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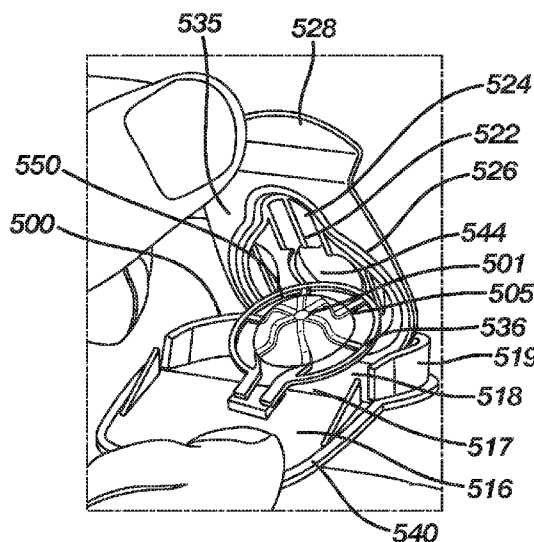


FIG. 5A

(57) Abstract: The present invention relates to contact lens packages which allow the lens to be removed from the lens package with a single touch. The lenses packages comprise a lens support which holds the lens in a convex position. When the package is drained there is less contact area between the support and wetted contact lens than between the user's finger and the contact lens, providing the desired one touch transfer.



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SINGLE TOUCH CONTACT LENS PACKAGE

Background of the Invention

Over the years, it has been a common perception that it would be ideal to provide users of contact lenses with a “single touch” package – that is, a package whereby the wearer of contact lenses can take the lens from the lens storage package with a single touch of one of his or her fingers, and then, with this single touch, position the lens correctly on the eye. In such a design, there would be no need for transfer and manipulation of the lens from one finger to another (as is currently common) before placing the lens on the eye. Providing such a single touch package would not only streamline the lens preparation and insertion process; it would also diminish the possibility of dropping the lens or exposing the lens to additional bacteria on a user's other fingers as the lens is being prepared for orientation and insertion onto the eye, and also reduces the possibility of touching the side of the lens which is intended to contact the eye.

Design of a single touch lens package faces some distinct challenges. The user ideally should be able to consistently position the lens to adhere to the finger during removal from the package, and then the lens needs to consistently release from the finger onto the eye. Contact lenses (of both the reusable and daily disposable variety) each have their own unique surface, bulk and geometric properties. Finger size and the force a contact lens wearer imparts on the lens during transfer can also vary. These factors can impact the process for taking the lens from the package onto the finger and then onto surface of the eye. Among other considerations: it would be desirable for users to be able to drain away any packaging solution which might impact the ability of adhering the lens to the finger, as variation in the amount of packaging solution adhering to the lens and package can impact the process of placing the lens on the finger. Also, the wearer may be concerned about the potential of transferring bacteria or external products such as make up to the contact lens; and of course, manufacture of the package itself should conform to expected industry standards recognized by the medical and commercial provider communities.

Further, the single touch package ideally should not result in an inordinate increase in the cost of goods over current contact lens packages, as this could result in increased costs to the user community. The package should not make it difficult to hold the lens when removed from the package. Additionally, if the configuration of the package were to maintain, or even reduce the volume of solution needed to package the lens, this would reduce the ecological impact of the lens package. Similarly, it would be beneficial if all or part of the package could be made of recycled materials, and/or recyclable in whole or part.

In addition, it would be advantageous if the package were composed of materials that are already approved by the various regulatory bodies and ideally did not require a change in solution chemistry or lens composition. Optimally, as well, the functionality of the package preferably does not incorporate any electronics or other electrical components, if such components could adversely affect performance of either the package or the lens.

There are several desirable attributes that have made achieving the function of a single touch package challenging and that are often lacking in known attempts to create a single touch package. These attributes include, for example, the following:

- The package ideally should protect lens. It should ensure the lens's integrity, while at the same time prevent crushing or damage to the lens.
- The lens package should maintain the hydration of the lens when stored. This will maintain the lens's properties. The lens in its package should be configured so that when desired, it is fully submerged in the packaging solution, yet be cleared of such solution when ready to be transferred to the wearer's finger. The package must have a retortable seal and contain both the lens and solution.
- The package preferably should maintain the lens in the desired convex orientation to the wearer. The lens should be correctly positioned on the lens support so that it can be easily removed by the user.
- The package should allow the packaging solution to be effectively drained away from the lens upon opening of the packaging and prior to lens

removal, to enable easier transfer to the wearer's finger and then onto the eye.

WO2014/195588, WO2009/069265, JP6339322 disclose packages which present the lens in a convex, bowl down configuration. However, the lens support structures substantially match the shape of the contact lens, which provides undesirable contact area between the lens and lens support. These references are also silent as to mechanisms for effective solution drainage from the lens and lens support.

US20190046353 discloses contact lens storage containers that facilitates an increased ease of lens removal. However, the package requires the user to pour out the packaging solution and does not provide the desired consistent one touch removal.

US20200229560 discloses packages with lens supports that support the concave (anterior or front) surface of the contact lens, or grates that support the contact lens peripheral edge and allows packaging solution to drain through a grate to a bottom chamber upon opening the lens package.

Thus, there remains a need for contact lens packages which provide a consistent one touch lens removal experience.

Summary of the Invention

The present invention provides a contact lens package whereby the lens is placed over a lens support composed of a suitable material which will enable functionality of the package while meeting all the other standard packaging requirements, such as appropriate strength, sterilizability and ease of opening. The package is filled with saline solution so that the lens remains hydrated during shipping and storage. When the package is in a closed position, such as during storage or transport, the lens and lens support is covered by a base on the bottom and a lid on the top, which function as a protective cover or outer shell (in addition to the other functions described herein). The lid is configured with a geometry so that upon opening the package a volume of air enters the package cavity beneath the lid and on top of the convex side of the lens. The influx of air prevents a suction force occurring between the lens and the lid and causes the lens to remain on the lens support with the lens concave surface down. The draining of the solution from the package causes the lens to lose

surface tension with the lens support surface. When in this position, the lens can be then adhered by transferal to user's finger, as the finger exerts a greater suction force due to surface tension than that exerted by the lens support on the lens. Thus, the lens is now maintained on the user's finger from the convex side of the lens and the user can transfer the concave side of the lens onto the eye surface. In contradistinction to present methods of applying contact lenses, in one motion the user can take the lens from the package and place it on the eye.

The present invention relates to a contact lens package comprising
a support for maintaining a contact lens in a convex position on the support during storage and upon opening the package; wherein
the lens has a peripheral edge and a lens profile;
the support has a profile that does not substantially match the lens profile; and
wetted contact between the support and the lens is less than about 20 mm², less than 18mm² or less than 15 mm².

The present invention further relates to a contact lens package comprising
a package base;
a package lid; and
a support for holding, in a convex position relative to the package base, a contact lens having a peripheral edge and a lens profile;

wherein the base and lid are sealed to form a cavity comprising the support, contact lens and packaging solution;

wherein the lens support comprises a plurality of peripheral supports which have a distal end extending at least 1 mm beyond the contact lens peripheral edge and provide at least 3, 3 to 14, 4 to 14, 3 to 8 or 4 to 8, 4 to 6 or 6 points of contact with the contact lens edge along the peripheral supports and wetted contact between the support and the lens after the package has been opened and the packaging solution has been directed away from the lens and support, is less than about 20 mm², less than 18mm² or less than 15 mm².

The present invention further relates to a contact lens package comprising

a support for holding, in a convex position relative to the support, a contact lens having a convex surface; and

a lens facing surface comprising at least one air entry guide configured such that, upon opening the package by a user, the at least one air entry guide guides air entering the package over the contact lens convex surface to reduce the incidence of the lens sticking to the interior surface.

Detailed Description of the Drawings

The present invention will be better understood from the appended drawings, in which:

Figures 1A-O are drawings of various lens support configurations.

Figure 2A is a drawing of a contact lens package base of the present invention.

Figure 2B is a drawing of a contact lens package base and lid of the present invention.

Figures 3A-H are drawings of lids showing examples of air flow management features of within present invention.

Figures 4A and B are drawings showing examples of air capture features within the present invention.

Figures 5A and B are drawings showing contact lens packages within the present invention.

Figure 6 is a graph of contact lens RMS values as a function of package fill volumes.

Figure 7 is a drawing of the interior of a package lid.

Detailed Description of the Invention

The present invention relates to packages for contact lenses, such as hydrogel contact lenses that permit the user to remove the contact lens from the package with the touch of a fingertip at or near the apex of the contact lens. The lens once transferred to the fingertip is in a position suitable for placement by the wearer on the eye, thereby simplifying lens removal from the package and insertion on the eye.

As used herein, the following terms have the foregoing meaning.

A benefit of the lens packages of the present invention is that they provide consistent one-touch lens transfer from the package to a wearer's finger, and then from the finger to the wearer's eye without the lens inverting, falling off the finger or further manipulation. Consistent lens transfer includes a transfer rate of at least about 70%, at least about 80% or at least about 90% transfer on the first touch of the finger (or "dab"). The lens also desirably "sits up" on the finger without collapsing or inverting and then transfers to the eye when placed there. Packages of the present invention may provide the desired one-touch transfer across a range of finger sizes, and dab pressures. Environmental conditions such as the temperature and whether the finger is wet or dry may also impact transfer rate, with higher temperatures generally improving lens transfer. Lens transfers evaluated in the present invention were conducted at room temperature.

Contact lenses refers to ophthalmic devices that reside on the eye. They have a generally hemispheric shape and can provide optical correction, cosmetic enhancement, UV blocking and visible light or glare reduction, therapeutic effect, including wound healing, delivery of drugs or neutraceuticals, diagnostic evaluation or monitoring, or any combination thereof. The term lens includes soft hydrogel contact lenses, which are generally provided to the consumer in a package in the hydrated state, and have a relatively low moduli, which allows them to conform to the cornea. Contact lenses suitable for use with the packages of the present invention include all hydrated contact lenses, including conventional and silicone hydrogel contact lenses.

A hydrogel is a hydrated crosslinked polymeric system that contains water in an equilibrium state, and may contain at least about 25%, or at least 35% water in the hydrated state. Hydrogels typically are oxygen permeable and biocompatible, making them excellent materials for producing contact lenses.

Conventional hydrogel contact lenses do not contain silicone containing components, and generally have higher water content, lower oxygen permeability, moduli and shape memories than silicone hydrogels. Conventional hydrogels are prepared from monomeric mixtures predominantly containing hydrophilic monomers, such as 2-hydroxyethyl methacrylate ("HEMA"), N-vinyl pyrrolidone ("NVP") or polyvinyl

alcohols. United States Patents Nos. 4,495,313, 4,889,664 and 5,039,459 disclose the formation of conventional hydrogels. Conventional hydrogels may be ionic or non-ionic and include polymacon, etafilcon, nelfilcon, ocufilcon lenefilcon and the like. The oxygen permeability of these conventional hydrogel materials is typically below 20-30 barrers.

Silicon hydrogel formulations include balafilcon samfilcon, lotrafilcon A and B, delfilcon, galyfilcon, senofilcon A, B and C, narafilecon, comfilcon, formofilcon, riofilcon, fanfilcon, stenfilcon, somofilcon, kalifilcon and the like. "Silicone hydrogels" refer to polymeric networks made from at least one hydrophilic component and at least one silicone-containing component. Silicone hydrogels may have moduli in the range of 60-200, 60-150 or 80 -130 psi, water contents in the range of 20 to 60%. Examples of silicone hydrogels include acquafilcon, asmoofilcon, balafilcon, comfilcon, delefilcon, enfilcon, fanfilcon, formofilcon, galyfilcon, lotrafilcon, narafilecon, riofilcon, samfilcon, senofilcon, somofilcon, and stenfilcon, including all of their variants, as well as silicone hydrogels as prepared in US Patent Nos. 4,659,782, 4,659,783, 5,244,981, 5,314,960, 5,331,067, 5,371,147, 5,998,498, 6,087,415, 5,760,100, 5,776,999, 5,789,461, 5,849,811, 5,965,631, 6,367,929, 6,822,016, 6,867,245, 6,943,203, 7,247,692, 7,249,848, 7,553,880, 7,666,921, 7,786,185, 7,956,131, 8,022,158, 8,273,802, 8,399,538, 8,470,906, 8,450,387, 8,487,058, 8,507,577, 8,637,621, 8,703,891, 8,937,110, 8,937,111, 8,940,812, 9,056,878, 9,057,821, 9,125,808, 9,140,825, 9,156,934, 9,170,349, 9,244,196, 9,244,197, 9,260,544, 9,297,928, 9,297,929 as well as WO 03/22321, WO 2008/061992, and US 2010/0048847. These patents are hereby incorporated by reference in their entireties. Silicon hydrogels may have higher shape memory than conventional contact lenses.

Hydrogel lenses are viscoelastic materials. Contact lenses can form optical distortions if the lens interacts with either the package or any air bubble in the package. The extent of the optical distortions, and the length of time needed for the distortions to relax out will vary depending on the chemistry, and to a lesser extent, geometry of the lens. Conventional lens materials, such as polyhydroxyethyl methacrylate-based lenses like etafilcon A or polymacon have low loss modulus and tan delta compared to silicone hydrogels, and may form fewer and less severe optical distortions as a result of contact

with packaging. The incorporation of silicones (which generally increase the bulk elastic response), wetting agents such as PVP (which generally increase the viscous response) or coatings of conventional hydrogel materials (which may lower the elastic response at the lens interface) can alter the lens viscoelastic properties. Conventional hydrogel contact lenses and silicone hydrogel contact lenses having short or stiff crosslinking agents and or stiffening agent have short shape memories and may be less susceptible to deformation during storage. As used herein, high or higher shape memory hydrogels display optical distortions from contact with an air bubble or package of at least about 0.18 after 5 weeks of accelerated aging at 55°C. Viscoelastic properties, including loss modulus and tan delta, can be measured using a dynamic mechanical analysis.

The contact lenses can be of any geometry or power, and have a generally hemispherical shape, with a concave posterior side which rests against the eye when in use and a convex anterior side which faces away from the eye and is contacted by the eyelid during blinking.

The center of the lens is the center of the lens optic zone. The optic zone provides optical correction and may have a diameter between about 7 and about 10 mm. The lens periphery or lens edge is the edge where the anterior and posterior sides meet.

The wetted lens is the contact lens and any residual packaging solution attached to it after packaging solution drainage. Wetted contact is the aggregated contact area between the wetted lens and lens support.

The contact lens package comprises a lens support surrounded by a reversible sealable chamber. The chamber may have any convenient form and may comprise package base which may have one or multiple compartments or base segments, lens support and at least one lid, each of which are described in detail below. As used herein, the phrases "the lid", "a lid", "the base" and "a base" encompass both the singular and plural. The lid and package base are sealed to each other to form a cavity which holds the contact lens, support and packaging solution in a sterile state during shipping and storage prior to use. The contact lens package is made from materials

which are compatible with the contact lens and solution, as well as retortable and biologically inert.

“Film” or “multilayer film” are films used to seal the package and are often referred to as lidstock. Multilayer films used in conventional contact lens packages may be used in the packages of the present invention as the base, a component of the lid, or both. Multilayer films comprise a plurality of layers, including barrier layers, including foil layers, or coatings, seal layers, which seal the film to the rest of the package, and may also comprise additional layers selected from peel initiation layers, lamination layers, and layers that improve other package properties like stiffness, temperature resistance, printability, puncture resistance, barrier resistance to water or oxygen and the like. The multilayer films form a steam sterilizable (retortable) seal.

The multilayer film can include PET, BON or OPP films layers to increase stiffness and temperature resistance, or to EVOH or PVdC coatings to improve barrier resistance to oxygen or moisture vapor.

Packaging solution is any physiological solution compatible with the selected lens material and packaging. Packaging solutions include buffered solutions having a physiological pH, such as buffered saline solutions. The packaging solution may contain known components, including buffers, pH and tonicity adjusting agents, lubricants, wetting agents, nutraceuticals, pharmaceuticals, in package coating components and the like.

The package base forms the bottom of the package. It can be made from any material suitable for packaging medical devices, including a flat sheet of foil or plastic, a laminate film, or plastic. The bottom of the lens support is disposed on and supported by the base surface facing into the package cavity. The lens support may also be integral with the base. The lens support may rest on the inner surface of the package base which may be horizontal or may be angled to maintain the lens support and lens in an angled position when the bottom of the base is horizontal. When the base is disposed at an angle, the angle is preferably at least about 15°, at least about 20°, about 20° to about 80°, about 20° to about 60° or about 20° to about 40° relative to level.

The packaging lid forms the uppermost structure of the package and seals with the base to form a cavity containing the lens support, lens, packaging solution and any other incorporated packaging features. The lid may be made from any material suitable for packaging medical devices, including a flat or molded sheet of foil or plastic, laminate films, or plastic. Packages comprising plastic for one structure and foil or laminated films as the other, or packages comprising foil or laminated films as the outer layer for the lid and base are known in the art and are examples of suitable combinations.

Lens Support & Transfer

The lens support keeps the lens in the desired convex orientation (bowl down relative to the base) and position (centered over the support) during shipping and storage. The lens support is designed to provide an open structure under the lens bowl to allow, upon opening, the packaging solution to drain from the lens and support without trapping water between the support; and a sufficient number of contact points with the lens to prevent the lens from collapsing onto, rotating off or translating across the support. This allows the apex of the lens to be supported by the lens' own elastic stiffness, or to minimize sinking of the lens apex while limiting the contact area between the support and lens. Too much contact between the support and the lens after solution draining, and water trapped between the support and the lens, can create surface tension between the lens and water on and around the lens support that is greater than the surface tension between a wearer's finger and the lens, interfering with efficient lens transfer. The sum of the contact between the lens and the lens support when the package is open, and the solution drained from the lens and lens support is the total contact area, which may be less than about 20 mm², less than 18mm² or less than 15 mm² and is distributed at least around the lens periphery, as described herein.

