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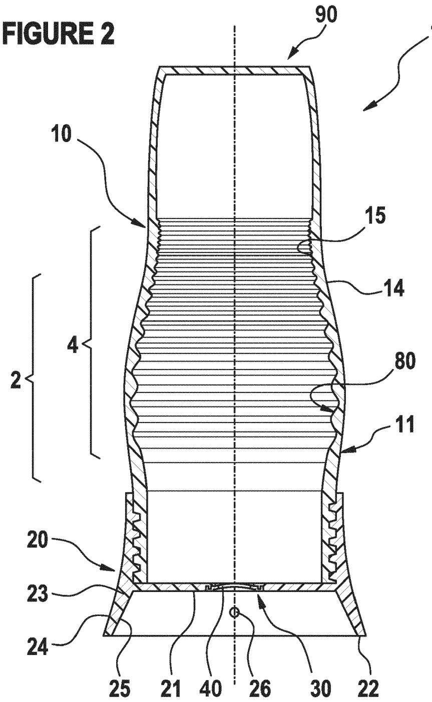
(54) DURABLE DISPENSING CONTAINERS

(57) The need for a durable environmentally-friendly dispensing package which is easy to dispense from, while having sufficient elasticity to return back to its original shape after dispensing, while also being easy to clean, and having reduced or no leakage during use, is met by making the container of a reversibly squeezable material and by providing rigid top and bottom rings fixedly attached to the squeezable material.

FIGURE 2



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Description

TECHNICAL FIELD

[0001] The present invention relates to durable liquid dispensing containers.

BACKGROUND OF THE INVENTION

[0002] Liquid consumer products are contained in a wide variety of containers. A number of containers enable the liquid consumer product to be dispensed by a user compressing or squeezing the body of the container. Such deformable containers are mostly made of PET, polyolefin or equivalent plastic materials.

[0003] These containers can be deformed thanks to a specific design of pre-determined lines of weakness: the plastic material bends around these lines and flexes under the user's hand pressure. A first drawback is therefore that these containers are not freely deformable. Hence, the deformation of a plastic container can only assume a discrete number of stable configurations: the resting configuration and one or more squeezed configurations. The range of flow rates that can be delivered with such a container is therefore limited to a discrete number of values. The container is often too sensitive to be able to deliver a micro-dose.

[0004] A second drawback is the absence of spring-back effect: after having been squeezed to dispense liquid, the container retracts only slowly to its default shape. This prevents the user from repeating the dispense of liquid at a high pace.

[0005] A third drawback appears in use, as the amount of squeezing force that the user needs to exert to dispense a desired flow rate of liquid is not constant through-out the lifetime of the container: depending on the volume of liquid remaining in the container, the squeezing force to be applied for dispensing a given flow of liquid varies.

[0006] In summary, a plastic squeezable container does not enable a user to precisely dose a desired amount of liquid.

[0007] Additionally, plastic containers such as PET and polyolefin containers are prone to cracking upon repeated use. These materials are thus not suited for a re-usable or durable container.

[0008] The document EP 3 321 199 A shows liquid condiment containers which include a bottle and a cap, and containing a condiment having a viscosity of from 5 Pa·s to 500 Pa·s, the bottle including a mouth, a body, and a bottom, the body having a flat shape in horizontal transverse section in an elected state, the bottle being made of low-density polyethylene as a main component, the bottle being flexibly deformed to easily discharge its content even when the content is a high-viscosity liquid condiment, and the original aesthetic appearance of the container is less liable to be impaired even when the content is reduced.

[0009] It is tempting to provide a container made of a more flexible material to overcome the above-mentioned drawbacks. However, although a more flexible material such as elastomeric material may be more durable, it does not enable as such to overcome all the drawbacks noted above: a too flexible material may not enable the container to spring back to its default shape quickly enough and the relationship between squeezing force and flow rate is not independent from the filling level.

[0010] Therefore, there is a need for an environmentally-friendly squeezable container. Such a container should be simultaneously: *versatile* - in the sense that the container offers a continuous and broad range of possible flow rates including micro-dosing, to limit spoilage of liquid as well as the ability to facilitate multiple dosing in one go and an improved spring-back; *intuitive to use* - in the sense that the relationship between the squeezing force and the dispensed flow rate remains independent from the volume of liquid present in the container, thereby leading the user to quickly learn the amount of force that is to be applied in order to obtain a desired flow rate, again limiting any spoilage of liquid; and *durable* - in the sense that the container does not deteriorate over time and is easily refillable.

SUMMARY OF THE INVENTION

[0011] The present disclosure provides for such a need, thanks to a package as claimed, and in particular a package combining a resiliently squeezable container with fixedly attached rigid rings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a front view of a durable liquid-dispensing package.

FIG. 2 is a cutaway view of a durable liquid-dispensing package.

FIG. 3 is a cutaway view of a durable liquid-dispensing package.

FIG. 4 is a cutaway view of a durable liquid-dispensing package.

FIG. 5 is a cutaway view of part of the package of FIG. 4.

FIG. 6 is a cutaway view of a durable liquid-dispensing package.

DETAILED DESCRIPTION OF THE INVENTION

[0013] It has been found that forming the durable container as described herein, and having the flexible container wall being affixed to a rigid element both at the top and bottom of the wall results in being more easily able to dispense small doses from the container, while ensuring that the dosing experience is less dependent on how the user holds the container, or the amount of liquid remaining in the bottle. The springback effect is improved: the flexible container returns quickly to its initial shape.

[0014] By resiliently squeezable, what is meant is that the container wall exhibits a degree of flexibility sufficient to permit deformation in response to manual forces applied to the outer surface of the container wall and a degree of resilience sufficient to return automatically to its undeformed condition when said manually applied forces are removed from the outer surface of the container wall.

[0015] By the terms "a" and "an" when describing a particular element, we herein mean "at least one" of that particular element.

[0016] The term "dose" as used herein is defined as the measured amount of liquid to be delivered by the package. The dose begins when the liquid first exits the cap orifice and ends once the flow of said liquid stops.

[0017] By "substantially independently from pressure" as used herein it is meant that pressure causes less than 10% variation from the target measured dose.

[0018] By "substantially constant liquid output or dosage" as used herein it is meant that variation from the target measured dose is less than 10%.

[0019] By "shear thinning" as used herein it is meant that the liquid referred to is non-Newtonian and preferably has a viscosity that changes with changes in shear rate.

[0020] By "drip-free" as used herein it is meant that no visible residue is left proximal to the nozzle of the cap following dosing and/or that no liquid exits the resilient container without squeezing.

[0021] A preferred field of use is that of dosage devices for domestic or household use, containing detergents such as hard surface cleaning compositions, liquid laundry detergent compositions, or other cleaning preparations, fabric conditioners and the like, typically having relatively low low-shear viscosities. A particularly preferred field of use is hard surface cleaning, especially manual dishwashing. For such applications, the resiliently squeezable container can have an overflow volume, as measured using the method described herein, of from 0.1 litres to 5 litres, preferably from 0.2 litres to 1.5 litres, more preferably from 0.25 litres to 0.75 litres. The volume of liquid dosed for each squeeze of the package is typically from 1ml to 50ml, preferably from 2ml to 30ml, more preferably 3ml to 20ml.

[0022] The word "package" is intended to depict the device which can be held in hand, comprising the squeezable container and additional elements, such as a base ring and a cap.

[0023] A "ring" should be understood as a generally elliptic or circular element. In some examples, a ring has an annular shape with a central hole. In some examples, the ring is void of hole. In some examples, the hole is not centered. In some examples, the hole is neither elliptic nor circular. In some examples, the ring may be a plate. In some examples, the ring may have a polygonal, e.g., square, hexagonal, etc., outer periphery.

[0024] A "base" is intended to depict a portion of the package which may be arranged in a lower half of the package as the backage is stored.

[0025] In some examples, a package for a liquid composition comprises a resiliently squeezable container for housing the liquid composition; a base fixedly attached to the container and comprising a base ring delimiting an orifice, wherein the base ring is rigid; and a cap comprising an attachment ring fixedly attached to the resiliently squeezable container opposite the base, wherein the attachment ring is rigid.

[0026] As indicated below, the resiliently squeezable container may be made from an elastomeric material (silicone, thermoplastic elastomer, etc.). The resiliently squeezable container may be made from a material having a Young's modulus comprised between 3 MPa and 150 MPa, preferably between 3.6 MPa and 120 MPa as measured according to ISO 527-1:2012. The resiliently squeezable container may be made from a material having a Shore A (Type A) hardness of from 0 to 80, preferably 5 to 60, more preferably 10 to 40 as measured according to ISO 868:2003.

[0027] In contrast, the base ring and the attachment ring are made from rigid materials. Examplary materials may be at least one of: polyethylene, polypropylene, polyethylene terephthalate, acrylonitrile butadiene styrene. Preferably, one or both rings are made of polyethylene or polypropylene, more preferably polypropylene. One or both of these rings may be made from a material having a Young's modulus comprised between 0.25 GPa and 4 GPa, preferably between 0.5 GPa and 3.5GPa as measured according to ISO 527-1:2012. One or both of these rings may be made from a material having a Shore D hardness comprised between 30 and 100, preferably between 55 and 100, more preferably between 65 and 95 as measured according to ISO 868:2003.

[0028] The base may be free of cap: there may not be a reversibly removable item disposed at or covering the base.

[0029] A top edge of the container can have a first diameter and the attachment ring of the cap has a second diameter that is greater than 50%, preferably greater than 60%, more preferably greater than 80% of the first diameter. These ratios facilitate the operation of refilling the container, especially for filling viscous liquids (soap, dishwashing liquid, oil, honey...).

[0030] The "diameter" is to be understood as an area-based diameter: should the cross-section of the package /container/cap/base be non-circular, the "diameter" is to be understood as an equivalent diameter which would lead to a same area (area-based diameter = 2.sqrt (area of non-circular element/π)).

[0031] The cap may comprise a one-way air valve configured to let air flow into the container. This valve participates in making the squeezable container spring back to its resting shape.

[0032] The package may be a bottom-dispensing package. In such a case, in normal use, the liquid can be dispensed from a base portion of the package. For that purpose, a slit-valve reversibly opens or closes the orifice of the base. The slit-valve may open under the actuation of a squeezing force by the hand of a user, preferably an adult user. In some examples (alternatively or complementarily), the liquid can be dispensed from a top portion of the package, for example through the cap. To that end, the cap or part of it may be removable, and/or a dispensing valve may be arranged therein.

[0033] An interior surface of the resiliently squeezable container can comprise at least one circumferentially oriented groove. The grooves may provide for a greater flexibility and spring-back of the container. An exterior surface of the resiliently squeezable container may be void of grooves, so that the exterior surface is left smooth.

[0034] The base can comprise a base wall made of an elastomeric material and the base ring can extend inwardly from the base wall. In some examples, the base wall is integrally made with the resiliently squeezable container. In some examples, the package may stably rest on the base wall. Hence, the base ring and the optional slit-valve are protected as the user handles or lays down the package.

[0035] The package may have a longitudinal direction and the resiliently squeezable container may have an elliptical, preferably circular, cross-section in any of the planes perpendicular to the longitudinal direction. This cross-section may suit well a human hand for making the dosing intuitive and repeatable. In some examples, the longitudinal direction is intended to be a vertical direction as the package lies in a resting position.

