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- (71) Applicant: **ADVANCED TECHNOLOGY MATERIALS, INC.** [US/US]; 7 Commerce Drive, Danbury, Connecticut 06810 (US).
- (72) Inventors: **TOM, Glenn**; 8646 Woodcliff Circle, Bloomington, Minnesota 55438 (US). **WARE, Donald**; 3920 Cheshunt Drive, Woodbury, Minnesota 55125 (US). **NELSON, Greg**; 1701 East 57th Street, Minneapolis, Min-

nesota 55417 (US). **MOWREY, Dale**; 35340 191st Avenue, Montgomery, Minnesota 56069 (US). **MUSOLF, Bruce**; 4147 Pennsylvania Avenue, Eagan, Minnesota 55123 (US). **ELLINGSON, Thea**; 2665 89th Court, Northfield, Minnesota 55057 (US). **SITZ, Dean**; 1492 15th Street North, Wahpeton, North Dakota 58075 (US). **ALBRECHT, James L.**; 7748 Marie Street, Wahpeton, North Dakota 58075 (US). **STURM, Scott**; 1051 Anthony Way, Victoria, Minnesota 55386 (US). **ROLSTON, Pat**; 3940 Cottage Grove Hill Road SE, Cedar Rapids, Iowa 53403 (US).

(74) Agents: **WITZANY, Nathan J.** et al.; Winthrop & Weinstein, P.A., Capella Tower, Suite 3500, 225 S 6th Street, Minneapolis, Minnesota 55402 (US).

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(54) Title: BREAKSEAL

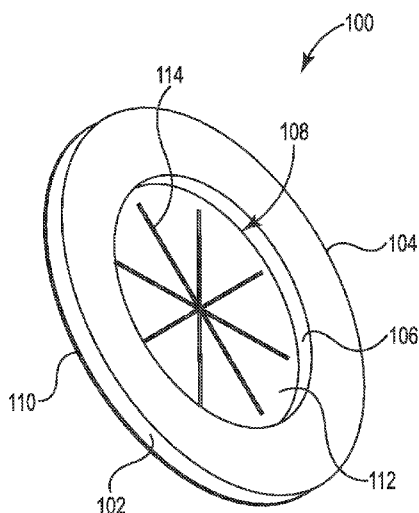


Fig. 1

(57) Abstract: A breakseal, and a method for making a breakseal, having a first layer of extruded MDPE or LDPE/LLDPE film in a flat washer shape defining a central opening therein and a second layer of PTFE film heat laminated to a first side of the first layer. The second layer is exposed and rupturable through the central opening of the first layer. In some embodiments, the first layer is made up of two sub-layers of MDPE or LDPE/LLDPE film in flat washer shapes bonded together by heat lamination. In another embodiment, a breakseal comprises a single component, molded structure including an outer rim portion having a first thickness and defining a central opening therein, and a central seal portion having a second thickness being smaller than the first thickness, wherein the central seal portion spans the central opening and is integrally formed with the outer rim portion.



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BREAKSEAL

Field of the Invention

[001] The present disclosure relates to novel and advantageous rupturable membranes or what are often referred to as breakseals. Particularly, the present disclosure relates to novel and advantageous breakseals, methods of making the breakseals, and methods of using the breakseals in shipping and dispensing systems, such as those typically used for the storage, transport, and dispense of photosensitive reagents or other ultrapure chemicals used in the semiconductor manufacturing industry.

Background of the Invention

[002] Container systems may be used in many industries for storing, shipping and/or dispensing materials of any viscosity. For example, numerous manufacturing processes require the use of ultrapure liquids, such as acids, solvents, bases, photoresists, slurries, cleaning formulations, dopants, inorganic, organic, metalorganic and biological solutions, pharmaceuticals, and radioactive chemicals. Such applications require that the number and size of particles in the ultrapure liquids be minimized. In particular, because ultrapure liquids are used in many aspects of the microelectronic manufacturing process, semiconductor manufacturers have established strict particle concentration specifications for process chemicals and chemical-handling equipment. Such specifications are needed because, should the liquids used during the manufacturing process contain high levels of particles or bubbles, the particles or bubbles may be deposited on solid surfaces of the silicon. This can, in turn, lead to product failure and reduced quality and reliability. In some cases the contents of a container may be expensive or even extremely expensive and, as such, defects in an end process, such as a semiconductor process, resulting from contamination of the liquid stored in the container system can have significant adverse and costly consequences at the least.

[003] To help protect the contents of such containers, often, at a mouth or other opening to such containers, a protective seal may be provided to, for example, seal in the contents of the container and prevent contaminants or light from being introduced into

the container and thus the materials stored therein. The seal may be a rupturable seal or membrane, or what is commonly referred to as a breakseal. A breakseal is typically designed such that the breakseal does not rupture or break by impact or pressures commonly occurring for example, during transport and handling of the container, but substantially easily tears when punctured for example, by a dispense system connector for dispensing the contents of the container. Various embodiments of breakseals have been conventionally used.

[004] For example, in one traditional breakseal configuration, a breakseal is formed as a two-layer structure, having a first layer of laminated low-density polyethylene (LDPE) foam and a second layer of polytetrafluoroethylene (PTFE) film, the two layers bonded together using an adhesive. In a central portion of the breakseal, tear lines or score lines may radially extended from the center, such that when a dispense system connector is pressed against the breakseal for connection with the container, the tear lines permit the breakseal to tear. The LDPE foam and use of adhesives in such breakseals, however, can lead to undesirable contamination, and thus downstream defects, in certain manufacturing processes. For example, the adhesive material used to bond the two layers may be introduced into the material stored within the storage container, thereby reducing the purity of the material and causing problems in downstream processes.

[005] Another breakseal configuration has been introduced and described in Korean patent 20-0452250, titled "One Layer Break Seal," which is herein incorporated by reference in its entirety. In general, the breakseal of Korean patent 20-0452250 has a circular plate shape made of a single layer of injection molded low-density polyethylene (LDPE). The inventors of the breakseal in Korean patent 20-0452250 assert that such breakseal eliminates drawbacks of the traditional breakseal described above. However, such breakseal is not without faults. Indeed, the breakseal of the Korean patent may be more difficult, and may take longer, to manufacture, each of which drives up manufacturing costs. For example, challenges in the molding process may be encountered during the manufacture of a molded breakseal of the shape and design as described in Korean patent 20-0452250. For example, a mold cavity having a relatively thick section would be required to mold the outer "donut shaped" rim of such a breakseal.

Sink, which occurs when material shrinks away from walls of a mold cavity, is often associated with such thick sections of a mold cavity. Sink adversely affects the structural integrity of the breakseal, which in turn adversely affects the molded products ability to function as a protective seal.

[006] There is a need for a better breakseal which reduces and/or minimizes contamination of contents in a container system. Particularly, there is a need for breakseals and methods of making the breakseals for use in shipping and dispensing systems, such as those typically used for the storage, transport, and dispense of photosensitive reagents or other ultrapure chemicals used in the semiconductor manufacturing industry. The present disclosure relates to breakseal embodiments which can overcome the disadvantages of traditional breakseals, and describes breakseal embodiments that can be produced with relatively lower cost and more simply than traditional breakseals and/or increase prevention of contamination to the contents of a container system.

Brief Summary of the Invention

[007] The present disclosure, in one embodiment, relates to a breakseal having a first layer of extruded medium-density polyethylene (MDPE) film in a flat washer shape defining a central opening therein and a second layer of PTFE film heat laminated to a first side of the first layer. The second layer is exposed and rupturable through the central opening of the first layer. The MDPE film may have a density of between about 0.930 g/cm³ and about 0.960 g/cm³. The first layer may have a thickness of between about 10 mil and 80 mil. In some embodiments, the first layer is made up of two sub-layers of MDPE film in flat washer shapes bonded together by heat lamination. The combined thicknesses of the sub-layers may be between about 10 mil and 80 mil, and in one embodiment, the thicknesses of each sub-layer may be about 30 mil. The second layer may have a thickness of between about 5 mil and 100 mil. In some embodiments, the second layer may include one or more score lines defined within the central opening to assist rupturing of the second layer within the central opening. As examples, the one or more score lines may include a plurality of score lines intersecting at a generally

central location of the second layer or may include a plurality of non-intersecting score lines extending from a generally central location of the second layer.

[008] The present disclosure, in another embodiment, relates to a method of making a breakseal including heat laminating a layer of PTFE film to a layer of extruded MDPE film, the layer of MDPE being in a flat washer shape and defining a central opening therein where the layer of PTFE is exposed. In some embodiments, the one or more surfaces of the layer of PTFE may be treated to roughen the one or more surfaces prior to being heat laminated to the first layer.

[009] The present disclosure, in a further embodiment, relates to a breakseal having a first layer of an extruded low-density polyethylene (LDPE)/linear low-density polyethylene (LLDPE) film in a flat washer shape defining a central opening therein and a second layer of PTFE film heat laminated to a first side of the first layer. The second layer is exposed and rupturable through the central opening of the first layer. The LDPE/LLDPE film may have a density of about 0.920 g/cm^3 . The first layer may have a thickness of between about 10 mil and 80 mil. In some embodiments, the first layer is made up of two sub-layers of LDPE/LLDPE film in flat washer shapes bonded together by heat lamination. The combined thicknesses of the sub-layers may be between about 10 mil and 80 mil, and in one embodiment, the thicknesses of each sub-layer may be about 30 mil. The second layer may have a thickness of between about 5 mil and 100 mil. In some embodiments, the second layer may include one or more score lines defined within the central opening to assist rupturing of the second layer within the central opening. As examples, the one or more score lines may include a plurality of score lines intersecting at a generally central location of the second layer or may include a plurality of non-intersecting score lines extending from a generally central location of the second layer.

[010] The present disclosure, in yet another embodiment, relates to a method of making a breakseal including heat laminating a layer of PTFE film to a layer of extruded low-density polyethylene (LDPE)/linear low-density polyethylene (LLDPE) film, the layer of LDPE/LLDPE being in a flat washer shape and defining a central opening therein where the layer of PTFE is exposed. In some embodiments, one or more surfaces

of the layer of PTFE may be treated to roughen the one or more surfaces prior to being heat laminated to the first layer.

[011] The present disclosure, in still a further embodiment relates to a molded breakseal. The molded breakseal may include an outer rim portion having a first thickness and defining a central opening therein, and a central seal portion having a second thickness being smaller than the first thickness, wherein the central seal portion spans the central opening and is integrally formed with the outer rim portion. A plurality of score lines may be formed to a depth into the central seal portion, such that the seal portion is configured to rupture generally uniformly on application of a pressure thereon above a predetermined threshold. The outer rim portion and integral central seal portion may be formed from perfluoroalkoxy (PFA). In some embodiments, the seal portion may be configured to rupture generally uniformly on application of a pressure thereon of between about 15 N and about 70 N. The plurality of score lines may intersect at a generally central location of the seal portion, or the plurality of score lines may include a plurality of non-intersecting score lines extending from a generally central location of the seal portion. The molded breakseal may further include one or more surface indentations formed on a surface of the outer rim portion. Likewise, the molded breakseal may include one or more surface indentations formed on a surface of the seal portion.