For lenses made from polymers with longer shape memory, the lens support may be designed to limit contact between the lens and support during storage. Such contact may be distributed around the lens peripheral edge. Contact between the lens optic zone, lens support and lid interior (including any air entry guides) may be transitory or there may be no contact between the optic zone and support, lid or air entry guides

Lenses, such as conventional hydrogels, having shorter shape memory, are less prone to distortion from packaging contact, and can have the contact points distributed around the periphery and throughout the lens profile, including the lens center zone (about 9mm, or about 5 mm diameter).

The lens supports of the present invention allow, upon dabbing, both the fingertip and lens to deform to match each other's shape, without causing lens inversion or damage to lens during removal from too much pressure during dabbing. Thus, an aspect of the removal of the lens from the present packages is to control the ratio of the contact area between the finger and lens as compared to the area between the lens and the lens support so that the contact area between the finger and lens exceeds the contact surface area of the lens support on the lens underside. This will ensure that surface tension between finger and lens exceeds surface tension between lens and lens support. Thus, the lens will adhere to the finger for lens transfer and placement onto the eye.

Figures 1A-P show examples of lens supports useful with the present invention. Each of these lens supports may be useful with any of the packages described herein. The lens support may provide a light resistive force on the lens during lens transfer to allow the lens to be adhered to the finger. As shown by Figures 1A-P, the lens support may be designed in a range of configurations. It should be appreciated that the configurations depicted herein are illustrative examples. Configurations not illustrated or those that combine aspects of the exemplary configurations depicted are possible within the scope of the appended claims as will be apparent to those skilled in the art in view of the balance of this disclosure.

The lens support provides at least 2, at least 3, 3 to 14, 4 to 14, 3 to 8 or 4 to 8, 4 to 6 or 6 points of contact with the contact lens edge along the peripheral supports 105. When two peripheral supports are used, they may be wider to provide stability, without exceeding the area of contact desired for consistent lens transfer. The peripheral points of contact prevent the lens from rotating off the lens and can be distributed in a number of configurations, in which the space between the furthest adjacent contacts is less than the diameter of the lens. In embodiments employing three contact points, the contacts may be arranged in an acute triangle as shown in Example 16. All (Figures 1B, C, H, K

and L) or most (Figures 1M-O) of the peripheral supports can be evenly distributed around the lens periphery. As the number of peripheral supports is increased the likelihood of residual packaging solution forming films between adjacent peripheral supports and solution bridging between the support and lens may be increased during drainage. Peripheral supports with less than 50% open space such as those in the form of a screen or strainer, generally provide insufficient drainage to insure one touch transfer.

Figure 1G shows a lens support comprising 6 planar peripheral supports 105 which join in the center of the lens support and extend outward to an unsupported distal end. Channel members 115 are one structure which may be used to help facilitate packaging solution drainage and are discussed in detail, below.

The peripheral supports 105 provide a path for packaging solution to drain from the lens when the package is opened. To facilitate drainage of the packaging solution, the peripheral supports are generally transverse to the lens edge, which helps prevent the lens from wrapping around the support, linear and may extend outward to a distance at least 1 mm beyond the contact lens peripheral edge. If the distal ends of the peripheral supports extend less than 2mm beyond the lens edge, packaging solution may be undesirably trapped under the lens, potentially interfering with effective lens transfer. If the central peripheral ends (such as the "V" notches of the peripheral support 105 in Figure 1D) are not connected to a center support, they may extend in toward the center of the support at least about 3mm from the contact point with the lens, as illustrated by the exemplary configuration of Figure 1D. If the peripheral supports extend less than 3mm from the lens contact point in toward the lens, the lens may slide off the peripheral support.

The peripheral supports 105 may be radially disposed around the center of the support. They may attach to each other as shown in Figure 1G, or at an elbow 104 as the terminal portion of a lens support arm as shown in Figures 1A and B. Peripheral supports 105 may extend inward from an at least partial peripheral ring 109 as shown in Figures 1C and 1D. And, peripheral supports 105 may connect to a central column or cylinder 107 as shown in Figure 1E, or any combination of the foregoing. When the peripheral supports extend inward, they may meet in a single central point (Figure 1G),

column, or cylinder 107 (Figure 1E). One or more of the peripheral supports 105 may meet adjacent peripheral supports to form an open center as is shown in Figure 1D. Alternatively or additionally, one or more peripheral supports 105 may extend inward from their distal end at the at least partial peripheral ring to an unsupported proximal end inside the circumference of the lens or to another point on the peripheral ring, as shown in Figure 1C. The peripheral supports may be planar, as in Figures 1B-G or may be angled as in Figure 1A. When angled, the angle may be from 0° to about 30°, or 0° to about 15° from level, and may slope toward the center of the support or the distal end of the peripheral support.

The distal end of adjacent peripheral supports 105 may connect to each other via terminal crosspieces which form a partial peripheral ring 109, as shown in Figures 1B and 1D or a full ring 109 as shown in Figure 1C. For example, Figure 1D shows a lens support comprising a partial peripheral ring 109 with planar peripheral supports 105 in the form of an open, six-armed asterisk shape, radially disposed around the center of the lens support.

When a full or partial peripheral ring is included it may have a diameter at least 4 mm larger than the contact lens (at least 2 mm from all contact lens edges) to facilitate drainage of the packaging solution away from the lens and lens support. For partial peripheral rings with complex shapes, such as the partial peripheral ring of Figure 1D, the diameter of the at least partial peripheral ring may be centered around the center of the lens support and is measured across opposite partial peripheral ring sections 109. Peripheral ring diameters of between about 16 and about 25 mm, about 18 and about 25 mm or about 18 and about 24 mm will be suitable for commercially available contact lenses.

The peripheral ring, when included, may rest on the base during storage, may be fixedly attach to the base, or may attach to vertical supports such as feet, stilts 110 as shown in Figure 1K, a raised base fin section as shown in Figure 1L, a central column or cylinder which keep it raised from the base. The vertical supports may extend about 4 to about 5 mm from the base for a horizontally disposed lens support, or about 2 to about 5mm, about 2.5 to about 5mm or about 3 to about 4mm for a lens support which

is tilted when the package is closed, such as the tilted lens support depicted in Figure 1H. When included, the vertical supports may be of the same length or may be of different lengths to maintain the lens at an angle relative to level. The upper limit of the height of vertical supports is limited by the desired size of the package, as increasing the length of the vertical supports increases the height of the overall package and the amount of solution required. A peripheral ring may also attach to a lifting or pivot structure, such as a lever or an extended channel member, described below, to facilitate raising the lens support from the base, to help drain packaging solution away from the lens.

The package base may also be designed such that the peripheral supports 105 (shown as part of a raised fin in the example embodiment of Figure 1H) are level with each other, but the base floor 120 and lens support 136 are disposed at an angle (Figure 1H). The lens support may be a separate structure or may be part of the base as shown in Figure 1H.

The lens support may further comprise at least one positioning structure (not shown) to prevent the lens from translating horizontally across the lens support, particularly for supports disposed at an angle in the package or upon opening and removal. These positioning structures may include notches, prongs or stops along the peripheral support outside the lens periphery, an open central support (described below), positioning pins or tabs inside the lens near the periphery of the lens, where the lens surface is more steeply angled, such as located outside the central zone of the lens (diameter of about 5 mm, about 6 mm, or about 7 mm), or a combination thereof.

As shown in Figures 1E, 1J and 1H, the lens support may further comprise an open structured central support to provide additional resistance, drainage pathways and/or to increase the contact area between the finger and the lens during lens transfer. The profile of the central support may be designed to keep the lens in the convex position preferably centered on the support during shipping and storage without significant contact, and provide the desired lens contact area after drainage and prior to contact by the user's finger. The central support may be configured such that a gap is created between the lens support and the lens, such as by having a substantially flat top that allows the top of the lens to be deformed by the finger and the finger pad to be

flattened, creating the desired bias in surface area. When present, the central support may be flat or may be slightly concave, preferably provides at least 0.5 mm between the lens apex and the top of central support upon draining (to minimize contact between the lens apex and the support) and provides a lens-finger contact area greater than the contact area between the lens and the rest of the lens support ("substantially flat top" or "flat top"). If slightly curved, the central support may have a slightly concave curve with a radius of curvature of at least about 10mm or at least about 6 mm, or less desirably a slightly convex curvature of about 10 mm or higher. It may be desirable to design the central support so that it does not contact the lens optical zone until lens transfer.

The top of the central support may have a diameter of about 1 mm to about 10 mm, about 3 mm to about 9 mm, about 5 to about 9 mm, or about 6 about 9 mm. For central supports having flat top regions with diameters less than about 5 mm, additional positioning structures may be desirable. The central support top may be oriented parallel to the lens periphery to form a column as shown in Figures 1A-1F. The central support top also provides resistance against the finger as the user presses down on the apex of the lens to initiate lens transfer.

The central support may be formed from a plurality of arms. The arms may form a flat top section 101, and be supported by one or more columns 108 extending up from the base, as shown in Figure 1J; at least one peripheral support 105 as shown in Figure 1A, B, C, E, F; at least one arm, as shown in Figure 1D; or vertical supports 110, in the form of fins as shown in Figure 1H or open supports 110 as shown in Figure 1K. When the arms extend beyond the flat top, they may include an optional side section 103, a shoulder transition 102 connecting the flat top 101 and optional side 103 sections, peripheral supports 105, an optional elbow transition 104 connecting the optional side 103 and peripheral support 105. The flat top section of the arms may connect in the center at point 106 as is shown in Figures 1A and 1B; a column 108 as in Figure 1i; ring; or may connect to an open full or partial cylinder 107 as is shown in Figure 1E, or the arms may connect to the package base, either as solid fins with a void 106a in the middle of the substantially flat top 101 (Figure 1H). The arms may also attach to the bottom of the lens support, as shown in Figure 1K, which has 6 arms with curved side sections 103, and a flat top section 101 formed by the upward facing ends of the arms.

The distal end of the peripheral support 105 may also be connected to individual supports from the base as shown in Figure 1K or directly to the base (Figure 1L).

As shown in Figures 1H and 1M the fins, base or both may also be hollow to minimize the amount of packaging material used. Hollow or solid fins also displace packaging solution, reducing the amount needed. The arms may be radially distributed around the center of the support structure.

The flat top section may also comprise an optional central fillet 106a centered in the flat top section as shown in Figures 1A, 1O and 1N. The central fillet may be included in lens supports with or without a central column, such as Figure 1N and 1A, respectively. When a central fillet is included, it can have a width across its longest dimension of about 0.1 to about 3mm; about 0.1 to about 2mm, or less than 1.5mm. The central fillet can have any shape, including a circle with a smooth or scalloped edge, triangle or square. The points of the triangle or square may be located on the arms, offset from the arms and may be rounded or pointed.

Upon opening the contact lens periphery will rest on the peripheral supports 105 and the lens may additionally rest on the central support or part of the central support, such as the shoulder transitions 102. The side sections 103 may have any shape that provides minimal contact, and preferably no contact with the contact lens upon packaging opening and drainage, such that upon lens transfer the desired contact area differential is achieved. The side sections may be straight (non-curved), as is shown in Figures 1B through F. The lens may also have no side supports, as shown in Figure 1J, where the flat top section 101 is supported by a central column 108. As solution drains, the lens may collapse toward central support. The configuration of the peripheral supports and profile of the lens supports of the present invention, including the central support (if present) do not substantially match the lens profile and prevent the lens from deforming or interacting with the lens support during drainage so that the lens resumes its shape and does not stick to the central support during lens transfer. Preferably, lens support profiles which do not substantially match the lens profile include central support profiles which provide clearance between the lens and side support (if present) of at least that provided by straight angled side sections with an outward angle from vertical of no more than about 10°, including central supports which have no side sections, or a

concave curve in the side section. It will be appreciated that lenses with higher moduli (such as silicone hydrogels) may deform less and may require central supports with less mismatch.

The height of the flat top section (when included) is measured from the point of contact between the lens and peripheral supports to the top of the shoulder and can vary depending on the sagittal depth and curvature of the contact lens. For effective transfer at least about 0.5 mm, about 0.5 to about 2 mm, 0.5 to about 1.5 mm, or about 0.8 to about 1 mm of deflection from the undeformed contact lens apex may be desirable. For a contact lens having a sagittal depth of 3.8 mm, flat top portions having a height of about 2 mm to about 3.3 mm, about 2.5- 3.3 mm, or about 3 to about 3.5 mm may be used. Column heights which are less than about 2 mm can trap packaging solution in the support base and encourage the lens to deform and buckle in the center. These heights, whether measured from the apex of the lens to the top of the flat top, if present, or from the base, will provide the desired contact area between the finger and the lens to provide consistent lens transfer, without inverting the lens.

Removing the central column and leaving a void in the center can also provide the desired lens transfer, particularly with lenses with a neutral shape after drainage. The void can have a diameter between about 5 mm and the diameter of the lens (which provides a support with only peripheral supports as in Figures 1F and 1M). The void can be clear to or below of the base of the lens. The void is desirably at least 5 mm throughout to provide adequate drainage.

Any structure below the void preferably has a low surface area so as not to interfere with packaging solution drainage. For example, for a void extending to the base of the lens, at least about 50% of the area of the void at base would be clear. Voids which extend below the base of the lens may have structures with greater surface area, so long as those structures do not project above the base.

The length of the arms may also vary, depending on where and to what the arm attaches in the flat top region and whether the arm has a peripheral support. Arms that attach to a center support, such as shown in Figure 1A, may have a length from the shoulder to the center point of about 1.5 to about 4.5 mm, about 2.5 to about 4.5 or about 3 to about 4.5 mm. The length of the arm side section (when present) is

determined by the height of the lens support, and may be from about 1.5 to about 4.5mm, or about 1.5 to about 3.5mm, or about 2 to about 3.5mm.

The sides sections may be perpendicular relative to the base, or may have any angle 103a (Figure 1A) or curve that is less than the curvature of the lens, such that the desired contact area is not exceeded. Suitable angles include up to about 15°, or between about 1° and about 10° outward from perpendicular.

The angle 103b at the elbow transition between the side section and the peripheral support (when connected to the arm) may be between about 60° and about 120°, or about 80° and about 100°.

The number and shape of the arms may also be varied, so long as they provide the desired balance of efficient drainage of the packaging solution upon opening, and contact area with the lens. The packages of the present invention may have one or more, three to eight, or three to six arms forming the central support, which may be designed to provide the desired contact area between the lens and finger, and resistance along the flat top against the finger touch, but only transitory contact with the contact lens at the optional side sections and shoulder transitions. The shoulder transitions may be disposed radially around the center of the support. The shoulder transitions can be spaced at roughly equal angles from the center. The arms may be planar as is shown in Figure 1A, or curved, for example in a U-shape (not shown), or may be branched, for example in a straight or curved "Y" shape 101b, shown in Figure 1B, a U-shape or a T-shape. Branching of the arm(s) may occur within the flat top region as shown in Figure 1B, or at the peripheral support 105c, as shown in Figure 1C. The support may have all planar arms, all branched arms or a mix of planar and branched arms, for example two branched arms and two straight arms as shown in Figure 1C, three branched arms as shown in Figure 1b, or all planar arms as shown in Figure 1A. Examples of suitable arm configurations include three to eight or three to six planar arms, 3 straight or curved Y-shaped arms, 2 to 4 planar arms and 2 branched arms (which may be straight or curved Y-shaped, U-shaped or T-shaped) arms and two planar arms and 2 branched arms (which may be straight or curved Y-shaped, U-shaped or T-shaped). The arm configurations may provide shoulder and peripheral

support contact points which are disposed along arm planes (Figure 1A), or shoulder and peripheral support contact points which are offset from each other (Figure 1C).

Each arm has a cross section sufficient to provide a lens support having resistance to prevent lens collapse during drainage, or excessive contact between the lens and lens support during lens transfer. The lens support is preferably formed from rigid materials, and the resistance of the arms may be controlled by the modulus of the lens support material selected and the dimensions of the arm. Rigid plastics which are suitable for injection molding small parts, such as polypropylene homopolymers and copolymers (COPs), cyclic olefin copolymers (COCs), and mixtures thereof are suitable materials. Depending on the additive packages included polypropylene homo- and copolymers generally have flexural moduli in the range of 1100-1800 MPa, COPs and COCs have flexural moduli in the range of 1800-2900 MPa, and blends of polypropylene and COPs or COCs may have flexural moduli in the range of 1100-2900 MPa. The polypropylene may be nucleated, controlled rheology or both, and both Ziegler-Natta and metallocene catalyzed polypropylenes may be used. Polypropylene polymers may also include additives including processing aids such as glycerol monostearate, zinc stearates and calcium stearates, fillers which can modify the properties of polypropylene and the like.

References throughout this description to conventional injection molding processes and the use of materials conventionally applied to injection molding should be understood as exemplary. Those of skill in the art will appreciate that other means of manufacture are possible within the scope of the appended claims, including but not limited to alternative molding processes, thermoforming, 3D printing, and the like.

The width of the arms can vary between the limits of the selected molding process and widths necessary for efficient packaging solution drainage upon opening.

Suitable arm widths include about 0.5 to about 1.5 mm, about 0.5 to about 1, or about 0.5 to about 0.7 mm, and it will be appreciated that lens support designs having fewer contact points may have thicker arms.

The height of the arms may vary from the limit of the injection molding process to the height of the arm from the base, in which case, the arm is a fin, as is shown in Figure 1E and H, which may be attached to the base, be molded as a part of the base

or may rest on the base. When the arm is not a fin, it can have a height of 0.5 to about 1.5mm, about 0.5 to about 1, or about 0.5 to about 0.7 mm. It will be appreciated that materials with lower moduli may benefit from arms that have a larger profile in either the height, width or both.

