von etwa 7,0 Pa.s bis etwa 20,0 Pa.s (7000 Centipoise bis etwa 20000 Centipoise) beträgt.

7. Abgabekappe (100) nach Anspruch 3, wobei der Abgabekanal (155) in Fluidkommunikation mit dem Rohrabschnitt (140) mittels einer Auslassöffnung (157) des Abgabekanals (155) steht, wenn die Kartusche (105) an der Basis (150) angebracht ist.

8. Abgabekappe (100) nach Anspruch 7, wobei die Auslassöffnung (157) einen Durchmesser von etwa 1,5 mm bis etwa 3,0 mm aufweist und der Rohrabschnitt (140) vier der wenigstens einen Auslassöffnungen (135) umfasst, welche jeweils einen Durchmesser von zwischen etwa 2,5 mm bis etwa 3,5 mm aufweisen.

9. Abgabekappe (100) nach Anspruch 1, umfassend einen Klappdeckel (180), welcher schwenkend an der Basis (150) angebracht ist, wobei der Klappdeckel (180) einen inneren Vorsprung (185) umfasst, welcher eine erste Dichtungsfläche umfasst, welche dazu eingerichtet ist, ein Austreten von Fluid aus dem Abgabekanal (155) der Basis (150) zu blockieren, sowie eine zweite Dichtungsfläche, welche dazu eingerichtet ist, ein Austreten von Fluid durch die

wenigstens eine Auslassöffnung (135) der Kartusche (105) zu blockieren.

10. Abgabekappe (100) nach Anspruch 1, wobei die Kartusche (105), welche in der Aufnahme (152) der Basis (150) anordenbar ist, Außengewinde (130) umfasst, um in die Aufnahme (152) geschraubt zu werden, wobei ein oder mehrere Vorsprünge (618) an den Außengewinden (130) mit einer oder mehreren Ausnehmungen (519a, 519b) an Innengewinden (552) der Aufnahme (152) eingreifen, um einem Benutzer eine auditive und/oder taktile Anzeige bereitzustellen, wenn die Kartusche (105) korrekt in der Aufnahme (152) positioniert ist.

11. Abgabekappe nach Anspruch 1 oder Anspruch 10, wobei die Kartusche (105) in der Aufnahme (152) der Basis (150) angeordnet ist.

12. Behälter (300), welcher die Abgabekappe (100) nach Anspruch 1 oder Anspruch 11 umfasst, welche auf den Flaschenhals (304) einer Flasche (302) geschraubt ist, wobei ein Primärfluid in der Flasche (302) angeordnet ist und ein Sekundärfluid in der Kartusche (105) angeordnet ist.

13. Abgabekappen-Basis (850) zum lösbaren Koppeln an einen Flaschenhals (1004) einer Flasche (1002), wobei die Abgabekappen-Basis (850) umfasst:

einen Hauptkörper (872) und ein Basis-Kolbenelement (865),
wobei der Hauptkörper (872) umfasst:

ein erstes Ende, welches eine Aufnahme (852) zum Aufnehmen einer Kartusche (905) umfasst;
ein zweites Ende, welches einen Zugangsabschnitt (891) zum Aufnehmen eines Fluids von der Flasche (1002) umfasst;

einen Abgabekanal (855), welcher sich von dem ersten Ende zu dem zweiten Ende für ein Abgeben von Fluid aus der Flasche (1002) erstreckt; und

einen Führungskanal (860), welcher um den Abgabekanal (855) herum angeordnet ist, wobei das Basis-Kolbenelement (865) zwischen einer ersten Position und einer zweiten Position entlang des Führungskanals (860) bewegbar ist, um mit der Kartusche (905) einzugreifen, wenn Fluid von der Flasche (1002) in dem Zugangsabschnitt (891) aufgenommen ist.

14. Abgabekappen-Basis (850) nach Anspruch 13, wobei der Zugangsabschnitt (891) wenigstens eine Kappenbasis-Öffnung (867) umfasst, durch welche Fluid in der Lage ist, zwischen dem Abgabekanal (855) und dem Führungskanal (860) zu strömen, um mit dem Basis-Kolbenelement (865) einzugreifen.

15. Abgabekappen-Basis (850) nach Anspruch 13, wobei entweder:

das Basis-Kolbenelement (865) eine ringförmige Konfiguration aufweist und eine innere Dichtung (870) und eine äußere Dichtung (871) umfasst, wobei die innere Dichtung (870) mit einer äußeren Fläche des Abgabekanals (855) eingreift und die äußere Dichtung (871) mit dem Führungskanal (860) eingreift; oder

das Basis-Kolbenelement (865) eine ringförmige Konfiguration aufweist und um den Abgabekanal (855) herum angeordnet ist, wobei das Basis-Kolbenelement (865) einen zylindrischen Abschnitt (882) umfasst, welcher radial innerhalb des Führungskanals (860) angeordnet ist, sowie einen Flanschabschnitt (883), welcher im Wesentlichen radial außerhalb des Führungskanals (860) an einem Ende des zylindrischen Abschnitts (882) angeordnet ist, um mit einer Kartusche (905) einzugreifen, welche in der Aufnahme (852) aufgenommen ist.

Revendications

1. Bouchon de distribution (100) comportant :

une base (150) présentant un canal de distribution (155) et configurée pour être fixée à un col de bouteille (304) d'une bouteille (302), la base (150) présentant un réceptacle (152) ;

un élément de piston de base (165) disposé dans la base (150) et mobile entre une première position et une seconde position de sorte que lorsqu'un fluide disposé dans la bouteille (302) est forcé vers le canal de distribution (155) pour distribuer le fluide, au moins une partie du fluide entre en contact avec l'élément de piston de base (165) et déplace l'élément de piston de base (165) vers la seconde position ; et

une cartouche (105) pouvant être disposée dans le réceptacle (152) de la base (150), dans lequel l'élément de

piston de base (165) est configuré pour entraîner un élément de piston de cartouche (145) de la cartouche (105) lorsque l'élément de piston de base (165) est déplacé depuis la première position vers la seconde position.

2. Bouchon de distribution (100) selon la revendication 1, dans lequel la base (150) comprend un canal de guidage (160) le long duquel au moins une partie de l'élément de piston de base (165) se déplace et le canal de distribution (155) s'étend à l'intérieur du canal de guidage (160).
5
3. Bouchon de distribution (100) selon la revendication 1, dans lequel la cartouche (105) comporte un récipient (115) et un élément de vanne (138) couplé à une surface externe du récipient (115), l'élément de vanne (138) présentant une partie de tube (140) s'étendant à l'intérieur du récipient (115), la partie de tube (140) incluant au moins une ouverture de sortie (135) dans une paroi de celui-ci, la partie de tube (140) étant mobile par rapport au récipient (115) entre une première position où l'au moins une ouverture de sortie (135) est recouverte par une paroi interne (127) du récipient (115) pour empêcher un fluide dans le récipient (115) de s'écouler dans la partie de tube (140) par l'intermédiaire de l'au moins une ouverture de sortie (135) et une seconde position dans laquelle le fluide dans le récipient (115) est capable de s'écouler à travers l'au moins une ouverture de sortie (135) et dans la partie de tube (140).
10
15
4. Bouchon de distribution (100) selon la revendication 3 configuré de sorte que la fixation de la cartouche (105) à la base (150) du bouchon de distribution (100) amène une extrémité de la partie de tube (140) en prise avec une extrémité du canal de distribution (155) de la base (150), déplaçant la partie de tube (140) pour ouvrir l'au moins une ouverture de sortie (135).
20
5. Bouchon de distribution (100) selon la revendication 3, dans lequel la partie de tube (140) comprend quatre des au moins une ouvertures de sortie (135).
6. Bouchon de distribution (100) selon la revendication 3, dans lequel le fluide dans le récipient (115) de la cartouche (105) présente une viscosité allant d'environ 7,0 Pa.s à environ 20,0 Pa.s (7 000 centipoises à environ 20 000 centipoises).
25
7. Bouchon de distribution (100) selon la revendication 3, dans lequel le canal de distribution (155) est en communication fluïdique avec la partie de tube (140) par l'intermédiaire d'un orifice de sortie (157) du canal de distribution (155) lorsque la cartouche (105) est fixée à la base (150).
30
8. Bouchon de distribution (100) selon la revendication 7, dans lequel l'orifice de sortie (157) présente un diamètre d'environ 1,5 mm à environ 3,0 mm et la partie de tube (140) comprend quatre des au moins une ouvertures de sortie (135), chacune présentant un diamètre d'environ 2,5 mm à environ 3,5 mm.
35
9. Bouchon de distribution (100) selon la revendication 1, comportant un couvercle rabattable (180) fixé de manière articulée à la base (150), dans lequel le couvercle rabattable (180) comprend une saillie intérieure (185) comportant une première surface d'étanchéité configurée pour bloquer la sortie de fluide à partir du canal de distribution (155) de la base (150), et une seconde surface d'étanchéité configurée pour bloquer la sortie de fluide à travers l'au moins une ouverture de sortie (135) de la cartouche (105).
40
10. Bouchon de distribution (100) selon la revendication 1, dans lequel la cartouche (105) pouvant être disposée dans le réceptacle (152) de la base (150) comporte des filetages externes (130) pour être vissée dans le réceptacle (152), dans lequel une ou plusieurs saillies (618) sur les filetages externes (130) viennent en prise avec un ou plusieurs évidements (519a, 519b) sur le filetage interne (552) du réceptacle (152) pour fournir à un utilisateur une indication auditive et/ou tactile lorsque la cartouche (105) est correctement positionnée dans le réceptacle (152).
45
11. Bouchon de distribution selon la revendication 1 ou la revendication 10, dans lequel la cartouche (105) est disposée dans le réceptacle (152) de la base (150).
50
12. Récipient (300) comportant le bouchon de distribution (100) selon la revendication 1 ou la revendication 11 vissé sur le col de bouteille (304) d'une bouteille (302) dans lequel un fluide primaire est disposé dans la bouteille (302) et un fluide secondaire est disposé dans la cartouche (105).
55
13. Base de bouchon de distribution (850) pour un couplage amovible à un col de bouteille (1004) d'une bouteille (1002), la base de bouchon de distribution (850) comportant :

EP 4 367 037 B1

un corps principal (872) et un élément de piston de base (865),
le corps principal (872) incluant :

une première extrémité comportant un réceptacle (852) pour recevoir une cartouche (905) ;
une seconde extrémité comportant une partie d'entrée (891) pour recevoir un fluide à partir de la bouteille (1002) ;
un canal de distribution (855) s'étendant à partir de la première extrémité à la seconde extrémité pour distribuer du fluide à partir de la bouteille (1002) ; et
un canal de guidage (860) disposé autour du canal de distribution (855), l'élément de piston de base (865) étant mobile entre une première position et une seconde position le long du canal de guidage (860) pour venir en prise avec la cartouche (905) lorsque du fluide provenant de la bouteille (1002) est reçu dans la partie d'entrée (891).

14. Base de bouchon de distribution (850) selon la revendication 13, dans laquelle la partie d'entrée (891) comprend au moins une ouverture de base de bouchon (867) à travers laquelle du fluide peut s'écouler entre le canal de distribution (855) et le canal de guidage (860) pour entrer en contact avec l'élément de piston de base (865).

15. Base de bouchon de distribution (850) selon la revendication 13, dans laquelle :

l'élément de piston de base (865) présente une configuration annulaire et comporte un joint interne (870) et un joint externe (871), le joint interne (870) venant en prise avec une surface externe du canal de distribution (855) et le joint externe (871) venant en prise avec le canal de guidage (860) ; ou
l'élément de piston de base (865) présente une configuration annulaire et est disposé autour du canal de distribution (855), l'élément de piston de base (865) incluant une partie cylindrique (882) disposée radialement vers l'intérieur du canal de guidage (860) et une partie de bride (883) disposée sensiblement radialement vers l'extérieur du canal de guidage (860) à une extrémité de la partie cylindrique (882) pour venir en prise avec une cartouche (905) reçue dans le réceptacle (852).