[012] The present disclosure, in another embodiment, relates to a method of forming a molded breakseal. The method may include drying or obtaining a dried PFA resin, installing, into a molding apparatus, or otherwise providing a mold designed to form a breakseal having: an outer rim portion defining a central opening therein and having a first thickness; a central seal portion having a second thickness being smaller than the first thickness, the central seal portion spanning the central opening and being integrally formed with the outer rim portion; and a plurality of score lines formed to a depth into the central seal portion, such that the seal portion is configured to rupture generally uniformly on application of a pressure thereon above a predetermined threshold, preparing the molding apparatus for a desired molding temperature, and injecting an amount of the PFA resin into the mold and molding a breakseal corresponding to the design of the mold.

[013] While multiple embodiments are disclosed, still other embodiments of the present disclosure will become apparent to those skilled in the art from the following detailed description, which shows and describes illustrative embodiments of the disclosure. As will be realized, the various embodiments of the present disclosure are capable of modifications in various obvious aspects, all without departing from the spirit and scope of the present disclosure. Accordingly, the drawings and detailed description are to be regarded as illustrative in nature and not restrictive.

Brief Description of the Drawings

[014] While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter that is regarded as forming the various embodiments of the present disclosure, it is believed that the disclosure will be better understood from the following description taken in conjunction with the accompanying Figures, in which:

[015] FIG. 1 is a perspective view of a breakseal according to one embodiment of the present disclosure.

[016] FIG. 2A is a side view of one embodiment of the breakseal of FIG. 1.

[017] FIG. 2B is a side view of another embodiment of the breakseal of FIG. 1.

[018] FIG. 3A is an enlarged, cross-sectional view of the breakseal of FIG. 2A.

[019] FIG. 3B is an enlarged, cross-sectional view of the breakseal of FIG. 2B.

[020] FIG. 4 is a top view of a score line pattern according to another embodiment of the present disclosure.

[021] FIG. 5 is an exploded cross-sectional view of a shipping and dispensing system according to one embodiment of the present disclosure.

[022] FIG. 6 is an enlarged, cross-sectional view of the location of a breakseal in a shipping and dispensing system according to one embodiment of the present disclosure.

[023] FIG. 7 is an exploded perspective view of a cap/closure and breakseal combination according to one embodiment of the present disclosure.

[024] FIG. 8 is a partial cross-sectional view of the cap/closure and breakseal combination of FIG. 7.

[025] FIG. 9A is a front view of a breakseal according to another embodiment of the present disclosure.

[026] FIG. 9B is a side, cross-sectional view of the breakseal of FIG. 9A.

[027] FIG. 10A is a front view of a breakseal according to yet another embodiment of the present disclosure.

[028] FIG. 10B is a side, cross-sectional view of the breakseal of FIG. 10A.

[029] FIG. 11A is a front view of a breakseal according to still another embodiment of the present disclosure.

[030] FIG. 11B is a side, cross-sectional view of the breakseal of FIG. 11A.

[031] FIG. 12 is a perspective view of the breakseal of FIG. 11A.

Detailed Description

[032] The present disclosure relates to novel and advantageous rupturable membranes or breakseals. Particularly, the present disclosure relates to novel and advantageous breakseals, methods of making the breakseals, and methods of using the breakseals in shipping and dispensing systems, such as those typically used for the storage, transport, and dispense of photosensitive reagents or other ultrapure chemicals used in the semiconductor manufacturing industry.

[033] A breakseal 100 according to one embodiment of the present disclosure is illustrated in FIGS. 1 and 2A. Breakseal 100 may have a generally circular plate shape, however the breakseal may be configured in any suitable shape so as to correspond to any suitably-sized container mouth. Generally, breakseal 100 comprises a two-layer structure. A first substantially flat washer-like layer 102 may include an outer edge 104 and an inner edge 106, the inner edge defining a central opening 108 of the washer layer. A second substantially flat circular layer 110 may be provided adjacent one side of the washer layer 102. The size of each of the two layers 102, 110 generally coincide. In a specific embodiment where the breakseal 100 has a generally circular plate shape, as shown in FIG. 1, the diameter of the outer edge 104 of washer layer 102 may be substantially the same as the diameter of circular layer 110. In one embodiment, this diameter may be about 35 mm; however, the size of the diameter of the breakseal 100 may be selected so as to correspond with the diameter of any suitably-sized container

mouth, and is certainly not limited to 35 mm. Similarly, the diameter of the inner edge 106 of washer layer 102, in one embodiment, may be about 22-23 mm; however, the size of the diameter of the inner edge 106 is not so limited and may generally be any diameter suitably less than the diameter of the outer edge 104.

[034] The washer layer 102 may comprise an extruded medium-density polyethylene (MDPE) film having a density of between about 0.930 g/cm³ and about 0.960 g/cm³ and a melt index of between about 0.5 g/10 min. and about 6.0 g/10 min. However, densities outside the 0.930 g/cm³ and about 0.960 g/cm³ range and melt indices of less than 0.5 g/10 min. and greater than about 6.0 g/10 min. may also be suitable for washer layer 102. The thickness of washer layer 102 may be between about 10 mil and about 80 mil. In one embodiment, the thickness of the washer layer 102 may be about 60 mil.

[035] In another embodiment, the washer layer 102 may comprise an extruded low-density polyethylene (LDPE)/linear low-density polyethylene (LLDPE) film, i.e., a film comprising a blend of LDPE and LLDPE resins, having a density of about 0.920 g/cm³. The LDPE resin may have a melt index of about 2.1 g/10 min., and the LLDPE resin may have a melt index of about 1.0 g/10 min. However, suitable densities other than 0.920 g/cm³ and suitable melt indices of greater than or less than 2.1 g/10 min., for the LDPE resin, and 1.0 g/10 min., for the LLDPE resin, may also be suitable for washer layer 102. As indicated above, the thickness of washer layer 102 may be between about 10 mil and about 80 mil. In one embodiment, the thickness of the washer layer 102 may be about 60 mil.

[036] In another embodiment, illustrated in FIGS. 2B, breakseal 100 may comprise an overall three-layer structure, with the washer layer 102 comprising two bonded sub-layers 202, 204 of an extruded MDPE or an extruded LDPE/LLDPE of the types described above. In such embodiments, the overall thickness of the washer layer 102 may be between about 10 mil and about 80 mil, and in one embodiment, preferably about 60 mil. The thickness of either sub-layer 202, 204 may be any suitable thickness such that the combination of the two sub-layers results in the desired thickness of washer layer 102. While the thicknesses of each sub-layer 202, 204 may be different, in some embodiments, the thicknesses of both sub-layers may be about the same, and in one

particular embodiment, the thickness of each sub-layer is about 30 mil. The sub-layers 202, 204, or certain portions or surfaces thereof, may be treated or etched, such as by but not limited to, corona etching, flame etching, or plasma etching, thereby roughening the surfaces, which increases the bondability of the sub-layers. The sub-layers may be bonded together by any suitable method; however, in one embodiment, the sub-layers are bonded by heat lamination so as to avoid the use of adhesives, which as stated above, can lead to undesirable contamination of contents of a container system to which the breakseal is attached, and can lead to downstream defects in certain manufacturing processes.

[037] The circular layer 110 may comprise polytetrafluoroethylene (PTFE). The thickness of layer 110 may be between about 5 mil and about 100 mil, or preferably between about 10 mil and 80 mil. In one embodiment, the thickness of layer 110 may be about 15-20 mil. In a particular embodiment, the thickness of the washer layer 102 may be about 60 mil, and the thickness of the circular layer 110 may be about 15-20 mil.

[038] The circular layer 110, or certain portions thereof, or one or more surfaces thereof, may be treated or etched, such as by but not limited to, corona etching, flame etching, or plasma etching, thereby roughening the surface, which increases the bondability of the circular layer and may introduce reactive sites on the layer's surface(s), consequently increasing the wettability and reactivity of the surface(s). The circular layer 110 may be bonded to the washer layer 102 using any suitable method; however, in one embodiment, the circular layer is bonded to the washer layer by heat laminating an outer periphery portion on one side of the circular layer to one side of the washer layer defined between the outer 104 and inner 106 edges. Heat laminating the circular layer 110 to the washer layer 102 in this manner avoids the need for adhesives, which as discussed above, can lead to undesirable contamination of contents of a container system to which the breakseal is attached, and can lead to downstream defects in certain manufacturing processes.

[039] In the opening 108 defined by inner edge 106 of washer layer 102, a central portion 112 of circular layer 110 may be exposed, as illustrated in FIG. 1. The central portion 112 of circular layer 110 may be designed to be rupturable or pierceable, such as by a dispense system connector configured for dispensing the contents of a

container to which the breakseal is attached, but generally does not rupture, tear, or break by impact or pressures commonly occurring, for example, during conventional transport and handling of the container. In one embodiment, the central portion 112 may include tear lines or score lines 114, as illustrated in FIG. 1 and also in FIGS. 3A and 3B (which respectively illustrate enlarged, cross-sectional side views of the breakseal embodiments of FIGS. 2A and 2B), so as to provide substantially easy rupture of the circular layer 110 when intended, such as when the dispense system connector is pressed into the central portion, and to guide more uniform tearing of the circular layer at the central portion upon rupture. The score lines 114 may be scored to any suitable depth, *d*, into the circular layer 110 less than the thickness of the circular layer. In embodiments with a circular layer 110 having a thickness of between about 15-20 mil, for example, the score lines 114 may be scored to a depth of between about 5 mil and 15 mil. While not limited so, as illustrated in FIGS. 3A and 3B, the score lines 114 may be provided on only one side, or only in one surface, of the circular layer 110, which can help improve resistance to unintentional tearing of the circular layer, such as during conventional transport and handling of the container. In one embodiment, the score lines 114 are provided on the side of circular layer 110 adjacent the washer layer 102, as such surface will conventionally be positioned away from the contents of the container to which the breakseal is attached and be visible to a consumer. The score lines 114 may be formed by any suitable method such as by die cutting, stamping, compression etching, surface etching, blading, molding, or any other method now known or later developed.

[040] Any suitable number of score lines 114 may be provided, as desired or required. In one embodiment, as illustrated in FIG. 1, the score lines 114 may be provided in a pattern of a plurality of score lines intersecting at a central location within the opening 108. However, any suitable pattern may be utilized, with FIG. 4 providing but one other such example where the plurality of score lines do not intersect. While FIGS. 1 and 4 illustrate score lines extending radially with respect to a central location, as already mentioned, any other suitable pattern is considered within the scope of the present disclosure, and the figures are not intended to limit the invention to specific patterns of score lines.