[0036] The cap may comprise a lid which removably engages the attachment ring. The removability of the lid enables refilling the container, and/or dispensing liquid from the container. In some examples, the lid, when removed, uncovers an opening which may have a diameter (or area-based diameter) of at least 25% and less than 90% of the maximal diameter (or area-based diameter) of the resiliently squeezable container. Preferably, the opening uncovered by the lid has a diameter comprised between 40% and 70% of the maximal diameter of the resiliently squeezable container.

[0037] The package may comprise the liquid composition housed in the resiliently squeezable container. In some examples, the liquid composition has a viscosity of from 50 mPa·s to 3,000 mPa·s, preferably from 300 mPa·s to 2,000 mPa·s, most preferably from 500 mPa·s to 1,500 mPa·s, measured at a shear rate of 10 s-1 following the viscosity test method described herein.

[0038] Optionally, at least one of: the base ring and the attachment ring, is fixedly attached to the resiliently squeezable container by an adhesive layer, by a mechanical snap, or by the resiliently squeezable container being overmolded on the base ring and/or the attachment ring.

[0039] In the present disclosure, "fixedly attached" is intended to mean that in normal use of the package (normal use including storing, transporting, handling, dispensing liquid, refilling the container, etc.), the rings cannot be detached from the container by the user. In other words, the package would be considered as being broken and non-functional if the connection between the container and the ring would be loose.

[0040] The attachment ring and/or the base ring can extend internally to the container and contact the container internally. This arrangement provides a feedback haptic force to the user applying a squeezing force.

[0041] The base and the cap can have a respective outer diameter, and the difference between the outer diameter of the base and the outer diameter of the cap is less than 20%. This provides for a balanced resting position of the package in either orientation and may facilitate storing or transporting of several packages in a compact manner.

[0042] The package can be between two and five times taller than wide.

[0043] The package can have a longitudinal direction and the resiliently squeezable container can have a longitudinal profile in a plane comprising the longitudinal direction, wherein the longitudinal profile comprises a convex portion and a concave portion, the base being closer to the convex portion than the concave portion. This shape may suit well the palm of a human hand for rendering the dosing intuitive and repeatable.

[0044] FIG. 1 is a front view of a package (1). The package (1) comprises a resiliently squeezable container (10) and a base (20). The resiliently squeezable container (10) comprises at least one container wall (11). The resiliently squeezable container (10) comprises a convex lower portion (2) and a concave upper portion (3). The convex portion (2) may be wider than the concave portion (3). The base (20) comprises a base wall rim (22) adapted for resting the package (1) on a flat surface.

[0045] The wider convex portion (2) is preferably situated on the container wall (11) where the container (10) would typically be gripped and squeezed. For good gripping and dispensing, the wider portion (2) preferably has a radius of from 25 mm to 120 mm, preferably from 40 mm to 100 mm, more preferably from 50 mm to 80 mm. Where the cross-section of the wider portion (2) of the container wall (11) is non-circular, such as oval or polygonal, the radius is calculated based on a circular cross-section having the same cross-sectional area (or area-based diameter). The radius of the wider portion (2) is calculated where the cross-sectional area is a maximum.

[0046] The narrow concave portion (3) is preferably situated adjacent to the wider portion (2) of the container wall (11), and in particular, adjacent to where the container wall (11) would typically be gripped and squeezed. The narrow portion (3) preferably has a radius of from 10 mm to 80 mm, preferably from 20 mm to 70 mm, more preferably from 30 mm to 60 mm. Where the cross-section of the narrow portion (3) of the container wall (11) is non-circular, such as oval or polygonal, the radius is calculated based on a circular cross-section having the same cross-sectional area. The radius of the narrow portion (3) is calculated where the cross-sectional area is a minimum.

[0047] The container wall (11) preferably has both a wider portion (2) and a narrow portion (3), more preferably wherein the narrow portion (3) is above the wider portion (2). Such containers (10) provide improved spring-back to the original shape once the squeezing pressure has been removed and comfortable grasp in a human hand (leading to repeatable and intuitive dosing).

[0048] The wider portion (2) and preferably both the wider portion (2) and the narrow portion (3) have either a circular or oval cross section, with a circular cross section being preferred. It has been found that such cross-sections result in improved spring-back of the container wall (11) back to the original shape, after the squeezing pressure has been removed. This is in contrast to stiffer containers such as those made from polyethylene terephthalate (PET), polyethylene, polypropylene, and the like, where an essentially flat front panel and preferably also a back panel are more desired.

[0049] That container (10) can have a height of from 75 mm to 300 mm, preferably from 100 ml to 270 ml, more preferably from 150 mm to 225 mm. In some examples, the height of the container is measured from the inner-surface of the orifice (30) which is within the package (1), to the top of the container (10) or, if present, the top of a cap of the container opposite the base.

[0050] The package can have an internal volume, for the liquid contained therein, of from 0.1 litres to 5.0 litres, preferably from 0.2 litres to 1.5 litres, more preferably from 0.25 litres to 0.75 litres. The liquid composition may be in direct contact with the squeezable container and in particular in direct contact with an inner surface of the container wall (11). In a variant, the liquid composition is held in a flexible bag housed in the squeezable container.

[0051] The present package is foreseen to be durable so that it can be repeatedly refilled and reused. In contrast, packages made from materials such as polyethylene terephthalate (PET), polyethylene, polypropylene, and the like, are prone to strain-hardening and cracking after repeated use, especially when at the thickness to provide the desired spring-back after use.

[0052] Therefore, the container wall (11) of use in the present example (and the examples shown in the following figures) is at least partially made from an elastomer, preferably wherein the elastomer is selected from the group consisting of: thermoplastic elastomer, silicone rubber, rubber, or a combination thereof, with thermoplastic elastomers and/or silicone rubber being preferred and thermoplastic elastomers being particularly preferred. The container wall is preferably fully made from the elastomer. Other materials may be used for other components of the package.

[0053] Elastomers are polymers with viscoelasticity, generally having low Young's modulus and high yield strain compared with other materials. Elastomers are amorphous polymers existing above their glass transition temperature, so that considerable segmental motion is possible. As such, they are relatively soft and deformable at ambient temperatures, for instance 21°C.

[0054] Thermoplastic elastomers (TPE) are copolymers or a physical mix of polymers, such as a plastic and a rubber, which comprises materials with both thermoplastic and elastomeric properties. Thermoplastic elastomers are relatively easy to manufacture, for example, by injection molding. Thermoplastic elastomers show advantages typical of both rubbery materials and plastic materials. The principal difference between thermoset elastomers and thermoplastic elastomers is the type of crosslinking bond in their structures. The crosslink in thermoset polymers is a covalent bond, such as created during a vulcanization process. In contrast, the crosslink in thermoplastic elastomer polymers is physical, reversible, typically comprising entanglements, a weaker dipole or hydrogen bond or a difference in material phase such as crystalline regions. For example, one of the constituent polymers, or segments of the constituent polymer has a melting or glass transition temperature well above room temperature. Examples of suitable thermoplastic elastomers, methods of making them, and methods of processing that, can be found in "Handbook of Thermoplastic Elastomers", December 2007, Drobny, ISBN 9780815515494.

[0055] Thermoplastic elastomers include reactor-made thermoplastic elastomers, such as styrene block copolymers (SBC), thermoplastic polyether block amides (TPA), thermoplastic polyurethane elastomer (TPU) and thermoplastic copolyester elastomer (TCA). Reactor-made thermoplastic elastomers are implemented in one polymer that is formed through a reaction process which results in polymer segments that provide the thermoplastic properties and polymer segments that provide the elastomeric properties. Other thermoplastic elastomers comprise a blend of polymers, such as homopolymers and/or copolymers, that give rise to crystalline domains where blocks from the polymer co-crystallizes with blocks in adjacent chains, such as in copolyester rubbers. Depending on the block length, the domains are generally more stable than the latter owing to the higher crystal melting point. That crystal melting point determines the processing temperatures needed to shape the material, as well as the ultimate service use temperatures of the resultant thermoplastic elastomer. Such materials include Hytrel®, a polyester-polyether copolymer and Pebax®, a nylon or polyamide-polyether copolymer. Reactor-made thermoplastic elastomers are preferred, especially thermoplastic polyurethane elastomers (TPUs).

[0056] Thermoplastic elastomers, often referred to as "thermoplastic olefins" are typically derived from polyolefins and are also preferred due to their improved recyclability. The thermoplastic elastomer can contain further ingredients such as plasticizers, fillers, compatibilizers, and the like.

[0057] Silicone rubbers are elastomers composed of silicone. Silicone rubbers are often one- or two-component polymers, and may comprise fillers to improve properties or reduce cost. Silicone rubber is generally non-reactive, stable, and resistant to extreme environments and a wide range of temperatures, while still maintaining their properties. Due to these properties and ease of manufacturing and shaping, silicone rubber can be found in a wide variety of products, including voltage line insulators; automotive applications; cooking, baking, and food storage products; apparel such as undergarments, sportswear, and footwear; electronics; medical devices and implants; and in home repair and hardware, in products such as silicone sealants. Silicone is typically a highly adhesive gel or liquid, which is converted to silicone rubber by curing, such as through vulcanisation (condensation curing), catalysed curing, or peroxide curing. This is normally carried out in a two-stage process at the point of manufacture into the desired shape, and then in a prolonged post-cure process. The curing process can be accelerated by adding heat or pressure.

[0058] Suitable rubbers can be either naturally derived, or synthetically derived. Naturally derived rubber comprises suitable polymers derived from natural sources, most often isoprene with minor impurities of other organic compounds. Natural rubber is typically harvested in the form of latex. The latex is then refined into rubber ready for commercial processing. Synthetically derived rubber is an artificial elastomer, derived from petroleum byproducts, which is crosslinked via vulcanisation. Rubber can be used either alone or in combination with other materials.

[0059] The elastomer can have a Shore A (Type A) hardness of from 0 to 80, preferably 5 to 60, more preferably 10 to 40. The Shore A hardness can be measured using the method described in ISO 868:2003 (last reviewed and confirmed in 2018). The elastomer can have a tensile elongation (break), measured in the flow direction at a stretch rate of 200mm/min at 23 °C using the method described in ISO 37:2017 (last reviewed and confirmed in 2022), of from 200% to 1000%, preferably from 250% to 750%, more preferably from 300% to 700%. The elongation at break is a characteristic value that describes the maximum percentage elongation that a tensile specimen experiences at the moment of break. It therefore describes the deformability of a material under tensile load. The elastomer can have a compression set, measured at 23°C over 72 hours using the method described in ISO 815-1:2019, of less than 50%, preferably less than 35%, more preferably less than 20%. The compression set measures the ability of the elastomer to withstand hardening and retain their elastic properties at ambient temperatures after prolonged compression. As such, the compression set provides an indication of the ability of the elastomer to withstand physical or chemical changes which prevent the elastomer from returning to its original dimensions after release of the deforming force, or lose too much of its elasticity.

[0060] The resiliently squeezable container (10) can be made using any suitable moulding process, such as injection moulding, rotational moulding or compression moulding.

[0061] Injection moulding is a method to obtain moulded products by injecting plastic materials molten by heat into a mould, and then cooling and solidifying them. The method is suitable for the mass production of products with complicated shapes. With injection moulding, the elastomer is first melted down so that it can be put into the injection unit. The injection unit can be a plunger, an extruder or similar. The injection unit is typically heated to above the melt temperature of the elastomer. The melted elastomer is then injected into the mould. Once injected, it can be vulcanized or cooled so that it forms the shape of the mold, creating an elastomer molded part. For thermoplastic elastomers, cooling is typically suffient.