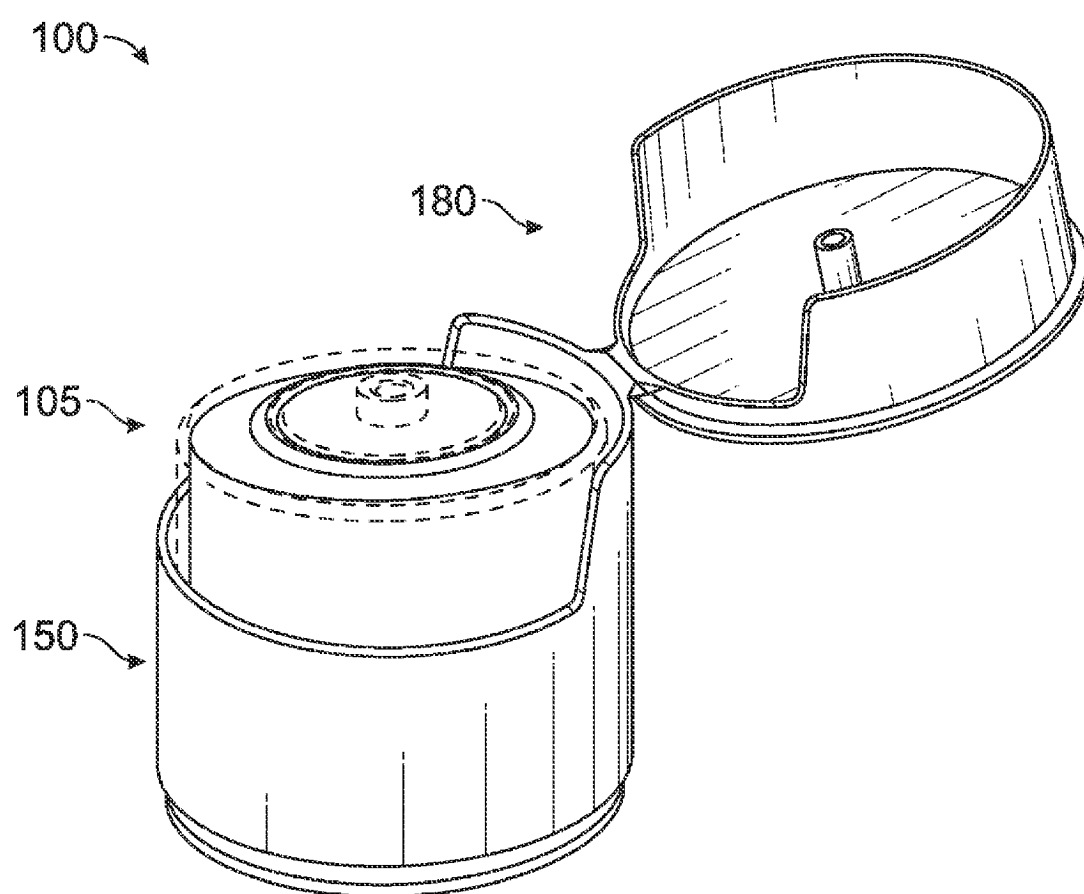


FIG. 1

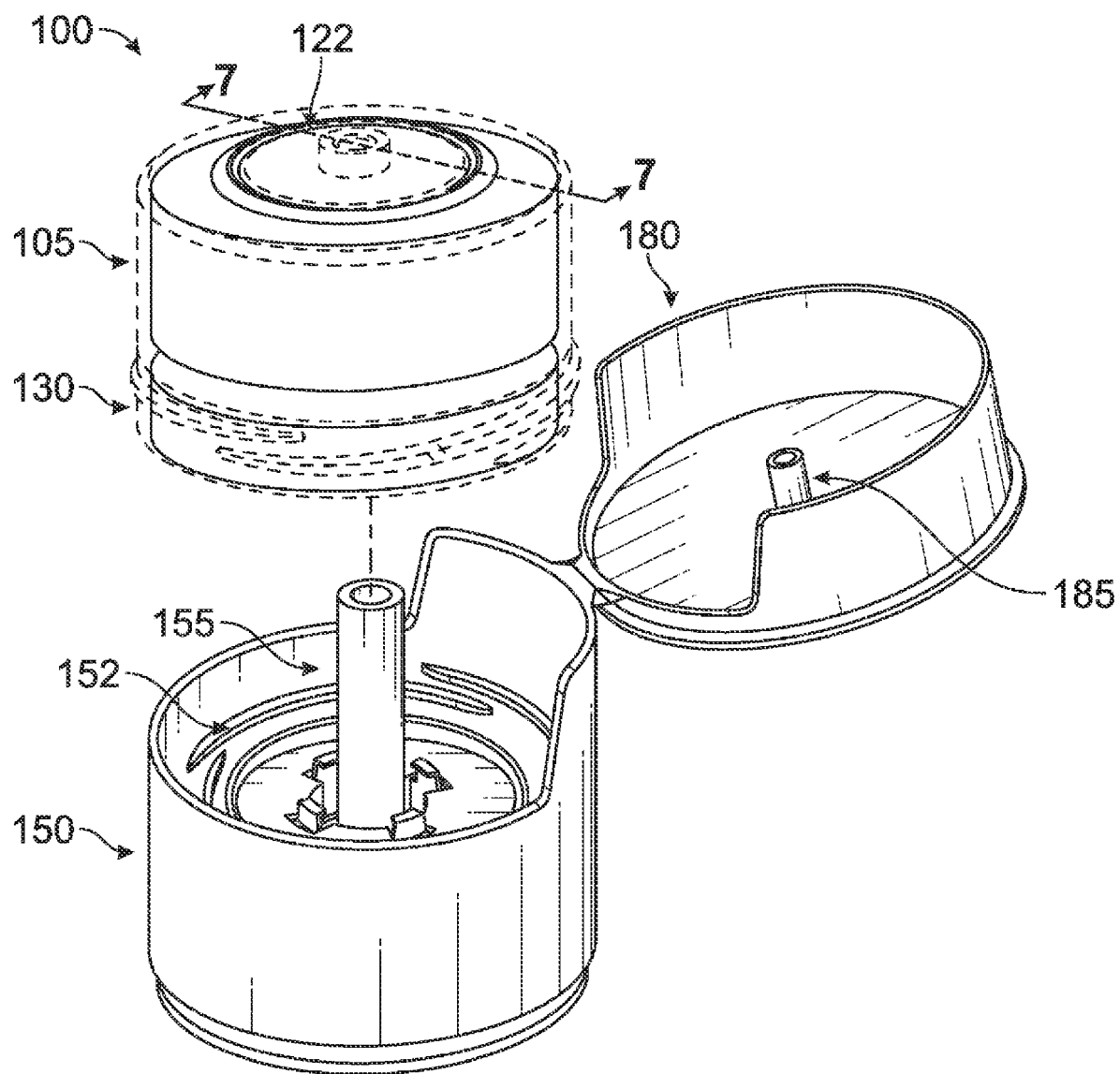


FIG. 2

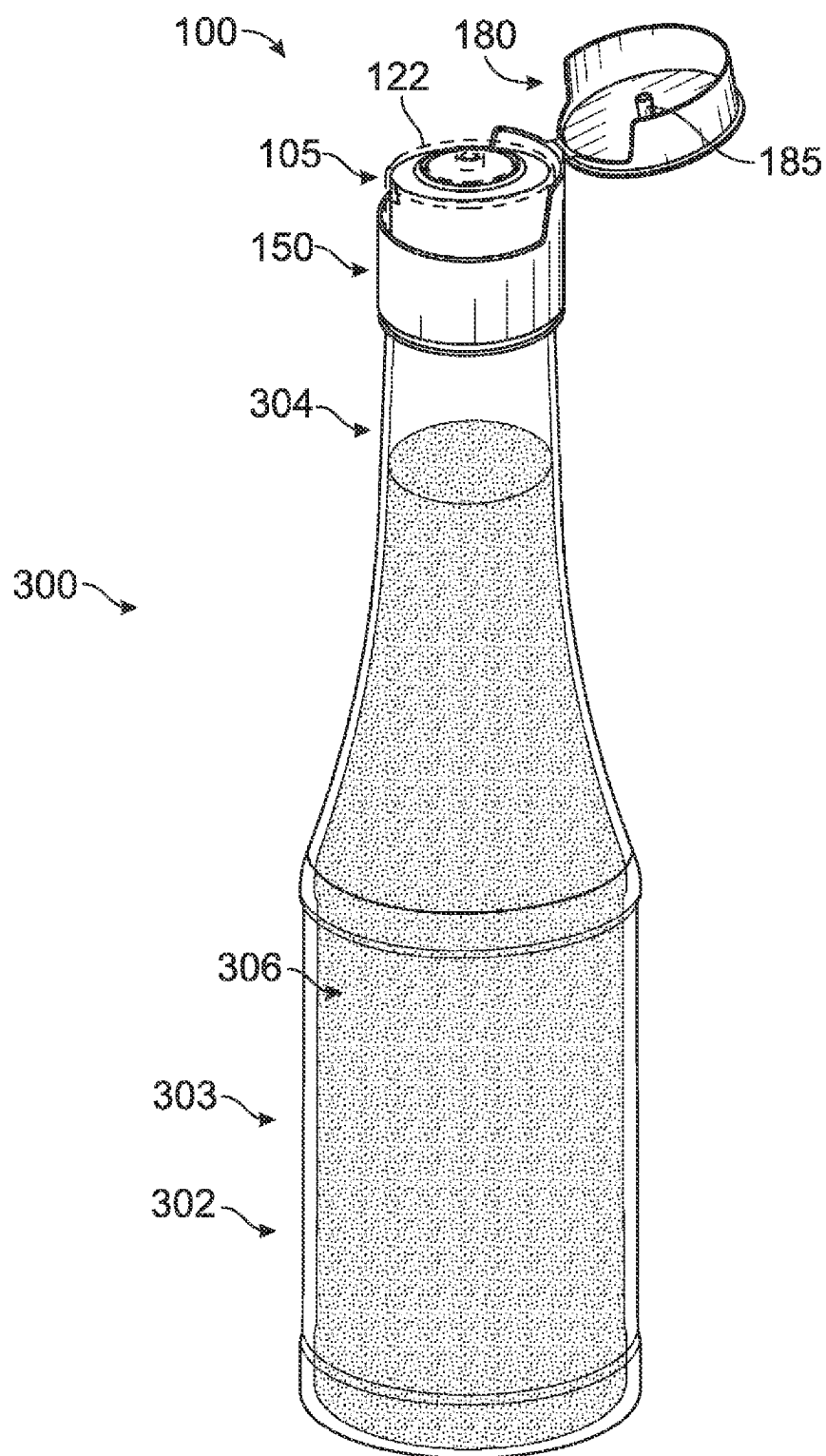


FIG. 3

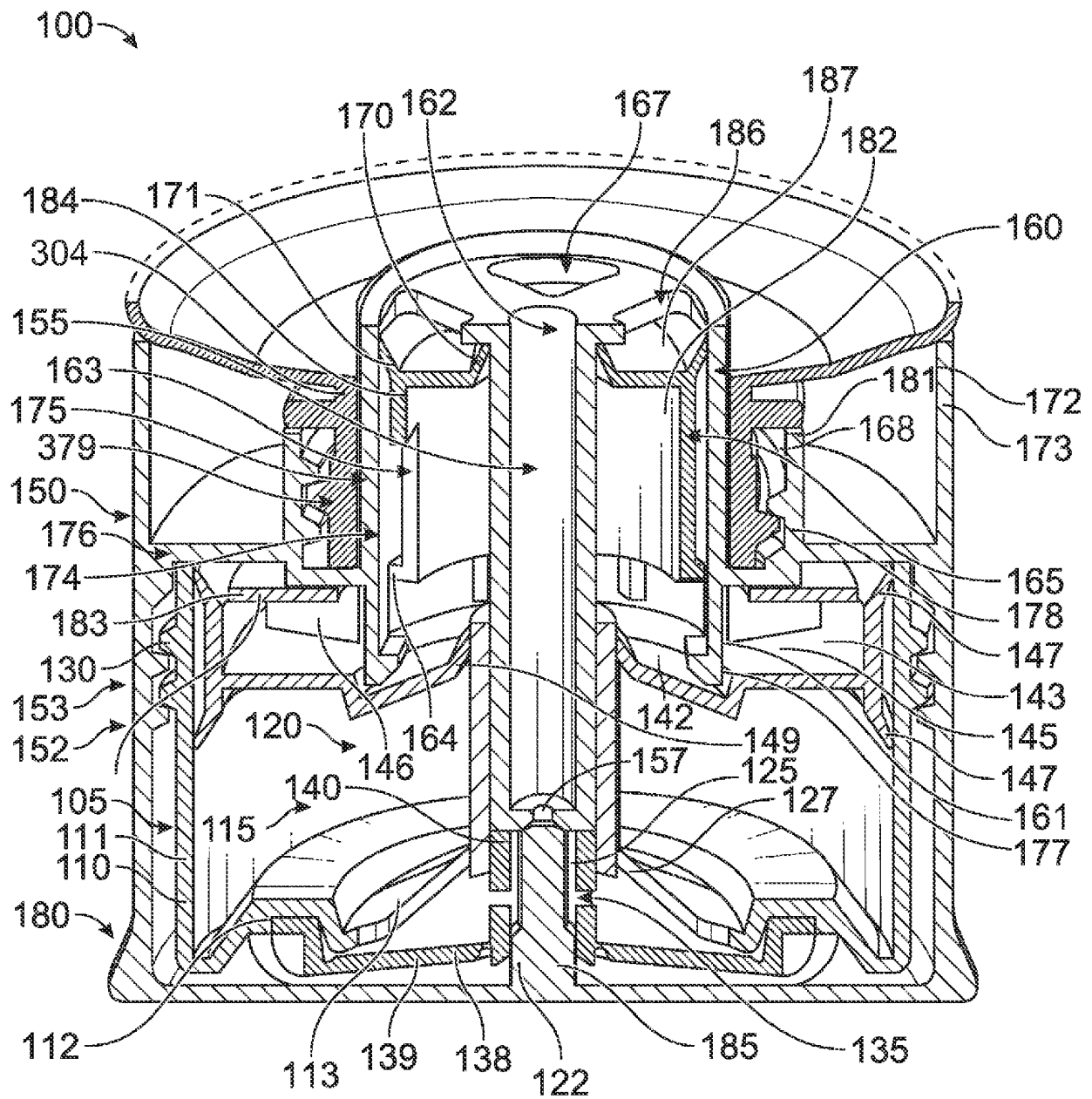


FIG. 4

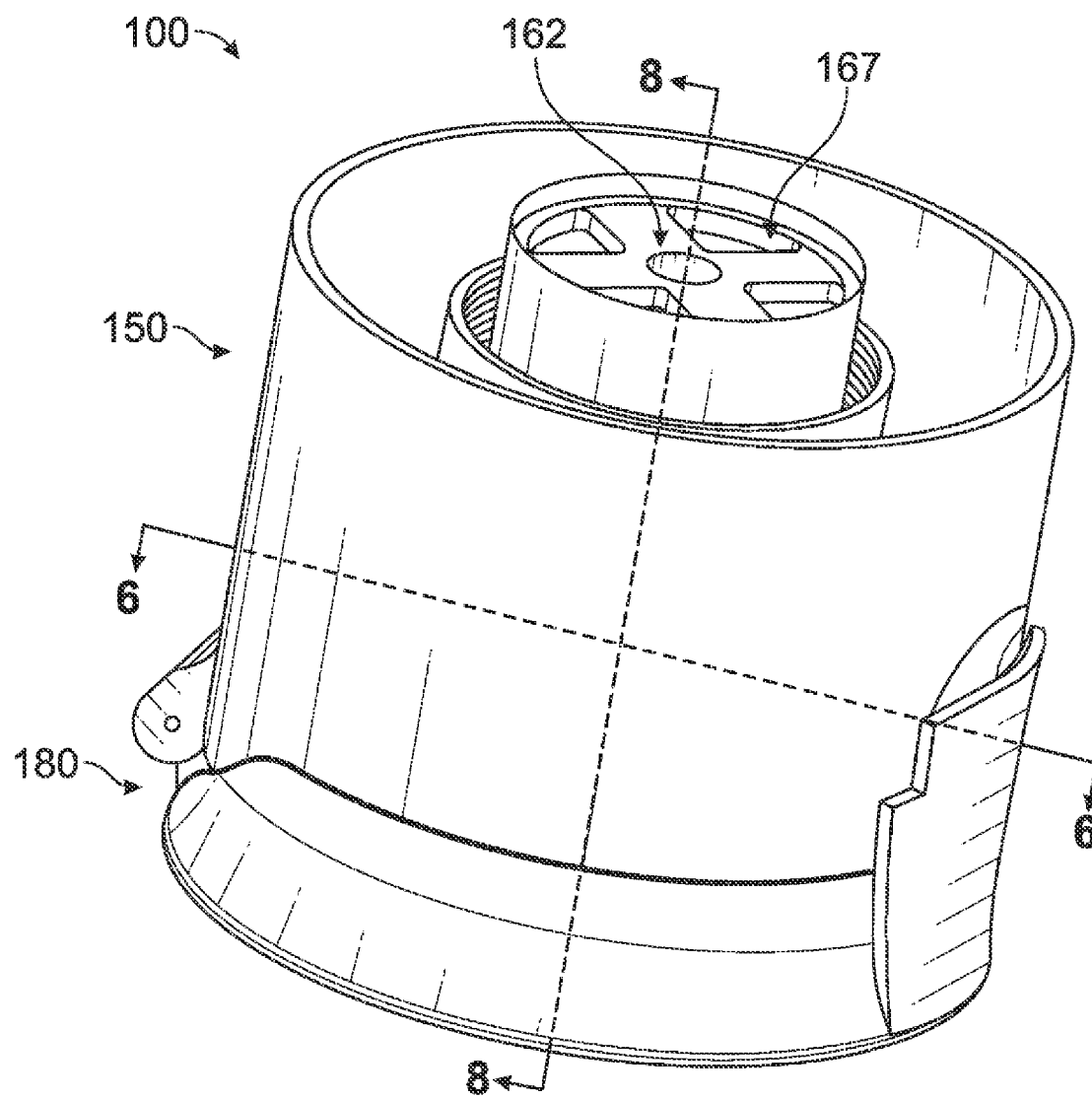


FIG. 5

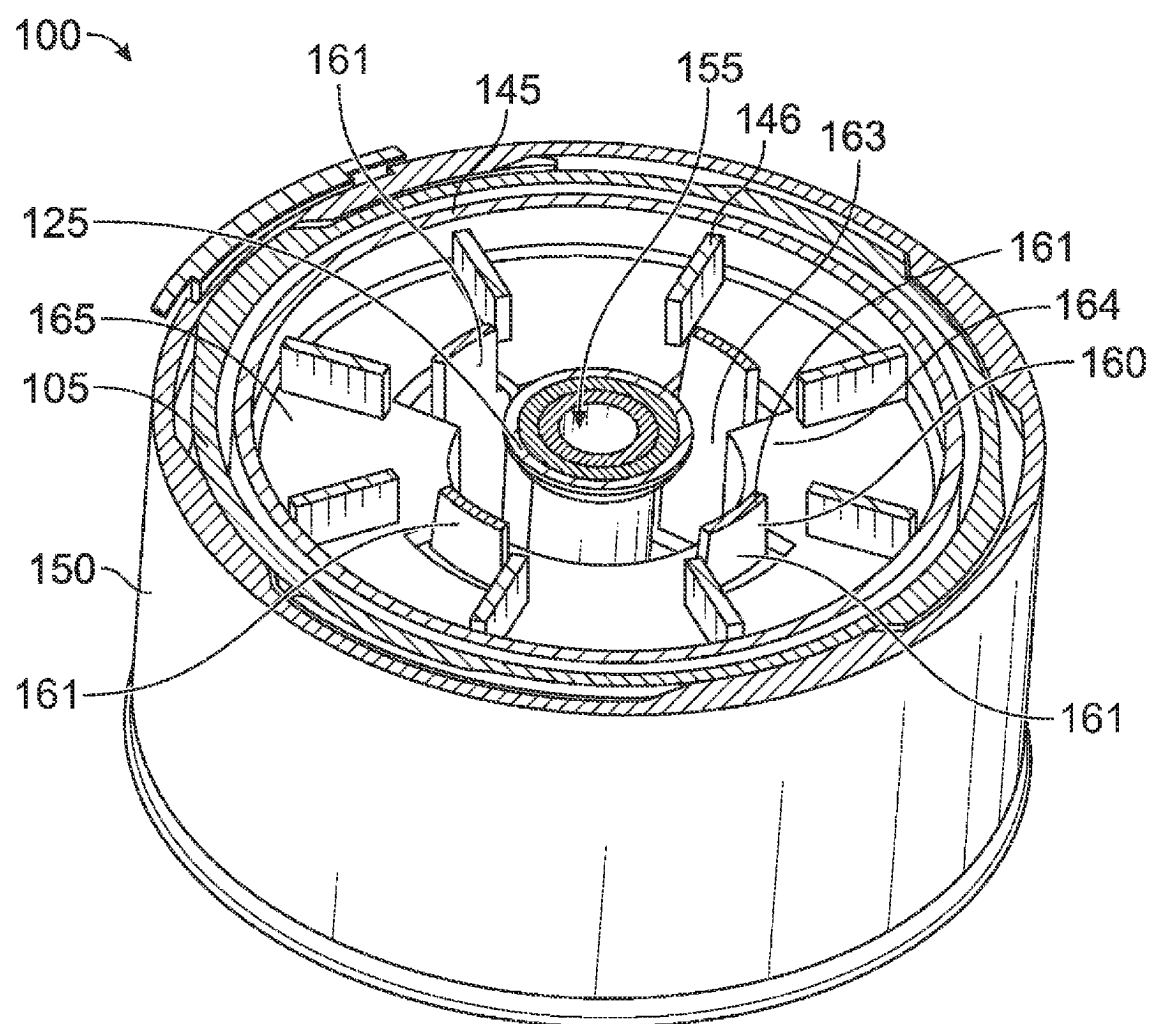


FIG. 6

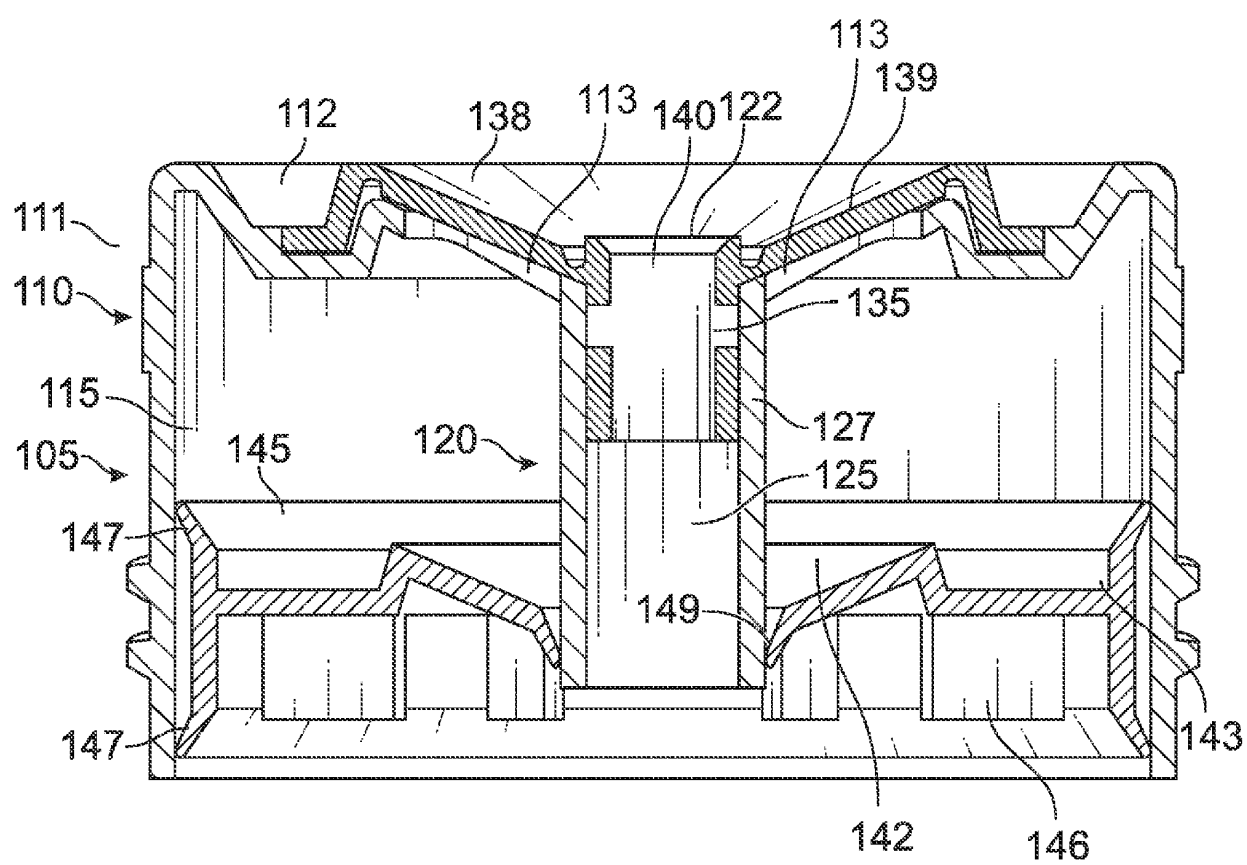


FIG. 7

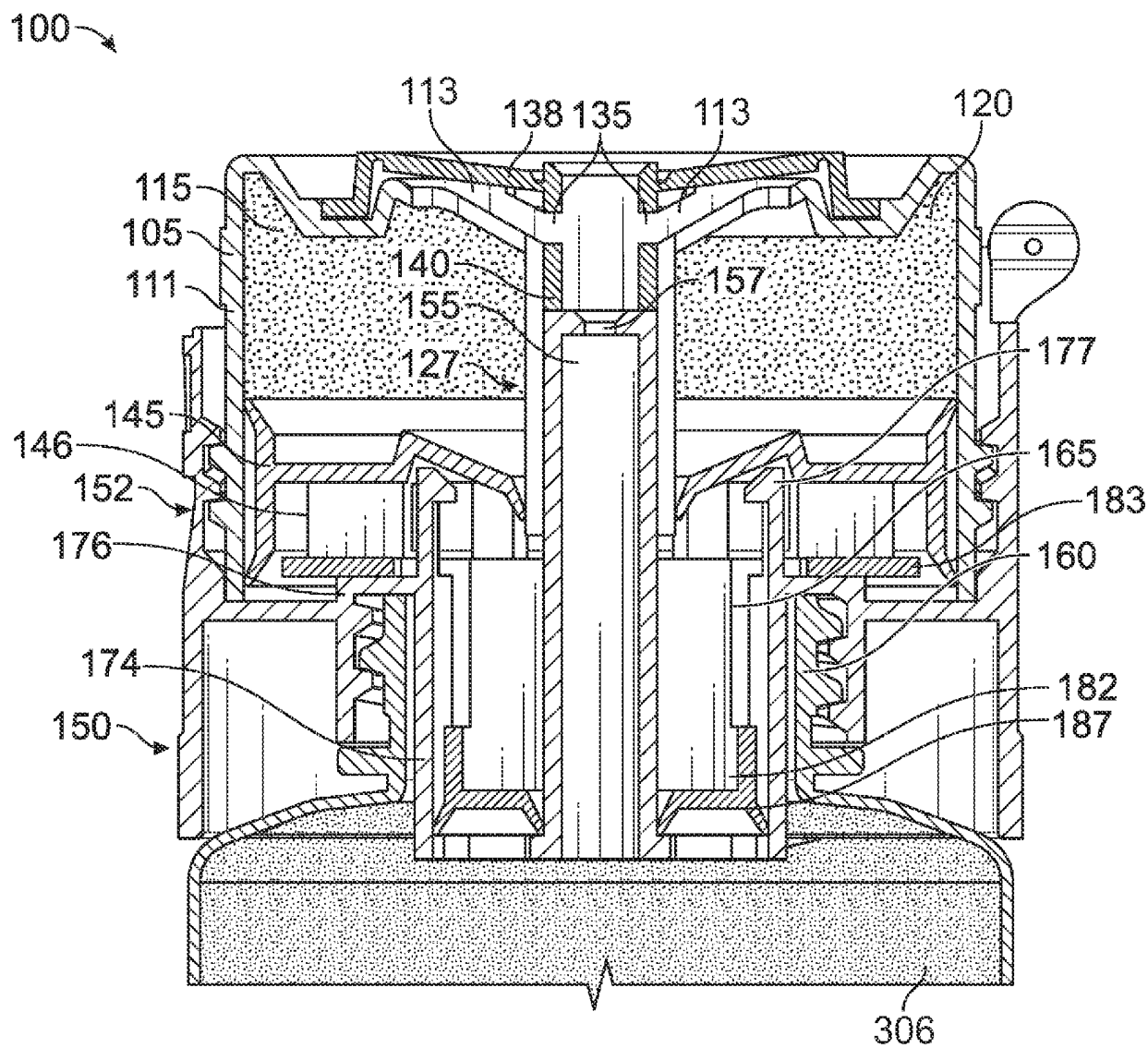


FIG. 8

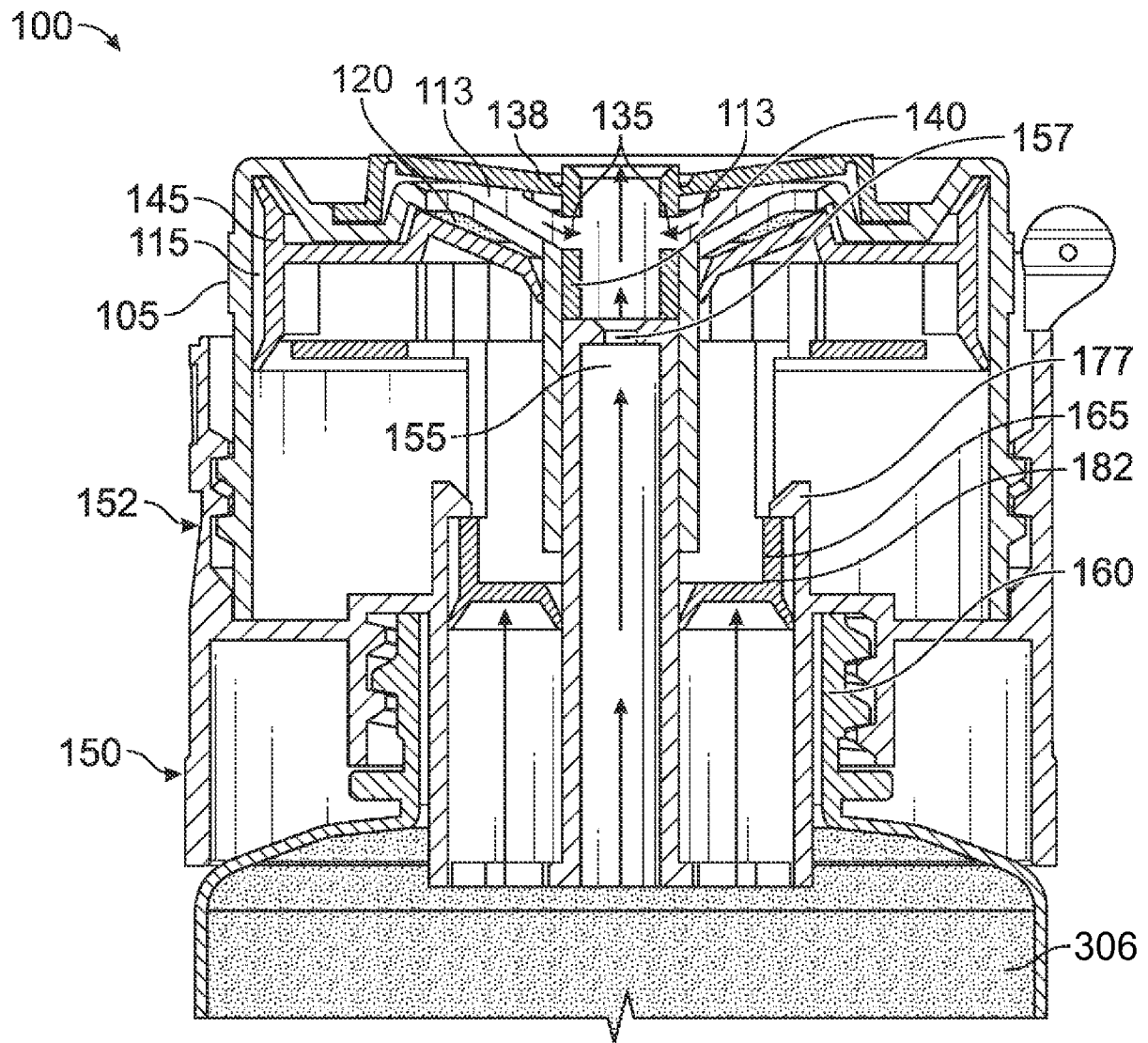


FIG. 9

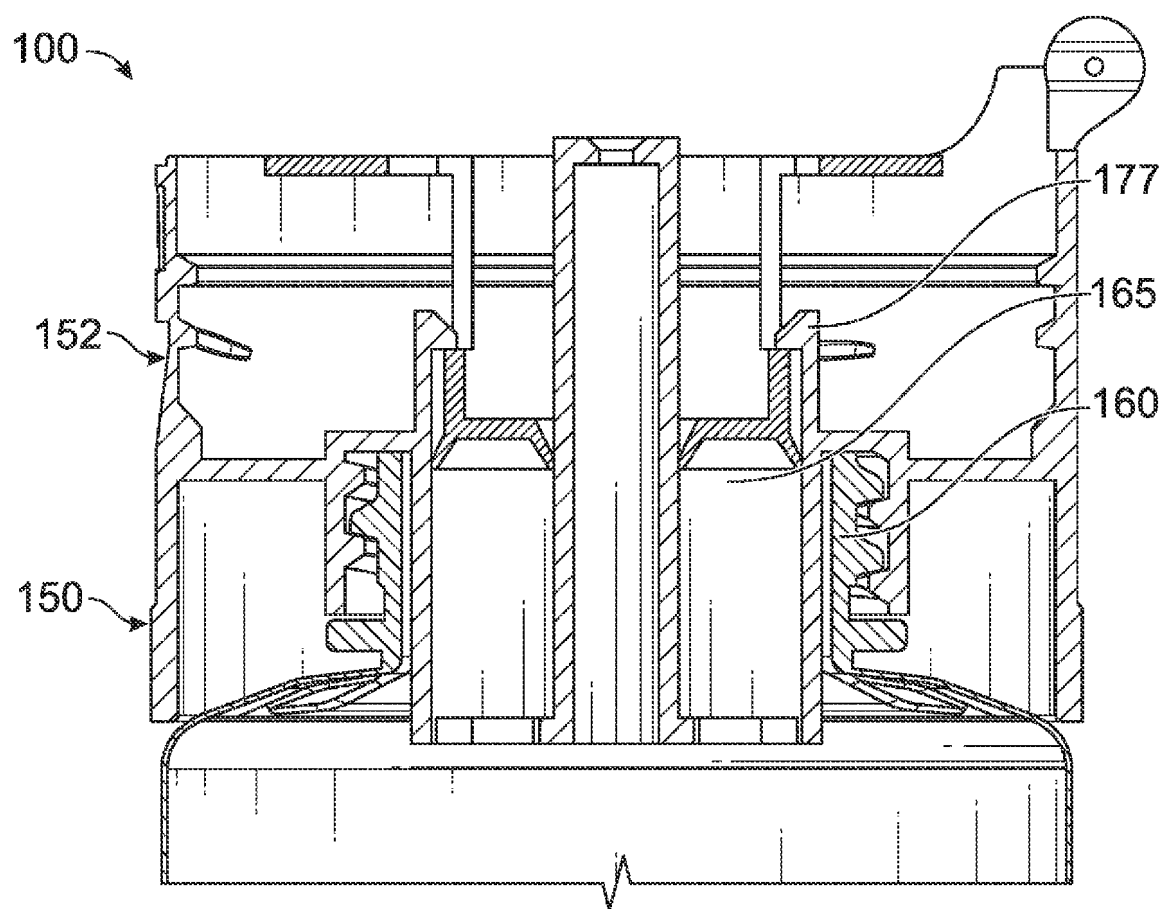