Suitable materials for the lens support must also be sterilizable, non-leaching, suitable for use with biomedical devices and inexpensive. Preferably the materials are also recyclable. The lens support materials can, but do not have to be, optically transparent. The lens support materials may be non-polar to encourage drainage of the packaging solution. Non-polar materials are those that have a contact angle of greater than 90° via the sessile drop method using deionized water at 25°C.

As can be seen, the lens support of the present invention can have a range of arm and peripheral support configurations and features and are not limited by the specific combinations shown in the Figures and discussed herein.

Additional combinations of arm configurations will be apparent to those of skill in the art with reference to the teachings of the present application. The only limits on the design of the arms are the ability to mold the lens support, and the number and orientation of contact points to balance lens support with the desired drainage upon opening.

Packaging Solution Drainage

The packages of the present invention may have additional features which with the lens support allow the packaging solution to be drained from the lens and lens support. The additional drainage features provide a drainage path for packaging solution. The drainage path creates, upon opening, an angled fluid film that forms between two solid members, such as adjacent peripheral supports, a generally vertical fluid film that forms between two solid members, such as a central column and a side section, or a steep or generally vertical path along a smooth solid surface, such as a side section. The shallower the angle of the drainage path, the easier it is to break the flow path and encourage the formation of packaging solution trapped between the lens and lens support, including reservoirs and residual films. Angled drainage paths having an angle between 10° and about 90° are suitable. Lens support and drainage features with sharp edges and very long routes can also break the drainage path.

Integrally angled or elevated lens supports, as described above, may provide the desired drainage. Lens supports may also be disposed horizontally on the lens base and comprise a lifting structure, as described below. A drainage channel, when present, cooperates with the lifting structure to create a temporary film of packaging solution flowing off the lens, and a path, working with gravity to drain that film away. In this way the drainage channel helps to minimize pooling of packaging solution between the back of the lens and lens support structures when the package is opened and the lens support is raised or tilted out of the packaging solution. Drainage channels comprise at least one channel member which extends outward from the arc of the peripheral ring, at least partial peripheral ring or the arc formed by the distal ends of the non-elongated peripheral supports. The drainage channel comprises a gap between two adjacent members or a when a single member is used, a split in the single member. For lens supports without a full peripheral ring, the drainage channel gap may begin at any point inside the lens periphery. For supports with a full peripheral ring, such as those shown in Figures 1C, 1I, and 1M-1O, the drainage channel gap may begin either at the inner edge of the peripheral ring, as shown in Figure 1C, or at any point inside the lens periphery. The drainage channel can extend at least 2 mm, about 2 to about 4mm or about 2.5 to about 3.5 mm in length beyond the peripheral ring or lens periphery if no peripheral ring is included. The drainage channel gap may provide a space outside the periphery of the contact lens for airflow, ensuring that air and packaging solution from the concave surface of the lens can, upon opening, drain without sucking the lens down onto the lens support. Thus, in Fig 1E, the portion of gap 111 which is inside the periphery of the lens, does not substantially participate in drainage.

The upper limit for the length of the drainage channel is defined by the final size of the packaging and if included, the lifting structure.

Referring to Figure 1B, the drainage channel members 115 may be formed by extending adjacent peripheral support sections 105 beyond the arc of the at least partial peripheral ring 109 and joining the distal ends via a crosspiece 114 to form a gap or open channel 111 between the drainage channel members 115. As shown in Figure 1C, the channel members 115 may be attached to and planar with the at least partial peripheral ring 109. As shown in Figure 1D, drainage channel 113 may also be formed

by extending ring support structures 105 from a point 112 inside the lens edge to a point beyond the arc of the at least partial peripheral ring and joined at the distal end by crosspiece 114. The drainage channel may also be formed by attaching the channel members 115 to the arms at any point, including, when the arms are fins, as shown in Figure 1F, to the bottom of the fin. The drainage channel may also be formed by providing a gap in the peripheral ring with planar arms extending therefrom, such that the peripheral ring and drainage slot 113 form a keyhole shape, as is shown in Figure 1C. When present, the peripheral ring/partial peripheral ring may connect to the elongated arms.

The drainage channel members 115 may be straight as shown in Figures 1C-G, may be curved as shown in Figure 1B, may flare out at the peripheral ring arc and taper in from the arc to the distal end or may be tapered from the at least partial peripheral ring to the distal end of the drainage channel. Any taper may be straight or curved. When the drainage channel is tapered, the channel tapers toward the crosspiece 114. The drainage channel may be about 0.8 to about 3mm wide, and when tapered may be about 1mm or about 0.8 mm wide at the distal end or cross piece.

Other drain channel configurations not illustrated or those that combine aspects of the exemplary configurations depicted are possible and within the scope of the appended claims as will be apparent to those skilled in the art in view of the balance of this disclosure. Furthermore, in some embodiments, a drainage channel may be omitted entirely. For example, when the lens support is fixedly angled relative to the bottom of the base, such as in Figure 1H, the drainage channel is not necessary, and the angle of the lens support provides the desired drainage upon opening the package.

Lens Presentation

The package of the present invention may also comprise a lifting structure for lifting the lens support from the lens solution. The lifting structure may present the lens support and lens from the base and packaging solution by any suitable means including tilting the lens support up, tilting the base down, raising the lens support up from the base, lowering the base down, or any combination thereof, and the like.

The drainage channel, in cooperation with other features of the package may function as the lifting means, or the lifting means may include additional structures such as springs, hinges, levers, pivot arms, folds, mechanical traps, handles and combinations thereof. The lifting member may comprise a rigid elongated member extending outward from a structure disposed along the bottom of the lens support, which may form part of the drainage channel. For example, lens supports having elongated drainage channels 115, may include a hinge line in the package base, such as is shown in Figure 2. Such a hinge line may be formed by a flexible sheet as the bottom-most layer of the package base, with molded plastic back and front sections which may abut each other or be separably attached to each other along the line of the fold 216, which allows the front 217 and back 218 of the base to pivot along fold 216, raising the lens support and lens 200 from the packaging solution. When a fold is included, it is preferably located outside the arc of the peripheral ring and transverse to the drainage channel and drainage gap, as is shown in Figure 2. The fold, when included, will define the distal end of the drainage channel, and should be positioned least 1 mm, about 2 to about 4mm or about 2.5 to about 3.5 mm in length beyond the at least partial peripheral ring or lens periphery if no peripheral ring is included. The position of the fold along the channel members may be selected to provide the desired lift separation from the package and drainage of the packaging solution away from the lens support and lens, such that upon separating the lid from the base to open the package, the distal end of the lifting structure pivots downward along the pivot line, the lens support is lifted out of the packaging solution and the solution is drained away from the lens. Upon opening the lifting structure pivots about the fold line to an angle of about 15 to about 80°, about 20° to about 70°, about 30° to about 60° or about 40° to about 60° relative to level.

For lens supports having shorter channel members, such as the keyhole configuration shown in Figure 1C, the fold may be adjacent to the peripheral ring arc, if the peripheral ring is more than 4mm larger than the contact lens diameter. For lens supports with longer channel members, the fold may be located between about 0.2 mm to the distal end of the drainage channel, about 1 mm to the distal end, about 2mm to

about distal end of drainage of the channel member's length from the peripheral ring arc.

The drainage channel member is preferably rigid across the fold line and may be fixedly attached to the front section of the base sheet. Any means for attaching the distal portion of the channel member to the base may be used including, an adhesive, glue, any suitable weld, including, but not limited to heat, ultrasonic or laser welding, or a mechanical trap.

When the drainage channel also functions as a the lifting mechanism, it may have any configuration suitable as a drainage channel, including at least two elongated peripheral supports extending beyond the arc of the at least partial peripheral ring, channel members extending from the peripheral ring, or separate channel members extending from the bottom of the lens support, any of which may connect at their distal end.

The lifting mechanism may also be a flexible attachment 245 between the lens support 236 and lid 235 and is located opposite from the lid removal tab 228, such as is shown in Figure 2B. The flexible attachment can have any suitable structure, include a hinge, a flexible fold, pivot arm, mechanical trap and the like. The action of pulling up tab 228, and lid 235 opens the package and also lifts lens support 236 from the base 240, presenting the lens 200 for removal by the user.

A simple loop, tab or handle could replace hinge 245 as the lifting mechanism. The user could open the lid and raise the lens support from the solution by lifting on the tab or handle.

Other hinge and lever configurations are known in the art, such as those disclosed in US20140027462, DE4415003 and JP6339322. Alternatively, the lens support side sections may be deformable, replaced with a spring structure, or a spring structure may be included under the peripheral supports or peripheral ring, such that in the closed position the lid engages with the lens support to compress the support, without compressing the lens. When the package is opened the spring relaxes and lens support raises the lens above the packaging solution. In this configuration, the peripheral supports, and central support top section (if present) are preferably made from rigid materials to limit contact between the lens to lens support and provide

resistance during lens transfer. Any deformable structures incorporated under the peripheral supports should be designed not to detract from any drainage features included in the lens (including peripheral supports and rings).

It will be appreciated that lifting mechanisms which raise the lens parallel to the base may not need a separate drainage channel.

Either the back, front or both may further comprise a reservoir 219 for capturing the packaging solution when the lens is raised from the base. The bottom of the package may comprise a retortable film, including multilayer films which are used for the packaging of contact lenses, may be formed from molded plastic or may have retortable film bottom, attached to base walls of molded plastic. Any combination of materials may be used for the base, so long as they meet the described performance requirements.

Lid

The package of the present invention further comprises a lid. In conventional contact lens packages the contact lens sits in a molded plastic base, having a bowl to receive the contact lens in a concave, bowl up position. A laminated foil sheet is heat sealed to the molded plastic base. In the package of the present invention, the laminated foil sheet forms the outer layer of the base of the package, and optionally the lid. The lens support and optional package side walls are attached to the base, and a molded plastic lid, or a flexible foil sheet and a molded plastic frame between the lid sheet and the lens, is releasably attached to the package base via a retortable seal, forming a cavity comprising the lens solution, lens and lens support. When the lid comprises a flexible sheet and a molded plastic frame, they may be separate or bonded together by any suitable means, including adhesive, glue, thermal bonding, welding such as heat, ultrasonic or laser welding, or a mechanical trap, and the like.

In addition to sealing the package, the lid may also be designed to control the flow of air into the package upon opening. It is desired that the contact lens remain on the lens support upon opening, instead of sticking to the lid. To achieve this air entering the package upon opening may be directed to travel over the top of the lens first.

Two features have been found to be beneficial in directing the air over the lens upon opening: air entry guides along the inner lid surface and an air entry scoop at the

designed point of opening, such as inside a retortable seal. Packages of the present invention may include, one, both or neither of these features.

The air entry guides provide space for the air to travel above the lens, without getting trapped or diverted and may also cooperate with the lens support to prevent the lens from lifting or sliding off the support structure until some air has entered the package above the lens. The contact area between the air entry guides and the lens is preferably low, less than about 50 mm² or less than about 30 mm².

The air entry guides may be molded into the lid, either on the inside surface of the lid or as a projection from the lid or may be a separate structure disposed between the lens and the lid when the package is sealed. Upon opening the package, the air entry guides direct air entering the package along designed path over the top of the lens, ensuring the lens remains on the lens support in the desired convex orientation. The air entry guides are disposed along the direction the package lid travels upon opening the package. The air entry guides may have any orientation other than perpendicular to the path of desired air flow. When the package is designed to be opened from the front, the air entry guides are preferably disposed from the front of the package to the back and the intentionally designed path is over the lens from the package front to back.

Suitable air entry guides may include prongs 321 projecting from the lid around the periphery of the lens as is shown in Figures 3A and 3B. The prongs may be rigidly mounted to a support ring or a molded plastic ring (Figure 3A) or may be flexibly mounted on a flexible sheet (Figure 3B), such as lidstock. The prongs may be radially disposed around the periphery of the contact lens, generally within 1 mm of the lens edge. The air entry guide can contain prongs around the entire periphery or primarily located along the front, sides or front and sides. The prongs may be adjacent to each other as is shown in Figure 3B or may be spaced apart as is shown in Figure 3A. When radial prongs are used, the optical zone of the lens may be free of prongs to encourage air to travel over the top of the lens while the prongs keep the edges of the lens from sticking to the lid.

The air entry guides may also be in the form of continuous or discontinuous (broken) ribs. The ribs can be attached to the inside surface of the molded lid (Figure 3C) or included via a separate molded structure (Figure 3D). The ribs are aligned

parallel to the path air enters upon package opening. The ribs may be spaced at least about 2 mm apart, about 2 to about 5 mm apart, or 2 to about 4.5 mm apart. The ribs may run in a straight line from front to back (Figures 3C and D) or may curve around the optic zone (Figure 3E) to prevent interaction between the ribs and the contact lens, which can cause optical distortions in high shape memory hydrogels. The ribs may run “edge to edge” across the inside lid surface, or their start or finish may be offset from the edge as shown in Figure 3G.

The ribs may also extend away from the lens, forming recesses(s) 337 projecting up from the lid surface as shown in Figure 3H. Such recesses may act as an air entry guide during opening as well as an air capture space, described below.

The ribs may have straight walls, may be wedge shaped, may comprise an arc, or may have one straight wall and one angled or arc shaped wall. The angled or arc shaped wall may slope along the curvature of the contact lens.

The rib height may be the same from the front of rib to the back (outer ribs in Figure 3B) or may be larger in the front than the back (Figures 3C and 3G). The ribs may have a shorter profile over the optic zone, as shown by the central rib in Figure 3C or there may be a gap in the ribs (“broken ribs” 322b), as shown in Figure 3F. Air entry guides comprising a central rib with a stepped-down rib height across the optical zone are effective in directing the air in the desired direction, while also minimizing contact with the optical zone of the contact lens. As shown in the Figures different height profiles and shapes can be incorporated into a single air entry guide structure.

The ribs may have a height of at least about 2 mm, which may extend from the interior of the lid toward the contact lens or may extend away from the contact lens and define a separate air entry channel. Rib heights may be at least about 2 mm at the highest points, such as those at 522 (the air entry guides outside the optic zone) and 0 to about 0.5 mm at the lowest points, such as those the back of the rib in Figures 3C and 3G or the midsection of the center rib in Figures 3D, E and F. Below a peak rib height of 2mm in at least part of the rib the air bubble may not propagate across the entire top of the lens and the lens may stick to the bowl. Rib heights above about 4 mm may undesirably increase the size of the package and volume of packaging materials and packaging solution needed.

When straight ribs are used with shorter profile in the center rib 322a (Figure 3D), the maximum length of the stepped-down profile along the rib is about 8.5mm. When curved ribs are used with a shorter profile in the in the center rib 322a (Figure 3D), the maximum length of the stepped down profile along the rib is about 9mm.

In addition to minimizing the height profile of the portion of any ribs 322a which traverse the optic zone of the contact lens, adjacent ribs 322b may be curved outside the optic zone. When curved ribs are included, the diameter of the curved rib region may be up to 11 mm or between about 7 to about 11 mm or about 8 and about 11 mm.

When the ribs are part of a separate molded plastic frame, it may comprise cross supports on the back side of the ribs. However, the height of the ribs should ideally maintain at least about 2mm of clearance between the lens and cross supports to provide the desired airflow. Preferably when cross supports are used they are located on the back of the ribs and do not protrude or extend into the pathways defined by the air entry guides. Preferably the air entry guide structure is free of transverse structures, such as cross supports, or has less than 3, or 1 or no cross supports.

When the air entry guides are a separate structure from the lid, as is shown in Figures 3D-F, the air entry guide may also comprise a full or partial ring around the air entry guides, shown as 327 a in Figure 3E and 327b in Figure 3B, respectively. When used, such air entry guides may be attached to the lens support by a hinge (not shown) opposite the front of the air entry guide, to form a clamshell structure around the lens, which can then be sealed in a single folded laminated sheet or sealed between two separate laminated sheets, which may be the same or different.

In addition to forming a sealed cavity to hold the lens and packaging solution, the lid of the present invention may also cooperate with the lens support to maintain the lens centered around the support with minimal contact between the optical zone of the lens and the support and lid. For lenses with high shape memory, the ribs may be designed so that any contact between the lens and the lid or lens support while the package is sealed is transitory.

A second feature that may contribute to air flow control is the air entry scoop 324, shown in Figures 3G and H and as 224 in Figure 2B. When included, the air entry scoop is located at the designed point of opening, inside the retortable seal, which is the

front of the package in Figure 3G. The scoop may be aligned with the opening tab, either directly as shown in Figures 3G and 3H, or may be offset, but aligned with opening tab 228 as shown in Figure 2B. In this embodiment, scoop 324 projects out from the periphery of the contact lens edge at least about 1 mm or at least about 2mm, and is located within the seal. The length of the projection is limited only by the desired size of the package. The air entry scoop has a width between about 2mm and the inner diameter of the seal arc 325. The air entry scoop may be shallower than the lid and may slope into the lid cavity, as is shown in Figure 3G. Aside from the dimensions above the scoop may have any shape including but not limited to round, ovoid, triangular, square rectangular or irregular. Packages of the present invention may forego a separate air entry scoop such as by providing at least about 2mm clearance between the interior lid wall and lens support at the opening tab.

Figure 3G is an inside view of a package lid and skirt region. The lid would be sealed to a film base along seal line 326. The air entry scoop 324 is at the front of the lid and comprises the front section of three broken air entry guide ribs 322a (which traverses the middle of, but has a shallow height within the optic zone) and 322b (which are curved around the optic zone of the lens). The package is opened by pulling up tab 328, which separates the lid from the base starting at the distal end of the air entry tab. The tab may have any form including a foil or plastic tab, grip, ring pull, handle or the like.