[0062] With transfer moulding, the elastomer is heated and not the mould. The liquid elastomer remains in a melted state until the moulding process begins. An injector, such as a plunger, pushes the elastomer into the closed mould where it forms the shape after being cooled or vulcanized. Once cooled, the mould can be opened to release the container.

[0063] Compression moulding is a method of moulding in which the moulding material, generally preheated, is first placed in an open, heated mould cavity. The mould is closed with a top force or plug member, pressure is applied to force the material into contact with all mould surfaces, while heat and pressure are maintained until the moulding material has cured. Where the process employs thermosetting resins, for instance in a partially cured stage, either in the form of granules, putty-like masses, or preforms, the process is essentially a vulcanisation process. For improved strength or resiliency, fibres can be added to the moulding material. Advanced composite thermoplastics can also be compression molded with unidirectional tapes, woven fabrics, randomly oriented fiber mat or chopped strand. The elastomer may be loaded into the mould either in the form of pellets or sheet, or the mould may be loaded from a plasticating extruder.

Materials are heated above their melting points, formed and cooled. The more evenly the feed material is distributed over the mold surface, the less flow orientation occurs during the compression stage. Compression moulding can also be used to produce sandwich structures that incorporate a core material such as a honeycomb or polymer foam into the resiliently squeezable container (10).

[0064] Although the invention is not limited to such examples, the figures illustrate a bottom-dispensing package. Bottom-dispensing packages have several advantages over other packaging types. The package does not need to be inverted, requiring fewer user motions for dispensing and providing greater positioning and dispensing control than for packages that dispense from orifices in the top of the package. In addition, there is no need to wait for the liquid contained within to reach the orifice before dispensing, especially when the amount of composition remaining within the package is low. Thus bottom-dispensing packages simplify activities such as hand dishwashing, where repeated dosing of detergent composition is required.

[0065] The package can be used as a dosage device for domestic or household use, containing detergents such as hard surface cleaning compositions, liquid laundry detergent compositions, or other cleaning preparations, fabric conditioners and the like. Other fields of use include dosage devices for manual and automatic dishwashing liquids, hair-care products and oral care applications such as mouth washes, beverages (such as syrups, shots of liquors, alcohols, liquid coffee concentrates and the like), food applications (such as food pastes and liquid food ingredients), pesticides, and the like. Preferably, the bottom dispensing container comprises a hard surface cleaning composition, more preferably a hand dishwashing composition. Examples of the liquid composition are given further below.

[0066] FIG. 2 is a cutaway view of a package. The package may have the same properties and features as detailed above in relation to the previous figure, unless explicitly excluded or obviously incompatible.

[0067] The package (1) comprises a resiliently squeezable container (10) and a base (20). The resiliently squeezable container (10) comprises at least one container wall (11). The resiliently squeezable container (10) comprises a wider, convex portion (2). The interior surface (15) of the container wall (11) comprises a zone (4) comprising grooves (80). The exterior wall (14) of the container wall (11) is smooth. The base (20) comprises a base ring (21) with an orifice (30) which can be equipped with a slit-valve (40). The base (20) of the package (1) comprises a base wall (23) connected to an outer periphery of the base ring (21). The base wall (23) extends to a base wall rim (22), such that the bottom-dispensing package (1) can rest on the base wall rim (22). The base wall (23) comprises a hole (26), connecting an exterior base wall surface (24) to an interior base wall surface (25). The base wall (23) can comprise from 1 to 8 holes (26), preferably from 1 to 4 holes (26) which may be angularly equidistantly spaced. Opposite the base, the container is closed by a cap ring integrally made with the wall 11.

[0068] In a preferred arrangement, the base (20) is free of a closing cap. Alternatively, the base (20) can comprise a closing cap, (not shown) which is at least partially detachable, more preferably fully removable from the base (20). When the package is more resistant to leakage due to changes in pressure during use, transport and storage, the closing cap is preferably not sealingly engaged to the orifice (30). Preferably, the base (20) does not comprise a closing cap or the base (20) comprises a closing cap which is fully detachable and can be removed and discarded prior to first use. Alternatively, the base (20) can also comprise a sticker covering the orifice (30) as additional protection against leakage during transport.

[0069] The at least one groove (80) is preferably at least partially positioned in the wider portion (2) of the container wall (11).

[0070] The container wall (11) can have a thickness of from 0.25 mm to 8.0 mm, preferably from 0.5 mm to 6.0 mm, more preferably from 1.0 to 4.0 mm. Where the grooves (80) are present, the wall thickness is measured as the distance between the exterior surface (14) and the groove top (82, see FIG. 5), measured perpendicular to the exterior surface (14) of the container wall (11).

[0071] The interior surface (15) of the resiliently squeezable container (10) comprises at least one circumferentially oriented groove (80). Providing the at least one circumferentially oriented groove (80) on the interior surface results in greater flexibility and springback of the container while ensuring that the exterior surface (14) can be left smooth or textured as desired, for example, by the addition of a logo or trademark. In addition, the exterior surface (14) of the container (10) remains easy to clean. The at least one groove (80) is preferably essentially horizontally oriented. As such, the groove (80) can have a spiral form or can be one or more horizontal groove (80). Multiple horizontal grooves (80) are preferred.

[0072] The presence of such grooves has been found to improve reinflation of the resiliently squeezable container (10) back to its original shape, even when the container is made from a flexible material such as an elastomer, and especially when the at least one groove (80) is positioned where the container (10) has a wider portion (2), such that at least part of the exterior surface of the container (10) has a convex shape, and particularly when the wider portion (2) is situated on the container (10) where the container (10) would typically be gripped and squeezed.

[0073] The at least one circumferentially oriented groove (80) can extend over at least 70%, preferably at least 80%, more preferably at least 95%, most preferably 100% of the circumferential length of the interior surface (15) of the container wall (11) where the at least one circumferentially oriented groove (80) is positioned.

[0074] The interior surface (15) of the container wall (11) preferably comprises multiple circumferentially oriented grooves (80). The circumferentially oriented grooves (80) can be present over a groove zone (4) which extends over at least 25%, preferably at least 50%, more preferably at least 75% of the height of the container wall (11).

[0075] Where the circumferentially oriented grooves (80) are present, the grooves (80) can be spaced out such that the pitch (noted 81 on FIG. 5) is from less than 1 mm to 15 mm, preferably from 2 mm to 12 mm, more preferably from 2.5 mm to 10 mm, wherein the pitch is defined as the distance between two adjacent peaks of the circumferentially oriented grooves (80) on the interior surface (15) of the resiliently squeezable container.

[0076] The pitch (noted 81 on FIG. 5) can be constant, but more preferably varies across the interior surface (15) of the container wall (11). The pitch can increase as the grooves (80) progress up the interior surface (15) of the container wall (11) and then decrease again, so that the pitch is widest where the container wall (11) would typically be gripped and squeezed. Such a distribution of the pitch (81) results in increased flexibility of the container wall (11) where the container (10) is gripped and squeezed, and increased rigidity for the container wall (11) further away from this position, and hence improved spring-back of the container (10) without increasing its stiffness.

[0077] As mentioned earlier, where the grooves (80) are present, the container wall (11) can have a thickness of from 0.25 mm to 8.0 mm, preferably from 0.5 mm to 6.0 mm, more preferably from 1.0 to 4.0 mm, measured as the distance between the exterior surface (14) and the groove top (82, see FIG. 5), measured perpendicular to the exterior surface (14) of the container wall (11).

[0078] The distance between the groove bottom (83, see FIG. 5) and the exterior surface (14) of the container wall (11) can be from 0.1 mm to 6.0 mm, preferably from 0.5 mm to 5.0 mm, most preferably from 1.0 mm to 3.0 mm.

[0079] Where the grooves (80) are not present, the container wall (11) can have a thickness of from 0.25 mm to 8.0 mm, preferably from 0.5 mm to 6.0 mm, more preferably from 1.0 to 4.0 mm, measured perpendicular to the exterior surface (14) of the container wall (11). As such, the container wall (11) where the grooves (80) are not present can be thicker or thinner than the thickness of the wall (11) where the grooves (80) are present. In preferred embodiments, the wall (11) where the grooves (80) are not present is thicker than the thickness of the wall (11) where the grooves are present. In such embodiments, the container wall (11) flexibility is highest where the grooves (80) are present.

[0080] The above features all result in both easy squeezing and improved spring back after the squeezing pressure is removed.

[0081] The exterior surface (14) of the container wall (11) can comprise further grooves or ribs. However, the exterior surface is preferably essentially free of such further grooves or ribs, with the possible exception of such further grooves and ribs which form part of a mark, such as a trademark, ingredients, or the like. Where such further grooves or ribs are present on the exterior surface (14) of the container wall (11), the thickness of the container wall (11) and the distance between the groove bottom (83, see FIG. 5) and the exterior surface (14) of the container wall (11) are measured assuming such further grooves, ribs and other markings are not present on the exterior surface (14) of the container wall (11). That is, assuming that the exterior surface (14) is smooth.

[0082] As noted above, the base (20) comprises an orifice (30) which optionally comprises a slit-valve (40).

[0083] A suitable slit-valve (40) can be a flexible, elastomeric, resilient, bi-directional, self-closing, slit-type valve mounted within the orifice (30). The slit-valve (40) comprises a flexible central portion having a slit or slits therein. The slits typically extend radially outward towards distal ends. For example, the orifice (30) may comprise a slit-valve (40) formed from one slit or two or more intersecting slits, that may open to permit dispensing of liquid through the orifice (30) in response to an increased pressure inside the resiliently squeezable container (10), such as when the resiliently squeezable container (10) is squeezed. The slit-valve (40) preferably comprises at least two coincident slits, preferably wherein the slits form a star pattern, defining flaps. More preferably, the slit-valve comprises two coincidental slits to balance ease of dosing and prevention of leakage. An example of slit valve is given in EP 3 686 118 A1.

[0084] The slit-valve (40) is typically designed to close the orifice (30) and stop the flow of liquid through the orifice (30) upon a reduction of the pressure differential across the slit-valve (40). The amount of pressure needed to open the slit-valve (40) will partially depend on the internal resistance force of the slit-valve (40). The "internal resistance force" (*i.e.*, cracking-pressure) refers to a pre-determined resistance threshold to deformation/opening of the slit-valve (40). In other words, the slit-valve (40) will tend to resist deformation/opening so that it remains closed under pressure of the steady state liquid bearing against the interior side of the orifice (30). The amount of pressure needed to deform/open the valve must overcome this internal resistance force. This internal resistance force should not be so low as to cause liquid leakage. Accordingly, the slit-valve (40) preferably has an opening pressure differential from the interior side to the exterior side of the orifice (30) of at least 10 mbar, preferably at least 15 mbar, more preferably at least 25 mbar, measured at 20 °C. The internal resistance force should not be so high as to make dispensing a dose of liquid difficult.

[0085] Especially where the package (1) comprises a low viscosity liquid, the use of a slit valve (40) which opens at a relatively low-pressure differential helps to avoid spurting of the composition out of the orifice (30). As such, especially where the package comprises a liquid detergent composition having viscosity of from 50 mPa·s to 3,000 mPa·s, preferably from 300 mPa·s to 2,000 mPa·s, most preferably from 500 mPa·s to 1,500 mPa·s, measured at a shear rate of 10 s^{-1}, following the viscosity test method described herein, the slit valve (40) preferably opens at a pressure differential of from 10 to 250 mbar, preferably from 15 to 150 mbar, more preferably from 25 to 75 mbar, measured at 20 °C.