FIG. 10

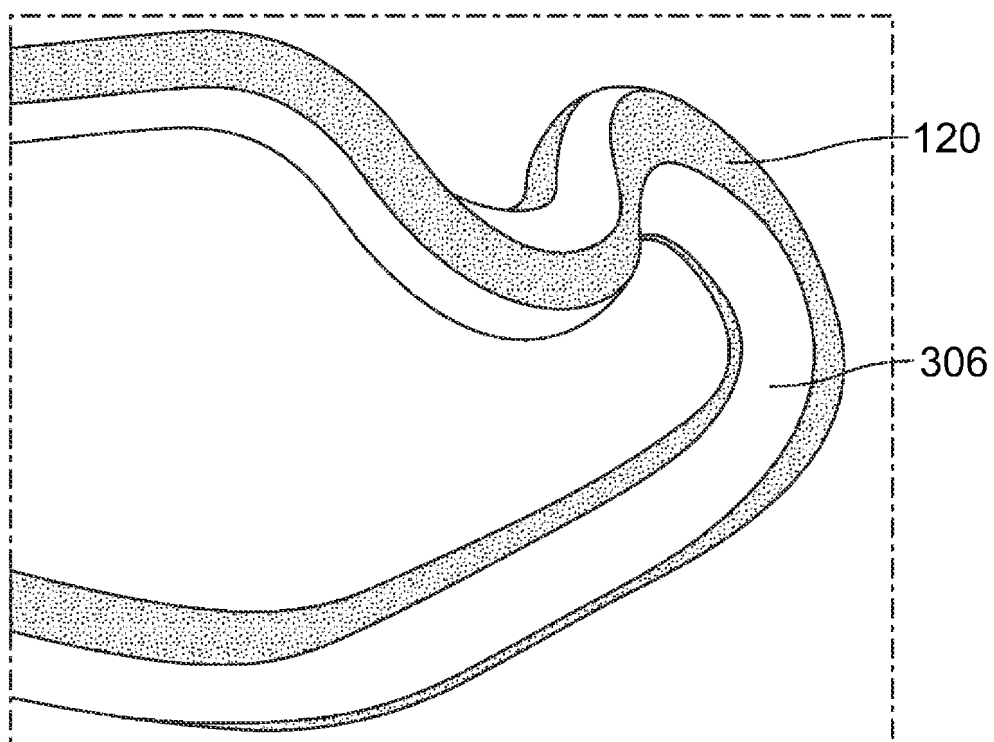


FIG. 11

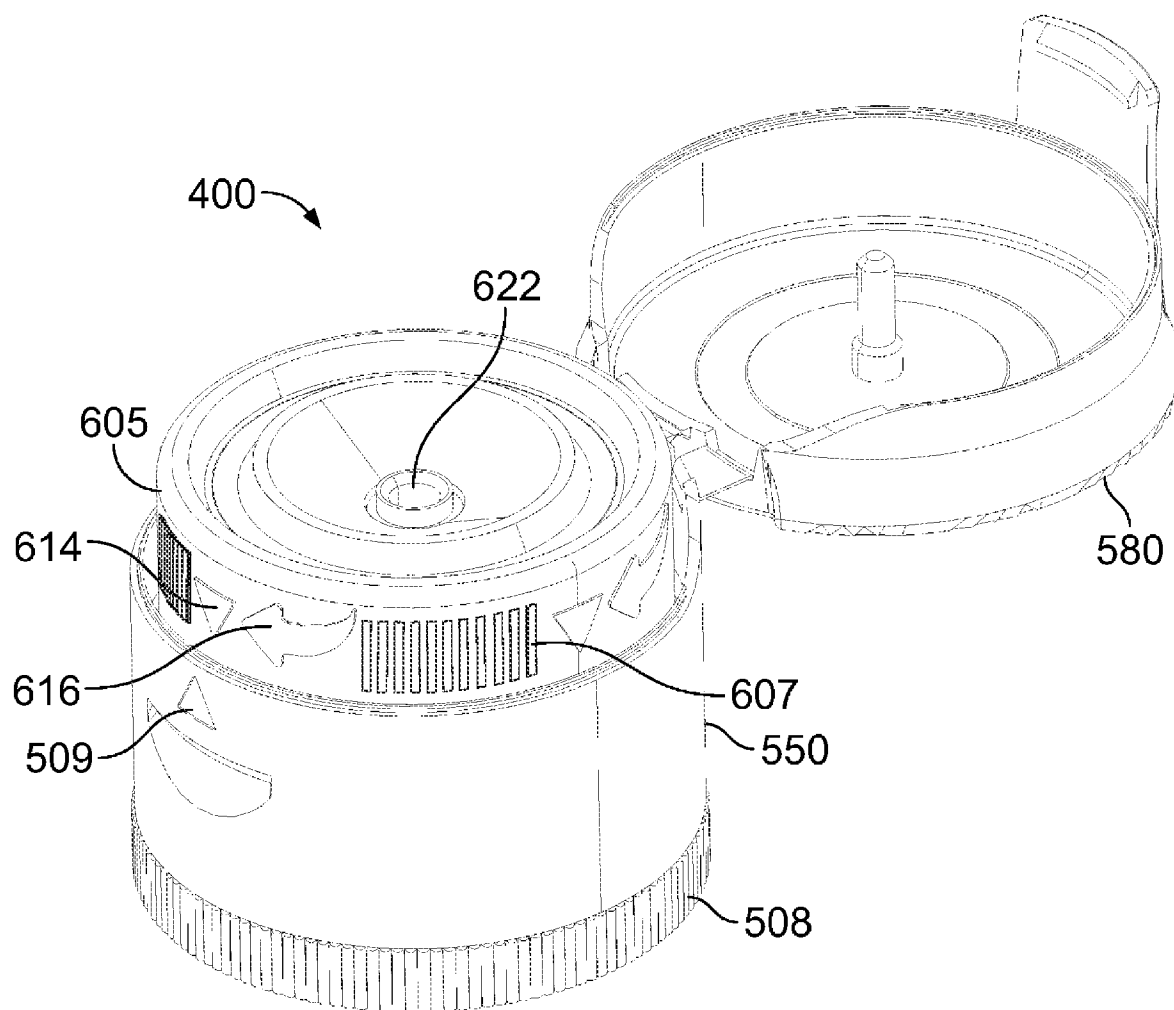


FIG. 12

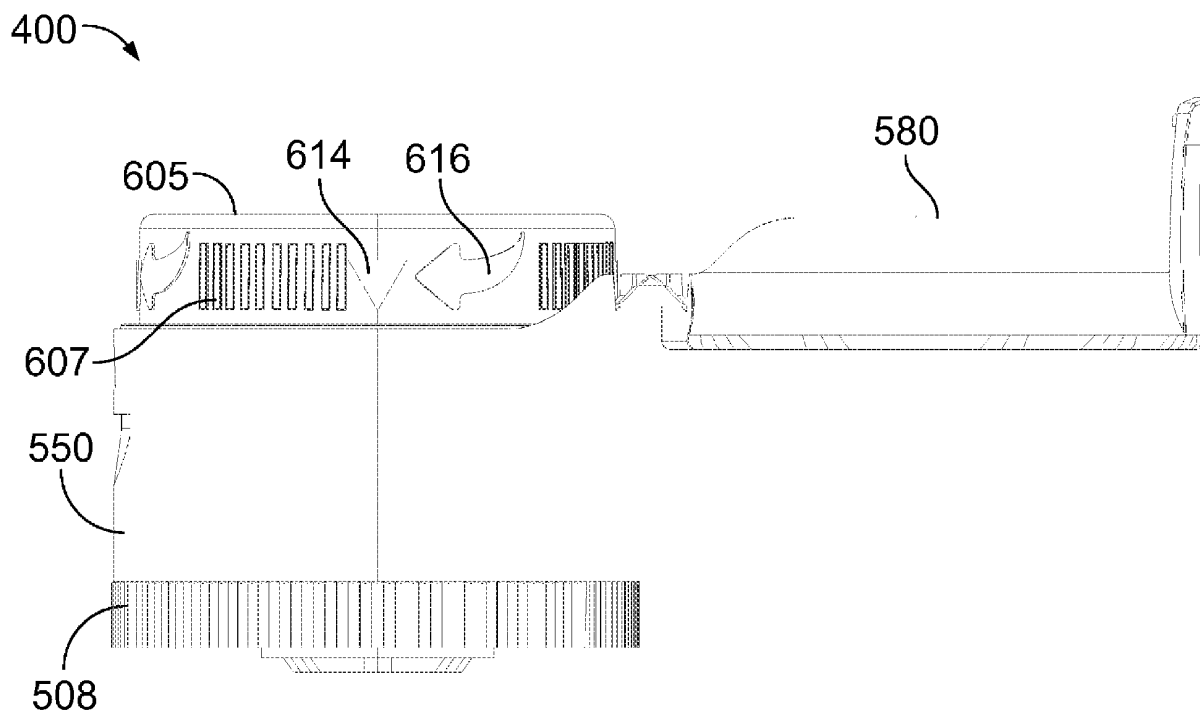


FIG. 13

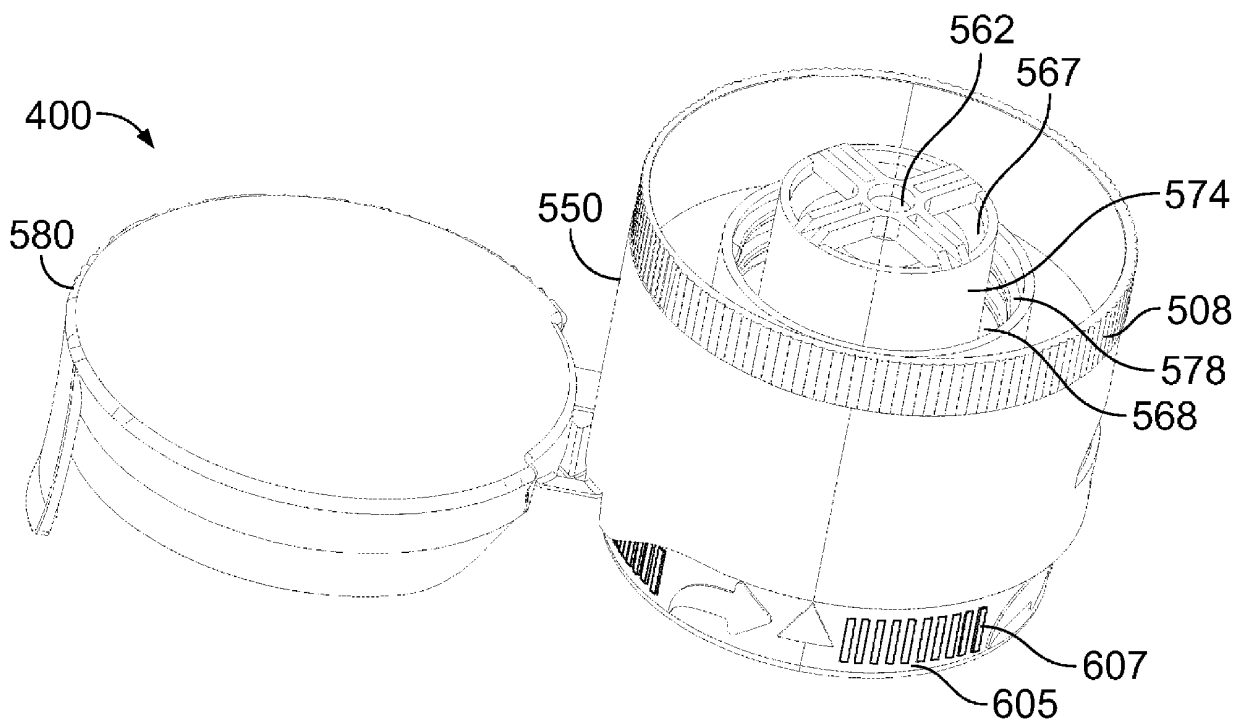


FIG. 14

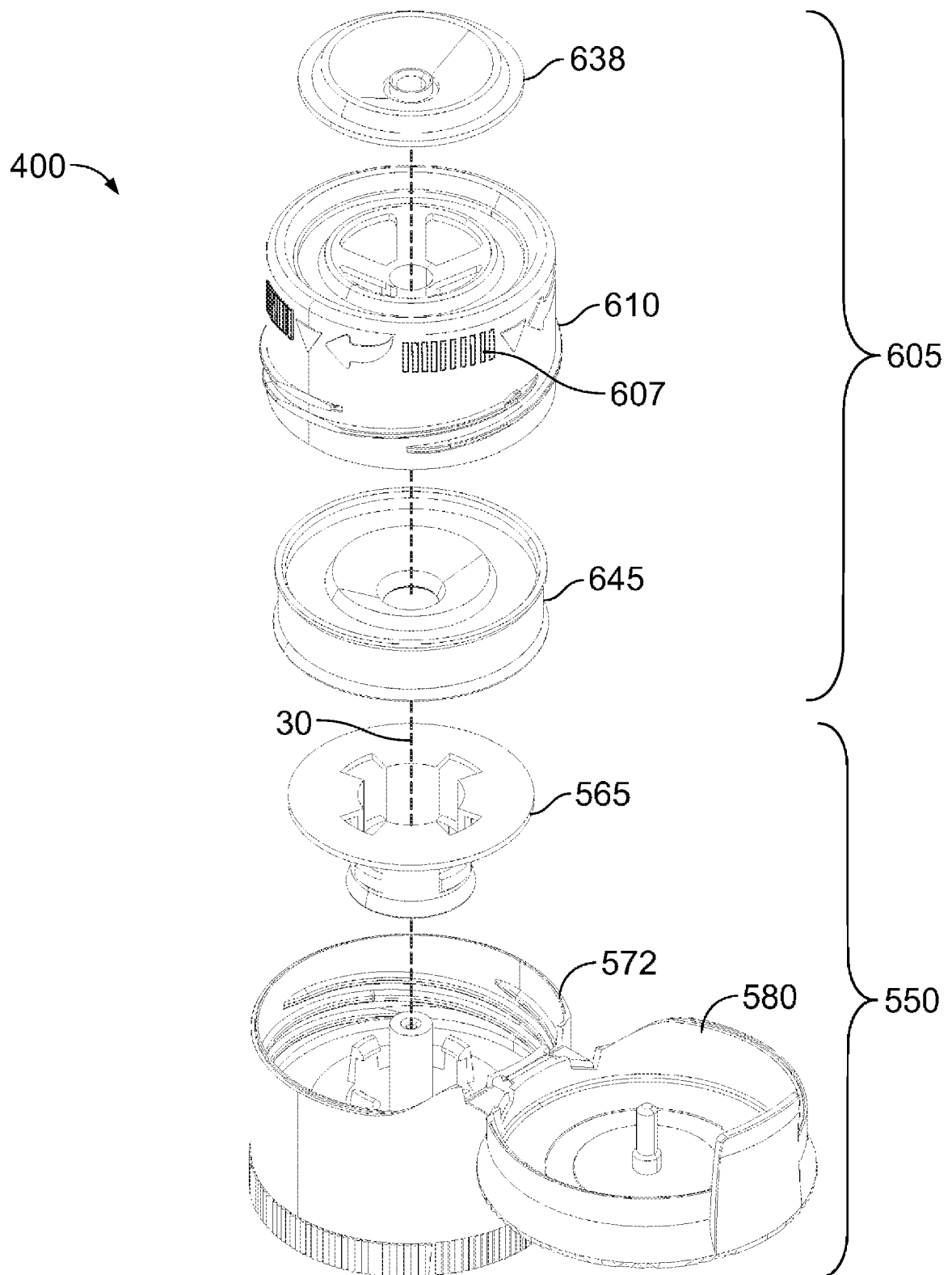


FIG. 15

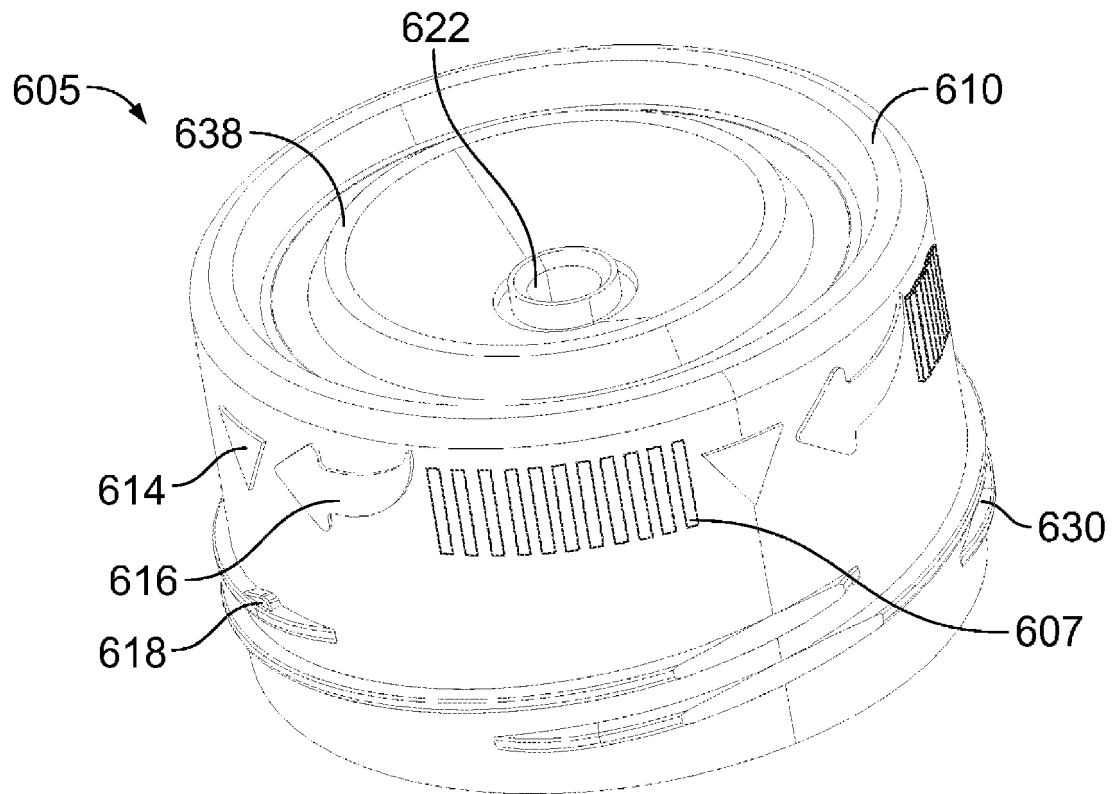


FIG. 16

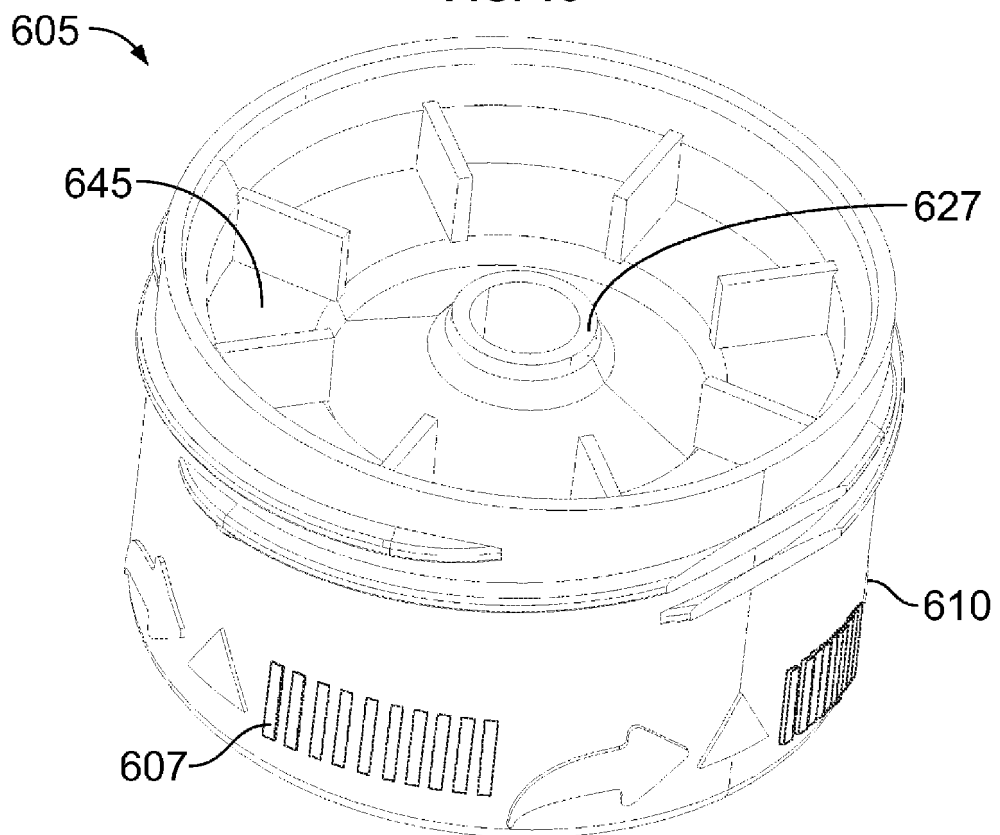


FIG. 17

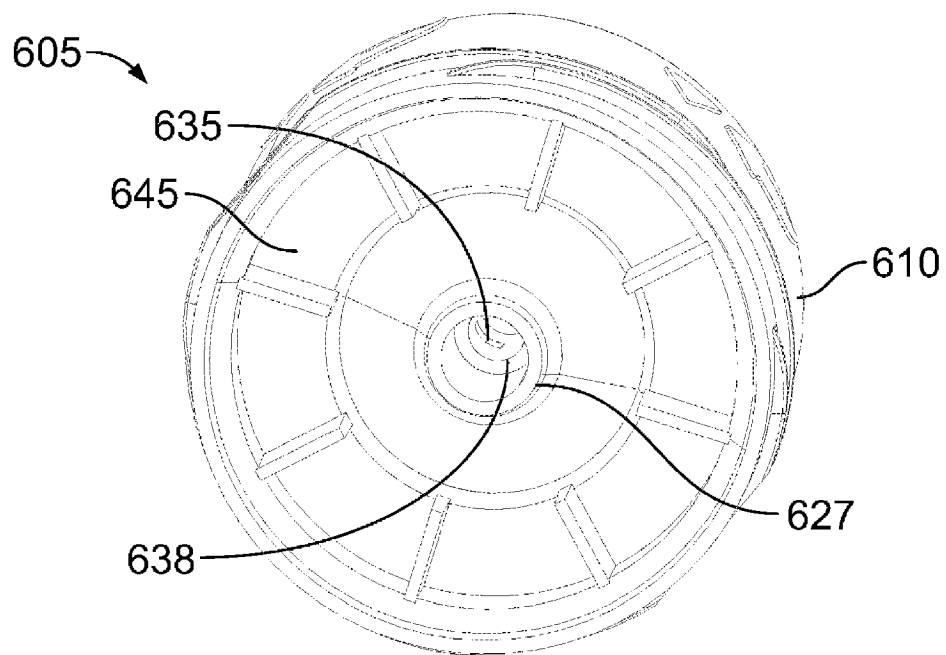


FIG. 18

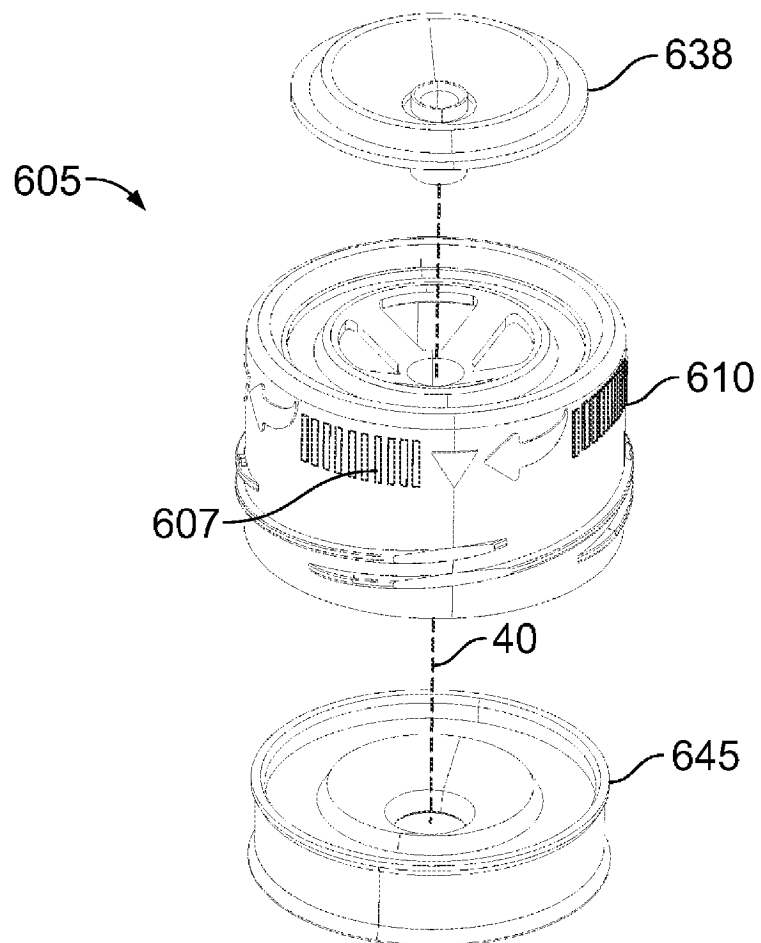