Air Bubble Management

For some lenses, it may be desirable to minimize contact between the lens and any air bubble in the package while it is sealed. While it is possible to design a package without any air bubble upon sealing the package (for example by using a two-sided foil pouch as the outer base and lid layers), air may still diffuse into the package over the lens shelf life. Thus, it may be desirable to include features within the package to capture the air bubble away from the lens, preferably in all storage orientations. As discussed above, this may be more desirable with lenses with longer shape memories.

The lids of the present invention may further comprise at least one air capture space away from the lens optic zone for air in the sealed package to occupy. The air

capture spaces are designed such that the air remains in at least one air capture space away from the lens regardless of package orientation. The air capture space may have a volume equal to or slightly greater than the volume of air to be sealed in the package, and any air which may diffuse into the package during storage to insure all the air present at sealing, and any that might diffuse in during storage are retained away from the optical zone of the lens.

The air capture space may be designed in a number of ways. For example, as shown in Figure 3G, the lid may further comprise a depression or dimple 329 above the center of the lens support to force any trapped air up around the periphery 330 of the dimple 329 and away from the lens apex, not shown. The depth of the dimple is selected so that the nadir of the dimple in the lid interior, or any air entry guide does not touch the apex of the lens when the package is sealed. The gap between the optic zone and any air entry guide or dimple is between about 0.25 and about 2 mm. Figure 4A is a drawing of the exterior of a package comprising a lid of the present invention. The dimple 430 is surrounded by an air capture channel 431. The depression formed by the dimple displaces any entrapped air into the air capture channels. The dimple may have a diameter of at least about the diameter of the optical zone of the lens. The combination of the dimple and the air capture channel holds the entrapped air in positions ranging from upright (base down), through 90°. When the package is upside down, the air bubble is above the lens edge, and not a concern.

The channel 431 may have the form of a ring as shown in Figure 4A or may have any other connected shape which provides sections which are higher than the center of the lid. For example, the air capture space may have the form of a continuous channel around the inside seal edge, with sections above and below the apex of the lid, such as shown in Figure 4B, with 3 raised channel portions 431a. The dimensions of the air capture channel may be determined based upon the volume of air to be included in the package and the amount of air which will diffuse in during storage, which can be readily calculated. The channel may have any cross-sectional shape including rounded edges, half round or half oval, rectangular or square. In some embodiments, the channel may have an interior width of about 1.5 to about 3 mm, or about 2 to about 3 mm.

Instead of a channel, or incorporated into the channels, the air capture space may comprise at least two air pods protruding from the lid along the inner seal edge. The raised channel portions 431a in Figure 4B are examples of 3 air pods linked in a continuous channel. The air pods 331a may be linear or arcuate (as shown in Figure 3H), be parallel or transverse to the air entry direction, and may be separated by the dimple or connected by a connecting channel 337. The air capture space may comprise at least one, two, three or more air pods, with or without connecting channels. The air pods may be wider, taller or both wider and taller than the connecting channel.

The air pods and connecting channel may have any cross-sectional shape that can be molded, including rounded edges, half round or half oval, rectangular or square. The connecting channel may have an interior width of about 1.5 to about 3 mm when it is desirable for the air bubble to pass between pods, or about 0.5 to about 2 mm in designs meant to prevent the air bubble from leaving the pod.

Air captures channels and air pods can be included in a lid with or without dimples.

The lens support and lid may be designed to cooperate when in the sealed orientation to keep the lens centered around the support structure without resting on the support structure or lid. This is more important for lenses that have longer shape memory, such as silicone hydrogel lenses, and the optics of the lens can be distorted by extended contact with any packaging feature or any air bubble trapped in the package. Contact between the support, lid and contact lens during storage and shipping may be acceptable with conventional hydrogel contact lenses, as they have shorter shape memory.

The lens support may be designed in a number of configurations to provide the desired drainage and support so long as the primary functionalities of providing sufficient drainage and contact with the lens sufficient to insure consistent "one touch" lens transfer to the finger are met. It will be apparent to those skilled in the packaging art that the packaging features described herein may be used in a variety of combinations to achieve the desired one touch packages. For example, if packaging solution is trapped between the lens and support, the efficiency of the drainage pathways may be increased, for example by increasing the open area beneath the lens

support, decreasing the contact area between the lens and support, decreasing sharp edges and shallow drainage paths, adding a drainage channel, with or without a tilting or lifting means or a combination thereof. If the lens sticks to the lid upon opening, air entry guides and/or an air entry scoop may be added.

The benefits of the packages of the present invention are apparent in use. Figures 5A and B include examples of packages of the present invention having different combinations of features. The figures and descriptions are exemplary only and should not be considered to limit the package designs of the present invention.

Figure 5A shows a view of the open package 500. There is included in the package 500, from top to bottom: a molded plastic lid 535 with a leak-free seal 526 on the outer perimeter of the lid cavity. Beneath lid 535 is air entry scoop 524. The air entry scoop in Figure 5A is an integral structure within the lid but could also be separate structure from the lid. The air entry guides 522 are in the form of broken ribs, and direct the flow of air above lens 550, so that the lens will not adhere to the lid 535 when package 500 is opened.

In the sealed state, the lens 550 is maintained in the space formed between package lid 535 and lens support 536 (lens cavity). The lens cavity may be designed so that lens 535 (particularly in the optical zone) is not compressed during shipping, and only minimally contacts the interior features of the package and maintains integrity until the package is opened. Also, the lens cavity should not provide too large a gap between the lens and interior package features, so that the lens is held in the desired convex orientation relative to the package base during shipping and storage.

A contact lens 550 rests below lid 535, upon lens support 536. The lens support may have a variety of configurations as detailed above. In general, the lens support 536 holds the lens in the desired convex position, with minimal contact area when the package 500 is opened to insure efficient transfer of the lens to the finger of the user. Lens support 536 is placed on the base 540, which has a front base section 516, a base fold line 517 and a base back section with a reservoir 519. The lens support is attached to the front base section 516, so that the lens support and lens can pivot up along fold line 517 from the back base section 518 upon opening. When the package is closed and sealed the base and lid form inner chamber 544. Inner chamber 544 is designed to

hold the correct volume of saline solution to allow the lens, lens support 536 and lid 535 to work together properly. Finally, base 540 also contains an outer reservoir 519, which captures any displaced solution which drains out of inner chamber 544 upon opening the package.

The package is opened by pulling tab 528 upward, which breaks seal 526. Air is introduced into package in a controlled fashion and is guided into the package by air entry guides 522 so that the lens is biased away from package lid 535 and maintained on lens support 536. This gentle force acts in conjunction with the draining of solution from the lens 550 and lens support 536 so that the lens is generally maintained in a "ready to use" position on the lens support 536. As the lid 535 is lifted, the front of the base 540 is lowered, pivoting lens support 536 about fold line 517 to drain the packaging solution from the lens 550 and lens support 536 and present the lens for transfer to the wearer's finger. The central optical zone of lens 550 is generally clear of contact with the arms, other than at the peripheral supports 505. The flat top region 501 provide resistance to enhance the ability to transfer lens 550 to the finger with "one touch".

Lid 535 and reservoir 519 may be polypropylene or any other material which can be used for medical device packaging, and base 540 formed with a foil or laminated film structure which is generally sealed to lid 535 via heat welding or any other method capable for forming a retortable seal.

Figure 5B shows an expanded view of another package of the present invention. The air entry guide has a full peripheral ring 527 and is a separate structure from lid 535. The air entry guide peripheral ring 527 connects to lens support 536 via a flexible connection 545, such as a hinge or a fold. The air entry guide and lens support close around lens 550 like a clamshell and protect the lens 550 from damage and maintain it in the desired position. The base 540 and lid 535 may be made out of any sheet or laminate film, and may be one single sheet folded opposite pull tab 528, or may be two separate sheets which may be made out of the same or different materials.

As shown in Figures 5A and 5B, the features of the package, including the lens support, lid and the air entry guides, no matter how created, may be designed to interact with the lens outside the optical zone to prevent damage to lens optical zone.

When the package is opened, such as by lifting the lid 535 from base 540, the air entry tab 524 and guides 522 direct the air over the lens 550, gently biasing the lens away from the inside of the lid and ensuring the lens remains on the lens support 536. Any packaging solution contained in package 500 is drained away from the lens 550 and lens support 536, such that only minimal packaging solution remains on the back side of the lens 550, and the lens support 536.

This gentle force acts in conjunction with the draining of solution and the arms of the lens support so that the lens is generally presented in a “ready to use” position on the lens support.

Because the contact area between the lens 550 and the lens support 536 are minimized and the packaging solution effectively withdrawn, the wearer can remove lens 550 from the package with a single touch of a finger and adhere the convex side of the lens 550 to the finger. Thus, the apex of lens 550 is positioned on the finger and may be directly applied to the eye with its concave portion placed directly on the eyeball. There is no need for the wearer to transfer the lens from the fingers on one hand to those of the other, as is common with currently designed contact lens packages. This improved series of steps not only is easier and more convenient for the user, but it also reduces contamination due to bacteria carried on the user's fingers.

Thus, the present invention provides packages which effectively channel packaging solution away from the lens and lens support and control the ratio of the contact area between the finger and lens as compared to the area between the lens and the lens support, ensuring that surface tension between finger and lens exceeds surface tension between lens and lens support. The lens thus presented, consistently adheres to the finger, providing a “one touch” lens transfer experience to the wearer.

The packages of the present invention may be manufactured using known materials and processes. The packaging materials may be virgin, recycled or a combination thereof. The volume within the package cavity can vary depending on the design selected.

As described above, not all the features described herein need to be incorporated into every package, and those of skill in the art, using the teachings herein, can combine the features to provide a wide variety of one touch packages. For

example, lens supports with central lens supports may be desirable for lenses with moduli less than about 25 psi, new wearers not used to one touch lens removal, or for wearers with a more forceful touch. Experienced wearers and those with a lighter touch may need packages with only peripheral supports. It will also be appreciated that the packages of the present invention provide numerous opportunities to include ornamental designs and features, for example in the design of peripheral supports and ring, arms, fins, air management pods and channels, as well as overall package shape and profile.

In summary, the contact lens packages of the present invention incorporate several novel functionalities which may be combined in a wide variety of combinations as described herein to provide the desired one touch packaging, including the following.

Preventing the lens from rotating off the support, which may be accomplished by including a minimum of 3 points of contact on the periphery of the lens, which may be arranged in an acute triangle.

Preventing the lens translating horizontally across the support, which may be accomplished by a horizontal or near horizontal contact near the periphery of the lens, where the lens surface is more steeply angled (located outside a central region having a diameter of at least about 5 mm, about 6 mm, or about 7 mm, or the contacts can be just outside the periphery of the lens).

Maintaining the lens, after drainage, in its neutral or near neutral shape for presentation for lens transfer.

This may be accomplished by minimizing contact between the lens apex and the support, which can be done by providing a central lens support with about 0.5 to about 2 mm, about 0.5 to about 1.5 mm, or about 0.8 to about 1 mm clearance between the top of the flat top section and the lens apex or leaving a void at least about 6 mm in diameter and clear from the lens apex to about the level of the base of the lens.

Resistance to the finger when dabbing

It is beneficial to increase finger surface area as well as control dab force and contact time upon dabbing.

For lenses with low moduli this requires a stiffened structure under the apex of the lens, which may also improve the consistency of transfer for lenses with higher moduli, including silicone hydrogels. When present, the height of the structure is no lower than the base of the lens. The support structure may also be less than 2 mm below lens apex.

- The shape of the surface may be flat or slightly concave (e.g. down to a radius of curvature of about 10 mm), but may less preferably be slightly convex (down to a radius of curvature of about 10 mm) or more concave (e.g. down to a radius of curvature of about 6 mm).
- The diameter of the surface should be about 1–10 mm, preferably 6–9 mm (to match fingertip size).
- The surface does not need to be continuous – it may be made up of a series of point or lines.

The optical zone is free floating and contact with the lens support during storage is transitory or non-existent. This can be achieved by making any central supports slightly lower than the profile of the lens (so that the lens only contacts the support at the periphery).

The following test methods were used in the Examples.

The root mean square wavefront error (“RMS error” or “RMS”) measures the deviation of the wavefront of a lens from the intended design wavefront. When the intended design is not known (such as when measuring commercially sourced contact lenses) the RMS can be measured by comparing the wavefront of a lens as packaged and sterilized in a conventional “bowl up” lens package with the same lens repackaged and sterilized in a package of the present invention.

A calibrated dual interferometric method was used for measuring root mean squared (RMS) optical path wavefront deviation from lens design target (“RMS”) in micrometers or microns (μm) with sphere/cylinder power and coma removed as measured using a 6.5 millimeter aperture. The instrument consists of a custom interferometer for the measurement of wavefront parameters and a Lumetrics

OptiGauge® II low-coherence interferometer. The two individual instruments combined are similar to Lumetrics Clearwave™ Plus, and the software is similar to Lumetrics OptiGauge Control Center v7.0 or higher. With the Clearwave™ Plus, a camera is used to find the lens edge, and then the lens center is calculated, which is then used to align a 1310 nanometer interferometer probe at the lens center for the measurement of sagittal height and center thickness. The transmitted wavefront is collected in series using a wavefront sensor (shack-Hartmann sensor). Multiple parameters from the transmitted wavefront of the contact lens are measured, and others are calculated from those measurements.

From the data collected, difference terms are calculated by comparing the measured values from the target. These include root mean squared optical path wave front deviation from lens design target in μm (sphere/cylinder power and coma deviation removed) as measured using a 6.5 millimeter aperture (RMS_65).

The lenses were placed, concave down, in optical quality glass cuvettes free of scratches, cleaning streaks, water spots or condensation and filled with packaging solution. Only lenses which are free from visual defects (non-circular edge, chips, and/or tears in the edge, folded, inverted in the package) were selected for measurement. The lenses were placed freely floating, without trapped air under the lens. The lenses were placed freely floating in the cuvette with care to not deform or damage the optic zone and without trapped air under the lens. The cuvettes with lenses are placed in interferometer, and the measurements are made at 20°C.

Examples

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Examples

The following were used in the Examples, below.

Buffered solution: 1000 g DI water, 13.55 gm NaCl, 27 gm boric acid, 5 gm sodium borate, 0.3 gm EDTA, and having a pH of about 7.4.

Packaging solution: RevitaLens Complete (Alexidine 0.00016%; Polyquaternium-1 0.0003% (PQ-1); EDTA.

Polypropylene: isotactic polypropylene homopolymer, having an MFR of 24 g/10 min, (Lumicene M3766) from Total

Lidstock: multilayer film comprising layers of oriented polypropylene (12 μ m), aluminum foil (50 μ m) and polyester film (12 μ m).

Examples 1-6 and Comparative Examples 1- 2

Several lens support architectures were evaluated to determine support features which can provide desirable lens support, package solution drainage and lens transfer. Each of the evaluated lens supports was 3D printed on a Form 2, using Formlabs Formlabs clear resin. The lens supports were printed with a drainage channel terminating in a 90° lever to allow the support and lens to be lowered and raised from a packaging solution chamber having dimensions 30mm x 45mm x 25mm.

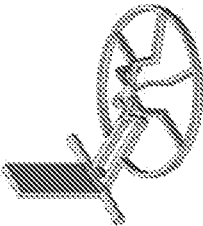
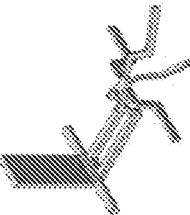
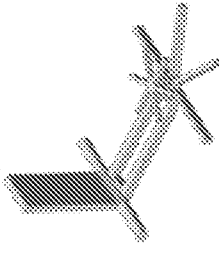
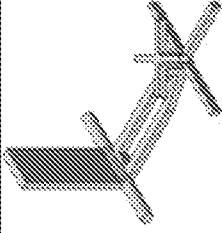
A 1-Day ACUVUE MOIST contact lens was removed from its package and placed on each lens support while the support is submerged in packaging solution to allow for full wetting, and mounting the lens centered on the support. The lens support and lens were submerged in the packaging solution chamber for at least 5 seconds, to insure is fully submerged with no air bubbles remained under the lens. Using an eye dropper, the packaging solution was withdrawn to expose the peripheral support. The support was then slowly pivoted from the remaining packaging solution using the lever and allowed to drain until the solution appeared to have drained from the lens and support or after about 10 seconds, which ever was sooner. The lens was evaluated for permanent fluid films, solution reservoirs and internal bridges between the lens and support. Photographs were taken and evaluated for lens centration, areas of fluid trapped between the lens support arms and the lens and lens deformation.

To ensure a consistent dab surface and simulate a low adhesion finger, a rubber nitrile glove was worn on the hand used for dab testing. The test was repeated at least 5 times for each support design, changing out the lens after 2 repeats.

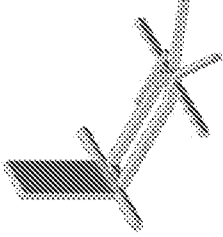
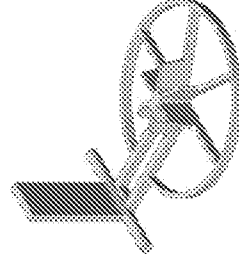
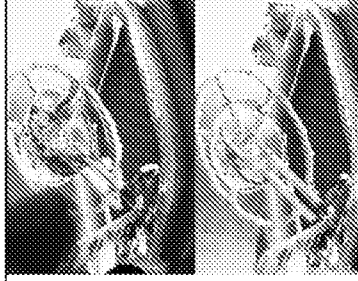
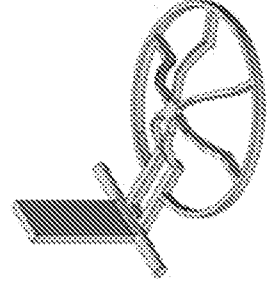
The results are shown in Table 1, along with a representative photograph, and a CAD drawing showing the lens support configuration.