[041] Additional breakseal embodiments 900, 1000, and 1100 of the present disclosure are illustrated in FIGS. 9-12. Breakseals 900, 1000, and 1100, like breakseal 100, may have a generally circular plate shape, however the breakseals may be configured in any suitable shape so as to correspond to any suitably-sized container mouth. Generally, breakseals 900, 1000, and 1100 may each comprise a single component, molded structure. Molded breakseals 900, 1000, and 1100 may include an outer rim portion 902 and a central seal portion 904. In general, the outer rim portion may have a thickness that is larger than any portion of the central seal portion 904. The outer rim portion 902 may include an outer edge 906 and inner edge 908, the inner edge defining an inner diameter generally coinciding with an outer diameter of the central seal portion 904. In a specific embodiment where the breakseals 900, 1000, and 1100 have a generally circular plate shape, as shown in FIGS. 9-12, the diameter of the outer edge 906 may be about 35 mm; however, the size of the diameter of the breakseals may be selected so as to correspond with the diameter of any suitably-sized container mouth, and is certainly not limited to 35 mm. Similarly, the diameter of the inner edge 908, in one particular embodiment, may be about 22-23 mm; however, the size of the diameter of the inner edge 908 is not so limited and may generally be any diameter suitably less than the diameter of the outer edge 906.

[042] Similar to central portion 112, the central seal portion 904, defined by inner edge 908 may be designed to be rupturable or piercable, such as by a dispense system connector configured for dispensing the contents of a container to which the breakseal 900, 1000, or 1100 is attached, but generally does not rupture, tear, or break by impact or pressures commonly occurring, for example, during conventional transport and handling of the container. In one embodiment, the central seal portion 904 may include tear lines or score lines 910, as illustrated in FIGS. 9-12, so as to provide substantially easy rupture of the central seal portion 904 when intended, such as when the dispense system connector is pressed into the central seal portion, and to guide more uniform tearing of the central seal portion upon rupture. The score lines 910 may be scored to any suitable depth into the central seal portion 904 less than the thickness of the central seal portion. While not limited so, as illustrated in FIGS. 9B, 10B, and 11B, the score lines 910 may be provided on only one side, or only in one surface, of the central seal portion

904, which can help improve resistance to unintentional tearing of the central seal portion, such as during conventional transport and handling of the container. In one embodiment, the score lines 910 are provided on a side of central seal portion 904 such that the scored surface will conventionally be positioned away from the contents of the container to which the breakseal is attached and be visible to a consumer. In one embodiment, the score lines 910 are formed during the molding process of the molded breakseal 900, 1000, and 1100 utilizing a mold configured to create such score lines. However, in other embodiments, the score lines 910 may be formed by any other suitable method such as by die cutting, stamping, compression etching, surface etching, blading, or any other method now known or later developed.

[043] Like the previously described breakseal embodiment 100, any suitable number of score lines 910 may be provided, as desired or required. In one embodiment, as described above with respect to score lines 114, the score lines 910 may be provided in a pattern of a plurality of score lines intersecting at a central location of the central seal portion 904. However, in other embodiments, as illustrated in FIGS. 9A, 10A, and 11A, the score lines 910 may be provided in a pattern of a plurality of score lines converging to a central location of the central seal portion 904 in a generally ‘starburst’ configuration, but not intersecting, thereby forming a center gate 912. In still other embodiments, any suitable pattern of score lines may be utilized. Score lines 910 may or may not extend all the way out to inner edge 908. While FIGS. 9A, 10A, and 11A illustrate score lines 910 extending radially with respect to a central location in a generally ‘starburst’ configuration, as already mentioned, any other suitable pattern is considered within the scope of the present disclosure, and the figures are not intended to limit the invention to specific patterns of score lines.

[044] In one example embodiment, illustrated in FIGS. 9A and 9B, the outer rim portion 902 may have a thickness of about 0.075 inches (approx. 1.9 mm) and the central seal portion 904 may have a thickness of about 0.040 inches (approx. 1 mm). The thickness of the outer rim portion 904 may be generally uniform, and except for score lines 910, the thickness of the central seal portion 904 may also be generally uniform. The score lines 910, in one embodiment, may be formed with sidewalls angled at about

45 degrees from perpendicular to the surface of the central seal portion 904 to a depth of about 0.035 inches (approx. 0.89 mm).

[045] In another example embodiment, illustrated in FIGS. 10A and 10B, the outer rim portion 902 may have a thickness of about 0.075 inches (approx. 1.9 mm) and the central seal portion 904 may have a thickness of about 0.020 inches (approx. 0.5 mm). The thickness of the outer rim portion 904 may be generally uniform, and except for score lines 910, the thickness of the central seal portion 904 may also be generally uniform. The score lines 910, in one embodiment, may be formed with sidewalls angled at about 45 degrees from perpendicular to the surface of the central seal portion 904 to a depth of about 0.015 inches (approx. 0.38 mm).

[046] In still another example embodiment, illustrated in FIGS. 11A-B and 12, the outer rim portion 902 may have a thickness of about 0.075 inches (approx. 1.9 mm) and the central seal portion 904 may have a thickness of about 0.028 inches (approx. 0.71 mm). The thickness of the outer rim portion 904 may be generally uniform, and except for score lines 910, the thickness of the central seal portion 904 may also be generally uniform. The score lines 910, in one embodiment, may be formed with sidewalls angled at about 45 degrees from perpendicular to the surface of the central seal portion 904 to a depth of about 0.023 inches (approx. 0.58 mm).

[047] The above embodiments are provided simply for examples and are not intended to be limiting on other embodiments of the present disclosure. Specifically, while particular thicknesses are provided for the outer rim portion 902 and the central seal portion 904, a particular angle is provided for the sidewalls of the score lines 910, and a particular depth into the central seal portion is provided for the score lines, it is recognized that any suitable thicknesses, angles, and depths may be utilized, as desired or required for the intended use of the breakseal.

[048] In one embodiment, illustrated in FIGS. 11A-B and 12, the outer rim portion 902 and/or the central seal portion 904 may include additional surface features, provided for any purpose. For example, the outer rim portion 902 may include one or more surface indentions 1102 either uniformly or non-uniformly patterned therein. The indentions 1102 may be configured in any desirable shape and size, and may be formed to any desired depth. Such surface indentations 1102 may, for example, impart additional

structural integrity as well as, or alternatively, allow a breakseal design that utilizes less material, thus reducing overall cost and waste for the breakseal. The surface indentations 1102 may also provide for even material flow during the molding process which eliminates sink around the outer rim portion 902. While indentions are illustrated, and particularly discussed, any other surface features, such as but not limited to protrusions, scores, texturing, etc., may be utilized as desired or required for the intended use of the breakseal.

[049] Likewise, for example, the central seal portion 904 may, in addition to or as an alternative for score lines 910, include one or more surface protrusions 1104 either uniformly or non-uniformly patterned therein. The protrusions 1104 may be configured in any desirable shape and size, and may be formed to any desired height. Such surface protrusions 1104 may, for example, impart additional structural integrity or may assist in the uniform rupture of the central seal portion 904. While protrusions are illustrated, and particularly discussed, any other surface features, such as but not limited to indentations, scores, texturing, etc., may be utilized as desired or required for the intended use of the breakseal.

[050] Additionally or alternatively, surface protrusions 1104 may provide protection for an apparatus used to puncture the breakseal 100 (900, 1000, 1100), such as, for example, a probe of a dispense system connector. As mentioned above, the breakseal 100 (or 900, 1000, or 1100) may be pierced, removed, punctured, or the like in order to access the contents of the shipping and dispensing system or other container. In some embodiments, this may create sharp surfaces or projections at the central seal portion 904 around the score lines 910 which could drag along the apparatus used to puncture the breakseal 100 (900, 1000, 1100) and cause damage to the apparatus. Surface protrusions 1104 protects the apparatus from damage by providing a smooth surface for the apparatus to slide along as it passes through the breakseal 100 (900, 1000, 1100).

[051] The single component, molded breakseals 900, 1000, and 1100 of the present disclosure may be manufactured from any suitable materials, including any of the materials described herein for breakseal 100 or for overpack 502 and liner 504, or combinations thereof. In one particular embodiment, breakseal 900, 1000, or 1100 may at least comprise, or in some embodiments may consist solely of, perfluoroalkoxy (PFA).

[052] The single component, molded breakseals 900, 1000, and 1100 may be manufactured utilizing any suitable molding method now known or later developed, including but not limited to, injection molding. In one embodiment, a method for setting up a molding apparatus or machine and manufacturing a single component, molded breakseal 900, 1000, or 1100 of the present disclosure may include some or all of the following steps: a) drying or obtaining a dried resin, such as PFA; b) installing a mold with the desired configuration in a mold machine; c) hook up oil lines to molding machine and/or start circulating oil through the mold; d) bring molding machine press barrel zones up to a desired molding temperature; e) set molding machine clamp tonnage, as desired; f) place dried resin in or direct dried resin to the molding press hopper; g) purge an amount of resin through injection barrel and/or check injection shot size, if desired; h) turn on pack pressure; i) inject and mold resin-based breakseals of the present disclosure; j) drop and/or pick parts from molding machine, and inspect parts, if desired. It is recognized, however, that not every step may be required in every embodiment and additional or alternative steps may be included. Likewise, the steps do not necessarily need to be performed in the order provided, but in fact, some steps may be performed out of order. Of course any conventional molding technique and method may be utilized to manufacture the single component, molded breakseals 900, 1000, and 1100 of the present disclosure, and such methods are not limited to solely that expressly described herein.

[053] A breakseal 100 (or 900, 1000, or 1100) according to the various embodiments of the present disclosure should generally protect the contents stored in a container to which the breakseal is attached from outside influences, such as external atmospheres and, if necessary, light, that can contaminate or otherwise ruin the contents of the container. Therefore, for protecting contents that are sensitive to light or ultraviolet (UV) rays, the breakseal may be configured with pigments to block light and/or manufactured with additives capable of blocking UV rays.

[054] In additional embodiments, the breakseal may be subjected to a cleaning step or process to further ensure quality and qualification of the breakseal for certain manufacturing processes.

[055] Breakseals according to the various embodiments of the present disclosure have advantages over traditional breakseals utilizing LDPE foam and/or adhesives

because the LDPE foam and use of adhesives in such traditional breakseals can lead to undesirable contamination, and thus downstream defects, in certain manufacturing processes. Breakseals according to the various embodiments of the present disclosure utilizing MDPE or LDPE/LLDPE films and bonding the layers using heat lamination reduce and/or minimize the contamination to the contents of a container to which the breakseal is attached. Additionally, breakseals according to the various embodiments of the present disclosure have advantages over other single layer injection molded LDPE breakseals because such single layer injection molded breakseals can be more difficult, and may take longer, to manufacture, each of which drives up manufacturing costs. Breakseals according to various embodiments of the present disclosure can also reduce or eliminate occurrence of sink during the molding process, which delivers improved structural integrity and improved seal performance.