FIG. 19

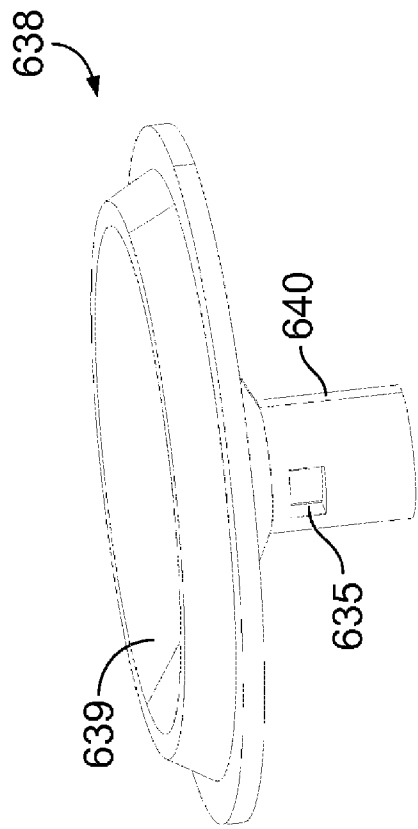


FIG. 20A

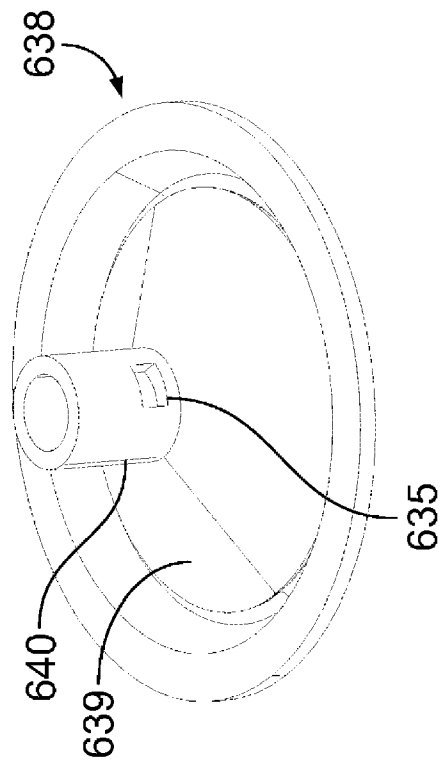


FIG. 20B

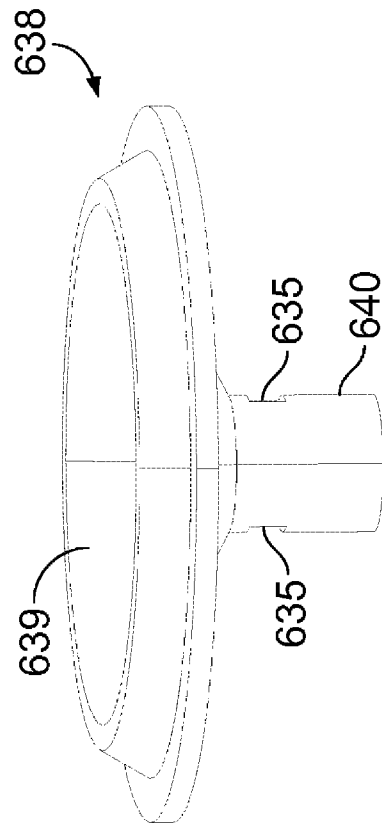


FIG. 20C

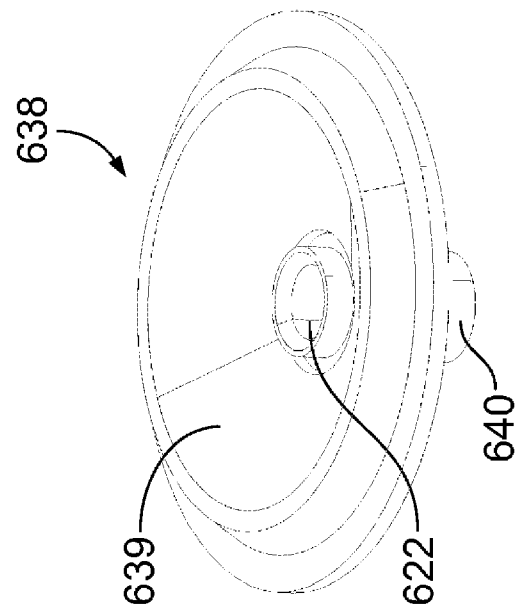


FIG. 20D

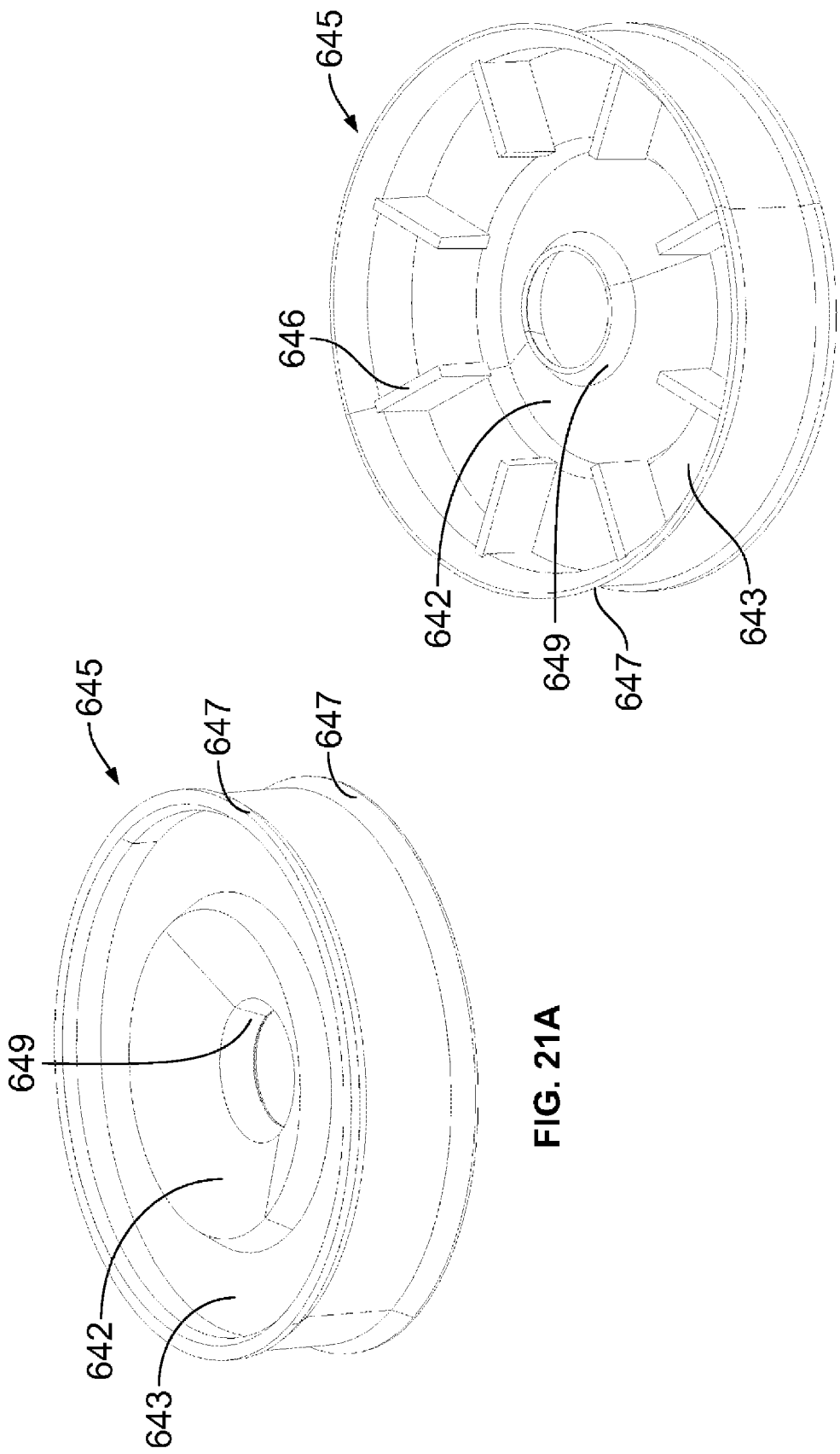


FIG. 21B

FIG. 21A

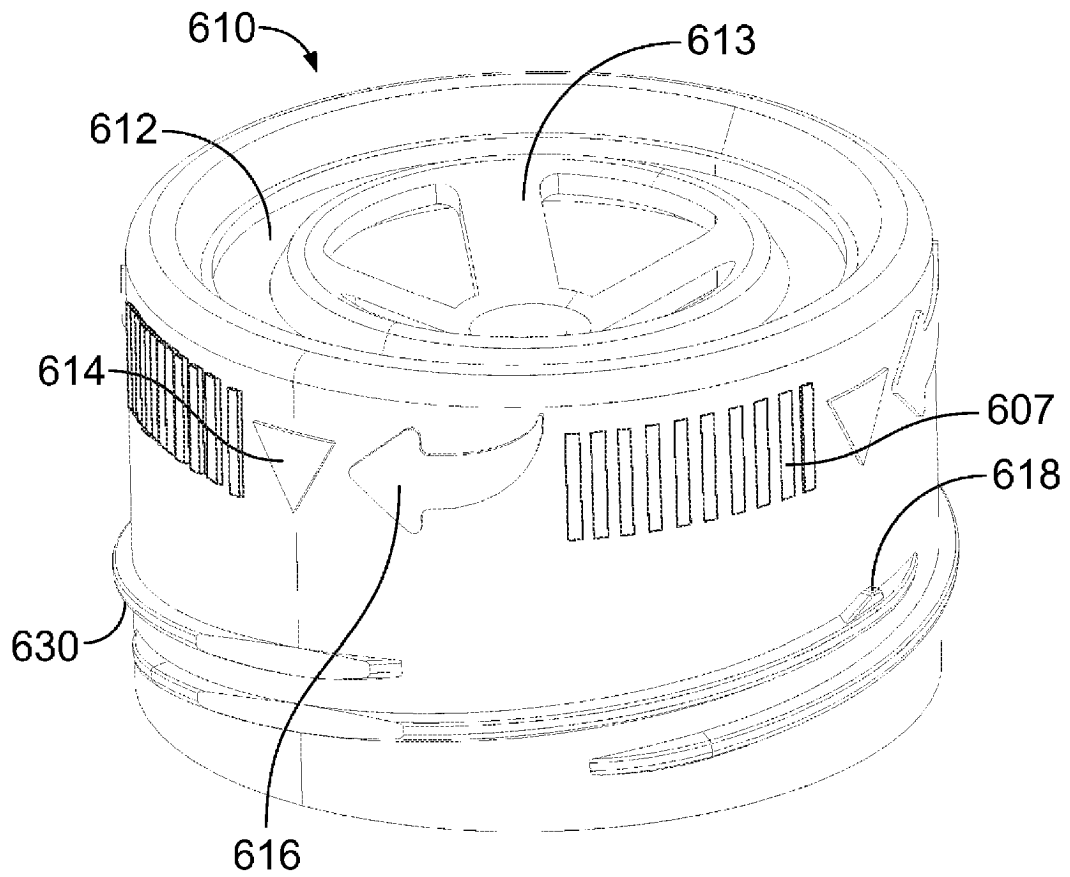


FIG. 22A

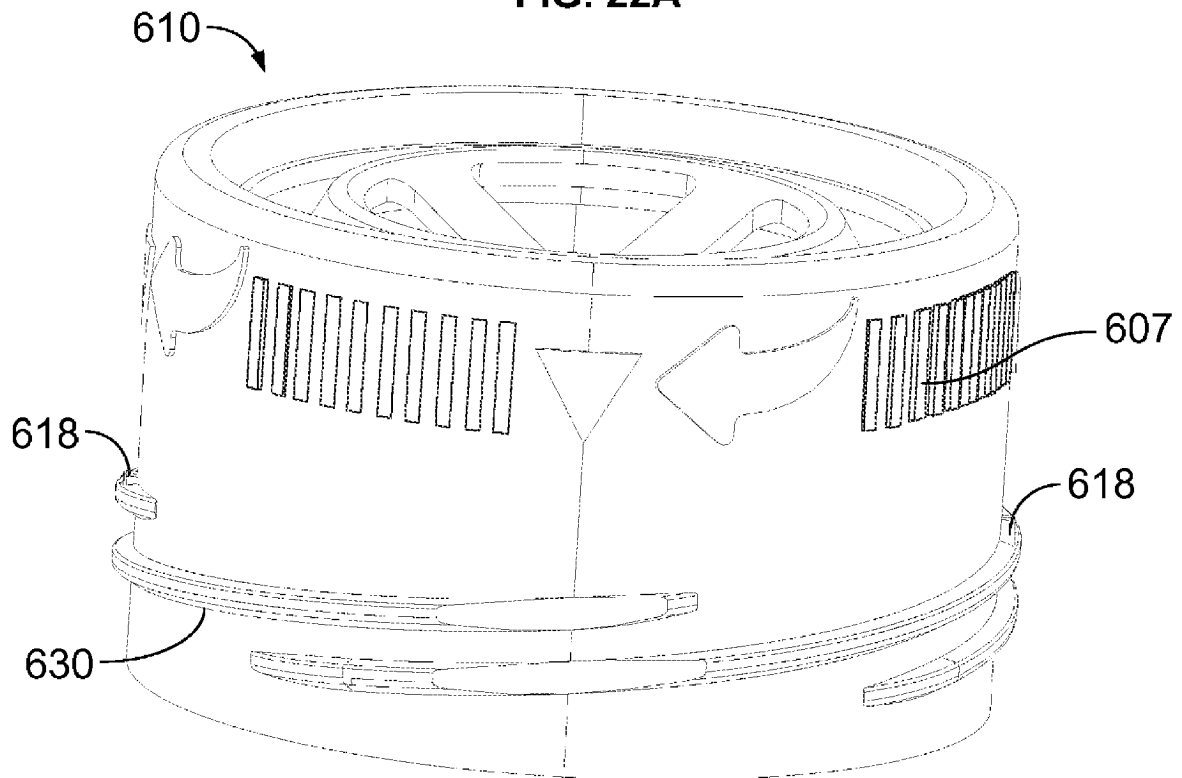


FIG. 22B

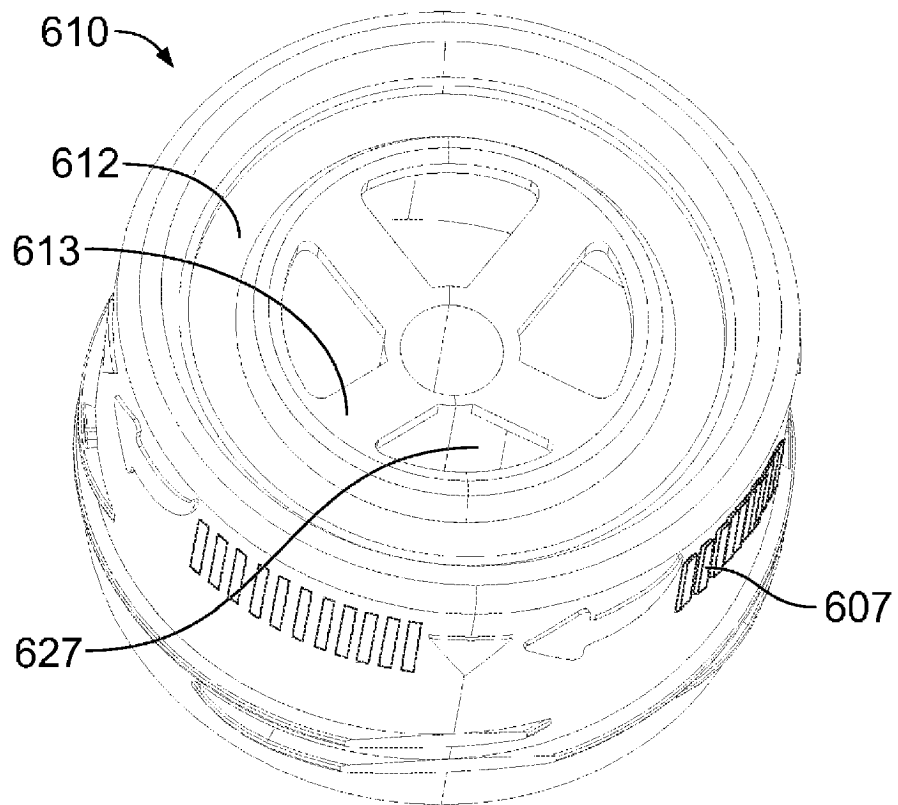


FIG. 22C

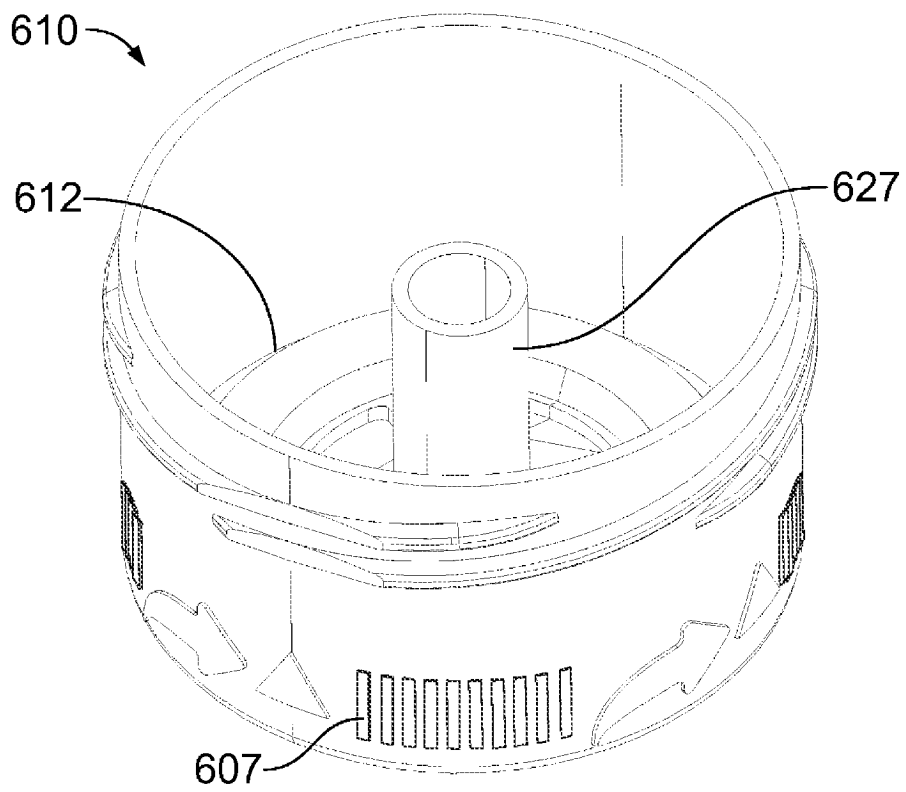