[0086] Moreover, the use of a slit-valve (40) which opens at such low-pressure differentials also means that a smaller pressure differential is required to draw air through the slit-valve (40) once the squeezing has been removed, so that the container (10) can return to its original shape. This is particularly important for packages (1) which comprise a more elastic container (10) since an insufficient pressure differential across the slit-valve (40) means that not enough air is drawn through the valve (40) and into the container (10) for the container to revert back to its undeformed shape.

[0087] The opening pressure differential (in mbar) is typically measured using a water column, to which the slit-valve has been sealingly attached to the bottom of the water-column, then measuring the water-height required to open the slit valve, at the target temperature. The opening pressure is typically available from the valve manufacture, including on technical literature provided for the valve.

[0088] Preferably the slit-valve (40) has a surface area of between 0.1 cm^2 and 10 cm^2, more preferably between 0.3 cm^2 and 5 cm^2, most preferably between 0.5 cm^2 and 2 cm^2. Preferably the slit-valve (40) has a height of between 1 mm and 10 mm, more preferably between 2 mm and 5 mm. Other dimensions could be used so long as they allow for the slit-valve (40) to remain in the fully closed position at rest.

[0089] The slit-valve (40) can be made from a thermoplastic elastomer, silicone, and mixtures thereof, preferably from silicone, and may comprise additives known in the art, such as for optimizing the valve durability and flexibility.

[0090] A rigid cap (90) may cover the container (10).

[0091] FIG. 3 is a cutaway view of a package. The package may have the same properties and features as detailed above in relation to some or all of the previous figures, unless explicitly excluded or obviously incompatible. Similarly, some or all of the features described in relation to FIG. 3 may be implemented into the examples discussed in the previous figures.

[0092] The package (1) comprises a resiliently squeezable container (10) and a base (20). The resiliently squeezable container (10) comprises at least one container wall (11). The container wall (11) has both a wider convex portion (2) and a narrow concave portion (3), with the narrow portion (3) being above the wider portion (2). The interior surface (15) of the container wall (11) comprises a zone (4) having grooves (80). The exterior wall (14) of the container wall (11) is smooth. The top of the container (10) comprises a one-way vent (70). The base (20) of the package (1) comprises a base wall (23) connected to the base periphery of the ring (21), and extending from said base periphery of the ring (21) to a base wall rim (22), such that the package (1) can rest on the base wall rim (22). The base (20) comprises an impact resistance system (50) localized upstream of the orifice (30). The impact resistance system (50) comprises a housing (51) having a cavity (52) therein and extending longitudinally and radially inwardly from the base (20), wherein the housing (51) comprises at least one inlet opening (53a) that provides a flow path for the liquid from the resiliently squeezable container (10) into the housing (51) and at least one outlet opening (53b) that provides a path of egress for the liquid from the housing (51) to the exterior atmosphere when the orifice (30) is opened. The cavity (52) is partially occupied by a compressible substance (54).

[0093] The resiliently squeezable container (10) can comprise a one-way vent (70). The one-way vent (70) allows the ingress of air into the container (10) while preventing the egress of air or other contents from the container (10). The one-way vent enables the squeezable container to return quickly to its resting configuration. The one-way vent also participates in the package presenting a better dosing control. The one-way vent (70) is preferably positioned on the top of the container (10), and/or in the container wall (11) above a height of 90% of the height of the package, with the top of the container (10) being preferred. Where the container (10) comprises a cap (90), the one-way vent (70) is preferably positioned in the cap (90), preferably in a rigid attachment ring (92) fixedly attached to the container (10). The one-way vent (70) is preferably centred in the cap (90).

[0094] Caps comprising a one-way vent are commercially available, such as the vented caps sold by Dow Coming and Nalgene. However, such caps are typically designed for venting gases from within the container to the outside to prevent pressure build up within the container, while preventing ingress of air into the container. In contrast, a suitable cap (90) comprising a one-way vent (70), for use in the present disclosure, must allow air to enter the container through the one-way vent (70), while preventing egress of the contents of the container (10) through the one-way vent (70).

[0095] For typical (optionally bottom-dispensing) packages (1), the spring-back of the container (10) after the squeezing force for dispensing has been removed provides the pressure differential to draw air through the orifice (30), so that the container (10) can return to its original shape after having squeezed the container (10). As such, with typical prior art resiliently squeezable containers, the container has to be sufficiently stiff that it is able to provide sufficient spring-back force to draw air through the orifice (30) and allow the container (10) to return to its original shape. When the resiliently squeezable container (10) comprises the one-way vent (70) as described herein, the container (10) can be made more malleable, while still being able to return back to its original shape after the squeezing force for dispensing has been removed. Thus, the one-way vent enables to further improve the control of dosing, including microdosing.

[0096] As such, when the container (10) comprises a one-way vent (70), the resiliently squeezable container (10) can have an elasticity index of from 0.75% to 1.75%, preferably from 0.85% to 1.4%, as measured using the elasticity index method described hereinafter.

[0097] The desired elasticity of the resiliently squeezable container (10) can be achieved using any suitable means, including through the selection of the material used for forming the container (10), limiting the wall thickness through using less resin material to make the container (10), or through the use of grooves (80) as described herein, and the design of their form.

[0098] As mentioned earlier, the one-way vent (70) allows the container (10) to recover to its original shape, while not requiring air to be suctioned through the dispensing orifice (30). As such, the orifice (30) can be made more resilient against leakage of the composition contained within the package (1), as this orifice does not need to form the air inlet. The one-way vent (70) preferably has an opening pressure which is less than the pressure required to draw air back though the orifice (30) of the base (20).

[0099] The one-way vent (70) can have an opening pressure differential from the exterior side to the interior side of from 10 mbar to 250 mbar, preferably from 15 mbar to 150 mbar, more preferably from 25 mbar to 75 mbar, measured at 20 °C.

[0100] The opening pressure differential (in mbar) is typically measured using a water column, to which the valve has been sealingly attached to the bottom of the water-column, then measuring the water-height required to open the valve, at the target temperature. The opening pressure is typically available from the valve manufacture, including on technical literature provided for the valve.

[0101] Suitable one-way valves include: duckbill valves, cross-slit valves, umbrella valves, flapper valves, ball valves, degassing valves, and spring-loaded valves.

[0102] Duckbill valves are typically one-piece, elastomeric components that act as backflow prevention devices or one-way valves or check valves. They have elastomeric lips in the shape of a duckbill which prevent backflow and allow forward flow. The main advantage of duckbill valves over other types of one-way valves is that duckbill valves are self-contained, in that the critical sealing function is an integral part of the one-piece elastomeric component as opposed to valves where a sealing element has to engage with a smooth seat surface to form a seal. Therefore, duckbill valves are easily incorporated and assembled into a wide variety of devices without the hassle or problems associated with the surface finish quality of mating seats and/or complex assembly processes. Duckbill valves can be supplied by Minivalve (Netherlands), Vernay, or other suppliers.

[0103] One-way Cross-slit valves are typically one-piece, elastomeric components that act as backflow prevention devices or one-way valves or check valves. They have a dome shape reinforced on one side to make them one-way only, preventing backflow and allowing forward flow. The main advantage of one-way slit valves over duckbill valves or other types of one-way valves is that they are designed to open wider, allowing a greater flow rate, and a stronger closing than duckbill valves. Similar to duckbill valves, the one-way cross-slit valves are self-contained, in the sense that the critical sealing function is an integral part of the one-piece elastomeric component as opposed to valves requiring an additional sealing element which has to engage with a smooth seat surface to form a seal. Therefore, one-way slit-valves are easily incorporated and assembled into a wide variety of devices without the hassle or problems associated with the surface finish quality of mating seats and/or complex assembly processes. One-way slit-valves can be supplied by Minivalve (Netherlands) or other suppliers.

[0104] Umbrella valves and Belleville valves are elastomeric valve components that have a diaphragm shaped sealing disk (umbrella shape). These elastomeric components are used as sealing elements in backflow prevention devices or one-way valves or check valves, in vent valves or pressure relief valves and in metering valves. When mounted in a seat, the convex diaphragm flattens out against the valve seat and absorbs a certain amount of seat irregularities and creates a certain sealing force. The umbrella valve will allow forward flow once the head pressure creates enough force to lift the convex diaphragm from the seat and so it will allow flow at a predetermined pressure in one way and prevent back flow immediately in the opposite way. Umbrella valves can be supplied by Minivalve (Netherlands) or other suppliers.

[0105] Another option for the air-vent is a degassing valve. Degassing valves can typically be found on bags of coffee and allow gases that are generated by the roasted beans to escape from the bag. When used in the present invention, the degassing valve is inversely mounted so that air can pass into the package (1) through the one-way vent (70) but not pass out of the package. Degassing valves are well known and typically comprise a cap, an elastic disc, a viscous layer, a plate usually made from polyethylene, and a paper filter. The elastic disc, such as a rubber diaphragm, is enclosed in the valve, and the side positioned on the exterior side of the container (10) or cap (70) has a viscous layer of sealant liquid that maintains surface tension against the valve. Once the pressure differential from the resiliently squeezable container (10) elastically returning to its original shape exceeds the surface tension, the elastic disc is released and air is able to ingress into the container (10). Suitable degassing valves are provided by EPAC Flexibles (Ghana), MTPak (China), WIPF Doypak (Turkey), and the like. Since the degassing valve is inversely mounted to the container (10) or cap (70), the valve is preferably protected by an air-permeable cover.

[0106] Other options are spring-loaded valves. Spring loaded valves comprise a spring which holds a closure means such as a ball or pin in place. As such, an opposing pressure differential is required to open the valve. The spring can be metal or another elastic material such as a suitable plastic or rubber.

[0107] Since the resiliently squeezable container is made from an elastomer, the bottom dispensing package (1) of the present invention is less prone to leakage due to pressure changes during storage and transport, for instance, from variations in temperature. However, leakage can also be due to transient liquid pressure increases from impact, such as if the package is dropped or placed on a surface with sufficient force. Such transient liquid pressure increases, also referred to as hydraulic hammer pressure, inside the container can momentarily force open the valve causing liquid to leak out.

[0108] As such, the base (20) of the bottom dispensing package (1) can further comprise: an impact resistance system (50) localized upstream of the orifice (30), as described in EP 3 492 400 A1. The system (50) comprises a housing (51) having a cavity (52) therein and extending longitudinally and radially inwardly from the base (20), wherein the housing (51) comprises at least one inlet opening (53a) that provides a flow path for the liquid from the resiliently squeezable container (10) into the housing (51) and at least one outlet opening (53b) that provides a path of egress for the liquid from the housing (51) to the exterior atmosphere when the orifice (30) is opened, wherein the cavity (52) is adapted to be partially occupied by a compressible substance (54).

[0109] A suitable compressible substance (54) can be selected from a gas, a foam, a sponge or a balloon, preferably a gas, more preferably air. The ratio of the volume of the gas, preferably air, inside the housing (51) at a steady-state to the volume of the resiliently squeezable container (10) can be higher than 0.001, preferably between 0.005 and 0.05, more preferably between 0.01 and 0.02.

[0110] The housing (51) can have an internal volume of from 200 mm3 to 250,000 mm3, preferably from 1,500 mm3 to 75,000 mm3. The inlet opening (53a) can have a total surface area of 1 mm2 to 250 mm2, preferably 15 mm2 to 150 mm2. The housing (51) typically comprises, or is made from, a plastic material, preferably a thermoplastic material, preferably polypropylene.