[056] FIG. 5 is an exploded view of one example container system for which a breakseal may be utilized. The container system illustrated in FIG. 5 is but one example, and is provided only for illustration of a sample use of breakseals of the various embodiments of the present disclosure. In general, a container system may be a liner-based shipping and dispense system 500 and may include a substantially rigid overpack 502, a liner 504 (illustrated with the bottom removed for sizing and clarity) for storing the contents of the container system therein, a liner retainer 506 for maintaining the liner 504 in place in the overpack 502, a breakseal 100 (or 900, 1000, or 1100), a cap 508 for covering the breakseal and liner mouth, and a dispense connector 510 for operably connecting with the liner mouth and discharging the contents of the liner for use in a downstream process. In some embodiments, cap 508 and dispense connector 510 may be provided as a single component providing multiple functionality, and in some cases, a unitary component. In still other embodiments, the cap 508 and connector 510 may couple together and work in conjunction to provide multiple functionality without requiring removal of the cap.

[057] The overpack 502 may include an overpack wall 512, an interior cavity 514, and a mouth 516. The overpack 502 may be comprised of any suitable material or combination of materials, for example but not limited to, one or more polymers, including plastics, nylons, EVOH, polyolefins, or other natural or synthetic polymers. In

further embodiments, the overpack 502 may be manufactured using polyethylene terephthalate (PET), polyethylene naphthalate (PEN), poly(butylene 2,6-naphthalate) (PBN), polyethylene (PE), linear low-density polyethylene (LLDPE), low-density polyethylene (LDPE), medium-density polyethylene (MDPE), high-density polyethylene (HDPE), polypropylene (PP), and/or a fluoropolymer, such as but not limited to, polychlorotrifluoroethylene (PCTFE), polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), and perfluoroalkoxy (PFA). The overpack 502 may be of any suitable shape or configuration, such as, but not limited to, a bottle, a can, a drum, etc.

[058] As described above, the shipping and dispense system 500 may include a liner 504, which may be disposed within the overpack 502. The liner 504 may include a liner wall 518, an interior cavity 520, and a mouth 522. The mouth 522 of the liner 504 may include a fitment portion 524. The fitment portion 524 may be made of a different material than the rest of the liner 504 and may be harder, more resilient, and/or less flexible than the rest of the liner. As illustrated more clearly in FIG. 6, which illustrates an enlarged, cross-sectional view of overpack mouth 516, liner mouth 522 and fitment portion 524, liner retainer 506, breakseal 100, and cap 508, the fitment portion may couple with the cap and/or dispense connector 510 by any suitable means, such as but not limited to, complementary threading, snap-fit or friction-fit means, bayonet means, or any other suitable mechanism or combination of mechanisms for coupling, as will be appreciated by those skilled in the art. In some embodiments, a cap or dispense connector may couple to, or may alternatively or additionally couple to, the mouth 516 of the overpack 502.

[059] In some embodiments, the liner 504 may be a collapsible liner that is substantially flexible, while in other embodiments the liner may be somewhat rigid but still collapsible, e.g., a rigid collapsible liner. The liner 504 may be manufactured using any suitable material or combination of materials, such as but not limited to, any of the materials or combination of materials listed above with respect to the overpack 502. However, the overpack 502 and liner 504 need not be manufactured from the same materials. In some embodiments, the material or materials selected and the thickness of that material or those materials may determine the rigidity of the liner 504. The liner 504 may have one or more layers and may have any desirable thickness. A liner 504 may

have a thickness of, for example, from about 0.05 mm to about 3 mm, or any other suitable thickness.

[060] The liner 504 may be configured to comprise any desirable shape that is appealing to the user, and/or assists in the collapse of the liner. The liner 504, in some embodiments, may be dimensioned and shaped to substantially conform to the interior of the overpack 502. As such, the liner 502 may have a relatively simplistic design with a generally smooth outer surface, or the liner may have a relatively complicated design including, for example but not limited to, indentations and/or protrusions. In some embodiments, the liner wall 518 may include a generally textured surface in order to minimize leaching and/or adhesion. For example, in some embodiments, the surface may include a plurality of bumps, scales, or projections, which may each have any appropriate size, for example, but not limited to, from about 0.5 – 100 μm . Texturizing features may be spaced any suitable distance from one another. In some embodiments, the texturizing may comprise a framework, such as a lattice or scaffold, for example. Examples of some suitable texturizing features are described in greater detail in U.S. Provisional Patent Appln. No. 61/334,006, titled, “Fluid Processing Components with Textured Surface for Decreased Adhesion and Related Methods,” filed May 12, 2010, which is hereby incorporated by reference herein in its entirety. The liner 504 may have a relatively thin liner wall 518, as compared to the thickness of the overpack wall 512. In some embodiments, the liner 502 may be flexible such that the liner wall 518 may be readily collapsed, such as by vacuum through the mouth 522 or by pressure between the liner wall 518 and overpack wall 512, referred to herein as the annular space therebetween.

[061] The liner 504, in a further embodiment, may have a shape, when inflated or filled, that is different from, but complimentary with, the shape of the overpack 502 such that it may be disposed therein. In some embodiments, the liner 504 may be removably attached to the interior of the overpack wall 512. The liner 504 may provide a barrier, such as a gas barrier, against drive gas migration from the annular space between the liner wall 518 and the overpack wall 512. Accordingly, the liner 504 may generally ensure and/or maintain the purity of the contents within the liner.

[062] In some embodiments, particularly where sterility of the contents of the liner must be substantially maintained, the liner 504 may be comprised of a material that

may help ensure or maintain a sterile environment for the contents disposed in the liner. For example, in some embodiments the liner may be comprised of TK8 manufactured by ATMI of Danbury, Connecticut, or any other suitable material. As noted above, in some embodiments, the liner 504 may comprise multiple layers. The multiple layers may comprise one or more different polymers or other suitable materials. In some embodiments, the thickness, ply, and/or the composition of the liner and/or the layers of the liner may allow for the secure and substantially uncontaminated shipment of the contents of the liner-based system of the present disclosure by limiting or eliminating typical weaknesses or problems associated with traditional liners or packages, such as, for example weld tears, pin holes, gas entrainment, and/or any other means of contamination. Similarly, or in addition, the liner 504 may also contribute to the secure and substantially uncontaminated shipment of the contents of the shipping and dispense system 500 of the present disclosure by configuring the liner to substantially conform to the shape of the overpack when the liner is filled, thereby reducing the amount of movement of the contents during shipping.

[063] The overpack 502 and liner 504 may each be manufactured using any suitable manufacturing process, such as but not limited to, injection blow molding, injection stretch blow molding, extrusion, etc., and may each be manufactured as a single component or may be a combination of multiple components. In some embodiments, the overpack 502 and liner 504 may be blow molded in a nested fashion, also referred to herein as co-blow molded. Examples of liner-based systems and methods utilizing co-blow molding techniques have been described in greater detail in International PCT Appl. No. PCT/US11/55560, titled, “Nested Blow Molded Liner and Overpack and Methods of Making Same,” filed October 10, 2011, which is hereby incorporated herein by reference in its entirety. In some embodiments a liner may be blow molded into an already formed overpack, whereby the overpack may function as the mold for the liner, and may also be referred to as “dual blow molding.” In such embodiments, the overpack may be manufactured by any suitable process.

[064] The liner-based shipping and dispensing systems described herein may be configured as any suitable shape, including but not limited to square, rectangular, triangular or pyramidal, cylindrical, or any other suitable polygon or other shape.

Differently shaped dispensers can improve packing density during storage and/or transportation, and may reduce overall transportation costs. Additionally, differently shaped dispensers can be used to differentiate dispensers from one another, such as to provide an indicator of the contents provided within the dispensers or to identify for which application or applications the contents are to be used, etc. In still further embodiments, the dispensers described herein may be configured as any suitable shape in order to “retrofit” the dispensers with existing dispense assemblies or dispense systems.

[065] A basic function of a breakseal 100 (or 900, 1000, or 1100) in the shipping and dispensing system 500 according to the various embodiments of the present disclosure may be generally the same as that of conventional breakseals and container systems, which is to protect the contents of the container. As seen more clearly in FIG. 6, a breakseal 100 (or 900, 1000, or 1100) may be seated within cap 508, and after the liner 504 is filled, the cap with breakseal seated therein, may be coupled or otherwise attached to the liner fitment portion 524, with the breakseal adjacent the liner mouth 522, thereby sealing the contents within the liner. The breakseal 100 (or 900, 1000, or 1100) may be seated within, or otherwise coupled with, the cap 508 by any suitable means, such as but not limited to friction-fit or snap-fit. As illustrated in FIG. 6, a lip 602 may be provided in cap 508 to retain breakseal 100 (or 900, 1000, or 1100) in place, if desired.

[066] For example, in one embodiment, illustrated in FIGS. 7 and 8, a breakseal 100 (or 900, 1000, or 1100) and shipping and/or storage cap/closure 700 may be provided separately or in combination for securely closing or sealing the contents of a shipping and dispensing system, such as the liner and overpack shipping and dispensing systems described herein, or other container. Such a shipping and/or storage cap/closure 700 may include features that allow it to be operably connected with an end user’s dispense connector instead of being removed prior to dispense. In some embodiments, for example, a cap/closure 700 may include a removable teartab or cover 702. Teartab 702 may be generally secured to a base of the cap/closure 702 during initial storage and shipping. When it is desirable to dispense the contents of the container, the teartab 702 may be removed, for example, by pulling on a teartab handle 704. As described in detail herein, below or underneath the teartab 702, the cap/closure 700 may further include a breakseal 100 (or 900, 1000, or 1100), such as the breakseal embodiments described

herein, so that contaminants are substantially prevented from getting into the dispenser. With the teartab 702 removed, the breakseal 100 (or 900, 1000, or 1100) may be exposed and a conventional or custom dispense connector may be coupled with the cap/closure 700 for dispense of the contents within the liner and overpack system. As mentioned above, the breakseal 100 (or 900, 1000, or 1100) may be pierced, removed, punctured, or the like in order to access the contents of the shipping and dispensing system or other container. In some embodiments, the dispense connector may pierce or puncture the breakseal as the dispense connector is operably coupled with the cap/closure 700. The breakseal 100 (or 900, 1000, or 1100) may be seated within, or otherwise coupled with, the cap/closure 700 by any suitable means, such as but not limited to friction-fit or snap-fit. As illustrated in FIG. 8, a lip 802 may be provided in cap/closure 700 to retain breakseal 100 (or 900, 1000, or 1100) in place, if desired. The breakseal 100 (or 900, 1000, or 1100) may generally be positioned such that, when the cap/closure 700 is operably coupled with a liner 504 and overpack 502, the breakseal is adjacent and forms a seal with the liner mouth 522.