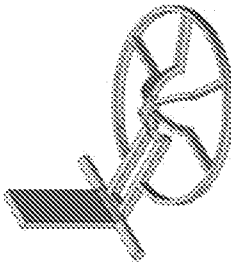
Attorney Docket No.: VTN6069WOPCT1

Table 1

Ex. #	Support	Representative Drainage Photo	1 st time Dab	Perm Films	Reservoirs	Bridges	Drainage Speed	Observations
1			5/5	None	Small	Moderate	Moderate	Lens deformed in multiple test. Solution remaining gathers around lens-support contact points, in particular at the front arms.
2			5/5	None	Small-Medium	Light-Moderate	Moderate	Lens deformed a lot and held solution in early stages of drainage, but did not affect dabbing
3			20/20	None	Small	Light	Fast	Excellent drainage
4			5/5	None	Small	Light	Moderate	Lens deformed a lot and held solution in early stages of drainage

Attorney Docket No.: VTN6069WOPCT1

CE1			0/5	None	Moderate	Severe	Fast	Poor drainage - lens wrapped to the central column. Mostly didn't dab after the second or third attempts.
5			5/5	None	Small	Light	Moderate-Fast	Pretty good initial drainage followed by rapid and almost complete drainage of any remaining solution.
6			5/5	None	Small	Light-Moderate	Slow	Poor initial drainage. Further drainage was slow, relatively thorough, and consistent, with initial bridge reservoir draining well.
CE2			20/20	None	Small	Severe	Moderate	Pretty stuck to the support in every test. Drains the initial bulk solution well but consistently leaves solution around the lens-support contact points.

CE3			0/2	None	Medium- Large	Moderate- Severe	Slow	Lens wrapped onto spokes gives poorer drainage. Convex geometry provided insufficient finger contact
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The drainage for each lens was categorized on the following properties:

Permanent fluid films ("Perm. Films") are films that form between the lens support structure and the (outside) surface of the lens and do not break after drainage. The following rating scale was used:

- Severe (> 50% of lens perimeter covered)
- Moderate (< 50% of lens perimeter covered)
- None

Solution reservoirs ("reservoirs") are larger volumes of solution that are retained on the inside of the lens, after drainage has taken place. The following rating scale was used:

- Large (lots of fluid visible, total volume estimated > 50 μ l)
- Medium (some fluid visible, total volume estimated 20–50 μ l)
- Small (little/no fluid visible, total volume estimated < 20 μ l)

Internal fluid bridges ("Bridges") are regions where fluid menisci bridge between the support structure and the lens. The following rating scale was used:

- Severe (> 15 mm of linear bridges)
- Moderate (5–15 mm of linear bridges)
- Light (< 5 mm of linear bridges)

Drainage speed is the time between lifting the lens out of solution until no more change in drainage is observed. The following rating scale was used:

- Slow (> 5 seconds)
- Moderate (2–5 seconds)
- Fast (< 2 seconds)

As the packaging solution drains from the contact lens, films of packaging solution may form between lens edge and peripheral ring. Films formed at beginning of drainage are good, and for lens supports with good drainage, the films break before drainage is completed. Residual films remaining once drainage has stabilized can interfere with lens transfer. Films noted in the tables are residual films that remained once drainage had stabilized.

Examples where the lens deforms and wraps onto the support structure tend to hold more solution in the lens. This can be detrimental to dabbing (Comparative Example 1), or slow down drainage (Example 4). The arrangement of both peripheral supports and central supports are important in reducing and preventing wrapping. Lens wrapping is significantly reduced with 6 peripheral supports (Example 3) compared to 4 peripheral supports (Example 4). A poorly distributed central support (Comparative Example 1) had much more wrapping than a well-distributed central support (Example 3).

The peripheral ring can also reduce lens wrapping, due to the surface tension of the films formed around the periphery of the lens. Example 1 showed less lens wrapping than Example 2 (no ring).

Example 5 is the same lens support as Example 3, but with a peripheral ring added around the peripheral supports. Both Example 5 and 3 showed excellent drainage speed (moderate-fast and fast respectively) and excellent drainage efficiency evidenced by no permanent fluid films, small solution reservoirs and only light internal fluid bridges.

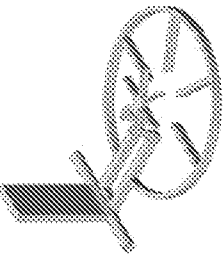
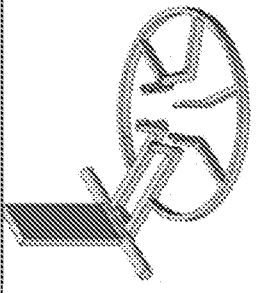
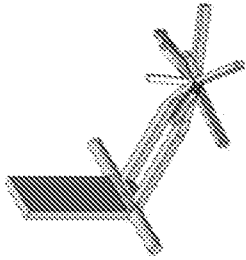
Example 6 is the same lens support design as Example 2, but the arms are solid fins which connect to the peripheral supports. The filling in the arm structures slowed the drainage speed, but the drainage efficiency was the same as Example 2, confirming that lens supports of the present invention with open arms or solid fins can provide good drainage and consistent lens transfer. The comparison between Example 2 and Example 6 also shows that drainage speed may be decreased by removing structures below the lens support (such as solid fins).

The lens support of Comparative Example 2 has a similar structure to Example 1, but with curved side sections, which formed severe internal fluid bridges which caused the lenses to stick to the lens support, creating undesirably high lens to support contact area. The increased contact resulted in a 0% transfer rate upon finger dabbing. Thus, support structures that form more solution bridges are less likely to dab successfully. The lens support of Comparative Example 3 had a fully curved lens support, with a smaller radius than the lens support of Comparative Example 2, but still evidenced undesirable solution reservoirs and internal fluid bridges. Comparative Example 3 also had a fully curved top section, which provided insufficient contact area between the lens and finger upon dabbing (0% first time dabbing success).

Comparative Example 3-4 and Example 7-8

The lens support testing was repeated as described in Examples 1 using the lens supports shown in Table 2.

Table 2

Ex. #	Support	Representative Drainage Photo	1 st time Dab	Perm Films	Reservoirs	Bridges	Drainage Speed	Observations
7			5/5	None	Small	Light	Fast	Minimal initial fluid retention around the support structure. The only place significant fluid is initially held is around the front arms.
CE3			2/5	None	Small	Moderate	Fast	Mode initial drainage. Suffer lens r shapil Many resen arms.
CE4			4/6	None	Medium	Moderate	Moderate	Fairly amou trapped soluti initiali Mosti well. Some left at ter.

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								Lens apex occasionally sunken

The lens support of Example 7 has the same structure as Example 1 except 4 of the side sections were removed, which resulted in faster and more efficient drainage. The lens supports of Examples 1, 5 and 7 show that lens supports having substantially flat top regions and peripheral supports with a variety of side or center column supports provide both excellent drainage and lens transfer. Examples 8 and 9 show that drainage can be improved by removing some or all of the side sections from the lens support. Comparative Examples 3 and 4 and Example 8 show that the arms in the flat top section can be removed and the top of the side section can provide the functionality of the flat top. Comparing Example 8 to Comparative Example 4, it can be seen that drainage and lens transfer can be improved by widening the width of the central void at the base. The lens support of Comparative Example 4 provided slightly worse drainage than Example 8 as packaging solution could pool in the base of the cone in Comparative Example 4. This was readily improved by widening

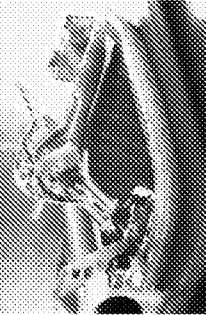
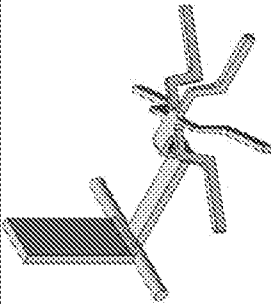
Attorney Docket No.: VTN6069WOPCT1

the width of the central void at the base (Example 8). Comparing Example 8 to Comparative Example 3 shows that increasing the angle of the side arms away from the lens decreases solution bridges and improves drainage speed.

Comparative Example 5

Example 2 was repeated except that the drainage gap between the elongated peripheral support was filled in. The results (with the data from Example 2 copied for ease of reference) are shown in Table 3, below.

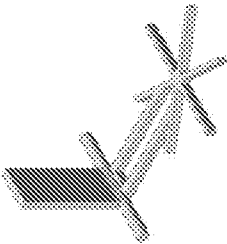
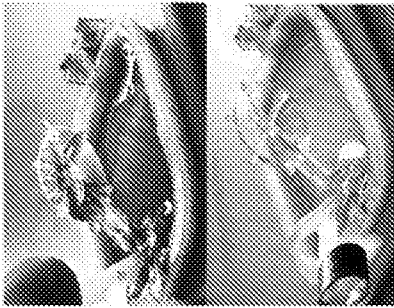
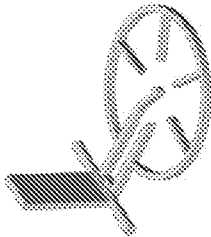
Table 3

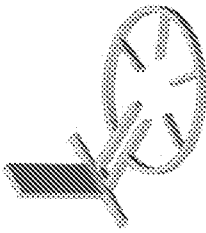
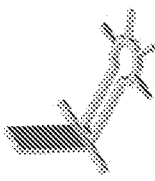
Ex. #	Support	Representative Drainage Photo	1 st time Dab	Perm Films	Reservoirs	Bridges	Drainage Speed	Observations
2			5/5	None	Small-Medium	Light-Moderate	Moderate	Lens deformed a lot and held solution in early stages of drainage, but did not affect dabbi
CE5			0/5	None	Medium-Large	Moderate	Slow	Reasonable initial drainage. Minimal further drainage after initially being removed from solution. Solution remaining on the lens prevented transfer to the finger.

Examples 9-10 and Comparative Examples 6-7

The procedure of Example 1 was repeated but lens supports comprising peripheral supports without any central supports were evaluated. The results are shown in Table 4, below.

Table 4

Ex. #	Support	Representative Drainage Photo	1 st time Dab	Perm Films	Reservoirs	Bridges	Drainage Speed	Observations
9			5/5	None	Small-Medium	Light-Moderate	Moderate	Poor initial drainage with significant lens deformation. In some cases the lens drained entirely allowing it to pop back up (although this wasn't necessary for successful transfer).
10			6/8	None	Small	Light-Moderate	Fast	Excellent immediate drainage. Lens was able to slide around on the support. The lens sometimes didn't pop back up very easily, but dabbing helped.

CE6			2/5	None	Small	Light	Fast	Excellent immediate drainage. Lens moved around a lot during drainage. Lens often caught on the spokes. No resistance to dab made it hard to transfer.. Lens apex occasionally sunken	The lens center collapsed onto the hexagonal central ring and didn't 'pop' back up. The lens didn't move during drainage.
CE7			0/3	None	Small-Medium	Moderate	Moderate		

Examples 9, 10 and Comparative Example 6 displayed significant lens movement during opening, which could be improved by providing one or more positioning guide along the top of one or more of the peripheral supports. Examples 9 and 10 show that lens supports with only peripheral supports and no central column can provide good drainage and lens transfer. Example 10 had an 8 mm gap between opposite peripheral supports, with one side of the drainage channel extending to the center of the support. The lens support of Comparative Example 6 is similar to that of Example 10, but without a peripheral support arm extending under the center of the lens. The lack of a structure in the center of the lens, caused the lenses to collapse in the center during drainage or upon attempted lens transfer, and also provided insufficient resistance during lens transfer. The ACUVUE Moist lenses used have a very low modulus, and lenses with higher moduli, such as silicone hydrogels, will not collapse as readily. As is shown by Examples 9 and 10, extending at least one peripheral support arm under the lens center decreases the collapse of the lens in the center, and provides good lens transfer. A flat dome can be designed with sufficient surface area to suck the lens to the dome to prevent the lens moving (Comparative Example 10) but it also prevents dabbing.

Examples 11-14

Example 7 was repeated varying the diameter of the peripheral ring as shown in Table 5. The support having a peripheral ring of 16 mm trapped solution between the lens and support. The supports with 18 and 25 mm peripheral rings both provided good drainage with few reservoirs of trapped packaging solution. While the 16 mm diameter used in the support for Example 14 was too small for a lens with a diameter of 14.2 mm, it would be acceptable for a lens with a smaller diameter.

Table 5

Ex. #	Ring Diameter (mm)	1 st time dab	Observations
11	14	2/10	Of the 8 failures 5 transferred on the

			second transfer attempt. Very good drainage but the outer diameter still seemed stuck to the ring.
12	16	5/10	Of the 5 failures 3 transferred on the second transfer attempt.
13	18	8/10	Of the 2 failures 2 transferred on the second transfer attempt.
14	23	5/10	Of the 5 failures 4 transferred on the second transfer attempt

Examples 15-16, Comparative Example 8-10

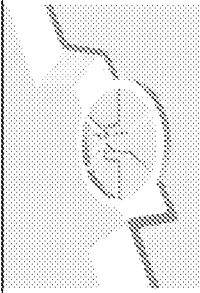
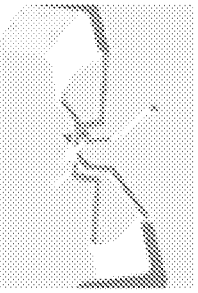
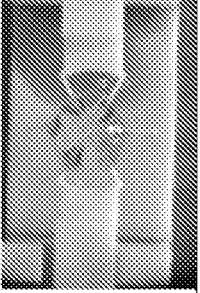
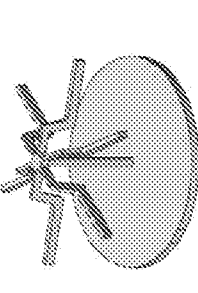
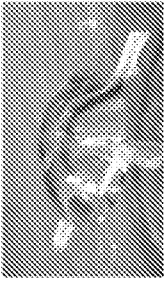
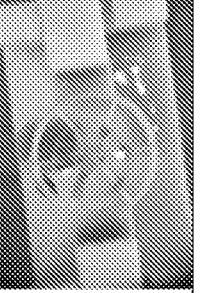
Several lens support architectures were evaluated to determine support features which can provide desirable lens support, package solution drainage and lens transfer. Each of the evaluated lens supports was 3D printed on a Form 2, using Formlabs Formlabs white resin. The lens supports were printed with "L" shaped grips on opposite sides of the lens support to allow the support and lens to be lowered and raised from a packaging solution chamber having dimensions 30mm x 45mm x 25mm.

A 1-Day ACUVUE MOIST contact lens was removed from its package and placed on each lens support while the support is submerged in packaging solution to allow for full wetting, and mounting the lens centered on the support. The lens support and lens were submerged in the packaging solution chamber for at least 5 seconds, to insure is fully submerged with no air bubbles remained under the lens. The lens holder was slowly lifted out of the chamber and set on a support of a similar size to the solution chamber, but with only two sides to support the grips. The lens holder was allowed to drain for about 10 seconds (until the drainage stopped changing) before evaluating the drainage and lens transfer. Photographs were taken and evaluated for lens centration, areas of fluid trapped between the lens support arms and the lens and lens deformation.

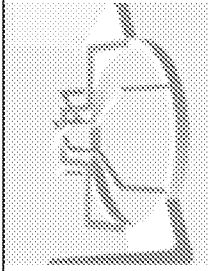
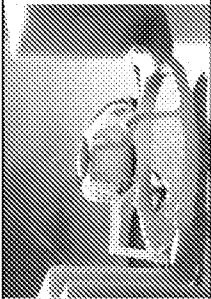
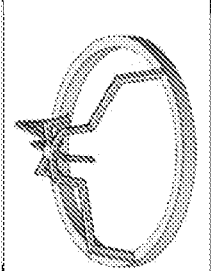
To ensure a consistent dab surface and simulate a low adhesion finger, a rubber nitrile glove was worn on the hand used for dab testing. The test was repeated at least 5 times for each support design, changing out the lens after 2 repeats.

The results are shown in Table 6, along with a representative photograph, and a CAD drawing showing the lens support configuration.

Table 6

Ex. #	Support	Representative Drainage Photo	1 st time Dab	Perm Films	Reservoirs	Bridges	Drainage Speed	Observations
CE8			0/2	Severe	Large	Severe	Slow	Films form between lens and ring and do not break
CE9			0/5	Moderate	Large	Severe	Slow	Poor drainage Considerable solution bridging and reservoirs
CE 10			0/5	None	Large	Severe	Slow	Bad drainage. The lens held lots of solution. No further drainage as being removed from pool.
15			4/5	None	Small-Medium	Light-Moderate	Moderate	When films formed between the ring and edge of the lens the drainage was good.

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					7/10	None	Light-Moderate	Light-Moderate	Fast		
16											

Drainage and hence dabbing are better when a vertical or highly angled fluid film is formed between the lens and the drainage reservoir (base of the pack or test setup) and breaks before dabbing. Example 15 formed fluid films between the periphery of the lens and the lower peripheral ring and drained well. Comparative Example 10 and Comparative Example 9 did not form vertical films and both drained poorly despite having very similar geometry to Example 15. The lens supports of Example 15, which had a flat top section and straight side sections with a width at the elbow of 7mm, provided good drainage with minimal lens-lens support contact, which provided consistent first-time transfer on finger dabbing (80%).

In cases when the films broke prematurely in Example 15, the lens did not drain as well.