[0111] The bottom dispensing package (1) can further comprise a baffle located in between the interior side of the orifice (30) and the impact resistance system (50), preferably the baffle includes an occlusion member supported by at least one support member which accommodates movement of the occlusion member between a closed position occluding liquid flow when the baffle is subjected to an upstream hydraulic hammer pressure.

[0112] FIG. 4 is a cutaway view of a package. The package may have the same properties and features as detailed above in relation to some or all of the previous figures, unless explicitly excluded or obviously incompatible. Similarly, some or all of the features described in relation to FIG. 4 may be implemented into the examples discussed in the previous figures.

[0113] The package (1) comprises a resiliently squeezable container (10) and a base (20). The resiliently squeezable container (10) comprises at least one container wall (11). The container wall (11) has both a wider convex portion (2) and a narrow concave portion (3), with the narrow portion (3) being above the wider portion (2). The interior surface (15) of the container wall (11) comprises a zone (4) having grooves (80). The exterior wall (14) of the container wall (11) is smooth. The top of the container (10) comprises a cap (90) which comprises a one-way vent (70), preferably the one-way vent (70) is arranged in a rigid attachment ring (92) of the cap (90), fixedly attached to the container (10). The base (20) can comprise a base ring (21) which can optionally be adapted for resting the package (1) on a flat surface. Alternatively, the base (20) can comprise a base wall (23), at least partially, preferably fully connected to the base periphery of the base ring (21), and extending from said base periphery of the base ring (21) to a base wall rim (22), such that the bottom-dispensing package (1) can rest on the base wall rim (22). Such a base wall (23) can further comprises an exterior base wall surface and an interior base wall surface.

[0114] Alternatively, or in addition, at least part of the base (20) can be made from an elastomer, in order to reduce leakage due to transient liquid pressure increases from impact. By making at least part of the base (20) from an elastomer, at least part of the aforementioned transient liquid pressure increases (hydraulic hammer pressure), is absorbed. The body of the base (20) is preferably at least partially made from an elastomer. The body of the base refers to the features of the base (20) which are formed together during moulding of the base (20). That is, excluding those elements, such as the optional slit-valve (40), impact resistance system (50), base ring (21) and the like, which are typically formed separately and mechanically connected to the body of the base (20). As a result, leakage due to transient liquid pressure increases from such impacts is reduced or even avoided. Preferably, the base wall (23) comprises an elastomer. For instance, the base wall (23) can be moulded from a hard plastic such as polypropylene and an elastomeric lip, comprising the base-wall rim (22) can be over-moulded onto the base wall (23). More preferably, the base wall (23) is made from an elastomer.

[0115] However, when the base wall (23) is at least partially made from elastomer, the base (20) can stick to surfaces due to negative pressure developing within the interior space bounded by the base wall (23), especially when the base wall rim (22) is wet. As such, the base wall (23) can comprise at least one hole (26 on FIG. 2) and/or the base rim (22) can comprise at least one channel (27). Since such holes (26, FIG. 2) and channels (27) connect the exterior base wall surface and the interior base wall surface, the development of a negative "suction" pressure within the region interior to the base wall (23) is avoided. The base wall (23) can comprise from 1 to 8 holes (26), preferably from 1 to 4 holes (26). The base rim (22) can comprise from 1 to 8 channels (27), preferably from 1 to 4 channels (27), more preferably 4 channels (27). Channels (27) in the base wall rim (22) are preferred. The channels (27) may be angularly equidistantly spaced and connect the exterior base wall surface to the interior base wall surface.

[0116] The elastomer used in the base (20) can have a Shore A (Type A) hardness of from 0 to 80, preferably 5 to 60, more preferably 10 to 40. The Shore A hardness can be measured using the method described in ISO 868:2003 (last reviewed and confirmed in 2018). The elastomer can have a tensile elongation (break), measured in the flow direction at a stretch rate of 200mm/min at 23 °C using the method described in ISO 37:2017 (last reviewed and confirmed in 2022), of from 200% to 1000%, preferably from 250% to 750%, more preferably from 300% to 700%. The elongation at break is a characteristic value that describes the maximum percentage elongation that a tensile specimen experiences at the moment of break. It therefore describes the deformability of a material under tensile load. The elastomer can have a compression set, measured at 23°C over 72 hours using the method described in ISO 815-1:2019, of less than 50%, preferably less than 35%, more preferably less than 20%. The compression set measures the ability of the elastomer to withstand hardening and retain their elastic properties at ambient temperatures after prolonged compression. As such, the compression set provides an indication of the ability of the elastomer to withstand physical or chemical changes which prevent the elastomer from returning to its original dimensions after release of the deforming force, or lose too much of its elasticity.

[0117] The body of the base (20) and the resiliently squeezable container (10) can be co-moulded together, especially where they are made from the same elastomer. In such embodiments, the resiliently squeezable container (10) and the base (20) are essentially a single element.

[0118] The base (20) comprises an impact resistance system (50) localized upstream of the orifice (30). The impact resistance system (50) comprises a housing (51) having a cavity (52) therein and extending longitudinally and radially inwardly from the base (20), wherein the housing (51) comprises at least one inlet opening (53a) that provides a flow path for the liquid from the resiliently squeezable container (10) into the housing (51) and at least one outlet opening (53b) that provides a path of egress for the liquid from the housing (51) to the exterior atmosphere when the orifice (30) is opened. The cavity (52) is partially occupied by a compressible substance (54).

[0119] As shown above, the container can comprise a cap (90) comprising a rigid attachment ring, the cap (90) preferably being detachable, at least in part.

[0120] Preferably the cap (90) is comprised on the top of the container, distal from the base (20). The cap (90) provides for easy refilling of the container (10). The cap (90) can be a screw-on cap, or a push-fit cap or other form of cap which sealingly engages with the container (10). Since the container wall (11) is at least partially made from an elastomer, the container wall (11) is very flexible. As such, if needed, the cap (90) can comprise an attachment ring which is fixedly attached to the container wall (11), for instance via gluing, welding. Alternatively, the container wall (11) can be moulded on the cap (90) or its attachment ring, or vice-versa. The cap (90) can be permanently attached to the enclosure, for instance, via a string or plastic chord, or may be fully detachable. The cap (90), and if present its attachment ring is preferably rigid.

[0121] FIG. 5 is a cutaway view of part of the container wall (11) of the package of FIG. 4, showing the grooves (80), and the groove top (82) and the groove bottom (83), as well as the exterior surface (14). FIG. 5 also shows the pitch (81) between adjacent grooves.

[0122] FIG. 6 is a cutaway view of a package. The package may have the same properties and features as detailed above in relation to some or all of the previous figures, unless explicitly excluded or obviously incompatible. Similarly, some or all of the features described in relation to FIG. 6 may be implemented into the examples discussed in the previous figures.

[0123] The package (1) comprises a resiliently squeezable container (10) for housing the liquid composition. The resiliently squeezable container (10) has a wall (11). The liquid composition is preferably housed in direct contact with an inner surface (15) of the wall (11). The inner surface (15) of the container (10) may be provided with grooves (80). The outer surface may be smooth. In the example shown, an outer layer (13) of a thin layer may be provided. The thin layer (13) may be made of an elastomeric material. The thin layer (13) may be printed over or labelled to provide the user with usage information and/or reglementary information and/or advertisement information.

[0124] The package (1) and/or the container (10) has a longitudinal direction (A). In any plane perpendicular to that direction (A), the cross-section or profile of the container and/or of the package may be an ellipse or a circle.

[0125] In any please comprising the longitudinal direction (A), the package (10) comprises a convex portion and a concave portion.

[0126] The package (1) comprises a base (20) with a rigid base ring (21) fixedly attached to the resiliently squeezable container (10). The base ring (21) may have one or more protrusions which engage in pockets formed in the container (10). The fixed attachment may result from the use of adhesive, mechanical snap, glue, or from the container (10) being overmolded on the base ring (21). The base ring (21) extends inwardly from the container (10). The base ring (21) may be made of one or more elements. When made of two elements, each element can have a series of grooves so that the two elements are fixedly engaged into each other, squeezing the container (10) between them. The base ring (21) may house an impact resistance system (50) as discussed above, as well as a dispensing slit valve (40) controllably and reversibly obturating an orifice (30). The package (1) may be a bottom-dispensing container.

[0127] The base (20) may comprise a base wall (23) partially or totally made of an elastomeric material. The base wall (23) may be integrally made with the container (10). The base wall (23) may such that the package (1) may rest stably on the base wall (23). The base ring (21) extends inwardly from the base wall (23).

[0128] The package (1) comprises a cap (90) opposite the base (20). The cap (90) comprises an attachment ring (92) fixedly attached to the container (10). The fixed attachment may result from the use of adhesive, mechanical snap, glue, or from the container (10) being overmolded on the attachment ring (92). The attachment ring (92) may comprise protrusions (posts) anchored into the container (10). A T-shape inner edge (16) of the container (10) may protrude in the attachment ring (92). A seal (91) may be provided to sealingly connect the attachment ring (92) to the container (10). The seal (91) may for instance be made of polypropylene or acrylonitrile butadiene styrene.

[0129] The attachment ring (92) may have a central opening (96). The central opening (96) may be funnelled. The central opening (96) may be configured to enable the container (10) being refilled with liquid. The central opening (96) has a diameter D92 which may be greater than 50%, preferably greater than 60%, more preferably greater than 80% of the diameter D12 of a top edge (12) of the container (10). The central opening (96) may be releasably covered by a lid (94). The lid (94) may be screwed or snap fit to the attachment ring (92). A seal (93) may be housed in the lid (94) (e.g., with a dove's tail connection) to sealingly close the central opening (96) as the lid (94) is in a closed position. The seal (93) may for instance be made of silicone or polyurethane. The lid (94) may house a one-way air valve (70) configured to let air flow into the container (10).

[0130] A top cover (95) may be fixed to the lid (94). An air path may be possible between the top cover (95) and the lid (94) to let air access into the one-way air valve (70). A series of radially oriented channels or grooves may be provided at a top surface of the lid (94) to facilitate air flowing from outside to the valve (70). The top cover (95) may be printed or labelled with information, such as usage, advertisement, reglementary information.

[0131] The base (20) may have an outer diameter (or area-based outer diameter) noted D20 and the cap (90) may have an outer diameter (or area-based outer diameter) noted D90. The difference may be less than 20%, i.e., D20 > 0.8 x D90 or D90 > 0.8 x D20. The package is thus balanced and can stably lay on a flat surface. It is also balanced when the user holds it, which makes dosing more intuitive and less dependant on the amount of liquid remaining in the container.

[0132] The container may be made of one of the elastomeric materials discussed above. The attachment ring and/or the base ring is made of a rigid material as discussed above. The optional lid (94) and top cover (95) may be made of a rigid material similar to the attachment ring.

[0133] In some or all of the examples given above, the package (1) is between two and five times taller than wide.

[0134] In some or all of the examples, part or all of the package may be at least partially transparent. For example, the base wall (23) or the convex portion of the container (10) or the outer thin layer (13) may be sufficiently transparent to let the amount of liquid in the container visible to a user.

Liquid composition:

[0135] Since the package is less prone to leakage, the package is particularly suited for containing liquid compositions, especially liquid detergent compositions, having a viscosity of from 50 mPa·s to 3,000 mPa·s, preferably from 300 mPa·s to 2,000 mPa·s, most preferably from 500 mPa·s to 1,500 mPa·s, measured at a shear rate of 10 s^{-1} following the viscosity test method described herein. The composition can be Newtonian or non-Newtonian, preferably Newtonian.