[067] In additional embodiments, an O-ring 706 may be provided as yet an additional liquid seal means or gasket between the cap/closure 700 and an overpack, and may also be seated within, or otherwise coupled with, the cap/closure by any suitable means, such as but not limited to friction-fit or snap-fit. As illustrated in FIG. 8, and also back in the embodiment of FIG. 6, a lip 804 may be provided in cap/closure 700 to retain the O-ring 706 in place, if desired. The O-ring 706 may generally be positioned such that, when the cap/closure 700 is operably coupled with a liner 504 and overpack 502, the O-ring is adjacent and forms a seal with or against the overpack mouth 516. In one embodiment, the O-ring 706 may be constructed of a material comprising PTFE coated ethylene propylene diene monomer (EPDM).

[068] In still further embodiments, the cap/closure 700 may include misconnect prevention means 708. The misconnect prevention means 708 may be similar to those provided with the misconnect prevention caps/closures of ATMI of Danbury, Connecticut, or those disclosed in U.S. Patent No. 5,875,921, titled "Liquid Chemical Dispensing System with Sensor," issued March 2, 199; U.S. Patent No. 6,015,068, titled "Liquid Chemical Dispensing System with a Key Code Ring for Connecting the Proper

Chemical to the Proper Attachment,” issued January 18, 2000; U.S. Patent No. 6,879,876, titled “Liquid Handling System with Electronic Information Storage,” issued April 12, 2005; U.S. Patent No. 7,747,344, titled “Liquid Handling System with Electronic Information Storage,” issued June 29, 2010; U.S. Patent No. 7,702,418, titled “Secure Reader System,” issued April 20, 2010; U.S. Patent Application No. 60/813,083 filed on June 13, 2006; U.S. Patent Application No. 60/829,623 filed on October 16, 2006; and U.S. Patent Application No. 60/887,194 filed on January 30, 2007, each of which is hereby incorporated by reference in its entirety. The misconnect prevention means 708 of the cap/closure 700 may comprise, for example but not limited to, punched or mechanical key codes 710, one or more RFID (Radio Frequency Identification) chips or sensors 712, such as one or more magnetic sensors, or any other suitable mechanism or combination of mechanisms that may be used to prevent misconnection between a dispense connector and the various embodiments of caps/closures described herein. For example, unique chemical key-coding 710 can help ensure that a dispense connector is mated with the proper cap/closure; without a matched code set, dispensing may be disabled. Additional misconnect prevention means of, for example, RFID chips or magnetic sensors 712, which must be read properly or aligned correctly before dispense is enabled can further increase connection reliability and safety.

[069] Further embodiments of caps and/or closures that may be used with embodiments of the present disclosure are those closure/connectors described in International PCT Appl. No. PCT/US12/65515, entitled, “Closure/Connectors for Liner-Based Shipping and Dispensing Containers and Methods for Filling Liner-Based Shipping and Dispensing Containers,” filed November 16, 2012, which is hereby incorporated by reference herein in its entirety. In some embodiments, the closure/connector may be a high-flow connector that allows for a generally high rate of dispensability, and in some cases, such a closure/connector may also include misconnect prevention features, such as those described above and in more detail in U.S. Patent Application No. 12/982,160, entitled, “Closure/Connectors for Liner-Based Dispense Containers,” filed December 30, 2010, and International PCT Appl. No. PCT/US11/56291, entitled, “Connectors for Liner-Based Dispense Containers,” filed October 14, 2011, both of which are hereby incorporated by reference herein in their

entirety. In other embodiments, the closure/connector or any cap/closure disclosed herein may include a head space venting port, that may allow headspace to be removed from the dispenser. Generally, the expression “headspace,” as used herein, may refer to the gas space in the liner that may rise to the top of the liner, above the contents stored in the liner. If all, or substantially all, of the headspace gas is removed, then generally the only remaining sources of gas bubbles, if any, would be from any folds in the liner.

[070] In some embodiments, the dispense connector features may allow for dispense using existing dispense systems, such as existing indirect pressure dispense systems. Generally, such indirect pressure dispense connector features may include a pressurizing gas inlet that generally permits a gas pressure in-line to be inserted through or coupled with the dispense connector and be in fluid communication with the annular space between the liner and the overpack. In such a system, a pressurizing fluid, gas, or other suitable substance may be introduced into the annular space, causing the liner to collapse away from the overpack wall, thereby pushing the contents of the liner out through a liquid outlet. In one embodiment, for example, to dispense liquid stored in the liner, the annular space between the liner and the overpack may be pressurized, as is further described in International Patent Application No. PCT/US2011/055558, filed October 10, 2011 entitled, “Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Enhanced Flexible Liners,” which is hereby incorporated herein by reference in its entirety. In a particular embodiment, the cap/closure 700 may be a cap consistent with those sold under the brands SmartCap or IntelliCap by ATMI of Danbury, Connecticut.

[071] Various embodiments of caps/closures described herein, including embodiments of breakseal 100 (or 900, 1000, or 1100), may help ensure that the contents of the shipping and dispensing system, such as the liner and overpack shipping and dispensing systems described herein, will be dispensed through a sealed or substantially sealed pathway, protecting the contents from external contamination. Additionally, such a seal can prevent solvent loss through evaporation.

[072] Examples of some of the types of materials that may be stored, shipped, and/or dispensed using embodiments of the present disclosure include, but are not limited to: ultrapure liquids, such as acids, solvents, bases, photoresists, slurries, detergents,

cleaning formulations, dopants, inorganic, organic, metalorganics, TEOS, and biological solutions, DNA and RNA solvents and reagents, pharmaceuticals, printable electronics inorganic and organic materials, lithium ion or other battery type electrolytes, nanomaterials (including for example, fullerenes, inorganic nanoparticles, sol-gels, and other ceramics), and radioactive chemicals; pesticides/fertilizers; paints/glosses/solvents/coating-materials etc.; adhesives; power washing fluids; lubricants for use in the automobile or aviation industry, for example; food products, such as but not limited to, condiments, cooking oils, and soft drinks, for example; reagents or other materials for use in the biomedical or research industry; hazardous materials used by the military, for example; polyurethanes; agrochemicals; industrial chemicals; cosmetic chemicals; petroleum and lubricants; sealants; health and oral hygiene products and toiletry products; or any other material that may be dispensed by pressure dispense, for example. Materials that may be used with embodiments of the present disclosure may have any viscosity, including high viscosity and low viscosity fluids. Those skilled in the art will recognize the benefits of the disclosed embodiments, and therefore will recognize the suitability of the disclosed embodiments to various industries and for the transportation and dispense of various products. In some embodiments, the storage, shipping, and dispensing systems may be particularly useful in industries relating to the manufacture of semiconductors, flat panel displays, LEDs, and solar panels; industries involving the application of adhesives and polyamides; industries utilizing photolithography technology; or any other critical material delivery application. However, the various embodiments disclosed herein may be used in any suitable industry or application.

[073] The liner-based systems of the present disclosure may hold up to approximately 200 liters, in some embodiments. Alternatively, the liner-based systems may hold up to approximately 20 liters. Alternatively, the liner-based systems may hold approximately 1 to 5 liters, or less. It will be appreciated that the referenced container sizes are examples only and that the liner-based systems of the present disclosure may be readily adapted for use with a wide variety of sized and shaped shipping and dispensing containers.

[074] The entire liner-based system of the present disclosure may be used a single-time and then disposed of, in some embodiments. In other embodiments, the overpack, for example, may be reused while the liner and/or any closures or connectors may be used only a single time. In still other embodiments, some portion of the closure and/or connector may be configured for a one-time use while other portions of the closure and/or connector may be configured for repeated use.

[075] Further examples and embodiments of the type of liners and overpacks that may be used are disclosed in more detail in: International PCT Appl. No. PCT/US11/55558, titled, "Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Enhanced Flexible Liners," filed October 10, 2011; International PCT Appl. No. PCT/US11/55560, titled, "Nested Blow Molded Liner and Overpack and Methods of Making Same," filed October 10, 2011; International PCT Appl. No. PCT/US11/64141, titled "Generally Cylindrically-Shaped Liner for Use in Pressure Dispense Systems and Methods of Manufacturing the Same," filed December 9, 2011; U.S. Prov. Appl. No. 61/703,996, titled "Liner-Based Shipping and Dispensing Systems," filed September 21, 2012; U.S. Prov. Appl. No. 61/468,832, titled "Liner-Based Dispenser," filed March 29, 2011 and related International PCT Appln. No. PCT/US2011/061764, filed November 22, 2011; U.S. Prov. Appl. No. 61/525,540, titled "Liner-Based Dispensing Systems," filed August 19, 2011 and related International PCT Appln. No. PCT/US2011/061771, filed November 22, 2011; U.S. Pat. Appl. No. 13/149,844, titled "Fluid Storage and Dispensing Systems and Processes," filed May 31, 2000 U.S. Pat. Appl. No. 11/915,996, titled "Fluid Storage and Dispensing Systems and Processes," filed June 5, 2006; International PCT Appl. No. PCT/US10/51786, titled "Material Storage and Dispensing System and Method With Degassing Assembly," filed October 7, 2010; International PCT Appl. No. PCT/US10/41629; U.S. Pat. No. 7,335,721; U.S. Pat. Appl. No. 11/912,629; U.S. Pat. Appl. No. 12/302,287; International PCT Appl. No. PCT/US08/85264; U.S. Pat. Appl. No. 12/745,605, filed February 15, 2011; U.S. Prov. Appln. No. 61/605,011, titled "Liner-Based Shipping and Dispensing System," filed February 29, 2012; and U.S. Prov. Appln. No. 61/561,493, titled "Closure/Connectors for Liner-Based Shipping and Dispensing Containers," filed November 18, 2011, each of which is hereby incorporated by reference herein in its

entirety. The overpack 502 and liner 504 for use with the shipping and dispense system 500 of the present disclosure may include any of the embodiments, features, and/or enhancements disclosed in any of the above noted applications, including, but not limited to, flexible, rigid collapsible, 2-dimensional, 3-dimensional, welded, molded, gusseted, and/or non-gusseted liners, and/or liners that contain folds and/or liners that comprise methods for limiting or eliminating choke-off and liners sold under the brand name NOWpak® by ATMI, Inc. for example. Various features of dispensing systems disclosed in embodiments described herein may be used in combination with one or more other features described with regard to other embodiments.

[076] The various embodiments of storage and dispense systems described herein may be utilized in any suitable dispense processes. For example, the various embodiments of storage and dispense system described herein may be utilized in pressure dispense processes, including direct and indirect pressure dispense, pump dispense, and pressure-assisted pump dispense, including various embodiments of inverted dispense methods disclosed in Korean patent registration no. 10-0973707, titled “Apparatus for Supplying Fluid,” which is hereby incorporated by reference herein in its entirety. Similarly, the various embodiments of storage and dispense system described herein may be utilized in traditional manual or automatic pour methods.