Horizontal films are not sufficient for drainage. Films are formed between the lens and the outer ring in Comparative Example 8, however the lens still didn't drain. Horizontal films also tend to be much more difficult to break, and hence impede lens removal.

Examples 17-2 and Comparative Example 11

ACUVUE OASYS 1Day lenses were packaged in polypropylene packages having the general configuration shown in Figure 5A (polypropylene lid, with polypropylene lens support affixed to a laminate foil base, having a cavity volume of about 1150 μ L). The lenses were sealed in the packages with the buffered solution as shown in Table 8, steam sterilized for 18 minutes at 121°C with the package base on the bottom and lid on top ("foil up"). The lenses were kept at room temperature in the foil up configuration. The RMS was for each lens, and the results are shown in Table 10, below. The number of samples used for each packaging solution is listed in the second column of Table 10. The control lenses were ACUVUE OASYS 1Day lenses in their original unopened packages, which were re-sterilized with the lenses of Examples 17-20. The RMS values were measured and are reported as the average.

Table 10

Ex. #	# repeats	PS Volume (μ L)	RMS (ave)	RMS (std dev)
17	11	1000	0.164	0.054
18	10	1050	0.074	0.050
19	12	1100	0.054	0.050
20	11	1150	0.029	0.008
CE11	15	Control	0.024	0.005

Both the magnitude and variability of the RMS values decreased as the volume of packaging solution increased to the maximum fill value, and the air bubble correspondingly decreased. With the dome on top and the lens in the convex position, the air bubble rested on and interacted with the optical zone of the contact lens, inducing optical distortions as shown by the higher and more variable RMS values for Examples 17 and 18. The volume of solution in Example 20 filled the cavity, so there was no air bubble to interact with the contact lens, and the Example 20 lenses show an average RMS of 0.029 $\pm$ 0.008. Example 19 also displayed acceptable RMS values, although they were more variable than the lenses of Example 20. Contact lens wearers can notice distortions having RMS values of about 0.1.

Polypropylene will allow some air to diffuse into the package cavity overtime, so even if the cavity is filled with packaging solution (no air bubble), and air bubble can form during storage. Packages which have foil sheets as the out layers can prevent the formation of an air bubble.

The present invention includes the following embodiments/elements/features in any order and in any combination.

1. A contact lens package comprising
a support for maintaining a contact lens in a convex position on the support during storage and upon opening the package; wherein
the lens has a peripheral edge and a lens profile;

the support has a profile that does not substantially match the lens profile; and wetted contact between the support and the lens is less than about 20 mm², less than 18mm² or less than 15 mm².

2. A contact lens package comprising
a package base;
a package lid; and
a support for holding, in a convex position relative to the package base, a contact lens having a peripheral edge and a lens profile;

wherein the base and lid are sealed to form a cavity comprising the support, contact lens and packaging solution;

wherein the lens support comprises a plurality of peripheral supports which have a distal end extending at least 1 mm beyond the contact lens peripheral edge and provide at least 3, 3 to 14, 4 to 14, 3 to 8 or 4 to 8, 4 to 6 or 6 points of contact with the contact lens edge along the peripheral supports and wetted contact between the support and the lens after the package has been opened and the packaging solution has been directed away from the lens and support, is less than about 20 mm², less than 18mm² or less than 15 mm².

3. The contact lens package of claims 1 or 2 wherein the support allows packaging solution to drain from the lens and support when removed from the packaging solution without trapping packaging solution between the lens and lens support.

4. The contact lens package of claims 1 or 2 wherein the lens further comprises an optic zone and the lens support further comprises, under at least a portion of the contact lens optic zone, a substantially flat top section with an open structure.

5. The contact lens package of claims 1 or 2 wherein said support further comprises a void under at least a portion of the contact lens optical zone.

6. The contact lens package of claims 1 or 2 wherein the contact lens is maintained in an uncompressed state when the package is sealed.
7. The contact lens package of claims 1 wherein said support comprises at least two peripheral supports.
8. The contact lens package of claim 2 or 7 wherein the peripheral supports are distributed around the lens periphery.
9. The contact lens package of any of the foregoing claims wherein the lens comprises an apex centered in the optic zone, the support further comprising a central support having a height, measured from the lens periphery, of not greater than 0.5mm below the contact lens apex.
10. The contact lens package of claim 9 wherein the central lens support further comprises a diameter of about 1 to about 10 mm, about 3 mm to about 9mm, about 5 mm to about 9mm, or about 6mm to about 9mm.
11. The contact lens package of claims 9 or 10 wherein the central lens support has open structure.
12. The contact lens package of claim 11 wherein said central lens support comprises a central column under the lens apex.
13. The contact lens package of claim 11 wherein said central lens support comprises a plurality of arms each arm comprising:
a flat top section, an optional side section and an optional peripheral support, a shoulder transition connecting the top and optional side sections, and an optional elbow transition connecting the optional side and optional peripheral support.

14. The contact lens package of claim 13 wherein the plurality of arms in the flat top section connect to each other in a center point under the lens apex, or connect to an open full or partial ring centered under the lens apex.
15. The contact lens package of claim 13 wherein the plurality of arms are in the form of fins connected to the package base.
16. The contact lens package of claim 13 wherein one end of at least some of the plurality of arms is attached to the peripheral lens supports and project upward and distal ends of the arms form the flat top section.
17. The contact lens package of any of the foregoing claims wherein at least some of the distal ends the peripheral supports are connected to vertical supports which raise the peripheral supports from the lens base.
18. The package of claims 2 to 17 further comprising at least a partial ring around the distal ends of the peripheral supports, at least 2mm beyond the contact lens peripheral edge.
19. The package of claim 13 -18 further comprising three to eight arms.
20. The package of claims 13-18 further comprising three to six arms.
21. The package of claim 13-20 wherein at least two of said arms have a Y shape.
22. The package of claim 13-20 having 3 Y-shaped arms.
23. The package of claim 13-20 comprising 2 straight arms and 2 Y-shaped arms.
24. The package of claim 21-23 wherein said Y-shaped arms comprise a curve across a top portion of the Y.

25. The package of any of claims 13-20 wherein said arms are straight.
26. The package of claim 18 wherein at least partial ring has a diameter of between about 16 and about 25 mm, about 18 and about 25 mm or about 18 and about 24 mm.
27. The package of claim 4 wherein said substantially flat top portion has a height of 0.5 mm, about 0.5 to about 2 mm, 0.5 to about 1.5 mm, or about 0.8 to about 1mm of deflection from the contact lens apex in an undeformed state.
28. The package of any of claims 9-27 wherein the support further comprises a central fillet centered in the flat top section having a width of about 0.1 to about 3mm; about 0.1 to about 2mm, or less than 1.5mm across its longest dimension.
29. The package of claims 13-28 wherein each of the arms and peripheral supports have a width of about 0.5 to about 1.5mm, about 0.5 mm to about 1 mm, or about 0.5 mm to about 0.7 mm.
30. The package of claims 13 to 29 wherein the arms have a width which provides part moldability and efficient packaging solution drainage upon opening.
31. The package of claims 13-30 wherein each arm has a height at the flat top section of about 0.5 to about 5 mm.
32. The package of any of claims 9 to 29 wherein the flat top has a center point in the center of the lens support and the shoulders are disposed radially around the flat top center.
33. The package of claim 32 wherein the arms attach at the center point and each arm has a length from the shoulder to the center point of about 1.5 to about 4 mm.

34. The package of any of the claims 9-33 wherein the angle from vertical at the flat top and side sections of the arm is up to about 15°, or between about 1° and about 10°.

35. The package of any of the foregoing claims wherein the angle between the side section and the peripheral support is between about 60° and about 120°, or about 80° and about 100°.

36. The package of any of the foregoing claims wherein the arms connect in the center of the flat top portion.

37. Package of any of the foregoing claims wherein the arms are radially distributed around the center of the support structure.

38. The package of any of the foregoing claims wherein the base is substantially flat.

39. The package of any of the foregoing claims wherein the lens does not contact the arm side sections.

40. The package of any of the foregoing claims wherein the arm side sections are straight.

41. The package of any of the foregoing claims wherein at least one peripheral support is elongated and comprises an opening extending distally at or before the periphery of the contact lens to form a drainage channel for the drainage of packaging solution from the contact lens and support structure.

42. The package of claim 41 wherein at least 2 peripheral supports are elongated and connected at their distal end with an opening therebetween to form the drainage channel.

43. The package of claims 41-42 wherein the partial ring connects to the elongated arms.

44. The package of claims 41-43 wherein the elongated arms are planar.
45. The package of claims 2 wherein the partial ring comprises an outwardly extending tab with an open drainage channel for the drainage of packaging solution from the contact lens and support structure.
46. The package of claims 41 through 45 wherein the drainage channel is tapered toward the outwardly extending tab distal end, curved from the peripheral ring arc to the distal end, flares out at the peripheral ring arc and taper in from the arc to the distal end.
47. The package of claims 41 through 45 wherein the drainage channel has straight walls.
48. The package of claims 41 through 47 wherein the drainage channel is about 2.5 to about 3.5 mm in length measured from an arc of the peripheral ring.
49. The package of claims 41 through 47 wherein the drainage channel has a width of about 0.8 to about 3mm wide.
50. The package of claims 41 through 47 wherein the drainage channel is tapered and has a width of about 1mm to about 0.8 mm wide at the distal end.
51. The package of any of the foregoing claims wherein the support is made from a polymer having a contact angle of greater than 100°.
52. The package of any of the foregoing claims wherein the lens support is disposed at an angle of at least about 20° from the package base.
53. The package of any of claims 2-52 wherein said peripheral supports are parallel to the package base, and at least about 4 mm or at least about 5mm from said package base.

54. The package of any of the foregoing claims further comprising a means for lifting the lens support from the lens solution.

55. The package of claim 54 wherein the lifting means is selected from levers, springs, hinges, pivot arms, folds, mechanical traps, handles and combinations thereof.

56. The package of claim 41, 42 or 45 wherein the lifting means comprises the drainage channel fixedly attached at the drainage channel distal end to the package base, and a hinge line in the package base, transverse to the drainage channel between the at least partial peripheral ring or an arc formed by the distal ends of the peripheral supports and the fixed attachment point between the drainage channel and package base.

57. The package of claim 56 wherein the hinge line is at least 1 mm, about 2 to about 4mm or about 2.5 to about 3.5 mm in length beyond the at least partial peripheral ring or lens periphery if no peripheral ring is included in the lens support.

58. The package of claim 54 wherein the lifting means raises the lens from the packaging solution by tilting the lens support and base away from each other to an angle of about 15 to about 80°, about 20° to about 70°, about 30° to about 60° or about 40° to about 60° relative to level.

59. The package of any of the foregoing claims further comprising a reservoir for capturing packaging solution when the lens and support are separated from the package base.

60. A contact lens package comprising
a support for holding, in a convex position relative to the support, a contact lens having a convex surface; and
a lens facing surface comprising at least one air entry guide configured such that, upon opening the package by a user, the at least one air entry guide guides air entering

the package over the contact lens convex surface to reduce the incidence of the convex lens surfaces sticking to the interior surface.

61. The contact lens package of claim 60 wherein the package interior defines a cavity comprising the support, at least one air entry guide, contact lens and packaging solution; and

upon opening the package and draining the packaging solution from the lens and the but prior to contact by a user's finger the lens maintains a convex shape on the lens support, and the support contacts the lens in at least two points distributed around the lens periphery.

62. The package of claims 60 or 61 wherein the lens has a profile and the support has a profile that does not substantially match the lens profile.

63. The package of claim 60- 62 wherein the contact area between the support and the lens after the package is less than about 20 mm², less than 18mm² or less than 15 mm².

64. The package any of the foregoing claims wherein the package further comprises a base comprising a laminated foil sheet.

65. The package of claims 60-64 wherein contact area between the at least one air entry guide and the lens is less than about 50 mm² or less than about 30 mm².

66. The package of claims 60-65 wherein the air entry guides are integral with the lens facing surface as projections from the lens facing surface, or recesses in the lens facing surface.

67. The package of claims 60-65 wherein the air entry guides are part of a separate structure disposed between the convex lens surface and the lid lens facing surface.

68. The package of claims 60-67 wherein the air entry guides are aligned parallel to a path air enters upon package opening.
69. The package of claims 60-68 wherein the air entry guides spaced at least about 2 mm apart, about 2 to about 5 mm apart, or 2 to about 4.5 mm apart.
70. The package of claims 60-69 wherein the contact lens comprises an optic zone, and a curved lens side section between the optic zone and the peripheral edge, and the air entry guides run in a straight line from the package front to back, curve around the optic zone or a combination thereof.
71. The package of claims 70 wherein the air entry guides traversing the optic zone have a shorter profile over the optic zone.
72. The package of claims 55-71 wherein the air entry guides comprise continuous ribs, discontinuous ribs and combinations thereof.
73. The package of claims 60-72 wherein the air entry guides have a maximum height of at least about 2mm, or about 2mm to about 4 mm.
74. The package of claims 71 wherein the air entry guide profile over the optic zone has a height of about 0.5mm or less.
75. The package of claims 60-74 wherein said lid facing surface is an interior surface of a package lid; and the package further comprises a base, which with the lid forms the cavity containing the lens support, lens and packaging solution;

the package further comprising an opening tab for initiating the separation of the lid from the base along a seal line forming the cavity, and an air entry scoop inside the seal line and in line aligned with the opening tab.

76. The package of claim 75 wherein the air entry scoop projects out from the periphery of the contact lens edge at least about 1 mm or at least about 2mm.

77. The package of claim 75 or 76 wherein the air entry scoop has a width between about 2mm and an inner diameter of the seal.

78. The package of claims 75-77 further comprising an opening tab for initiating the separation of the lid from the base along a seal line forming the sealed cavity, wherein there is at least about 2mm clearance between the seal line and lens support at the opening tab.

79. The package of claims 75-78 wherein the air entry tab further comprises at least one air entry guide.

80. The package of claims 60 to 79 wherein the lens support, lens facing surface and at least one air entry guide cooperate to maintain the lens centered around the support with minimal contact between the lens, the support and at least one air entry guide.

81. The package of claim 80 wherein contact between the lens, the at least one air entry guide and the support is transitory.

82. The package of claims 60-81 further comprising an air capture space away from the lens optic zone for air in the cavity to occupy.

83. The package of claim 82 where the air remains in the air capture space away from the lens regardless of package orientation.

84. The package of claims 82-83 wherein the air capture space has a volume equal to or slightly greater than the volume of air to be sealed in the package.

85. The package of claims 82-83 wherein the air capture space has a volume equal to or slightly greater than the volume of air sealed in the package, and any air which may diffuse into the package during storage.

86. The package of claims 75-85 wherein the lid comprises a concave dome over the lens and lens support, the concave dome comprising a depression centered above the lens support.

87. The package of claims 82-87 wherein said air capture space comprises a channel around the circumference of lid, inside the seal.

88. The package of claim 86 where the air capture space is disposed around the depression circumference.

89. The package of claim 82-86 wherein the air capture space comprises at least two air pods protruding from the lid along the periphery of the lid, inside the seal.

90. The package of claims 88 further comprising one, two, three or more air pods protruding from the lid along the inside of the seal line.

91. The package of claim 88 wherein the air pods are linear, arcuate, or a combination thereof.

92. The package of claim 90 comprising two planar air pods spaced across the lid and oriented parallel or perpendicular to the opening tab.

93. The package of claims 82 through 92 wherein the air pods are connected via a connecting channel.

94. The package of claim 93 wherein the air pods are wider, taller or both wider and taller than the connecting channel.

95. The package of claims 93-94 wherein the channel has an interior width of about 1.5 to about 3 mm, or about 2mm about 3 mm.

96. The package of claims 60 through 95 comprising, when the package is sealed, at least about 0.25 mm and about 2 mm clearance between the lens optic zone and any air entry guide or dimple.

97. The package of any of the foregoing claims where the base and lid are a single unitary part.

98. The package of any of the foregoing claims where the base and lens support are a single unitary part.

99. The package of any of the foregoing claims where the base, lens support and lid are a single unitary part.

It is to be understood that the present invention is to be determined from the appended claims and their equivalents.

We Claim

1. A contact lens package comprising
 - a. a support for maintaining a contact lens in a convex position on the support during storage and upon opening the package; wherein
 - b. the lens has a peripheral edge and a lens profile;
 - c. the support has a profile that does not substantially match the lens profile; and wetted contact between the support and the lens is less than about 20 mm², less than 18mm² or less than 15 mm².
2. A contact lens package comprising
 - a. a package base;
 - b. a package lid; and
 - c. a support for holding, in a convex position relative to the package base, a contact lens having a peripheral edge and a lens profile;
 - d. wherein the base and lid are sealed to form a cavity comprising the support, contact lens and packaging solution;
 - e. wherein the lens support comprises a plurality of peripheral supports which have a distal end extending at least 1 mm beyond the contact lens peripheral edge and provide at least 3, 3 to 14, 4 to 14, 3 to 8 or 4 to 8, 4 to 6 or 6 points of contact with the contact lens edge along the peripheral supports and wetted contact between the support and the lens after the package has been opened and the packaging solution has been directed away from the lens and support, is less than about 20 mm², less than 18mm² or less than 15 mm².
3. The contact lens package of claims 1 or 2 wherein the support allows packaging solution to drain from the lens and support when removed from the packaging solution without trapping packaging solution between the lens and lens support.