[0136] Preferably, the composition has a density between 0.5 g/mL and 2 g/mL, more preferably between 0.8 g/mL and 1.5 g/mL, most preferably between 1 g/mL and 1.2 g/mL.

[0137] The detergent composition, especially when formulated as a hand dishwashing composition, can comprises from 5% to 50%, preferably from 8% to 45%, most preferably from 15% to 40%, by weight of the total composition of a surfactant system.

[0138] For hand dishwashing applications, the surfactant system preferably comprises an alkyl sulfate anionic surfactant and a co-surfactant. The co-surfactant can be selected from the group consisting of an amphoteric surfactant, a zwitterionic surfactant and mixtures thereof. The surfactant system can comprise the anionic surfactant and co-surfactant in a weight ratio of from 8:1 to 1:1, preferably 4:1 to 2:1, more preferably from 3.5:1 to 2.5:1.
The surfactant system can comprise from 40% to 90%, preferably from 65% to 85%, more preferably from 70% to 80% by weight of the surfactant system of anionic surfactant, preferably alkyl sulfate anionic surfactant, more preferably alkyl sulfate anionic surfactant selected from the group consisting of: alkyl sulfate, alkyl alkoxy sulfate, and mixtures thereof. Preferred alkyl alkoxy sulfates are alkyl ethoxy sulfates. More preferred anionic surfactants are an alkyl ethoxy sulfate or a mixed alkyl sulfate - alkyl ethoxy sulfate anionic surfactant system, with a mol average ethoxylation degree of less than 5, preferably less than 3, more preferably less than 2 and more than 0.5. The mol average ethoxylation degree is calculated as the mole average degree of ethoxylation for the alkyl ethoxy sulfate blend or, if alkyl sulfate is present, for the mixed alkyl sulfate - alkyl ethoxy sulfate anionic surfactant system.
Preferably the alkyl ethoxy sulfate, or mixed alkyl sulfate - alkyl ethoxy sulfate, anionic surfactant has a weight average level of branching of from 5% to 60%, preferably from 10% to 50%, more preferably from 20% to 40%. The weight average branching degree is calculated as the weight average degree of branching for the alkyl ethoxy sulfate blend or, if alkyl sulfate is present, for the mixed alkyl sulfate - alkyl ethoxy sulfate anionic surfactant system.

[0139] Suitable examples of commercially available alkyl sulfate anionic surfactants include, those derived from alcohols sold under the Neodol® brand-name by Shell, or the Lial®, Isalchem®, and Safol® brand-names by Sasol, or some of the natural alcohols produced by The Procter & Gamble Chemicals company.

[0140] The surfactant system may comprise further anionic surfactant, including sulfonate such as HLAS, or sulfo-succinate anionic surfactants. However, the composition preferably comprises less than 30%, preferably less than 15%, more preferably less than 10% by weight of the surfactant system of further anionic surfactant. Most preferably, the surfactant system comprises no further anionic surfactant, other than the alkyl sulfate anionic surfactant.

[0141] The composition can further comprise a co-surfactant selected from the group consisting of an amphoteric surfactant, a zwitterionic surfactant and mixtures thereof, as part of the surfactant system. The composition preferably comprises from 0.1% to 20%, more preferably from 0.5% to 15% and especially from 2% to 10% by weight of the cleaning composition of the co-surfactant.

[0142] The surfactant system of the cleaning composition of the present invention preferably comprises from 10% to 40%, preferably from 15% to 35%, more preferably from 20% to 30%, by weight of the surfactant system of a co-surfactant.

[0143] The co-surfactant is preferably an amphoteric surfactant, more preferably an amine oxide surfactant. Preferably, the amine oxide surfactant is selected from the group consisting of: alkyl dimethyl amine oxide, alkyl amido propyl dimethyl amine oxide, and mixtures thereof. Alkyl dimethyl amine oxides are preferred, such as C8-18 alkyl dimethyl amine oxides, or C10-16 alkyl dimethyl amine oxides (such as coco dimethyl amine oxide). Suitable alkyl dimethyl amine oxides include C10 alkyl dimethyl amine oxide surfactant, C10-12 alkyl dimethyl amine oxide surfactant, C12-C14 alkyl dimethyl amine oxide surfactant, and mixtures thereof. C12-C14 alkyl dimethyl amine oxide are particularly preferred.

[0144] Suitable zwitterionic surfactants include betaine surfactants. Such betaine surfactants includes alkyl betaines, alkylamidobetaine, amidazoliniumbetaine, sulfobetaine (INCI Sultaines) as well as the phosphobetaine. The most preferred zwitterionic surfactant is cocoamidopropylbetaine.

[0145] The surfactant system can further comprise from 1% to 25%, preferably from 1.25% to 20%, more preferably from 1.5% to 15%, most preferably from 1.5% to 5%, by weight of the surfactant system, of an alkoxylated non-ionic surfactant.

[0146] Preferably, the alkoxylated non-ionic surfactant is a linear or branched, primary or secondary alkyl alkoxylated non-ionic surfactant, preferably an alkyl ethoxylated non-ionic surfactant, preferably comprising on average from 9 to 15, preferably from 10 to 14 carbon atoms in its alkyl chain and on average from 5 to 12, preferably from 6 to 10, most preferably from 7 to 8, units of ethylene oxide per mole of alcohol.

[0147] Alternatively, or in addition, the compositions can comprise alkyl polyglucoside ("APG") surfactant, to improve sudsing beyond that of comparative nonionic surfactants such as alkyl ethoxylated surfactants. If present, the alkyl polyglucoside can be present in the surfactant system at a level of from 0.5% to 20%, preferably from 0.75% to 15%, more preferably from 1% to 10%, most preferably from 1% to 5% by weight of the surfactant composition.

[0148] The cleaning composition can have a pH of from 5 to 12, more preferably from 7.5 to 10, as measured at 10% dilution in distilled water at 20°C. The pH of the composition can be adjusted using pH modifying ingredients known in the art.

[0149] Suitable cleaning compositions are described in European Application EP3511402.

TEST METHODS:

Immersed volume, Overflow volume and Elasticity index:

[0150] The test is done on containers which are at least 3 days old, in order to avoid the effects of container shrinkage after making. The test is done at a room temperature of 20 °C and a room atmospheric pressure of 1013 +/- 1 Pa.

[0151] Distilled water having a density of 1.000 +/- 0.002 g/ml, when measured at 20 °C is added to a beaker of volume at least 5 L. If desired, a dye may be added to improve visibility, so long at the target density is achieved.

[0152] The container is weighed using a laboratory balance having an accuracy of 0.001 g.

[0153] The container is then fully immersed in the beaker, with the opening facing up with the distilled water in the beaker at 20 °C, expelling any remaining air in the container by gentle shaking. Holding the container by the stiffest part of the neck, the container is carefully lifted out of the beaker while avoiding squeezing of the container and spilling any of the solution. The filled container is wiped dry and re-weighed on the balance, in order to measure the weight of solution contained in the container when the container was immersed. From the weight of the distilled water, the immersed volume (ml) can be deduced. The container is then topped up to the brim with additional distilled water at 20 °C and the container reweighed, in order to measure the weight of the distilled water contained within the container after topping up to the brim. From this weight of surfactant solution, the overflow volume can be deduced. The overflow volume is the total volume of the distilled water contained in the container after topping up. The time between immersion in the basin and weighing must be less than 2 minutes.

[0154] The elasticity index is calculated using the following equation, expressed as a percent:

$$\text{Elasticity index} = \frac{\text{Overflow volume} - \text{Immersed volume}}{\text{Immersed volume}} \times 100\%$$

Peak pressure

[0155] The peak pressure is the pressure within the empty container at a defined temperature above the fill temperature. A temperature and pressure probe (preferably MSR145B4 data logger) is placed within the empty container and the container is capped with a sealingly engaged cap (without an orifice), with the container maintained at a temperature of 20 °C and an atmospheric pressure of 1013 +/- 1 Pa, while ensuring that no additional pressure beyond the surrounding atmospheric pressure is exerted on the container during capping. The container is placed within a constant temperature oven, set at the desired temperature for 4 hours at 1013 +/- 1 Pa and the maximum (peak) pressure logged by the temperature and pressure probe is recorded. The method is repeated using 5 different containers and the average peak pressure is recorded.

Leakage

[0156] The containers are filled to 10% of the container size (recommended fill volume) at 20 °C with Fairy® original dark green dishwashing product having a viscosity in the range of 1,000 +/-200 mPa.s, measured at a shear rate of 10 s^{-1} (for example, Belgian market product, 2018), and the containers sealed with caps comprising V21 - 145 slit-valves (supplied by Aptar). Cups are weighed before the containers are placed upside down in the cups, with the container cap positioned a distance from the bottom of the cup. The containers are then placed, with the cups in a constant temperature oven kept at 40 °C. The containers and cups are then removed from the oven after an hour, the container removed from the cup and the cup reweighed, in order to measure the weight of product that has leaked from the container.

Viscosity

[0157] The viscosity of the liquid detergent compositions is measured using a DHR-1 rotational rheometer from TA instrument, using a cone-plate geometry of 40 mm diameter, 2.008° angle with truncation gap of 56 μm. Unless otherwise mentioned, the viscosity is measured at a shear rate of 10 s^{-1}.

Leakage Resistance

[0158] The purpose of the Leakage Resistance Test is to assess the ability of a liquid dispenser to prevent leakage of the liquid from an inverted container during "impact". The impact occurs when the inverted container is dropped, liquid dispenser side down, from a certain height onto a flat surface. The drop is supposed to mimic the resulting transient liquid pressure increases upon impact inside the inverted container. The leakage resistance ability of the liquid dispenser is evaluated through measurement of the drop height till which no volume/weight of the liquid leaks out when dropped. A higher leak-free drop height correlates to better leakage resistance ability for the liquid dispenser. The steps for the method are as follows:

1. Use a drop tester apparatus. The apparatus consists of two top and bottom open ended cylindrical tubes with an approximate diameter of 12 cm, *i.e.* an outer tube tightly surrounding an inner tube movable in vertical direction into the outer tube, the outer tube having a cut out section to enable visual assessment of the relative height of the inner tube within the outer tube through a grading scale applied on the outer tube. A removable lever is applied at the bottom of the inner tube, allowing an inverted container positioned with its opening downwards within the inner tube to rest on the lever. When the lever is manually removed the inverted container drops down and the amount of leaked liquid after the exposure is weighed. Therefore, a piece of paper is positioned on a hard surface at the bottom of the open ended outer container to capture the leaked liquid. The weight of the paper is measured on a balance prior and after the drop test to define the amount of leaked liquid. The height at which the lever was positioned prior to manual removal is measured as the drop height.
2. Fill an inverted container having a defined volume (*e.g.,* 400 mL or 650 mL) with a standard liquid dishwashing detergent having a density of 1.03 g/mL and a Newtonian viscosity of 1000 cps at 20 °C when measured on a Brookfield type DV-II with a spindle 31 at rotation speed 12 RPM to a defined fill level within the inverted container. For example, with a 400 mL inverted container fill with 400 mL of liquid dishwashing detergent, and with a 650 mL inverted container fill with 650 mL of liquid dishwashing detergent. The liquid fill level, inverted container volume and liquid composition is kept constant when cross-comparing different closing systems.
3. Assemble a liquid dispenser comprising a valve (Simplicity 21-200 "Simplisqueeze®" valve available from Aptar Group, Inc.) with the inverted container, as shown in FIG. 4. The liquid dispenser has a frustoconical shaped exterior portion (*e.g.*, bottom diameter 65 mm, top diameter 34 mm and height 30 mm) for resting on the flat surface, and optionally fitted with an internally developed baffle (e.g., diameter 7 mm, 5 ribs emerging from center ball of 4 mm to the outside), an impact resistance system according to the present invention or both.