[077] Generally, in use, a liner-based system of the present disclosure may be initially readied for filling and/or shipped to a fill site. The liner-based system may subsequently be filled with a desired substance and may be shipped to an end-user. The liner may be filled with, or contain, for example, an ultrapure liquid, such as an acid, solvent, base, photoresist, dopant, inorganic, organic, or biological solution, pharmaceutical, or radioactive chemical. However, it is recognized that the liner may be filled with any other suitable materials, such as but not limited to the materials previously listed.

[078] The liner may be filled to the top of the liner in some embodiments, leaving generally no excess space for headspace gas, while in other embodiments there may be some relatively small amount of space left at the top of the liner. “Headspace” refers to the amount of gas, such as air for example, that remains at the top of the liner after the liner has been filled with a desired substance. Limiting or substantially

eliminating headspace in a filled liner may be advantageous because it may limit or substantially eliminate the risk of headspace gas contaminating the contents of the liner, when for example, the liner-based assembly is moved during shipping. Thus, in some embodiments, any headspace gas, or a substantial portion of headspace gas may be removed prior to, during, or after sealing the liner.

[079] Once the liner has been filled, the liner may be sealed, secured, and/or capped in any suitable manner that keeps the substance within the liner and minimizes or substantially eliminates exposure of the substance to contaminants outside of the liner. As discussed above, and illustrated in FIG. 6, a breakseal 100 (or 900, 1000, or 1100) may be seated within cap 508, and after the liner 504 is filled, the cap with breakseal seated therein, may be coupled or otherwise attached to the liner fitment portion 524, with the breakseal adjacent the liner mouth 522, thereby sealing the contents within the liner. The contents may be sealed under pressure, if desired, and may further be wrapped in a bag and/or box to be readied for transport. In some embodiments, some or any headspace may be removed after a cap or connector is secured to the liner. In such embodiments, the annular space between the liner and the overpack may be pressurized so as to compress the walls of the liner inward, thereby forcing any headspace out of the liner and into a holding area in a cap and/or connector, for example, as is further described in U.S. Prov. Appln. No. 61/561,493, which is hereby incorporated by reference herein in its entirety. It will be understood, however, that any suitable method of removing headspace is contemplated and within the scope of the present disclosure.

[080] The end-user may then store and/or dispense the contents of the container. When it is desired to dispense the contents of the liner, the cap 508 may be removed and the dispense connector 510 may be operably connected to the fitment portion 524 of the liner 504. As discussed above, in some embodiments, cap 508 and dispense connector 510 may be provided as a single component providing multiple functionality, and in some cases, a unitary component, and as such removal of the cap may be unnecessary. In still other embodiments, the cap 508 and connector 510 may couple together and work in conjunction to provide multiple functionality without requiring removal of the cap.

[081] The connector may include a probe 526 that is configured, or can nonetheless be utilized, to rupture the circular layer 110 or central seal portion 904 upon

application of pressure or force by the probe, for example, on the central portion 112 of the circular layer, as discussed above, while coupling with the fitment portion 524 of the liner 504. While a breakseal 100 (or 900, 1000, or 1100) can be designed such that any suitable amount of force or pressure is required in order to initiate tearing or rupturing of the circular layer 110 or central seal portion 904, in one embodiment, the breakseal may be configured such that the amount of force required to initiate tearing or rupturing is from about 15 N to about 70 N, and preferably from about 22 N to about 62 N. Upon coupling with the fitment portion 524 and rupturing of the circular layer 110 or central seal portion 904, the probe 526 of the dispense connector 510 will be in fluid communication with the interior cavity 520 of the liner 504. The contents of the liner 504 may thus be dispensed through the mouth 522 of the liner using any suitable dispense method, such as by pressure dispense, including direct and indirect pressure dispense, pump dispense, pressure-assisted pump dispense, inverted dispense, pouring, or any other suitable means of dispensing the contents of a container consistent with the intended use of the material, or application involved. In some embodiments, a dispense connector, configured for a particular dispense method, may be affixed to the liner-based system in preparation for dispense of the contents of the liner. The dispense connector may be configured to be compatible with particular dispense systems used by an end-user, which may vary from industry to industry.

[082] In further embodiments, to aid in dispense, such as but not limited to, in pump dispense applications, any of the liner-based systems of the present disclosure may include an embodiment that has a dip tube extending any suitable distance into the liner. In other embodiments, the liner-based systems of the present disclosure may not include a dip tube, such as for some pressure dispense or inverted dispense applications. In alternative embodiments, each embodiment of a potentially self-supporting liner described herein, may be shipped without an overpack and placed in a pressurizing vessel at the receiving facility in order to dispense the contents of the liner.

[083] In the foregoing description various embodiments of the invention have been presented for the purpose of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiments were chosen

and described to provide the best illustration of the principals of the invention and its practical application, and to enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth they are fairly, legally, and equitably entitled.

Claims

We claim:

1. A breakseal comprising:

a first layer comprising extruded medium-density polyethylene (MDPE) film in a flat washer shape defining a central opening therethrough;

a second layer comprising polytetrafluoroethylene (PTFE) film heat laminated to a first side of the first layer, the second layer exposed through the central opening, the second layer being rupturable within the central opening.

2. The breakseal of claim 1, wherein the MDPE film has a density of between about 0.930 g/cm³ and about 0.960 g/cm³.

3. The breakseal of claim 2, wherein the first layer has a thickness of between about 10 mil and 80 mil.

4. The breakseal of claim 1, wherein the first layer comprises two sub-layers of MDPE film in flat washer shapes bonded together by heat lamination.

5. The breakseal of claim 4, wherein the combined thicknesses of the sub-layers between about 10 mil and 80 mil.

6. The breakseal of claim 5, wherein the thicknesses of each sub-layer is about 30 mil.

7. The breakseal of claim 1, wherein the second layer has a thickness of between about 5 mil and 100 mil.

8. The breakseal of claim 1, wherein the second layer comprises one or more score lines defined within the central opening to assist rupturing of the second layer within the central opening.

9. The breakseal of claim 8, wherein the one or more score lines include a plurality of score lines intersecting at a generally central location of the second layer.

10. The breakseal of claim 8, wherein the one or more score lines include a plurality of non-intersecting score lines extending from a generally central location of the second layer.
11. A method of making a breakseal, the method comprising heat laminating a layer of polytetrafluoroethylene (PTFE) film to a layer of extruded medium-density polyethylene (MDPE) film, the layer of MDPE being in a flat washer shape and defining a central opening therein where the layer of PTFE is exposed.
12. The breakseal of claim 7, wherein one or more surfaces of the layer of PTFE are treated to roughen the one or more surfaces prior to being heat laminated to the first layer.
13. A breakseal comprising:
- a first layer comprising an extruded low-density polyethylene (LDPE)/linear low-density polyethylene (LLDPE) film in a flat washer shape defining a central opening therethrough;
 - a second layer comprising polytetrafluoroethylene (PTFE) film heat laminated to a first side of the first layer, the second layer exposed through the central opening, the second layer being rupturable within the central opening.
14. The breakseal of claim 13, wherein the LDPE/LLDPE film has a density of about 0.920 g/cm^3 .
15. The breakseal of claim 13, wherein the first layer has a thickness of between about 10 mil and 80 mil.
16. The breakseal of claim 13, wherein the first layer comprises two sub-layers of LDPE/LLDPE film in flat washer shapes bonded together by heat lamination.
17. The breakseal of claim 16, wherein the combined thicknesses of the sub-layers between about 10 mil and 80 mil.

18. The breakseal of claim 17, wherein the thicknesses of each sub-layer is about 30 mil.
19. The breakseal of claim 13, wherein the second layer has a thickness of between about 5 mil and 100 mil.
20. The breakseal of claim 13, wherein the second layer comprises one or more score lines defined within the central opening to assist rupturing of the second layer within the central opening.
21. The breakseal of claim 20, wherein the one or more score lines include a plurality of score lines intersecting at a generally central location of the second layer.
22. The breakseal of claim 20, wherein the one or more score lines include a plurality of non-intersecting score lines extending from a generally central location of the second layer.
23. A method of making a breakseal, the method comprising heat laminating a layer of polytetrafluoroethylene (PTFE) film to a layer of an extruded low-density polyethylene (LDPE)/linear low-density polyethylene (LLDPE) film, the layer of LDPE/LLDPE being in a flat washer shape and defining a central opening therein where the layer of PTFE is exposed.
24. The breakseal of claim 23, wherein one or more surfaces of the layer of PTFE are treated to roughen the one or more surfaces prior to being heat laminated to the first layer.
25. A molded breakseal comprising:
 - an outer rim portion defining a central opening therein and having a first thickness;
 - a central seal portion having a second thickness being smaller than the first thickness, the central seal portion spanning the central opening and being integrally formed with the outer rim portion; and

a plurality of score lines formed to a depth into the central seal portion, such that the seal portion is configured to rupture generally uniformly on application of a pressure thereon above a predetermined threshold.

26. The molded breakseal of claim 25, wherein the outer rim portion and integral central seal portion are formed from perfluoroalkoxy (PFA).

27. The molded breakseal of claim 25, wherein the seal portion is configured to rupture generally uniformly on application of a pressure thereon of between about 15 N and about 70 N.

28. The molded breakseal of claim 25, wherein the plurality of score lines intersect at a generally central location of the seal portion.

29. The molded breakseal of claim 25, wherein the plurality of score lines include a plurality of non-intersecting score lines extending from a generally central location of the seal portion.

30. The molded breakseal of claim 25, further comprising one or more surface indentations formed on a surface of the outer rim portion.

31. The molded breakseal of claim 28, further comprising one or more surface indentations formed on a surface of the seal portion.

32. A method of forming a molded breakseal, the method comprising:

drying or obtaining a dried perfluoroalkoxy (PFA) resin;

installing, into a molding apparatus, or otherwise providing a mold designed to form a breakseal having:

an outer rim portion defining a central opening therein and having a first thickness;

a central seal portion having a second thickness being smaller than the first thickness, the central seal portion spanning the central opening and being integrally formed with the outer rim portion; and

a plurality of score lines formed to a depth into the central seal portion, such that the seal portion is configured to rupture generally uniformly on application of a pressure thereon above a predetermined threshold;

preparing the molding apparatus for a desired molding temperature; and

injecting an amount of the PFA resin into the mold and molding a breakseal corresponding to the design of the mold.