FIG. 22D

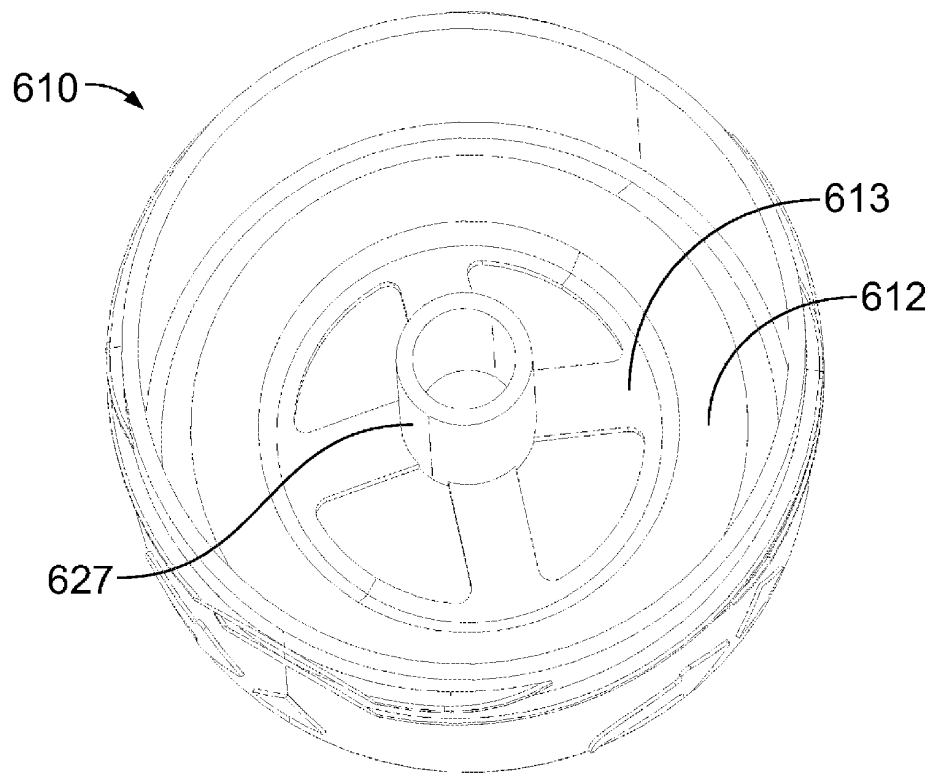


FIG. 22E

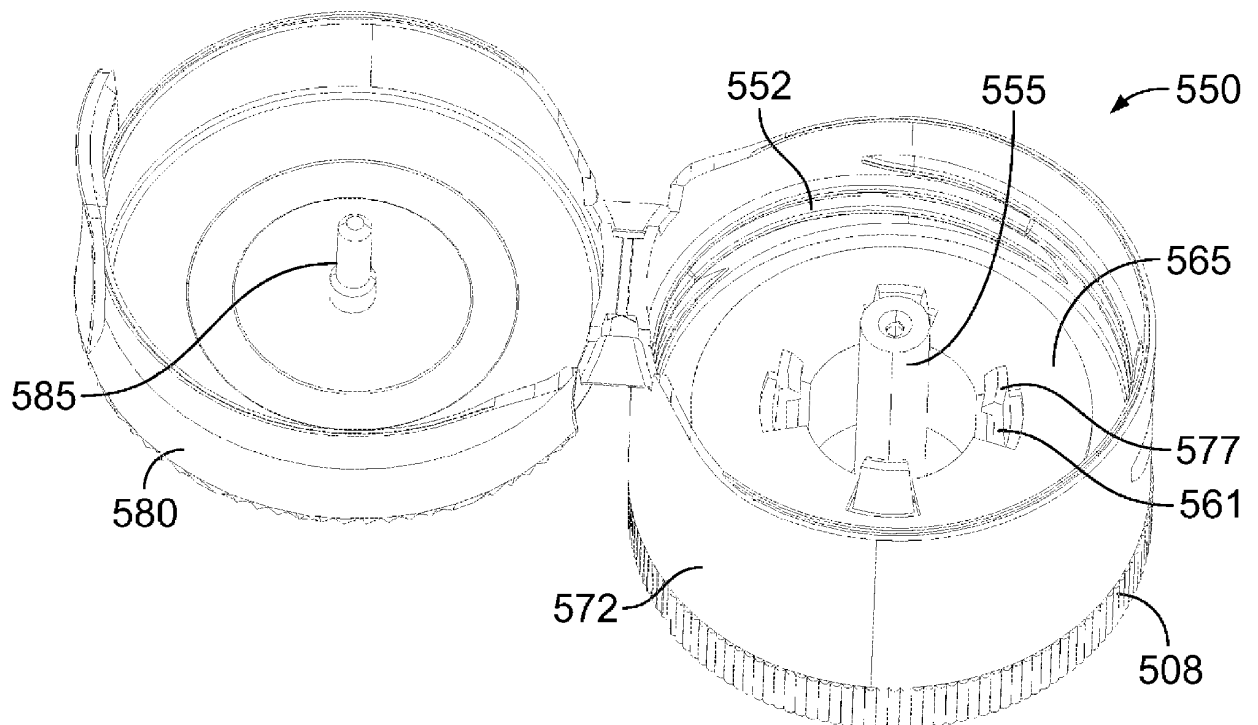


FIG. 23

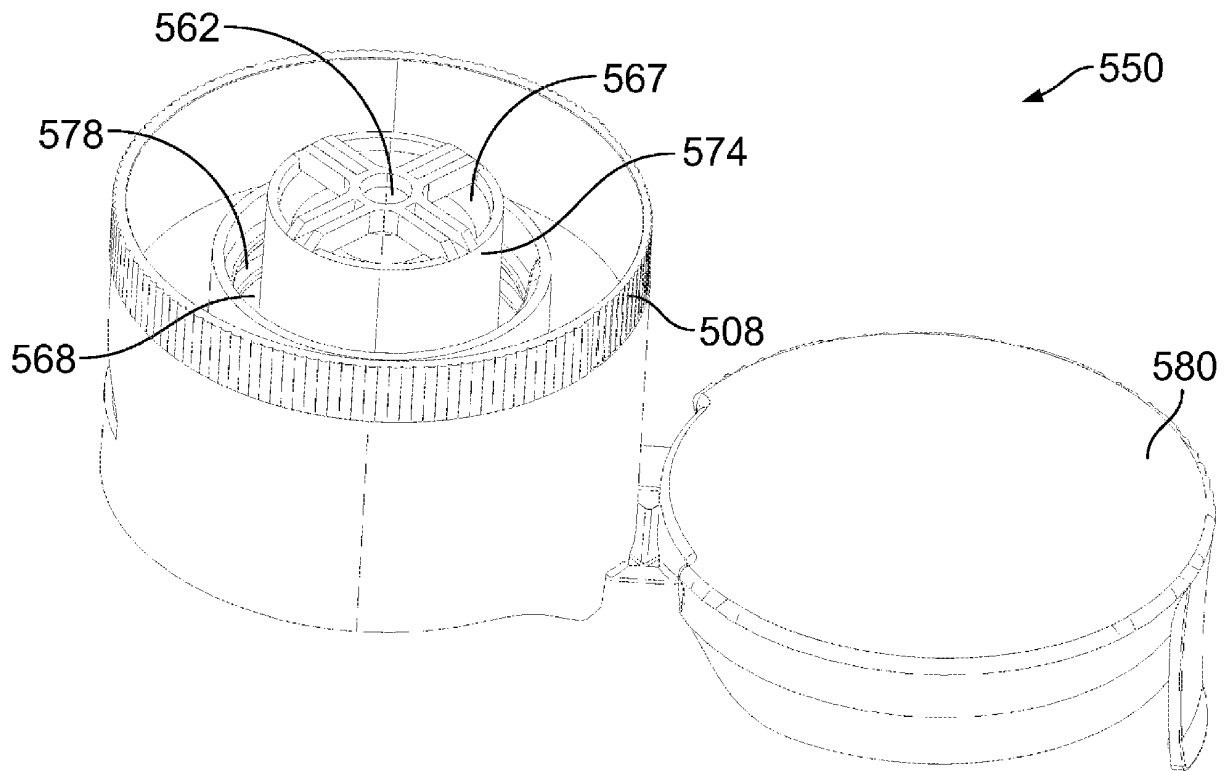


FIG. 24

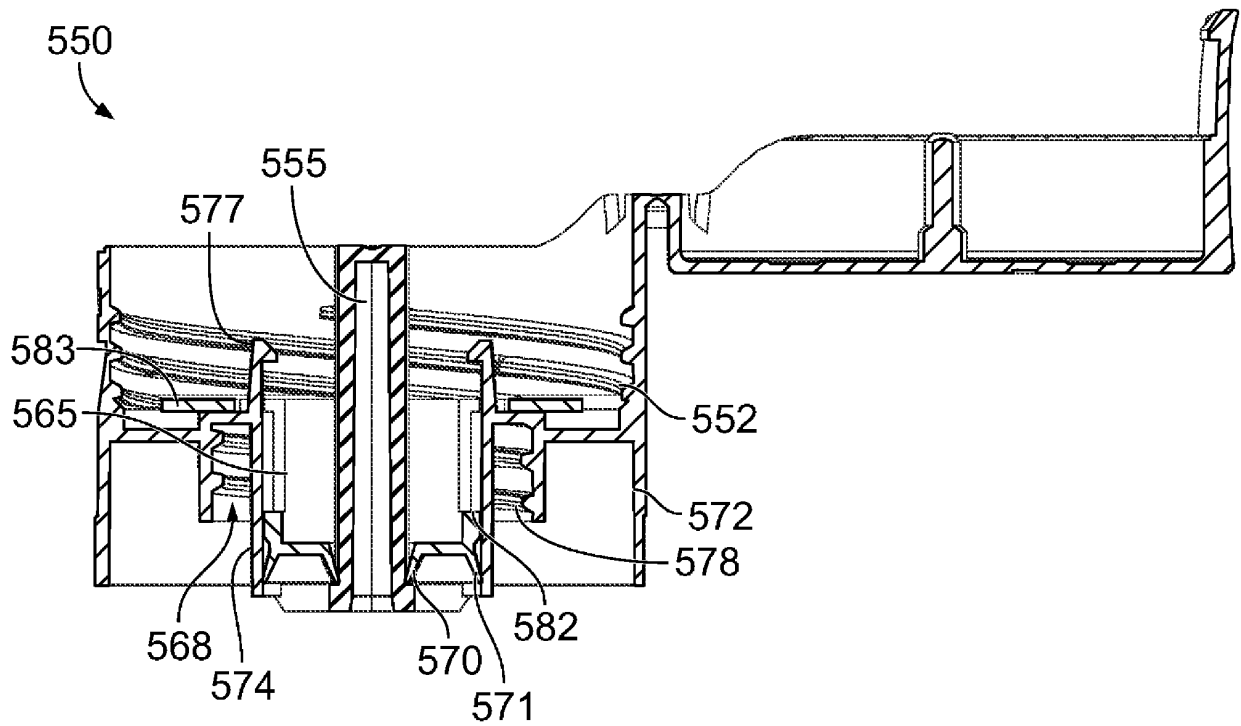


FIG. 25

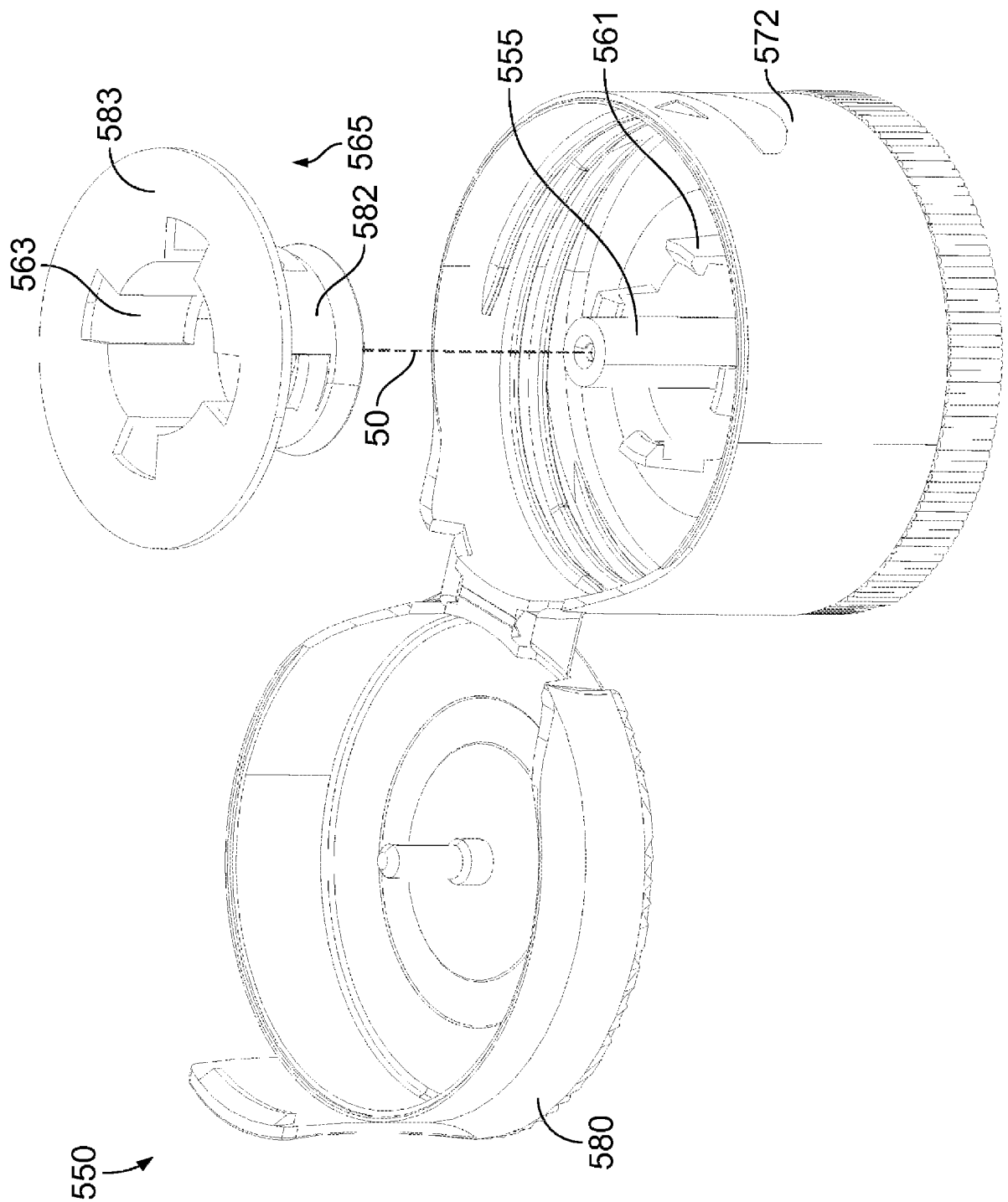


FIG. 26

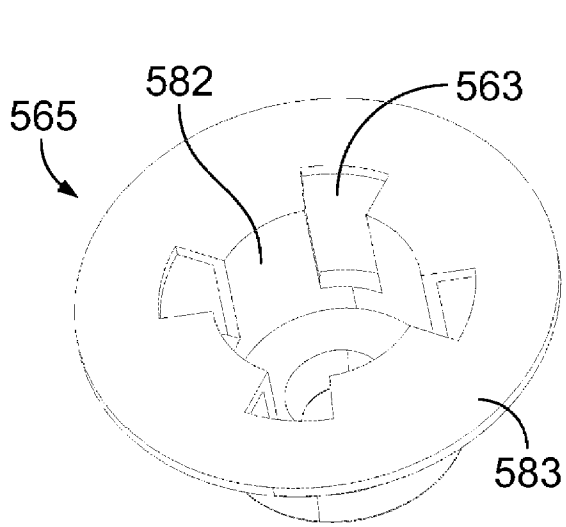


FIG. 27A

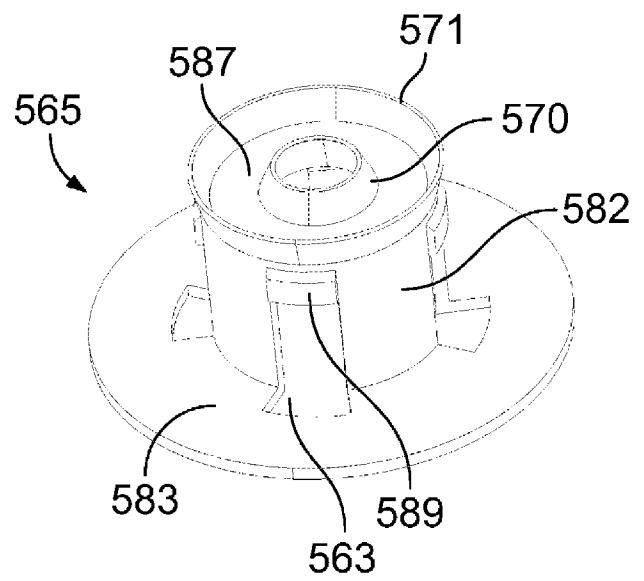


FIG. 27B

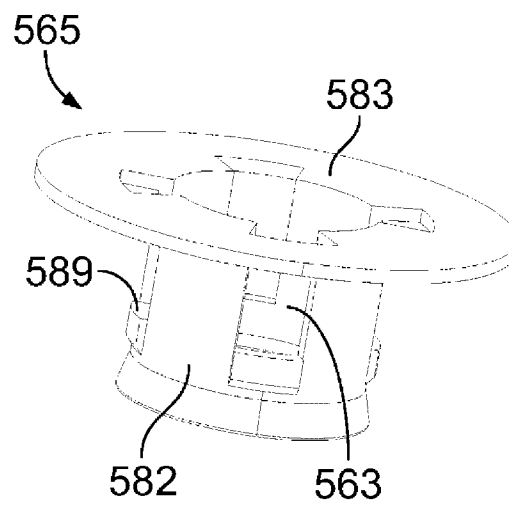


FIG. 27C

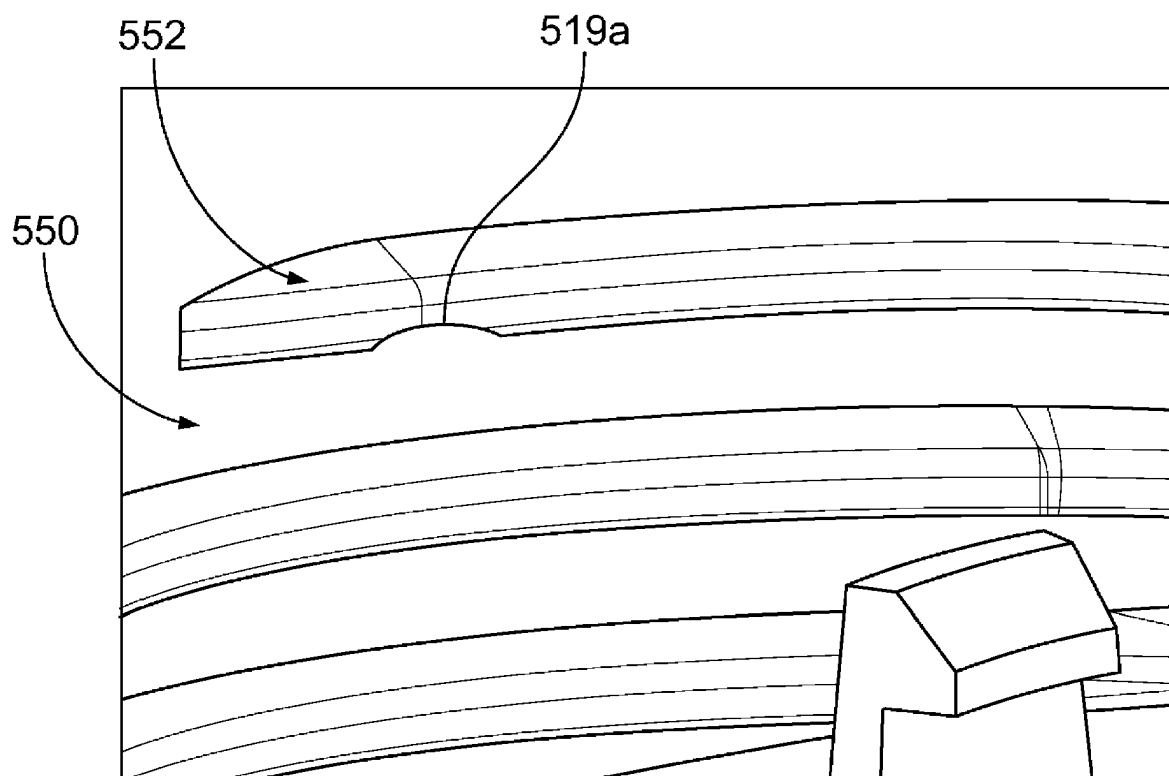


FIG. 28A