4. Set up the drop height (from 2 cm to 15 cm) on the drop tester.
5. Cut a piece of paper approximately 7 cm x 7 cm for fitting the opening at the lower end of the outer tube.
6. Weigh the piece of paper using a Mettler Toledo PR1203 balance and record its weight.
7. Place the piece of paper under the opening at the lower end of the outer tube.
8. Place the assembled liquid dispenser and inverted container, liquid dispenser side down, into the inner tube of the drop tester.
9. Pull back the lever in the drop tester in a quick and smooth motion.
10. Remove the tubes and the assembled liquid dispenser and inverted container from the drop tester.
11. Weigh the piece of paper a second time and record the weight. Calculate the weight difference of the paper, and the delta corresponds to the amount of liquid leaked from the liquid dispenser.
12. Repeat steps 5 to 11 four more times for a total of five replicates for each test condition.
13. Calculate the average maximum drop height at which no liquid leaked.

The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean "about 40 mm."

Claims

1. A package (1) for a liquid composition comprising:

a resiliently squeezable container (10) for housing the liquid composition;
a base (20) fixedly attached to the container and comprising a base ring (21) delimiting an orifice (30), wherein the base ring (21) is rigid; and
a cap (90) comprising an attachment ring (92) fixedly attached to the resiliently squeezable container (10) opposite the base (20), wherein the attachment ring (92) is rigid.

2. The package of claim 1, wherein a top edge (12) of the container (10) has a first diameter (D12) and the attachment ring (92) of the cap has a second diameter (D92) that is greater than 50%, preferably greater than 60%, more preferably greater than 80% of the first diameter.

3. The package of any of the preceding claims, wherein the resiliently squeezable container (10) is made of an elastomeric material, and wherein the base ring (21) and/or the attachment ring (92) are made of one of: polypropylene, polyethylene, or polyethylene terephthalate, preferably the base ring (21) and/or the attachment ring (92) are made of polypropylene or polyethylene, more preferably the base ring (21) and/or the attachment ring (92) are made of polypropylene.

4. The package of any of the preceding claims, wherein the cap (90) comprises a one-way air valve (70) configured to let air flow into the container (10).

5. The package of any of the preceding claims, wherein the package (1) is a bottom-dispensing package, and wherein a slit-valve (40) reversibly opens or closes the orifice (30) of the base (20).

6. The package of any of the preceding claims, wherein an interior surface (15) of the resiliently squeezable container (10) comprises at least one circumferentially oriented groove (80).

7. The package of any of the preceding claims, wherein the base comprises a base wall (23) made of an elastomeric material and the base ring (21) extends inwardly from the base wall (23).

8. The package of the preceding claims, wherein the package (1) may stably rest on the base wall (23).

9. The package of any of the preceding claims, wherein the package (1) has a longitudinal direction (A) and the resiliently squeezable container (10) has an elliptical, preferably circular, cross-section in any of the planes perpendicular to the longitudinal direction (A).

10. The package of any of the preceding claims, wherein the cap (90) comprises a lid (94) which removably engages the attachment ring (92).

11. The package of any of the preceding claims, further comprising the liquid composition housed in the resiliently squeezable container, the liquid composition having a viscosity of from 50 mPa·s to 3,000 mPa·s, preferably from 300 mPa·s to 2,000 mPa·s, most preferably from 500 mPa·s to 1,500 mPa·s, measured at a shear rate of 10 s^{-1}.

12. The package of any of the preceding claims, wherein at least one of: the base ring (21) and the attachment ring (92), is fixedly attached to the resiliently squeezable container (10) by an adhesive layer, by a mechanical snap, or by the resiliently squeezable container (10) being overmolded on the base ring (21) and/or the attachment ring (92).

13. The package of any of the preceding claims, wherein the base (20) and the cap (90) have a respective outer diameter (D20, D90), and the difference between the outer diameter of the base (D20) and the outer diameter of the cap (D90) is less than 20%.

14. The package of any of the preceding claims, wherein the package (1) is between two and five times taller than wide.

15. The package of any of the preceding claims, wherein the package has a longitudinal direction (A) and the resiliently squeezable container (10) has a longitudinal profile in a plane comprising the longitudinal direction, wherein the longitudinal profile comprises a convex portion (2) and a concave portion (3), the base (20) being closer to the convex portion (2) than the concave portion (3).