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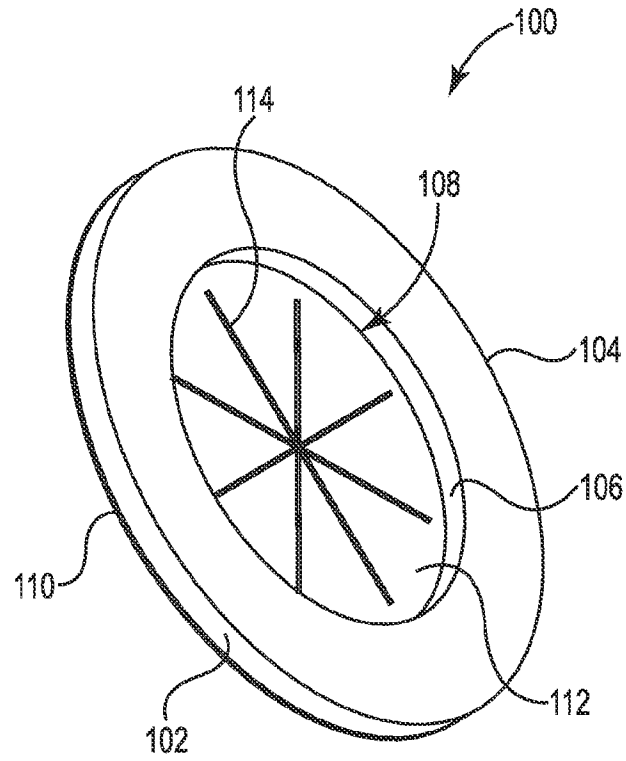


Fig. 1

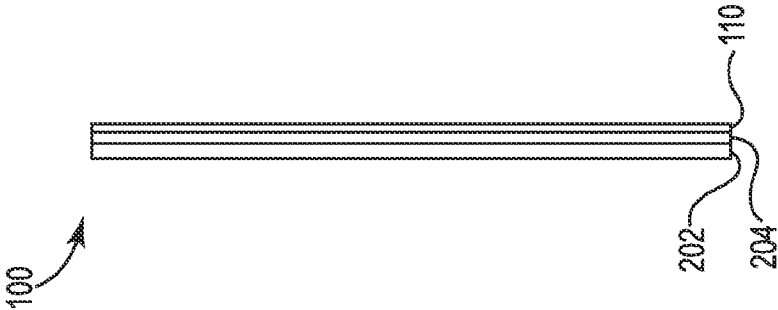


Fig. 2B

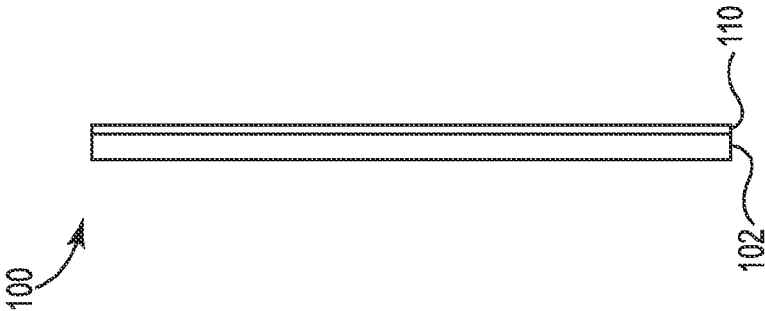


Fig. 2A

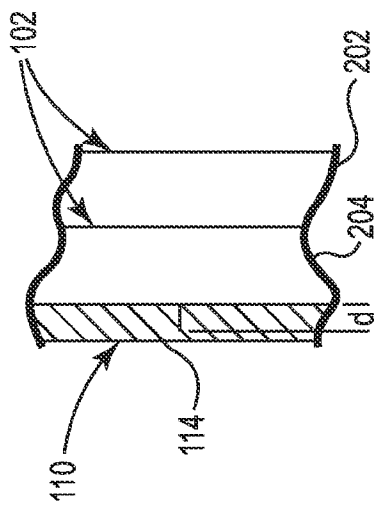


Fig. 3B

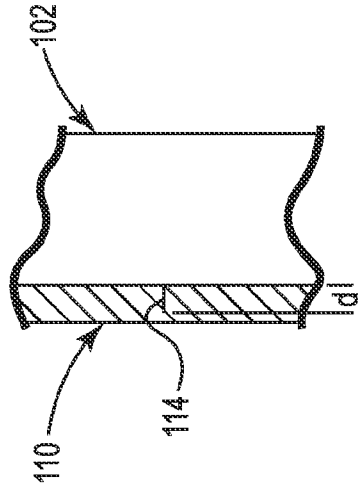
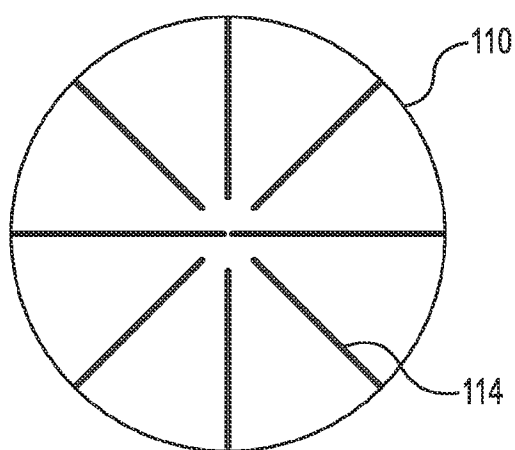


Fig. 3A

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**Fig. 4**

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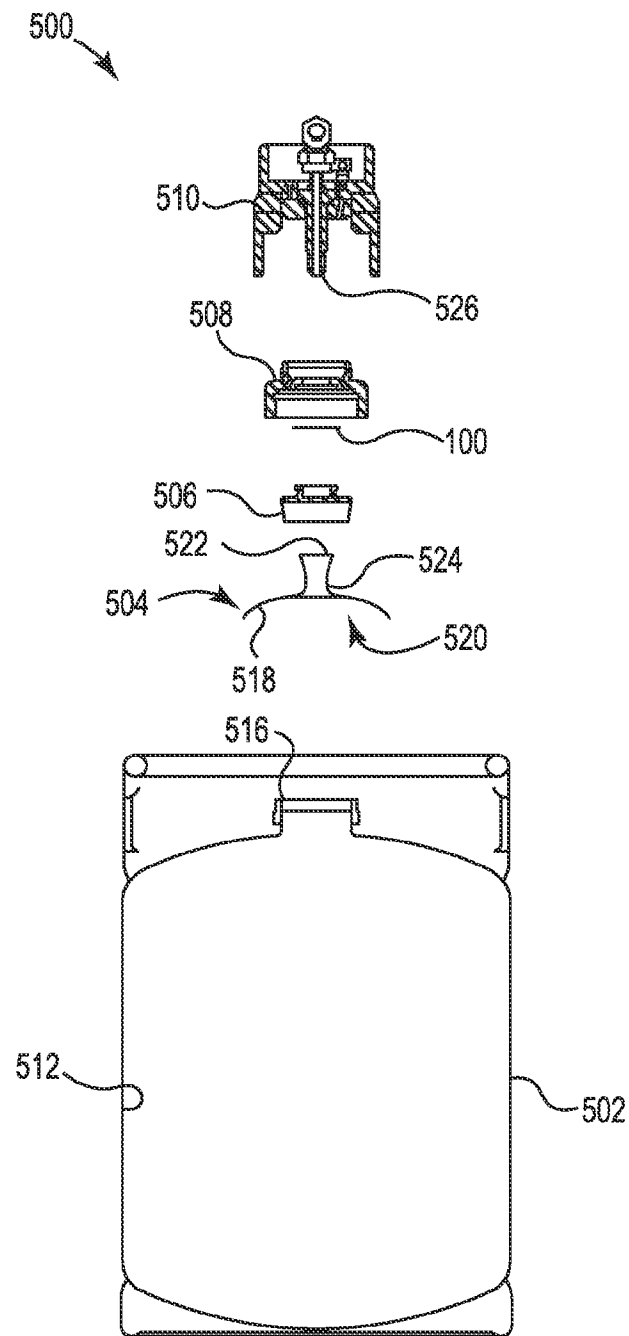


Fig. 5

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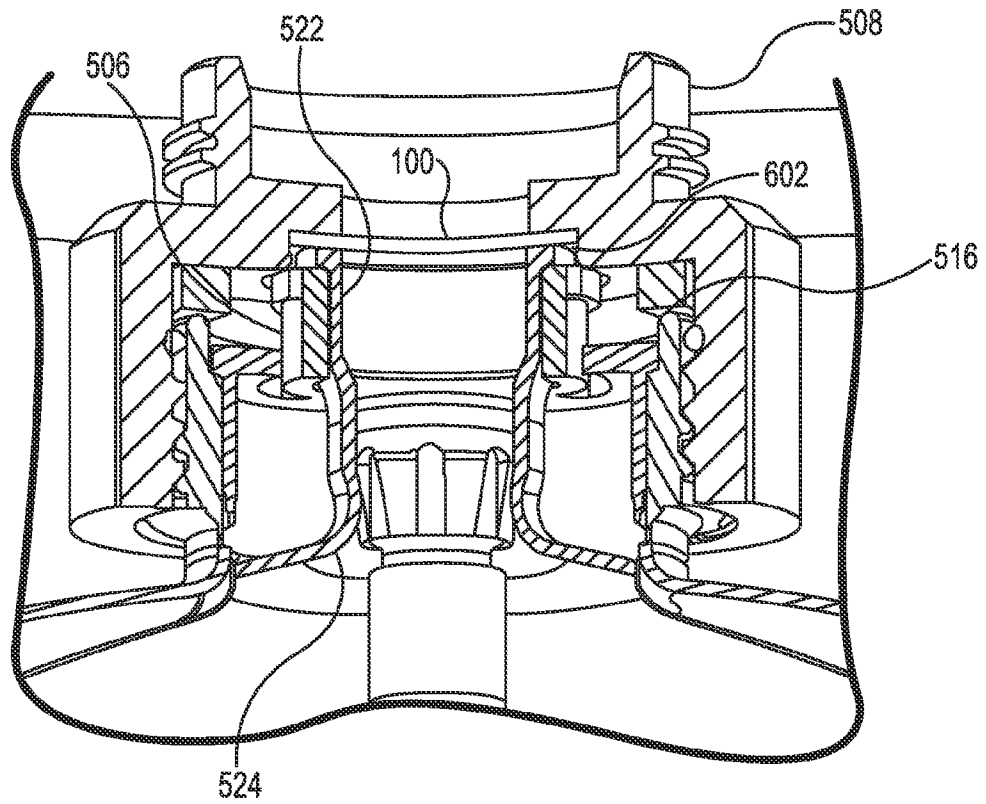