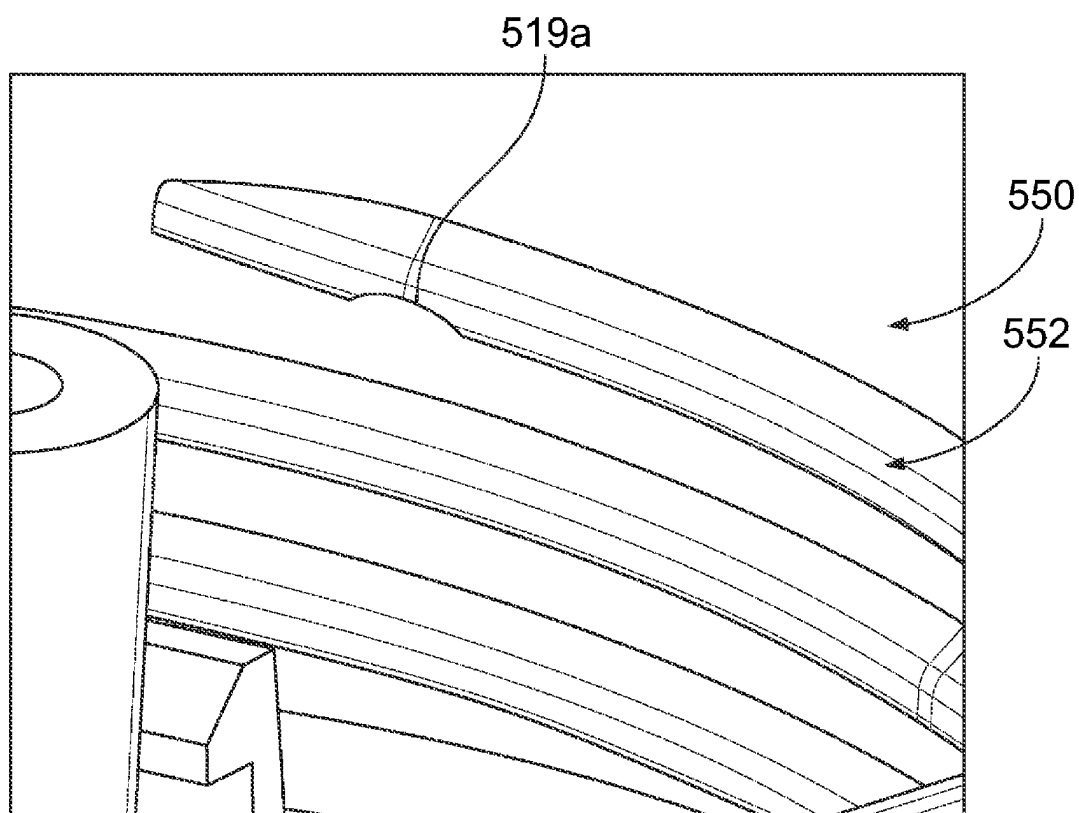


FIG. 28B

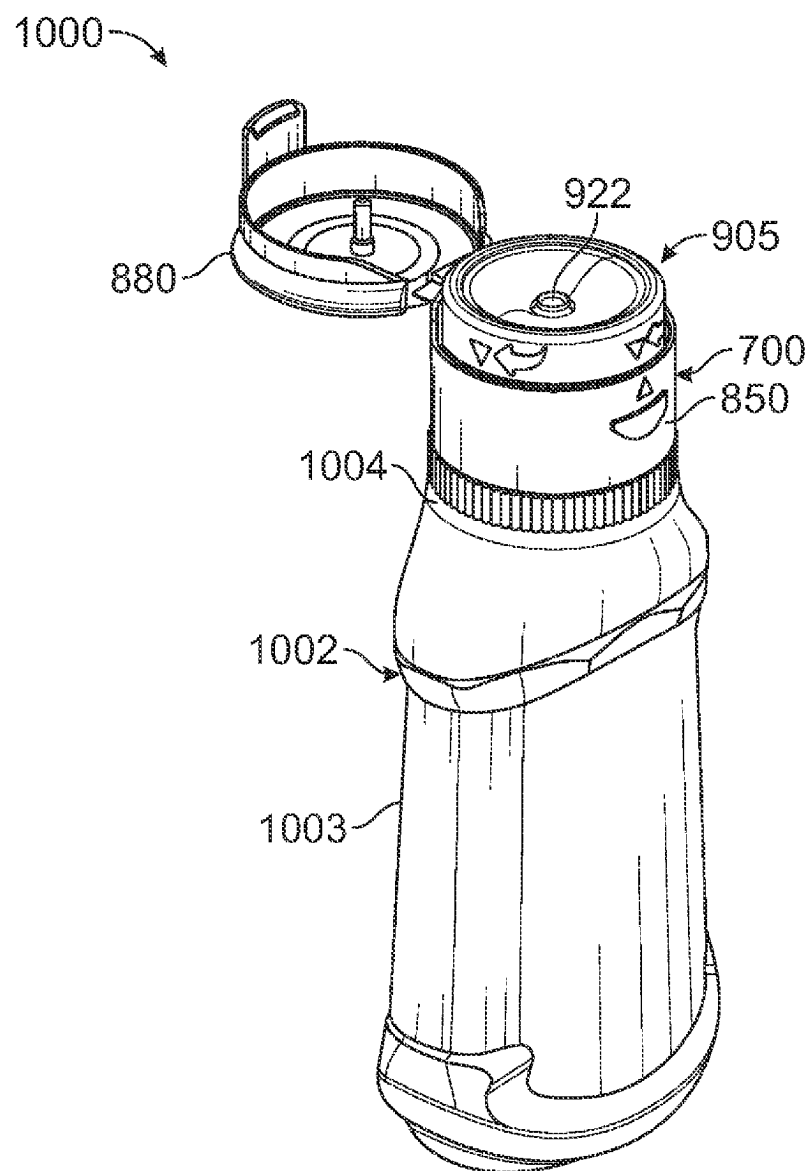


FIG. 29

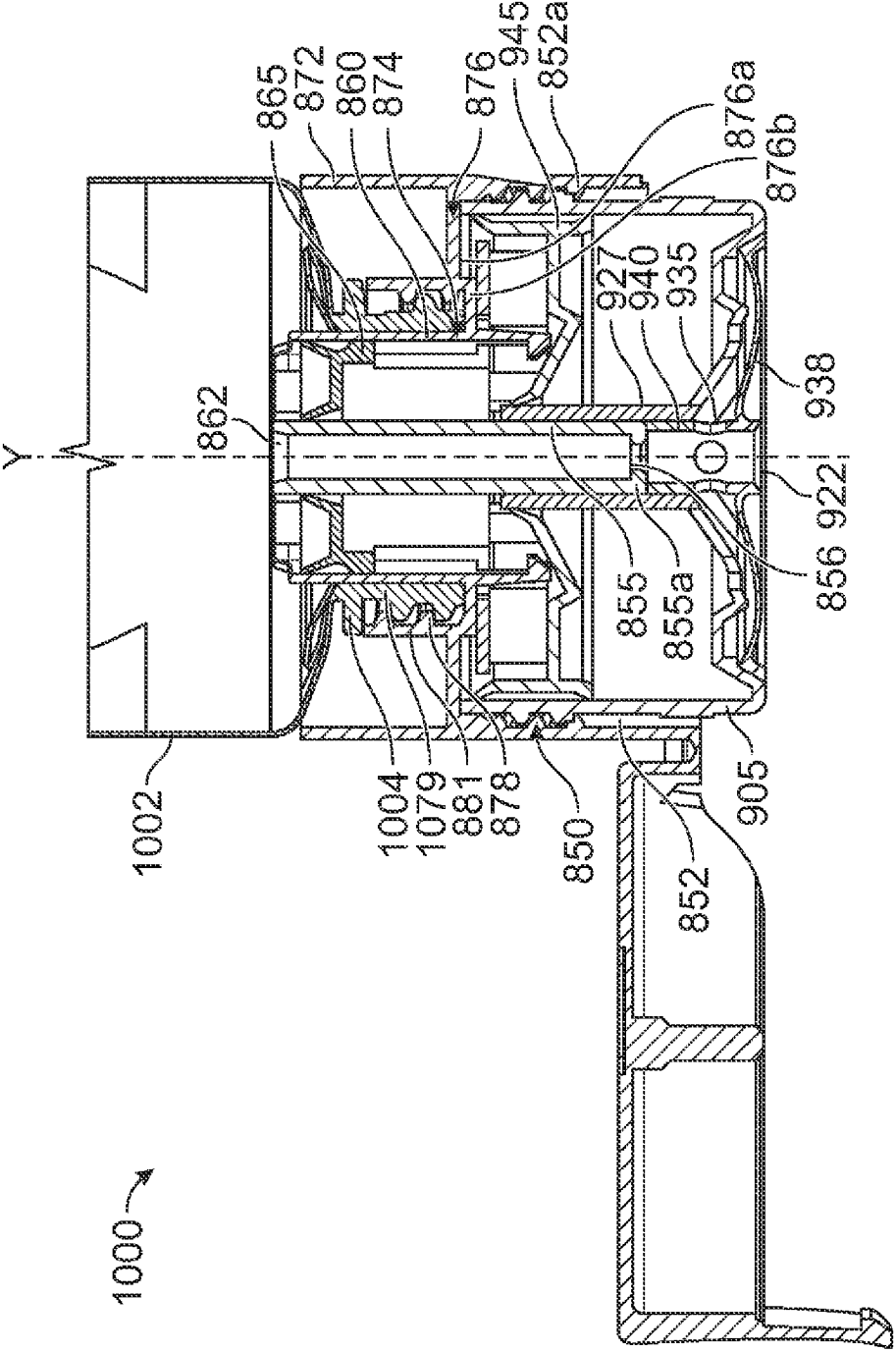


FIG. 30

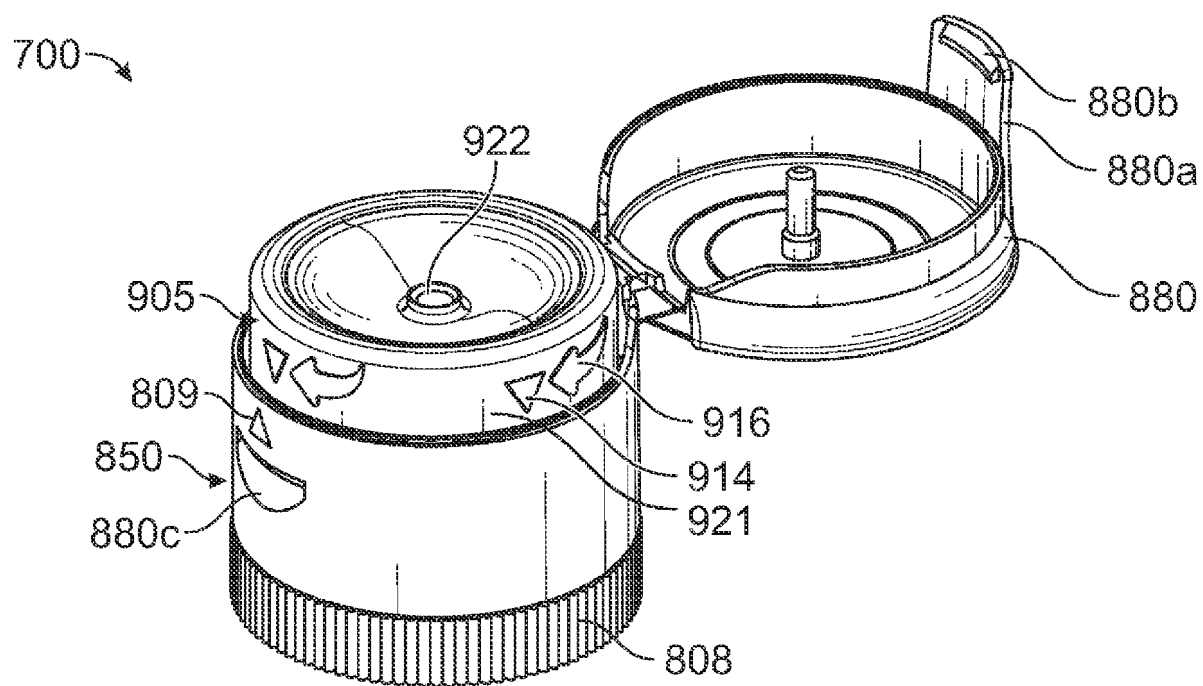


FIG. 31

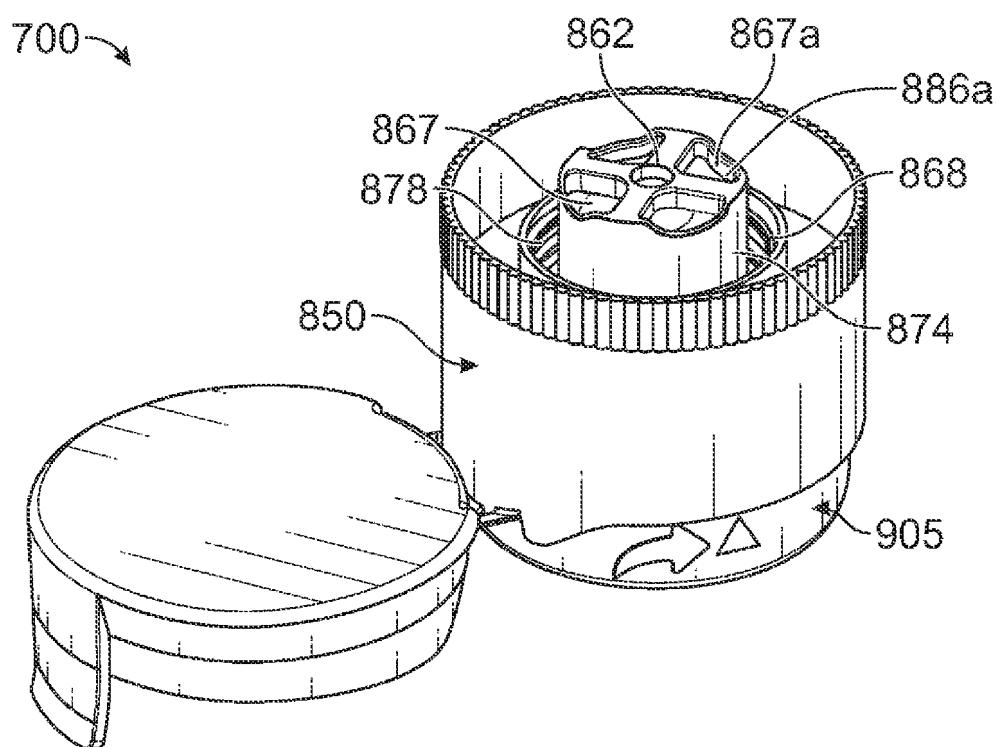


FIG. 32

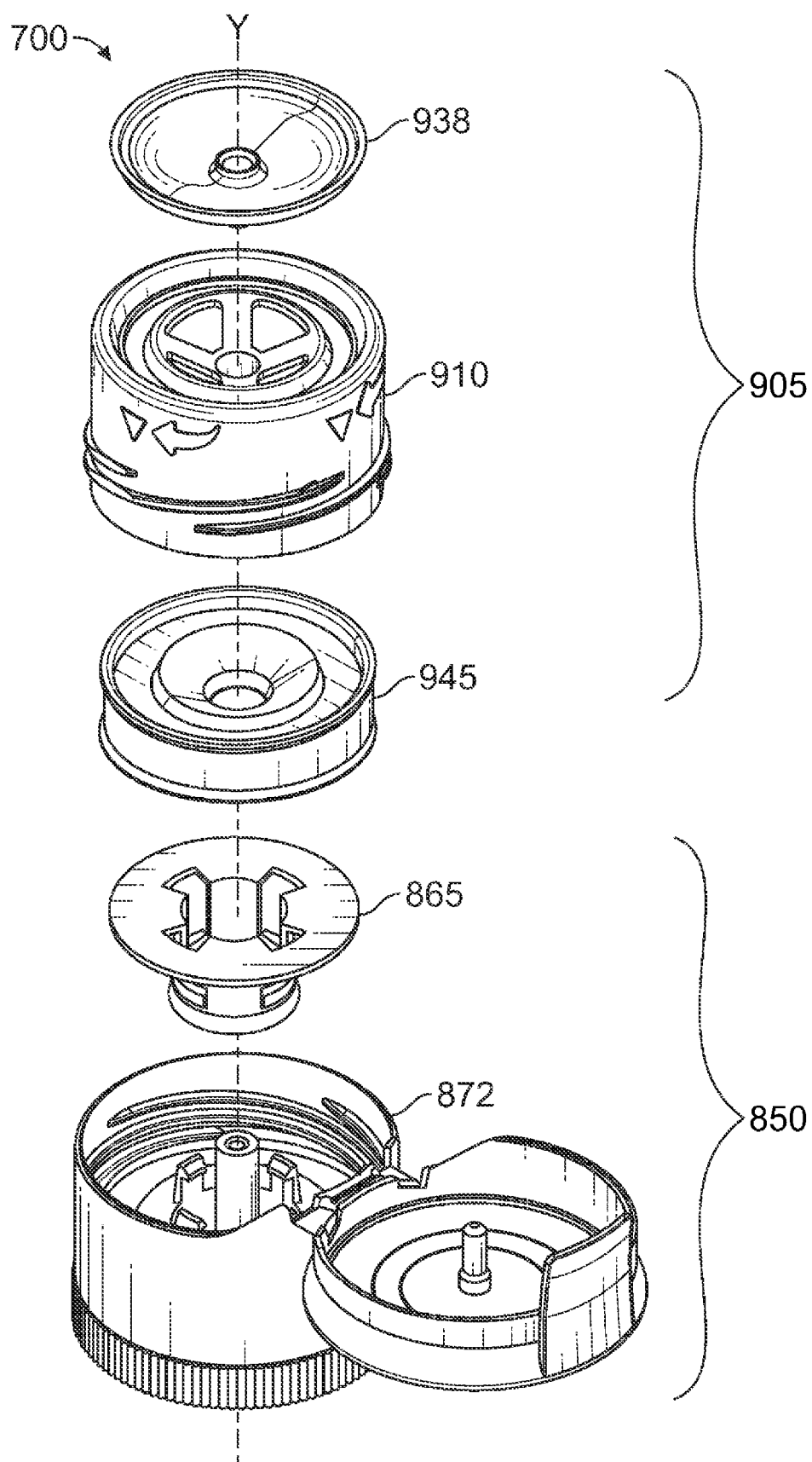


FIG. 33

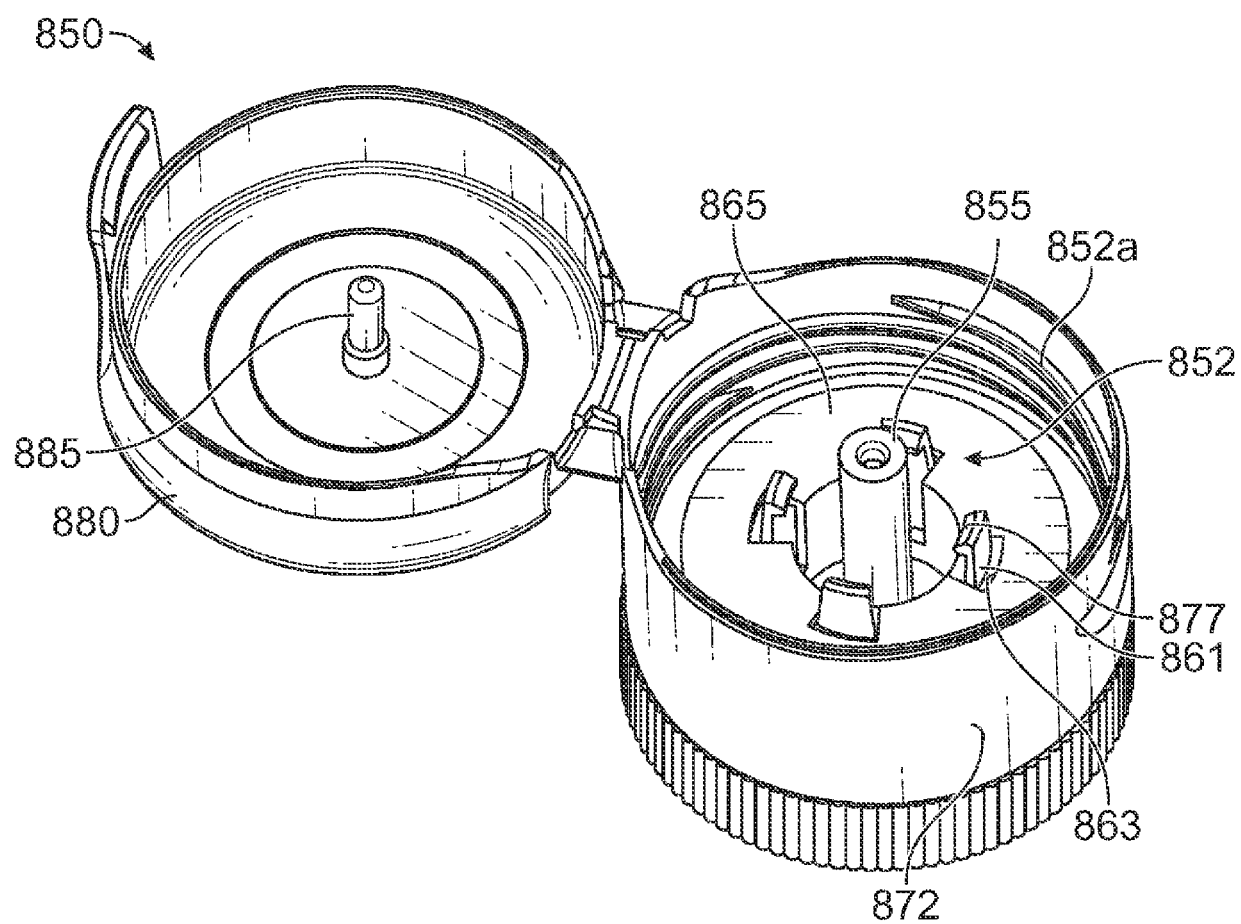


FIG. 34A

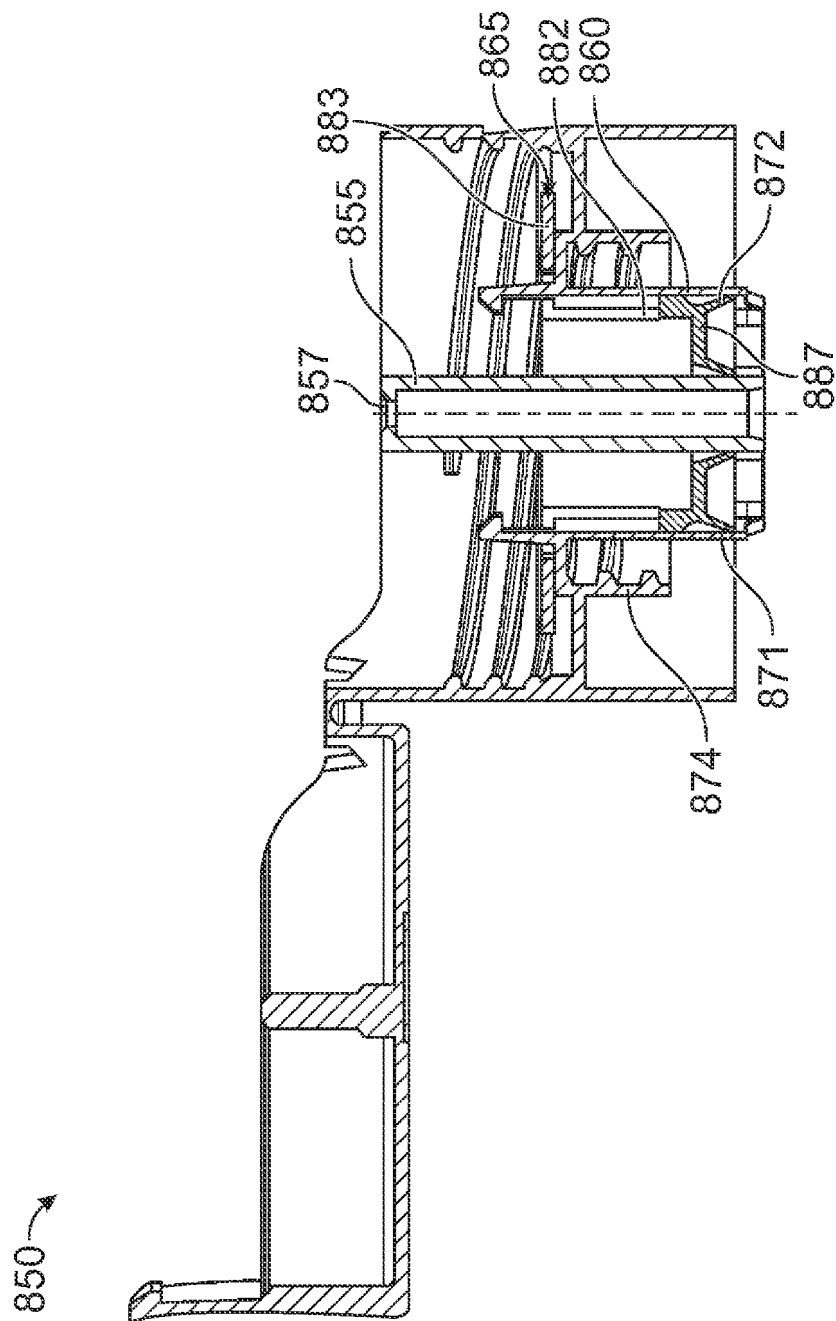


FIG. 34B

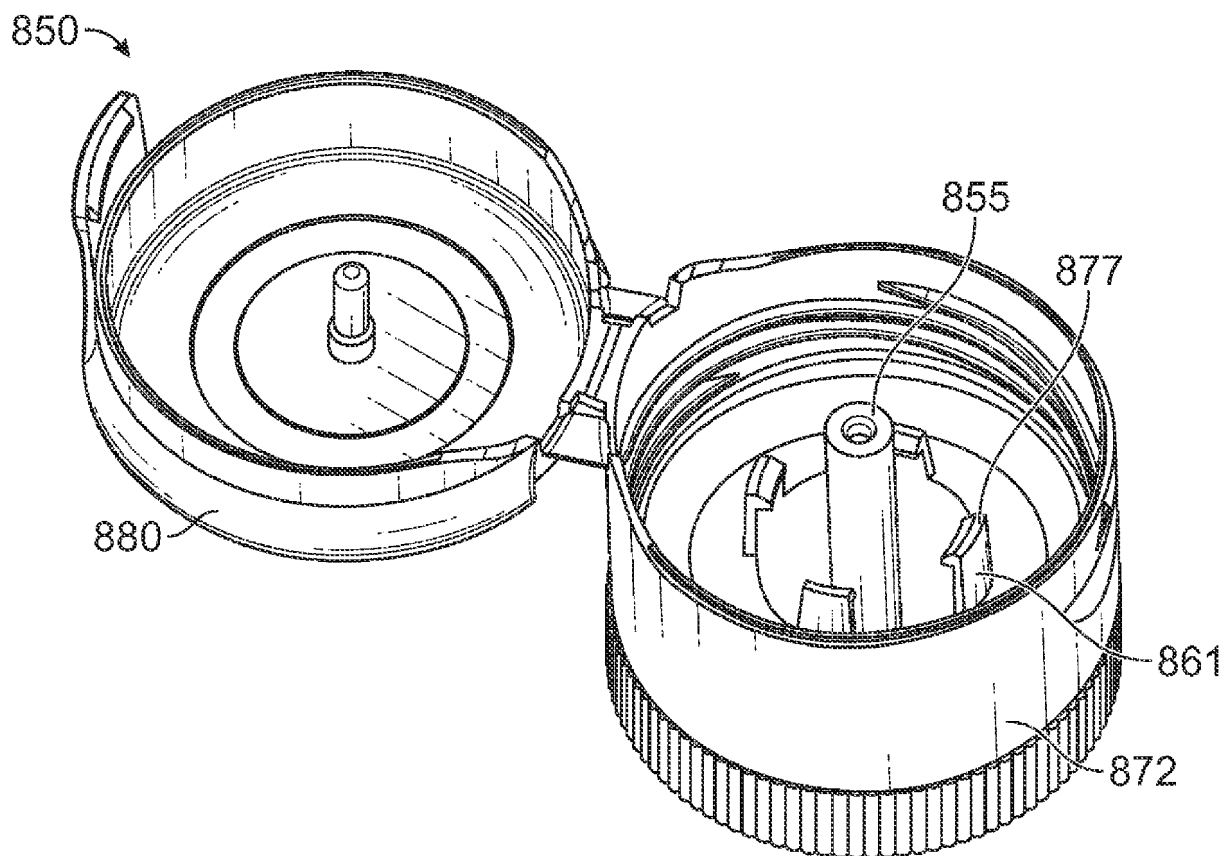


FIG. 35A