4. The contact lens package of claims 1 or 2 wherein the lens further comprises an optic zone and the lens support further comprises, under at least a portion of the contact lens optic zone, a substantially flat top section with an open structure.
5. The contact lens package of claims 1 or 2 wherein said support further comprises a void under at least a portion of the contact lens optical zone.
6. The contact lens package of claims 1 or 2 wherein the contact lens is maintained in an uncompressed state when the package is sealed.
7. The contact lens package of claims 1 wherein said support comprises at least two peripheral supports.
8. The contact lens package of claim 2 or 7 wherein the peripheral supports are distributed around the lens periphery.
9. The contact lens package of any of the foregoing claims wherein the lens comprises an apex centered in the optic zone, the support further comprising a central support having a height, measured from the lens periphery, of not greater than 0.5mm below the contact lens apex.
10. The contact lens package of claim 9 wherein the central lens support further comprises a diameter of about 1 to about 10 mm, about 3 mm to about 9mm, about 5 mm to about 9mm, or about 6mm to about 9mm.
11. The contact lens package of claims 9 or 10 wherein the central lens support has open structure.
12. The contact lens package of claim 11 wherein said central lens support comprises a central column under the lens apex.

13. The contact lens package of claim 11 wherein said central lens support comprises a plurality of arms each arm comprising:
 - a flat top section, an optional side section and an optional peripheral support,
 - a shoulder transition connecting the top and optional side sections, and an
 - optional elbow transition connecting the optional side and optional peripheral support.
14. The contact lens package of claim 13 wherein the plurality of arms in the flat top section connect to each other in a center point under the lens apex, or connect to an open full or partial ring centered under the lens apex.
15. The contact lens package of claim 13 wherein the plurality of arms are in the form of fins connected to the package base.
16. The contact lens package of claim 13 wherein one end of at least some of the plurality of arms is attached to the peripheral lens supports and project upward and distal ends of the arms form the flat top section.
17. The contact lens package of any of the foregoing claims wherein at least some of the distal ends the peripheral supports are connected to vertical supports which raise the peripheral supports from the lens base.
18. The package of claims 2 to 17 further comprising at least a partial ring around the distal ends of the peripheral supports, at least 2mm beyond the contact lens peripheral edge.
19. The package of claim 13-18 further comprising three to eight arms.
20. The package of claims 13-18 further comprising three to six arms.
21. The package of claim 13-20 wherein at least two of said arms have a Y shape.

22. The package of claim 13-20 having 3 Y-shaped arms.
23. The package of claim 13-20 comprising 2 straight arms and 2 Y-shaped arms.
24. The package of claim 21-23 wherein said Y-shaped arms comprise a curve across a top portion of the Y.
25. The package of any of claims 13-20 wherein said arms are straight.
26. The package of claim 18 wherein at least partial ring has a diameter of between about 16 and about 25 mm, about 18 and about 25 mm or about 18 and about 24 mm.
27. The package of claim 4 wherein said substantially flat top portion has a height of 0.5 mm, about 0.5 to about 2 mm, 0.5 to about 1.5 mm, or about 0.8 to about 1mm of deflection from the contact lens apex in an undeformed state.
28. The package of any of claims 9-27 wherein the support further comprises a central fillet centered in the flat top section having a width of about 0.1 to about 3mm; about 0.1 to about 2mm, or less than 1.5mm across its longest dimension.
29. The package of claims 13-28 wherein each of the arms and peripheral supports have a width of about 0.5 to about 1.5mm, about 0.5 mm to about 1 mm, or about 0.5 mm to about 0.7 mm.
30. The package of claims 13 to 29 wherein the arms have a width which provides part moldability and efficient packaging solution drainage upon opening.
31. The package of claims 13-30 wherein each arm has a height at the flat top section of about 0.5 to about 5 mm.

32. The package of any of claims 9 to 29 wherein the flat top has a center point in the center of the lens support and the shoulders are disposed radially around the flat top center.
33. The package of claim 32 wherein the arms attach at the center point and each arm has a length from the shoulder to the center point of about 1.5 to about 4 mm.
34. The package of any of the claims 9-33 wherein the angle from vertical at the flat top and side sections of the arm is up to about 15°, or between about 1° and about 10°.
35. The package of any of the foregoing claims wherein the angle between the side section and the peripheral support is between about 60° and about 120°, or about 80° and about 100°.
36. The package of any of the foregoing claims wherein the arms connect in the center of the flat top portion.
37. Package of any of the foregoing claims wherein the arms are radially distributed around the center of the support structure.
38. The package of any of the foregoing claims wherein the base is substantially flat.
39. The package of any of the foregoing claims wherein the lens does not contact the arm side sections.
40. The package of any of the foregoing claims wherein the arm side sections are straight.
41. The package of any of the foregoing claims wherein at least one peripheral support is elongated and comprises an opening extending distally at or before

the periphery of the contact lens to form a drainage channel for the drainage of packaging solution from the contact lens and support structure.

42. The package of claim 41 wherein at least 2 peripheral supports are elongated and connected at their distal end with an opening therebetween to form the drainage channel.
43. The package of claims 41-42 wherein the partial ring connects to the elongated arms.
44. The package of claims 41-43 wherein the elongated arms are planar.
45. The package of claims 2 wherein the partial ring comprises an outwardly extending tab with an open drainage channel for the drainage of packaging solution from the contact lens and support structure.
46. The package of claims 41 through 45 wherein the drainage channel is tapered toward the outwardly extending tab distal end, curved from the peripheral ring arc to the distal end, flares out at the peripheral ring arc and taper in from the arc to the distal end.
47. The package of claims 41 through 45 wherein the drainage channel has straight walls.
48. The package of claims 41 through 47 wherein the drainage channel is about 2.5 to about 3.5 mm in length measured from an arc of the peripheral ring.
49. The package of claims 41 through 47 wherein the drainage channel has a width of about 0.8 to about 3mm wide.

50. The package of claims 41 through 47 wherein the drainage channel is tapered and has a width of about 1mm to about 0.8 mm wide at the distal end.
51. The package of any of the foregoing claims wherein the support is made from a polymer having a contact angle of greater than 100°.
52. The package of any of the foregoing claims wherein the lens support is disposed at an angle of at least about 20° from the package base.
53. The package of any of claims 2-52 wherein said peripheral supports are parallel to the package base, and at least about 4 mm or at least about 5mm from said package base.
54. The package of any of the foregoing claims further comprising a means for lifting the lens support from the lens solution.
55. The package of claim 54 wherein the lifting means is selected from levers, springs, hinges, pivot arms, folds, mechanical traps, handles and combinations thereof.
56. The package of claim 41, 42 or 45 wherein the lifting means comprises the drainage channel fixedly attached at the drainage channel distal end to the package base, and a hinge line in the package base, transverse to the drainage channel between the at least partial peripheral ring or an arc formed by the distal ends of the peripheral supports and the fixed attachment point between the drainage channel and package base.
57. The package of claim 56 wherein the hinge line is at least 1 mm, about 2 to about 4mm or about 2.5 to about 3.5 mm in length beyond the at least partial peripheral ring or lens periphery if no peripheral ring is included in the lens support.
58. The package of claim 54 wherein the lifting means raises the lens from the packaging solution by tilting the lens support and base away from each other to an

angle of about 15 to about 80°, about 20° to about 70°, about 30° to about 60° or about 40° to about 60° relative to level.

59. The package of any of the foregoing claims further comprising a reservoir for capturing packaging solution when the lens and support are separated from the package base.

60. A contact lens package comprising

- a. a support for holding, in a convex position relative to the support, a contact lens having a convex surface; and
- b. a lens facing surface comprising at least one air entry guide configured such that, upon opening the package by a user, the at least one air entry guide guides air entering the package over the contact lens convex surface to reduce the incidence of the convex lens surfaces sticking to the interior surface.

61. The contact lens package of claim 60 wherein the package interior defines a cavity comprising the support, at least one air entry guide, contact lens and packaging solution; and

- a. upon opening the package and draining the packaging solution from the lens and the but prior to contact by a user's finger the lens maintains a convex shape on the lens support, and the support contacts the lens in at least two points distributed around the lens periphery.

62. The package of claims 60 or 61 wherein the lens has a profile and the support has a profile that does not substantially match the lens profile.

63. The package of claim 60- 62 wherein the contact area between the support and the lens after the package is less than about 20 mm², less than 18mm² or less than 15 mm².

64. The package any of the foregoing claims wherein the package further comprises a base comprising a laminated foil sheet.
65. The package of claims 60-64 wherein contact area between the at least one air entry guide and the lens is less than about 50 mm² or less than about 30 mm².
66. The package of claims 60-65 wherein the air entry guides are integral with the lens facing surface as projections from the lens facing surface, or recesses in the lens facing surface.
67. The package of claims 60-65 wherein the air entry guides are part of a separate structure disposed between the convex lens surface and the lid lens facing surface.
68. The package of claims 60-67 wherein the air entry guides are aligned parallel to a path air enters upon package opening.
69. The package of claims 60-68 wherein the air entry guides spaced at least about 2 mm apart, about 2 to about 5 mm apart, or 2 to about 4.5 mm apart.
70. The package of claims 60-69 wherein the contact lens comprises an optic zone, and a curved lens side section between the optic zone and the peripheral edge, and the air entry guides run in a straight line from the package front to back, curve around the optic zone or a combination thereof.
71. The package of claims 70 wherein the air entry guides traversing the optic zone have a shorter profile over the optic zone.
72. The package of claims 55-71 wherein the air entry guides comprise continuous ribs, discontinuous ribs and combinations thereof.

73. The package of claims 60-72 wherein the air entry guides have a maximum height of at least about 2mm, or about 2mm to about 4 mm.
74. The package of claims 71 wherein the air entry guide profile over the optic zone has a height of about 0.5mm or less.
75. The package of claims 60-74 wherein said lid facing surface is an interior surface of a package lid; and the package further comprises a base, which with the lid forms the cavity containing the lens support, lens and packaging solution;
- the package further comprising an opening tab for initiating the separation of the lid from the base along a seal line forming the cavity, and an air entry scoop inside the seal line and in line aligned with the opening tab.
76. The package of claim 75 wherein the air entry scoop projects out from the periphery of the contact lens edge at least about 1 mm or at least about 2mm.
77. The package of claim 75 or 76 wherein the air entry scoop has a width between about 2mm and an inner diameter of the seal.
78. The package of claims 75-77 further comprising an opening tab for initiating the separation of the lid from the base along a seal line forming the sealed cavity, wherein there is at least about 2mm clearance between the seal line and lens support at the opening tab.
79. The package of claims 75-78 wherein the air entry tab further comprises at least one air entry guide.
80. The package of claims 60 to 79 wherein the lens support, lens facing surface and at least one air entry guide cooperate to maintain the lens centered around the

support with minimal contact between the lens, the support and at least one air entry guide.

81. The package of claim 80 wherein contact between the lens, the at least one air entry guide and the support is transitory.

82. The package of claims 60-81 further comprising an air capture space away from the lens optic zone for air in the cavity to occupy.

83. The package of claim 82 where the air remains in the air capture space away from the lens regardless of package orientation.

84. The package of claims 82-83 wherein the air capture space has a volume equal to or slightly greater than the volume of air to be sealed in the package.

85. The package of claims 82-83 wherein the air capture space has a volume equal to or slightly greater than the volume of air sealed in the package, and any air which may diffuse into the package during storage.

86. The package of claims 75-85 wherein the lid comprises a concave dome over the lens and lens support, the concave dome comprising a depression centered above the lens support.

87. The package of claims 82-87 wherein said air capture space comprises a channel around the circumference of lid, inside the seal.

88. The package of claim 86 where the air capture space is disposed around the depression circumference.

89. The package of claim 82-86 wherein the air capture space comprises at least two air pods protruding from the lid along the periphery of the lid, inside the seal.

90. The package of claims 88 further comprising one, two, three or more air pods protruding from the lid along the inside of the seal line.
91. The package of claim 88 wherein the air pods are linear, arcuate, or a combination thereof.
92. The package of claim 90 comprising two planar air pods spaced across the lid and oriented parallel or perpendicular to the opening tab.
93. The package of claims 82 through 92 wherein the air pods are connected via a connecting channel.
94. The package of claim 93 wherein the air pods are wider, taller or both wider and taller than the connecting channel.
95. The package of claims 93-94 wherein the channel has an interior width of about 1.5 to about 3 mm, or about 2mm about 3 mm.
96. The package of claims 60 through 95 comprising, when the package is sealed, at least about 0.25 mm and about 2 mm clearance between the lens optic zone and any air entry guide or dimple.
97. The package of any of the foregoing claims where the base and lid are a single unitary part.
98. The package of any of the foregoing claims where the base and lens support are a single unitary part.

99. The package of any of the foregoing claims where the base, lens support and lid are a single unitary part.

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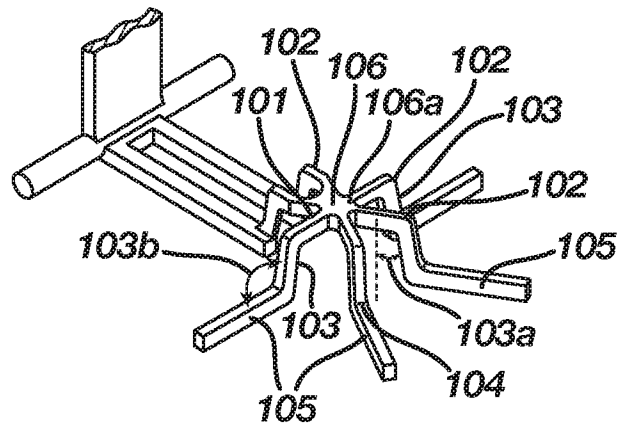


FIG. 1A

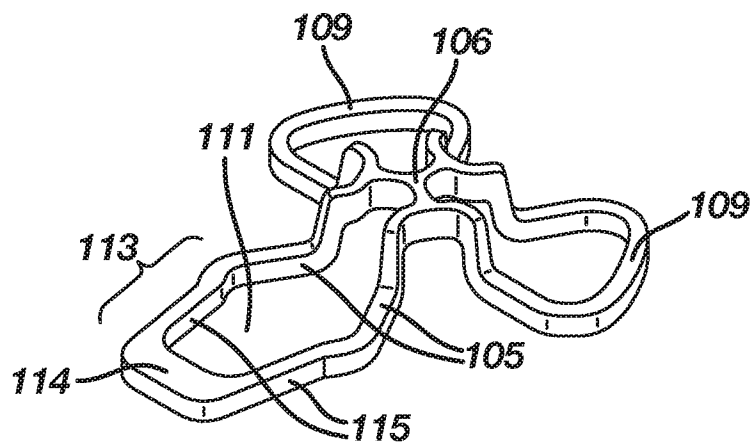


FIG. 1B

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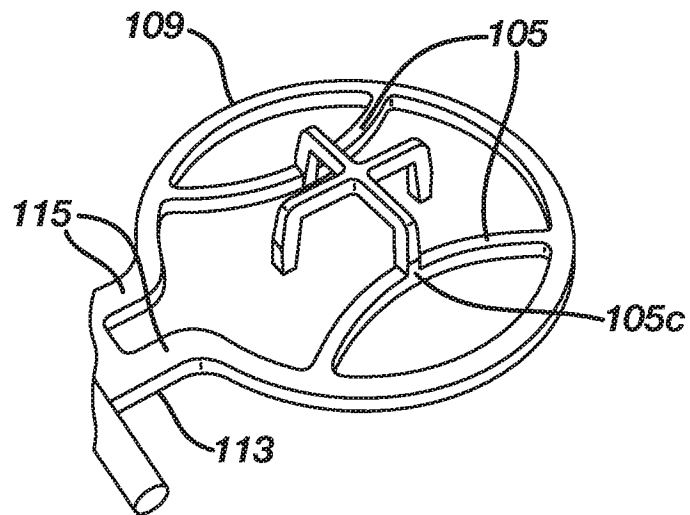


FIG. 1C

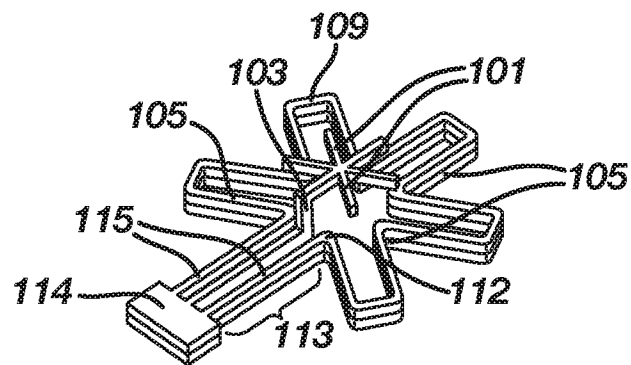


FIG. 1D

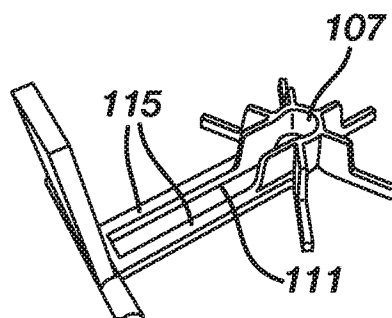


FIG. 1E

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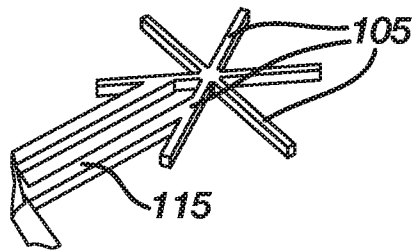