FIGURE 1

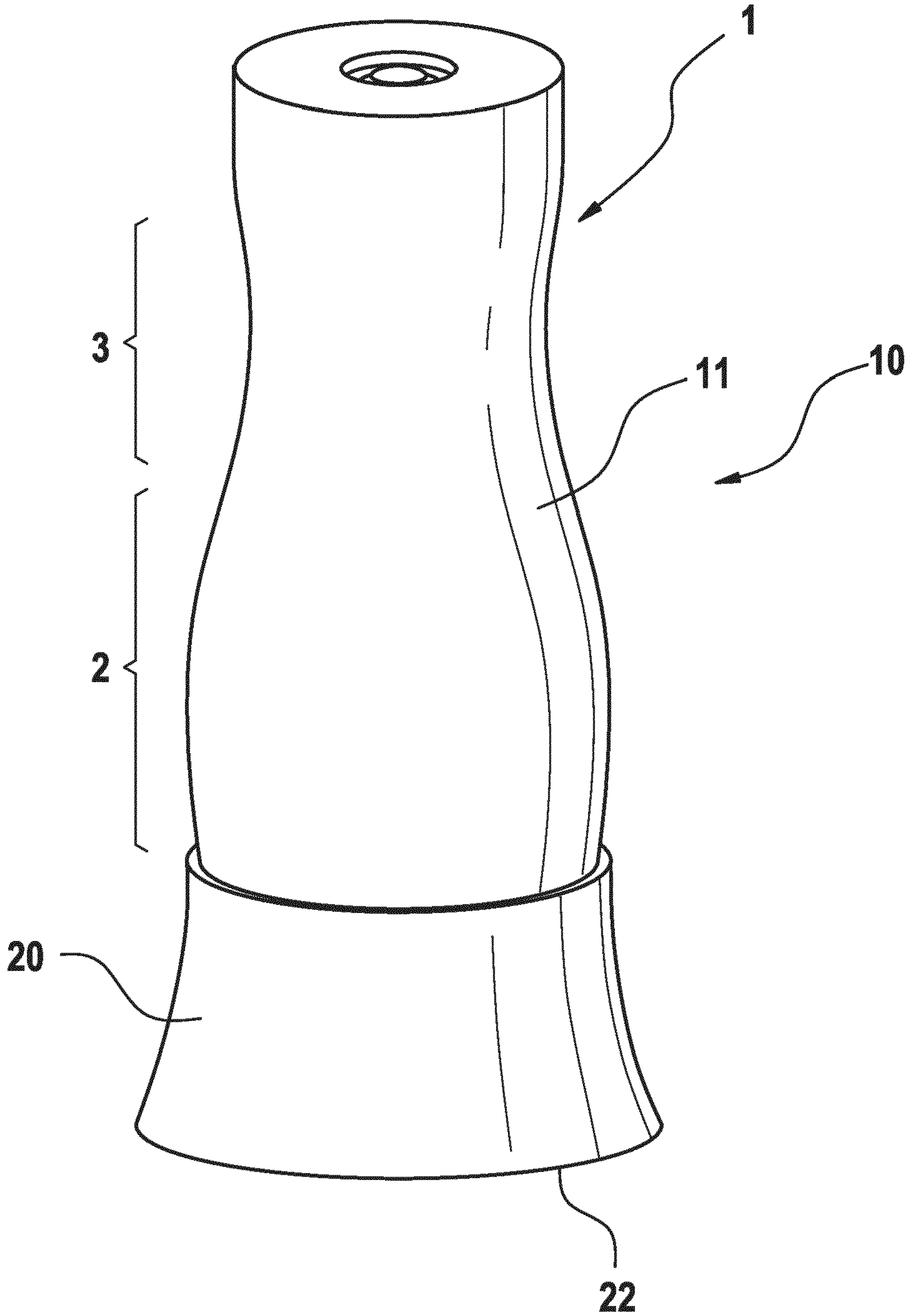


FIGURE 2

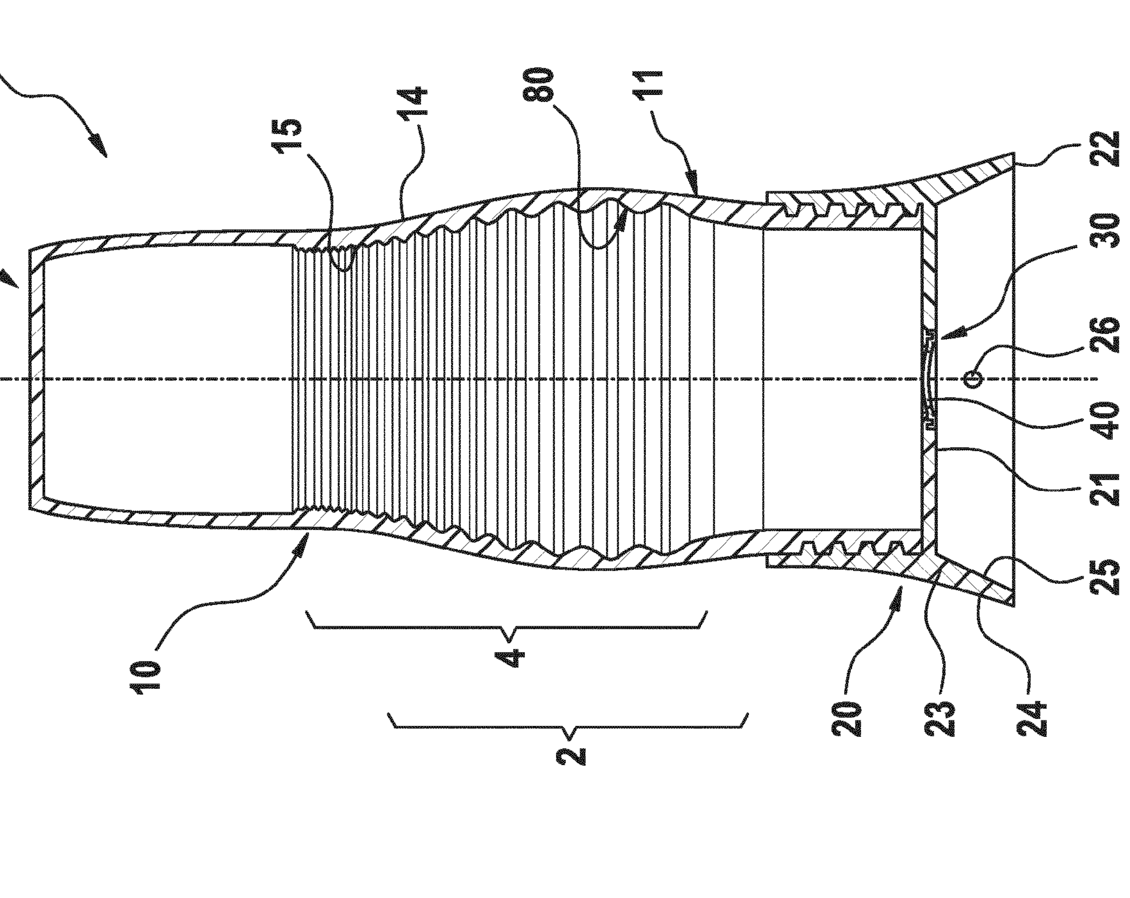


FIGURE 3

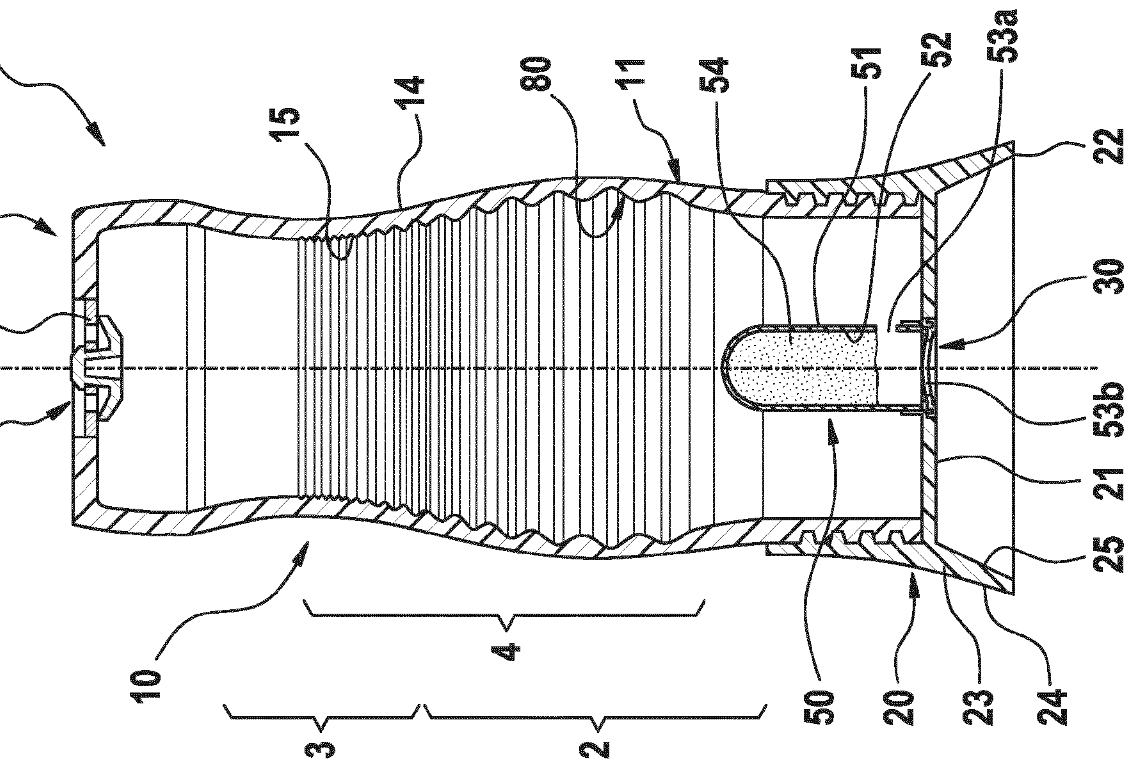


FIGURE 5

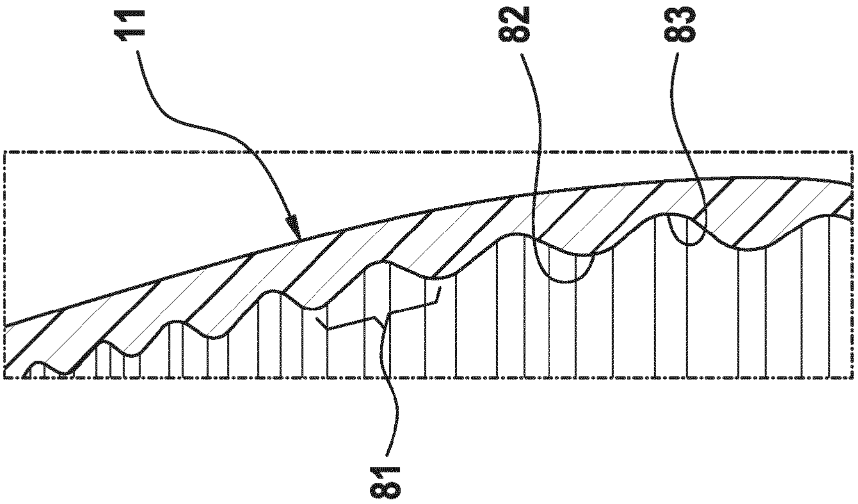
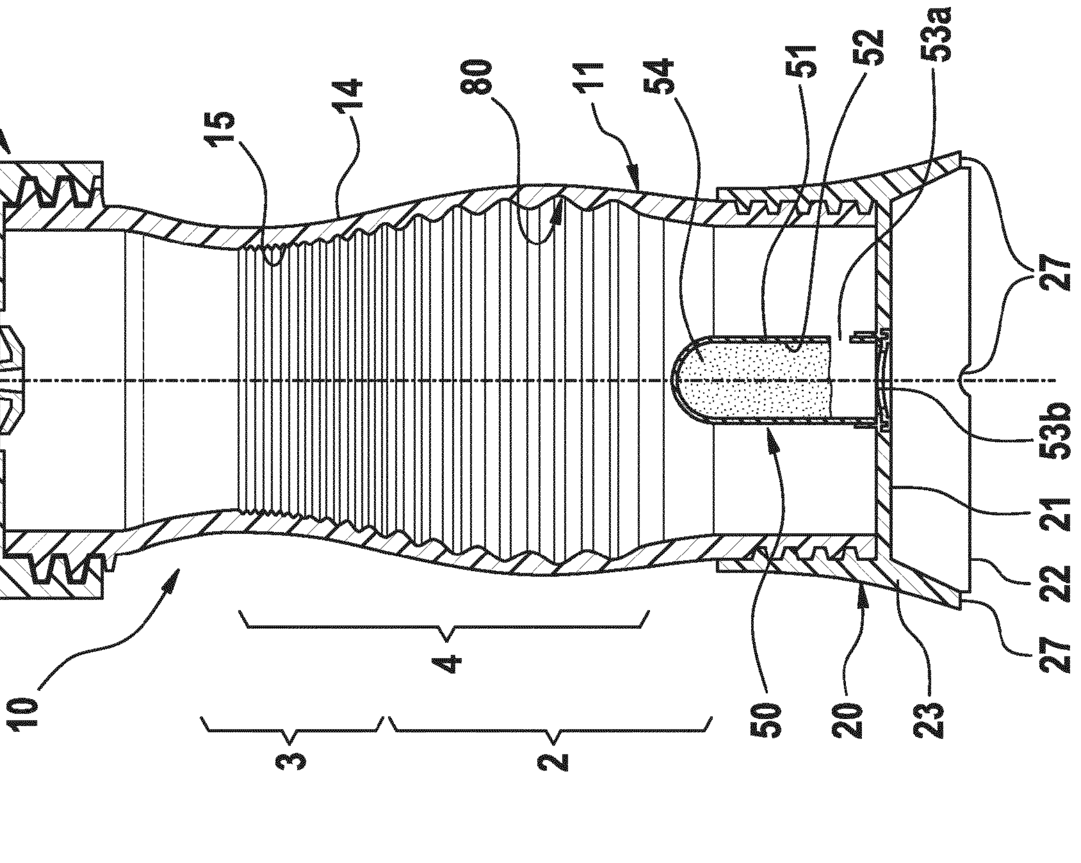
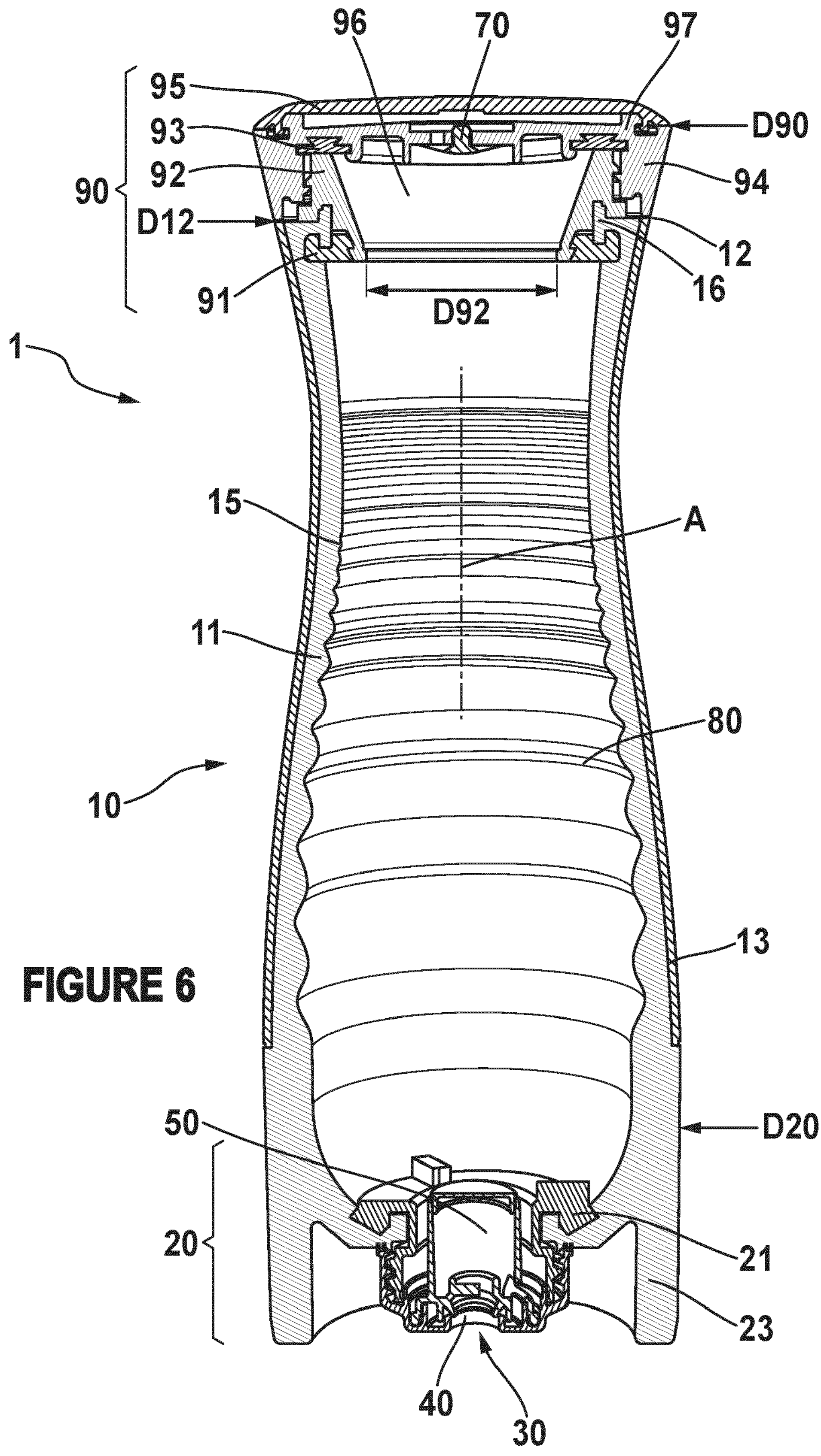


FIGURE 4




96
70
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D90
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94
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D12
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16
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D92
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A
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80
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13
D20
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23
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FIGURE 6

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 9332

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1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 June 2024	Rodriguez Gombau, F

CATEGORY OF CITED DOCUMENTS

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13-06-2024

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