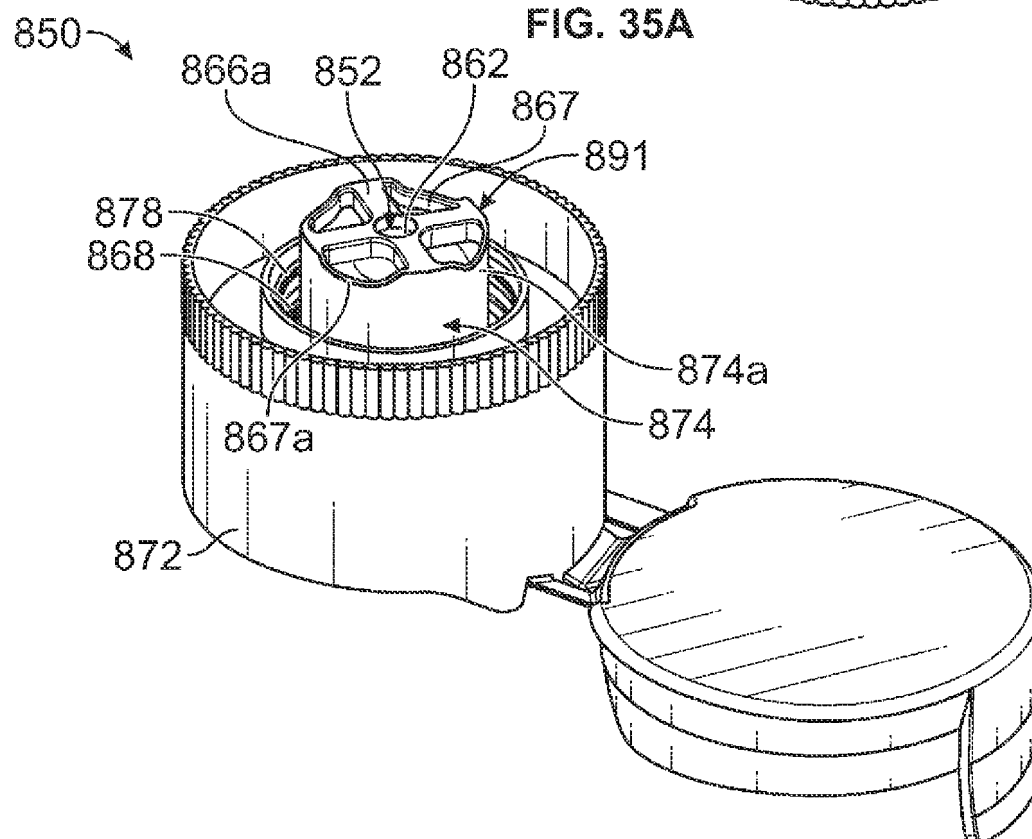


FIG. 35B

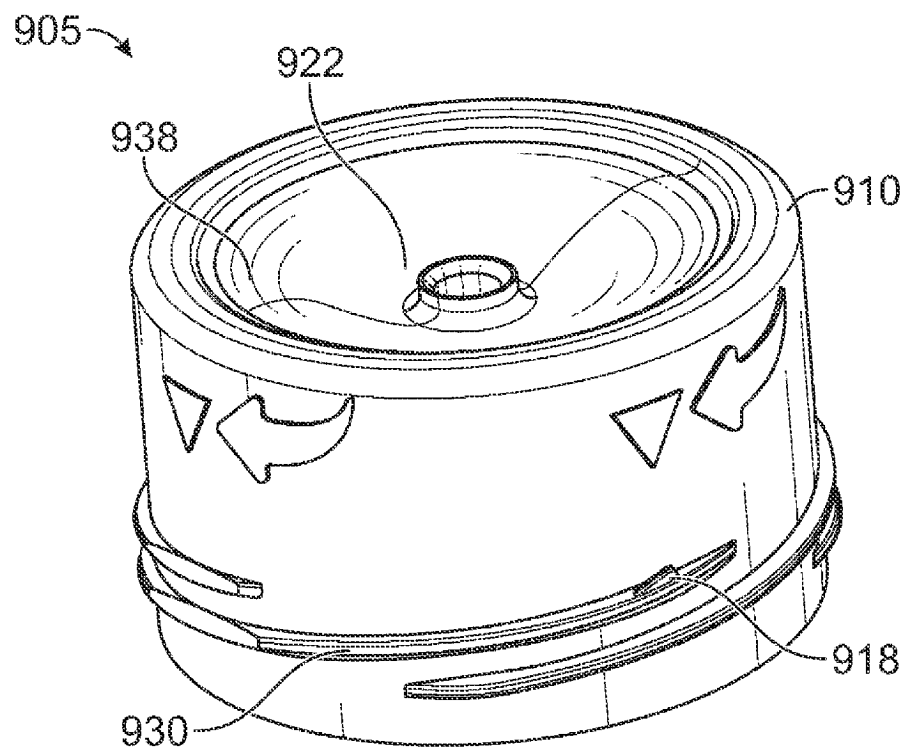


FIG. 36A

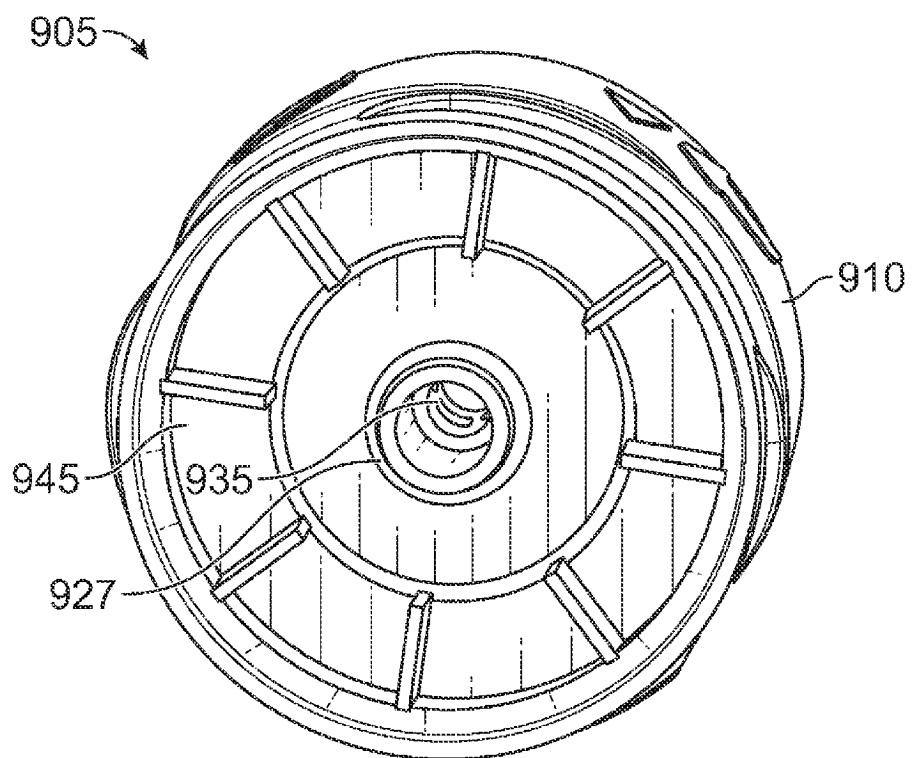


FIG. 36B

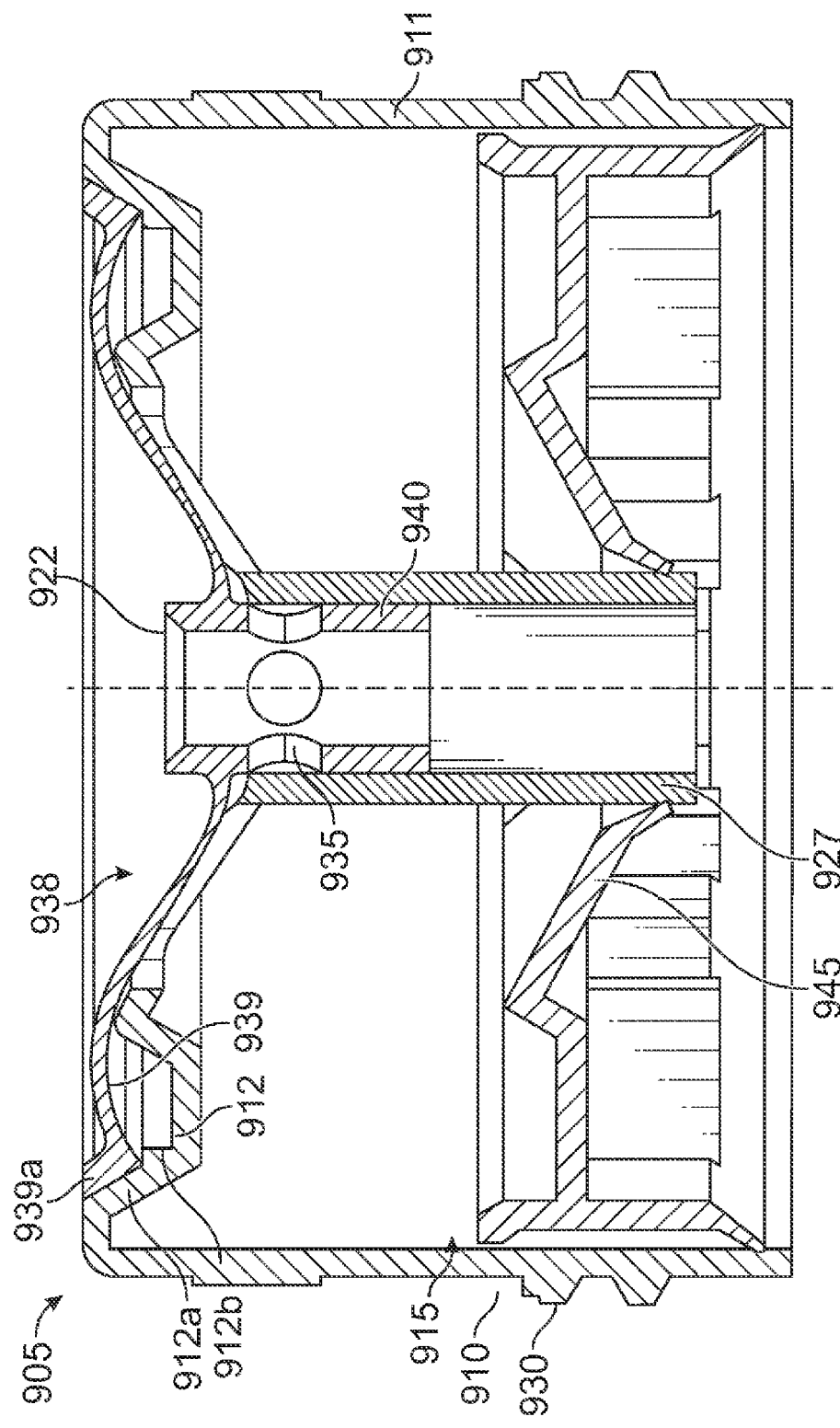


FIG. 36C

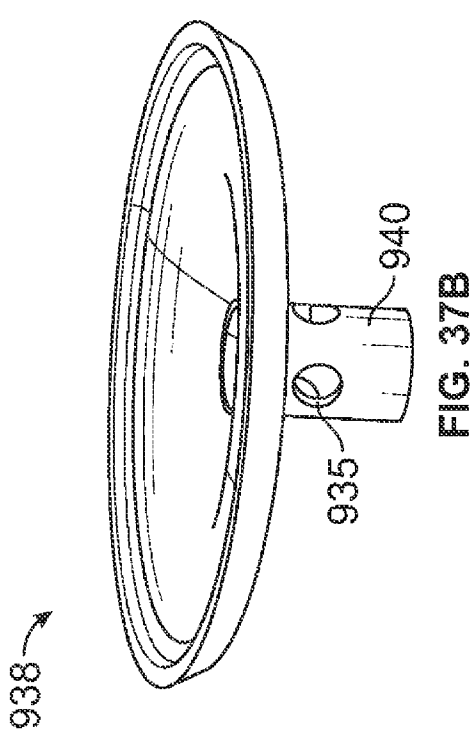


FIG. 37A

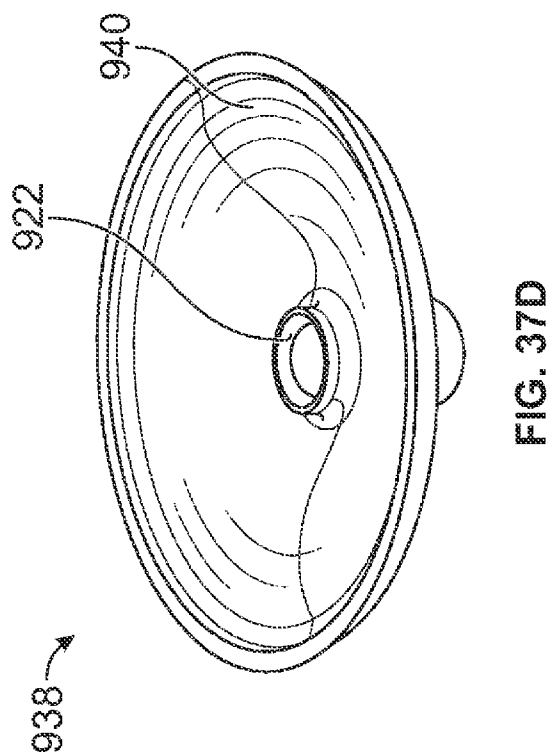


FIG. 37B

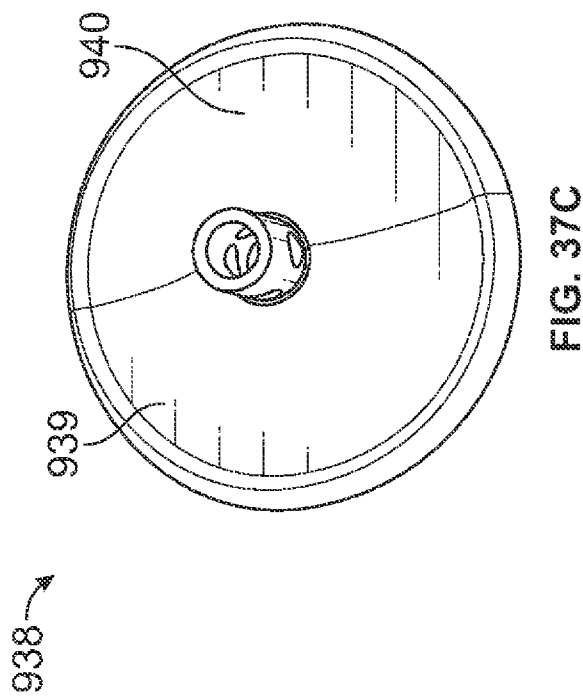


FIG. 37C

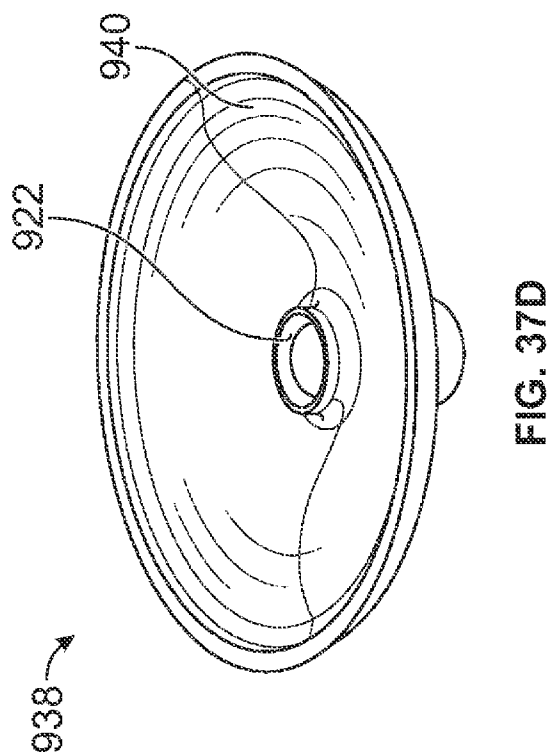


FIG. 37D

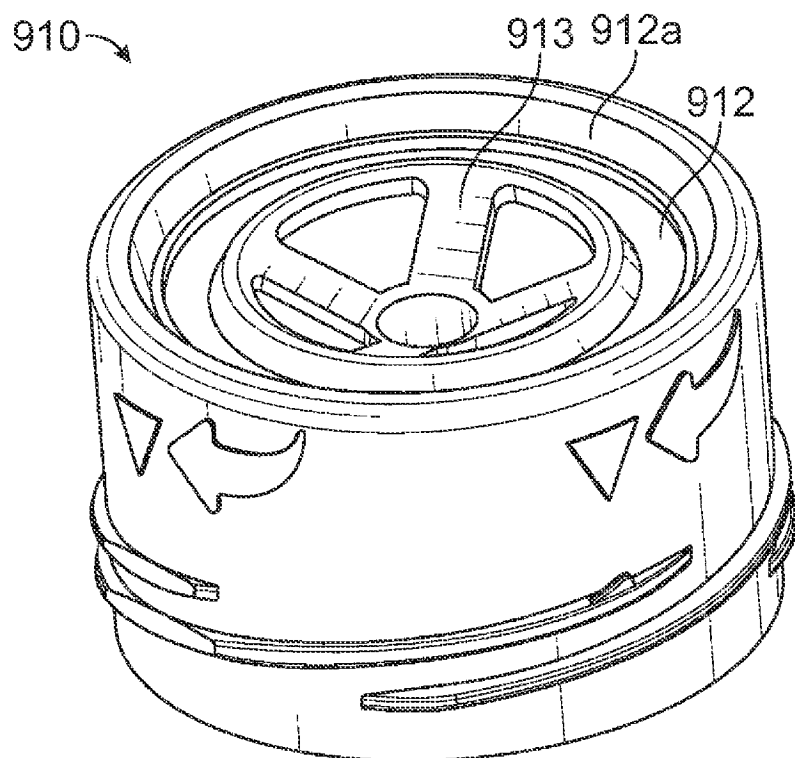


FIG. 38A

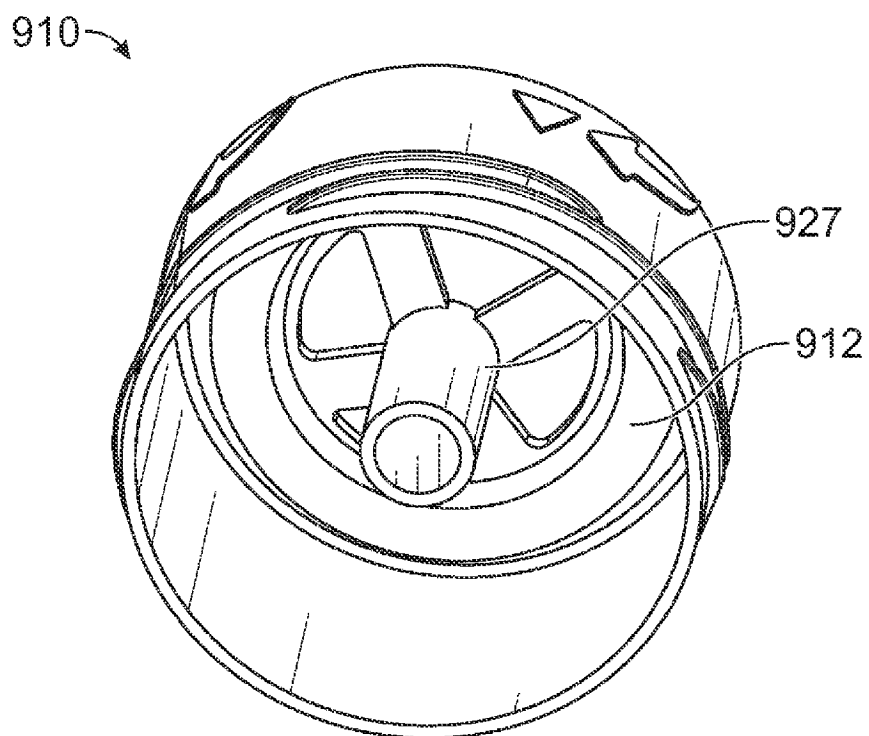