FIG. 1F

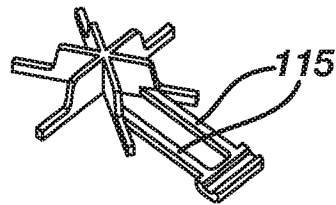


FIG. 1G

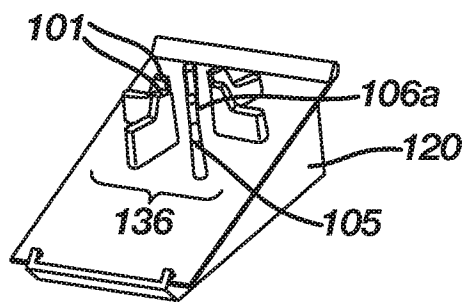


FIG. 1H

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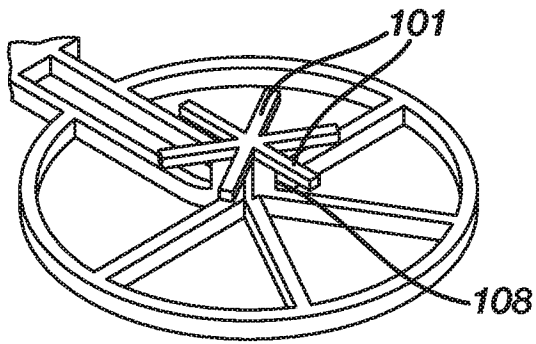


FIG. 1I

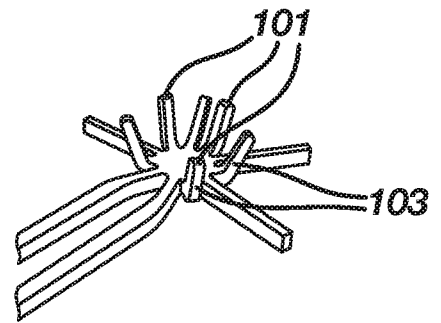


FIG. 1J

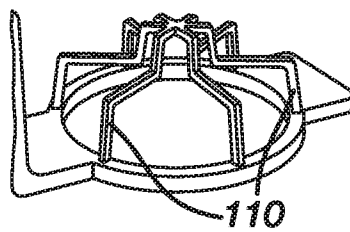


FIG. 1K

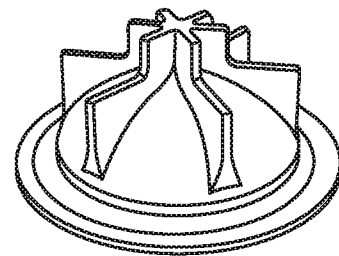


FIG. 1L

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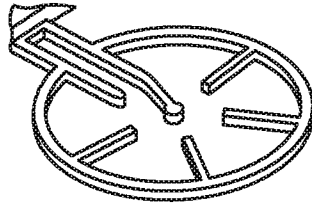


FIG. 1M

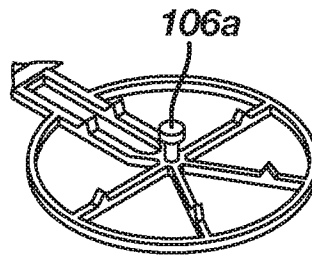


FIG. 1N

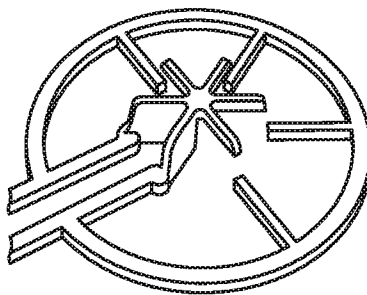


FIG. 1O

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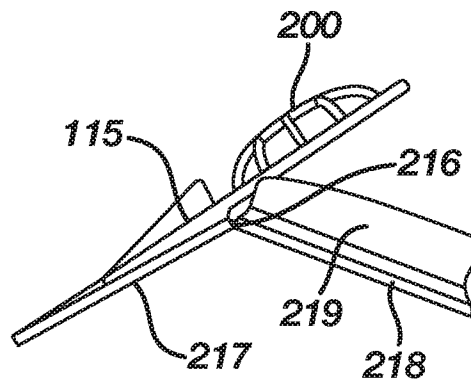


FIG. 2A

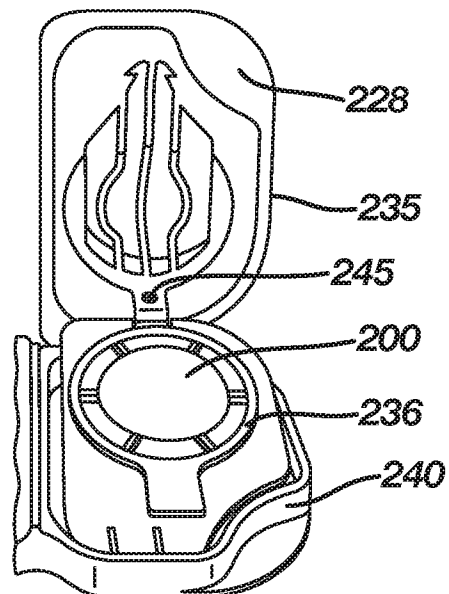


FIG. 2B

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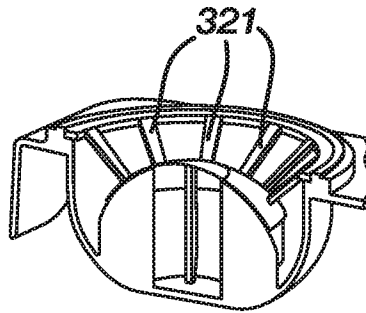


FIG. 3A

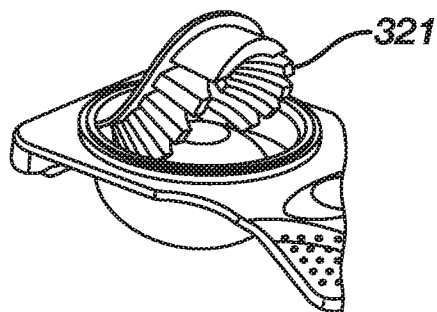


FIG. 3B

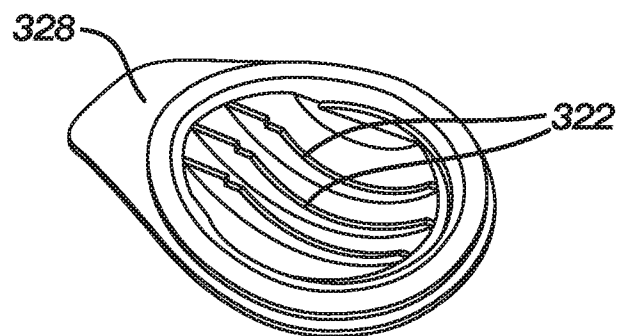


FIG. 3C

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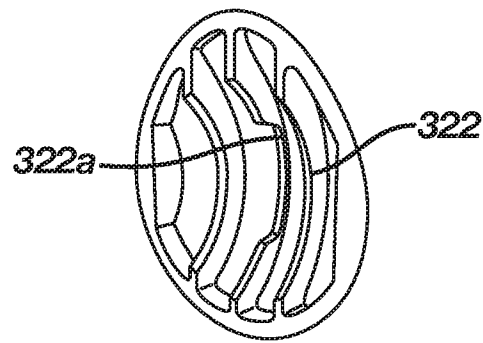


FIG. 3D

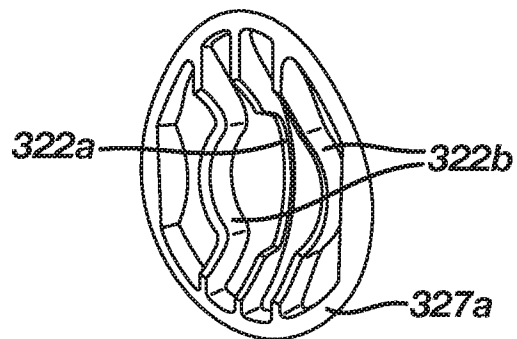


FIG. 3E

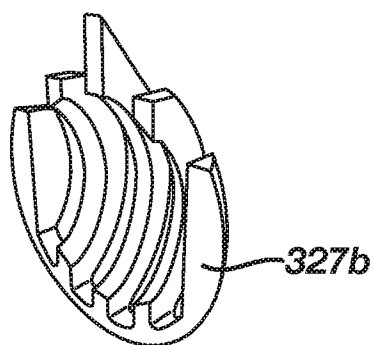


FIG. 3F

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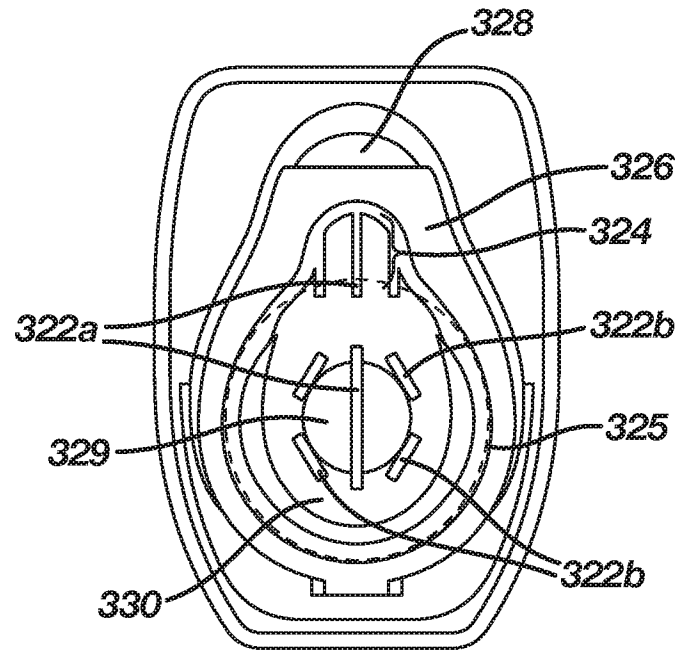


FIG. 3G

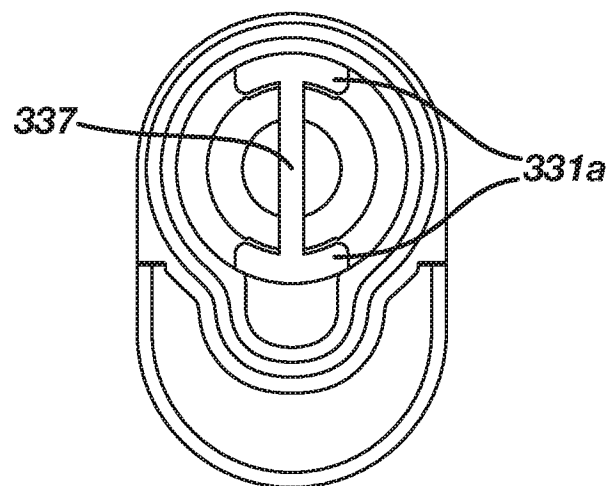


FIG. 3H

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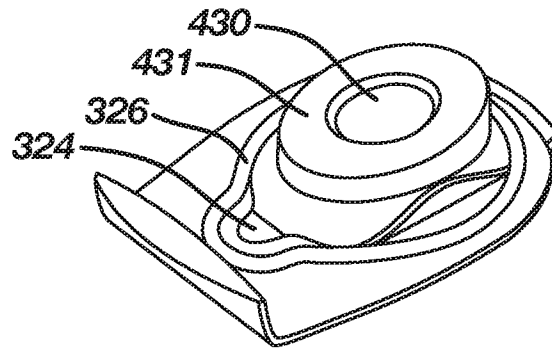


FIG. 4A

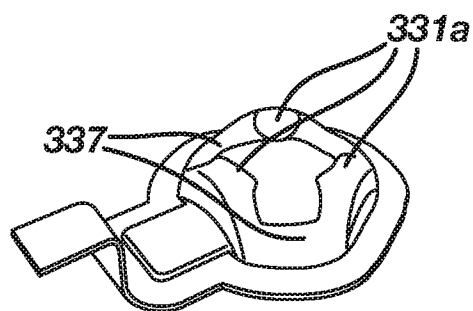


FIG. 4B

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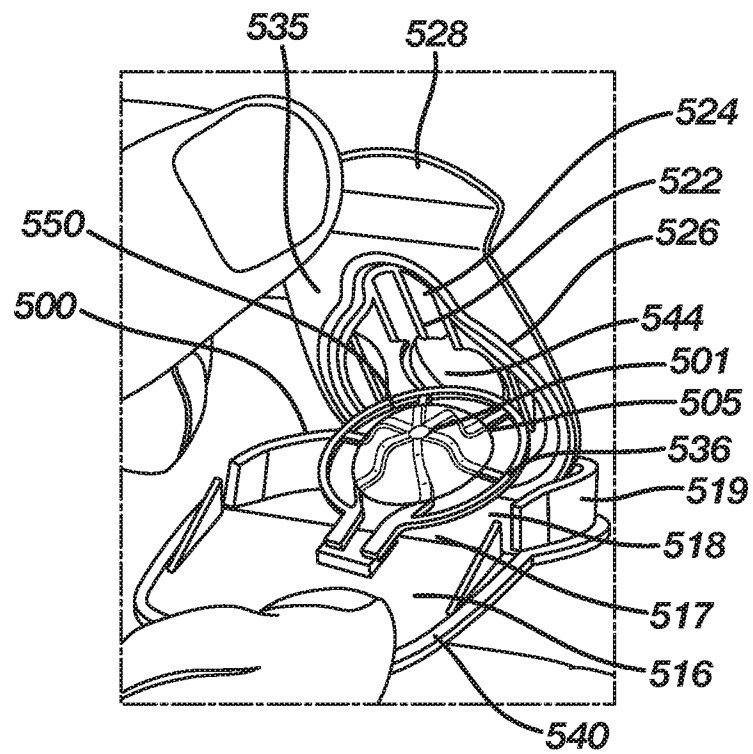


FIG. 5A

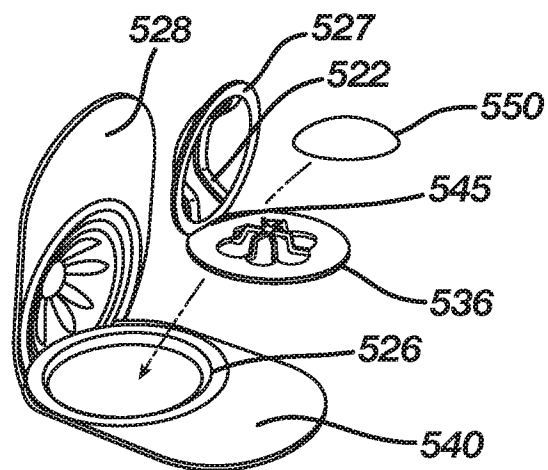
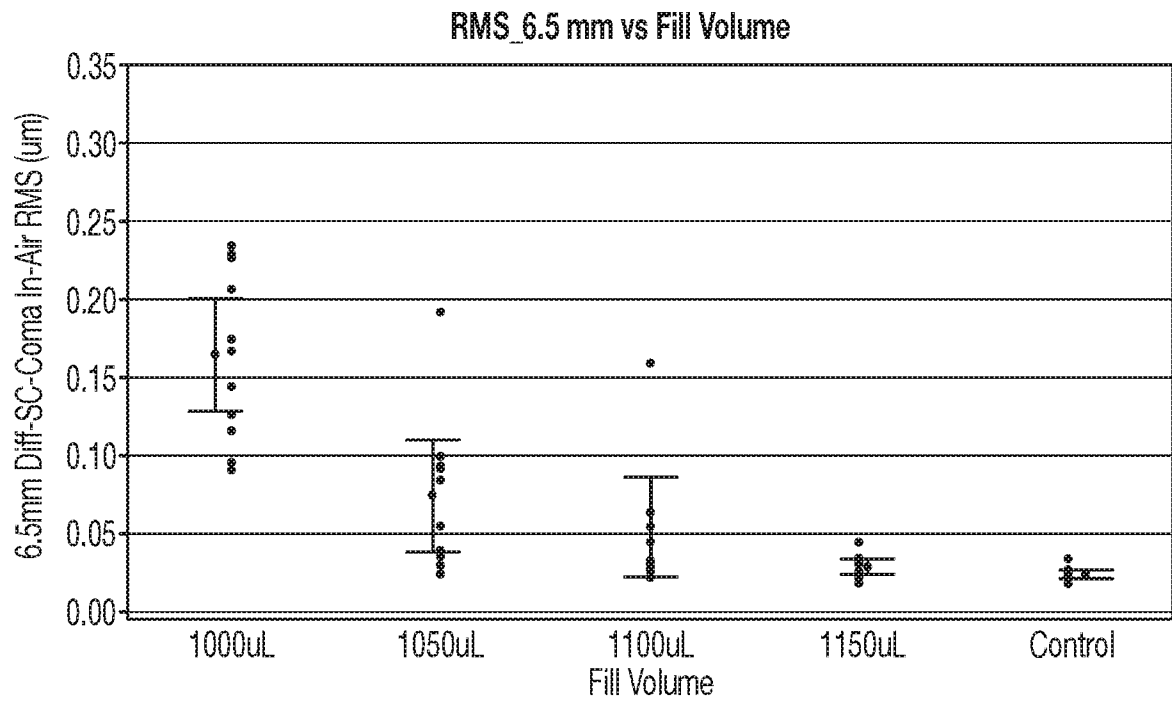
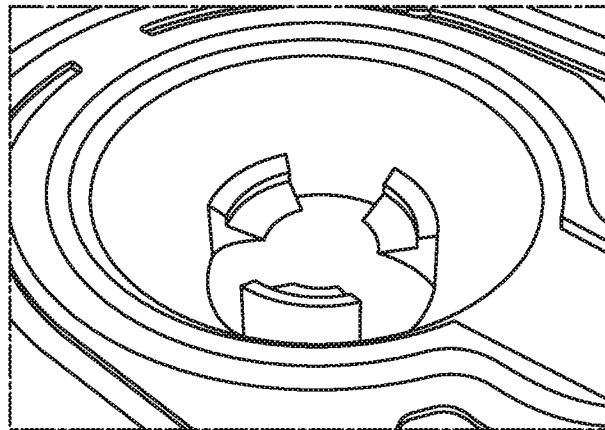


FIG. 5B

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**FIG. 6****FIG. 7**