FIG. 38B

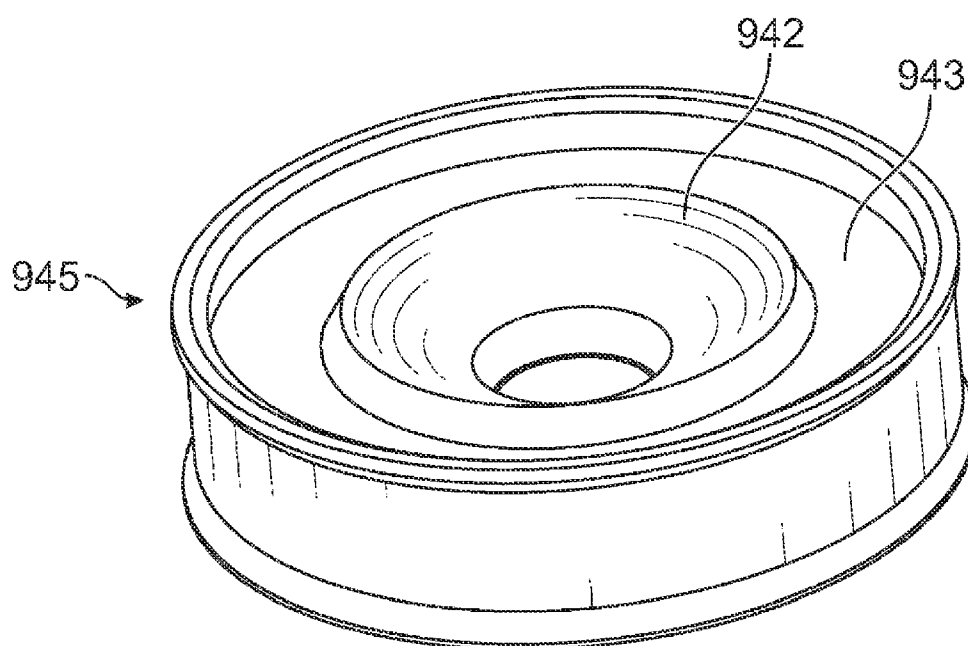


FIG. 39A

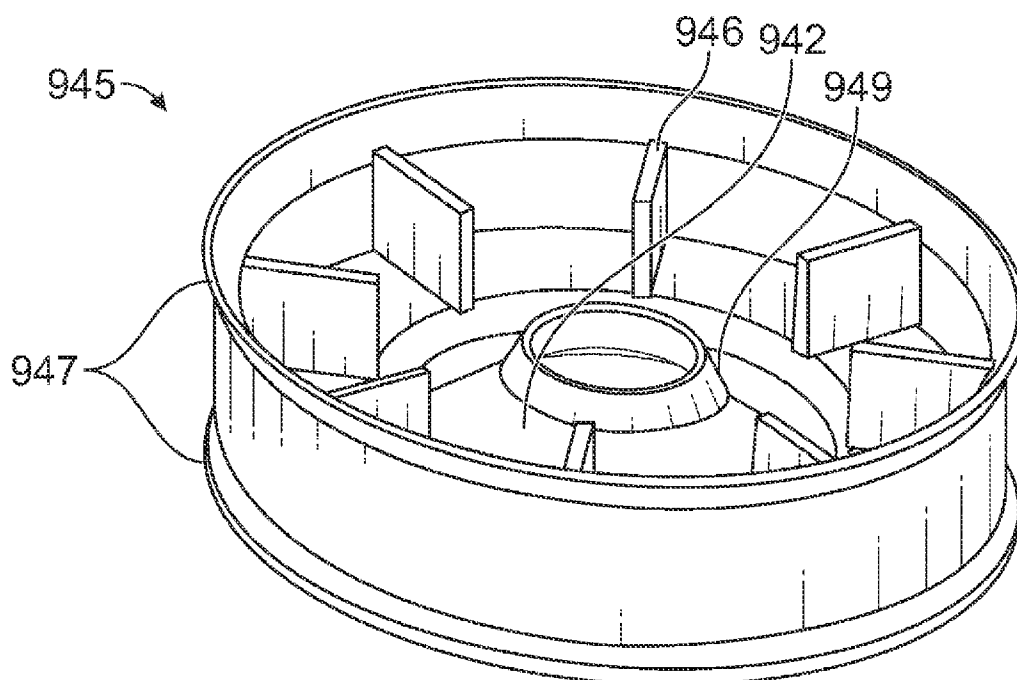


FIG. 39B

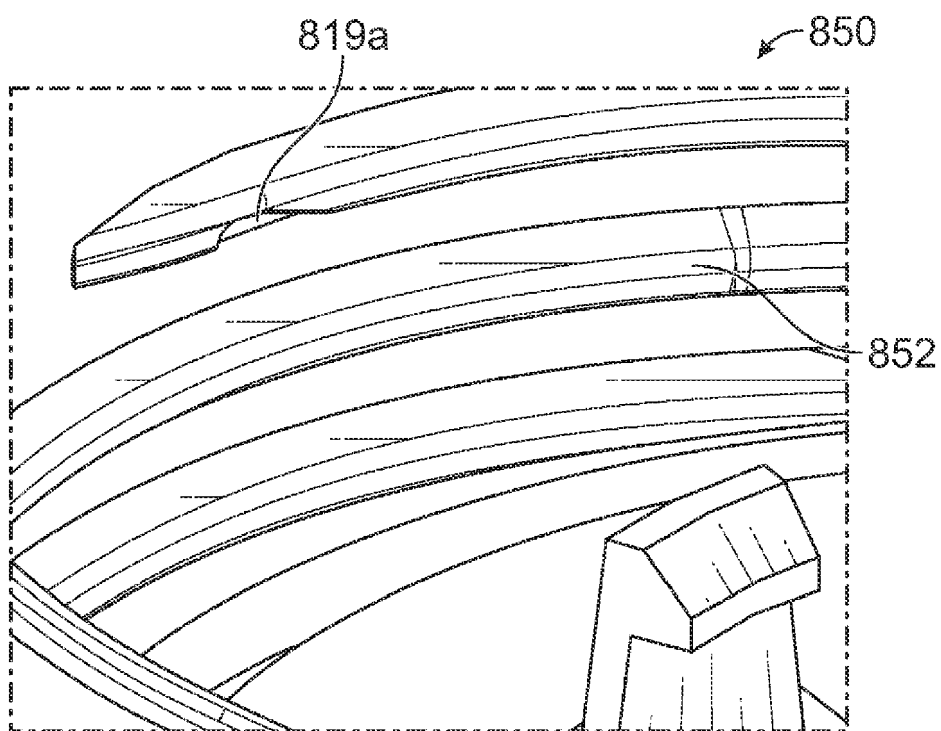


FIG. 40A

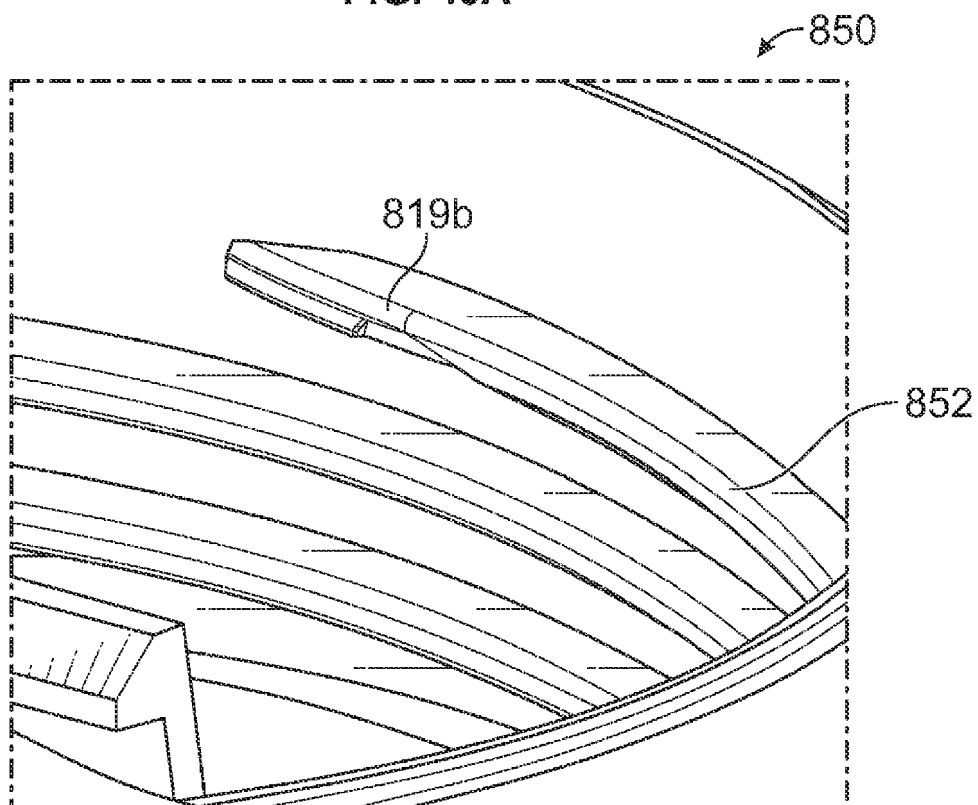


FIG. 40B

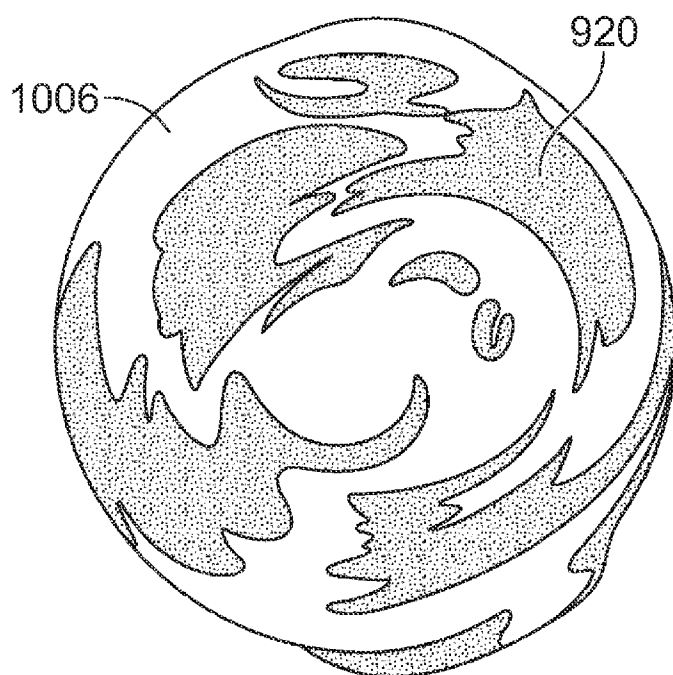


FIG. 41A

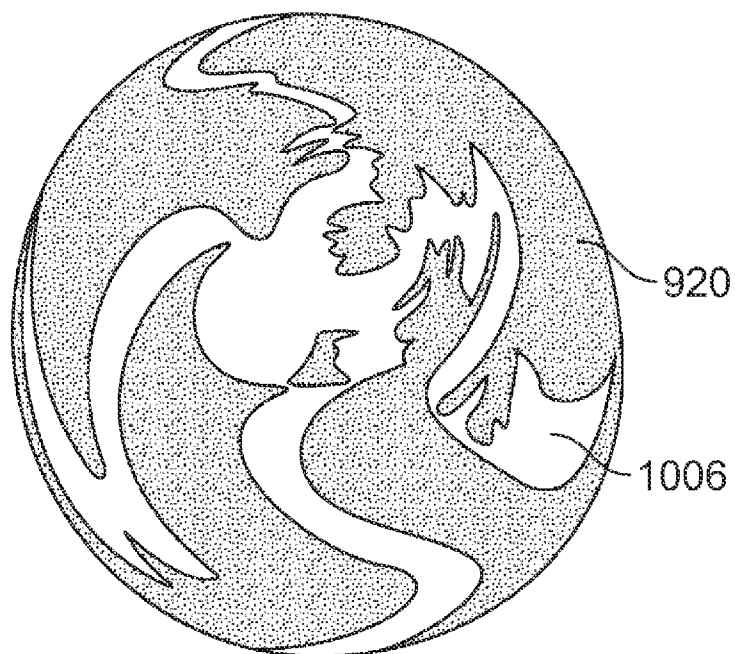


FIG. 41B

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 8672185 B [0006]
- US 8074825 B [0006]
- US 8684231 B [0006]
- US 4964541 A [0006]