Fig. 6

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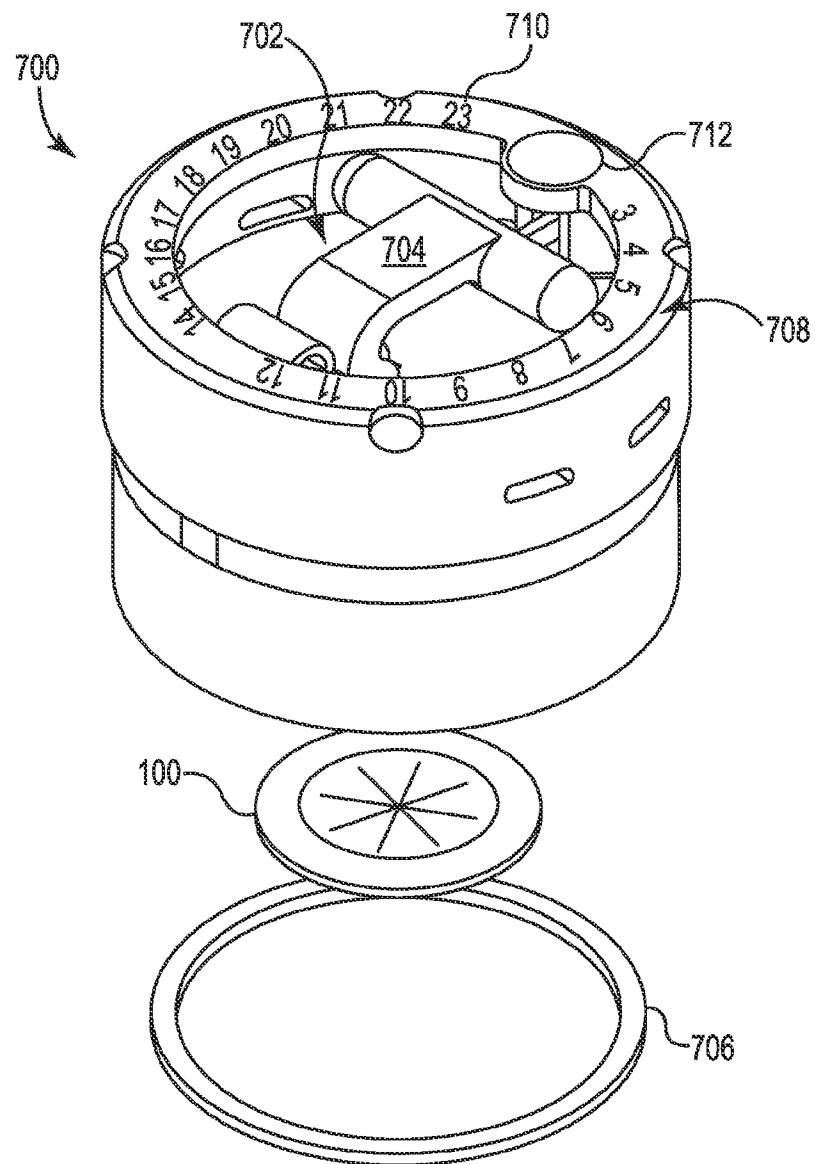


Fig. 7

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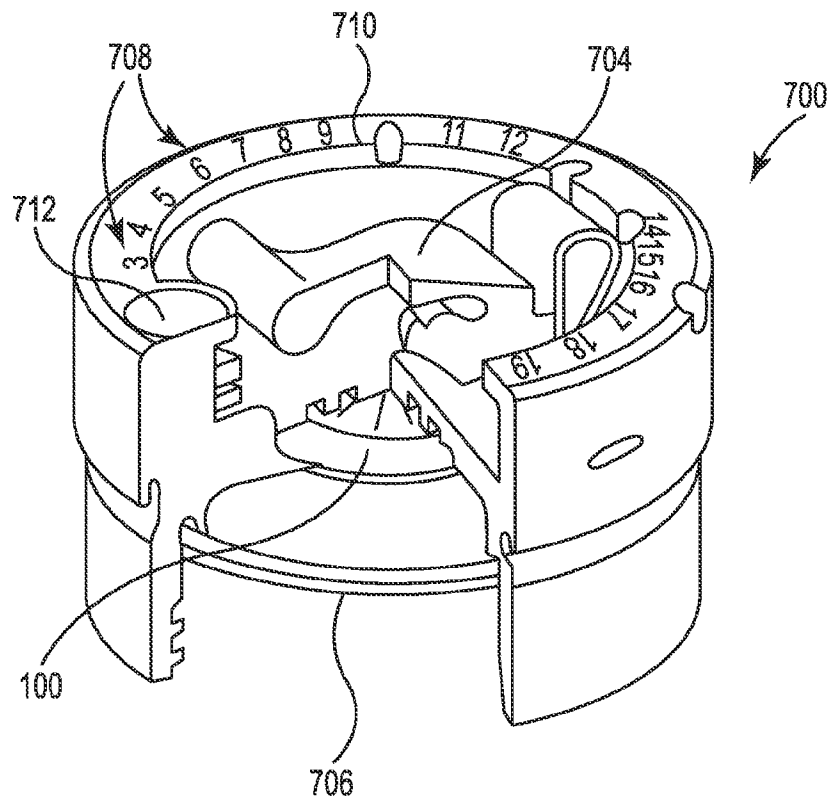


Fig. 8

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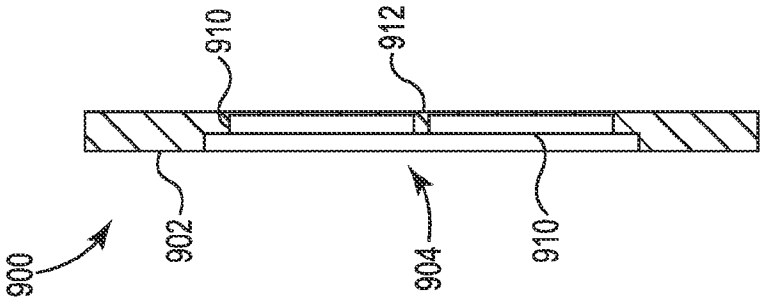


Fig. 9B

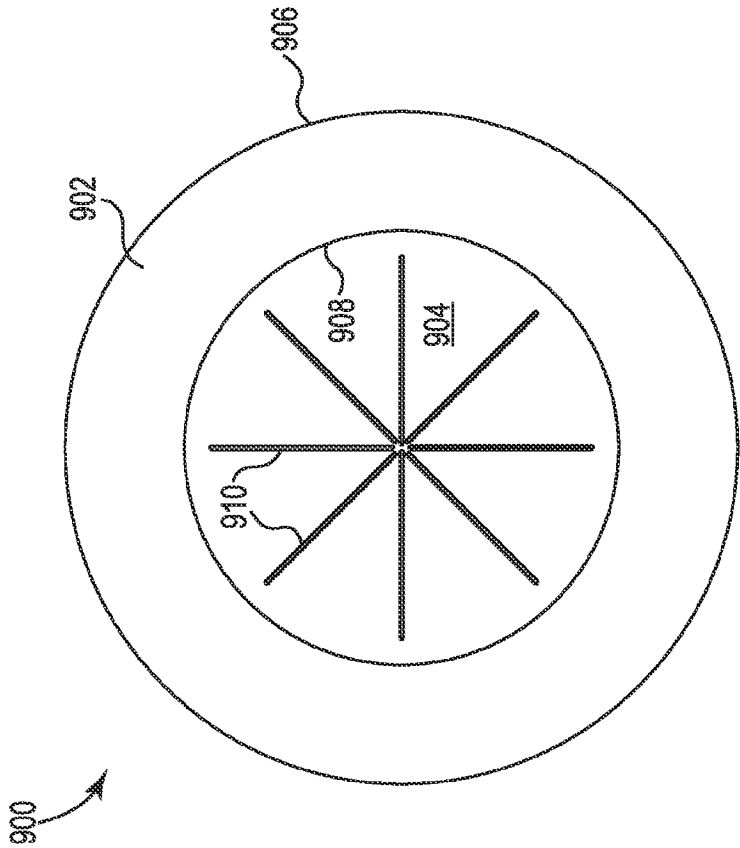


Fig. 9A

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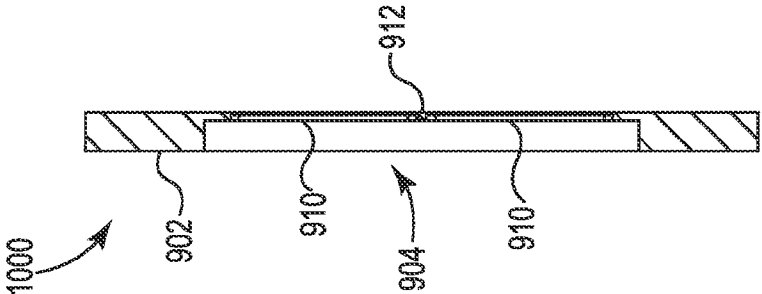


Fig. 10B

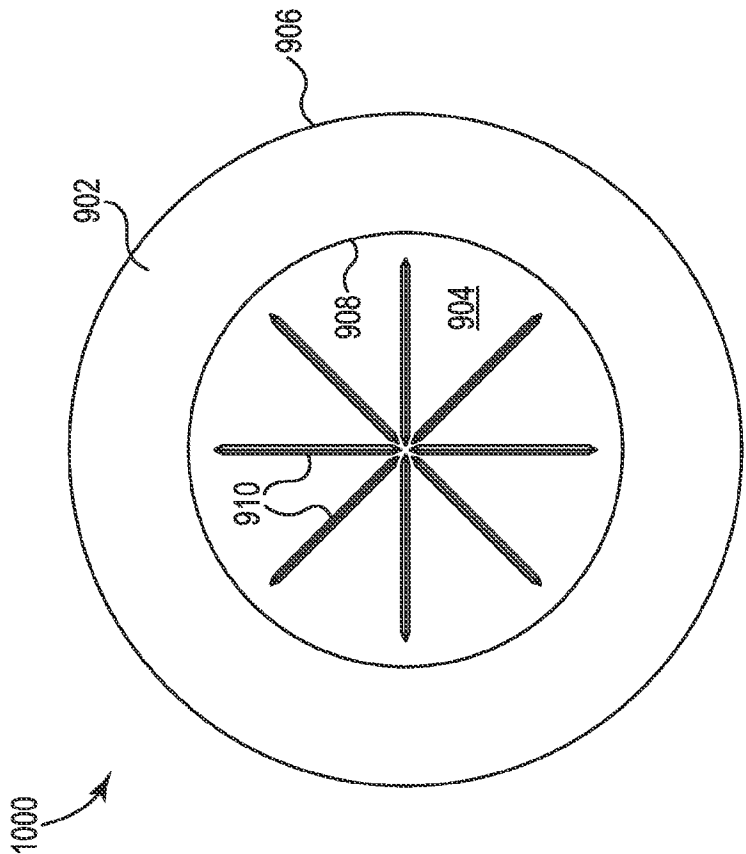


Fig. 10A

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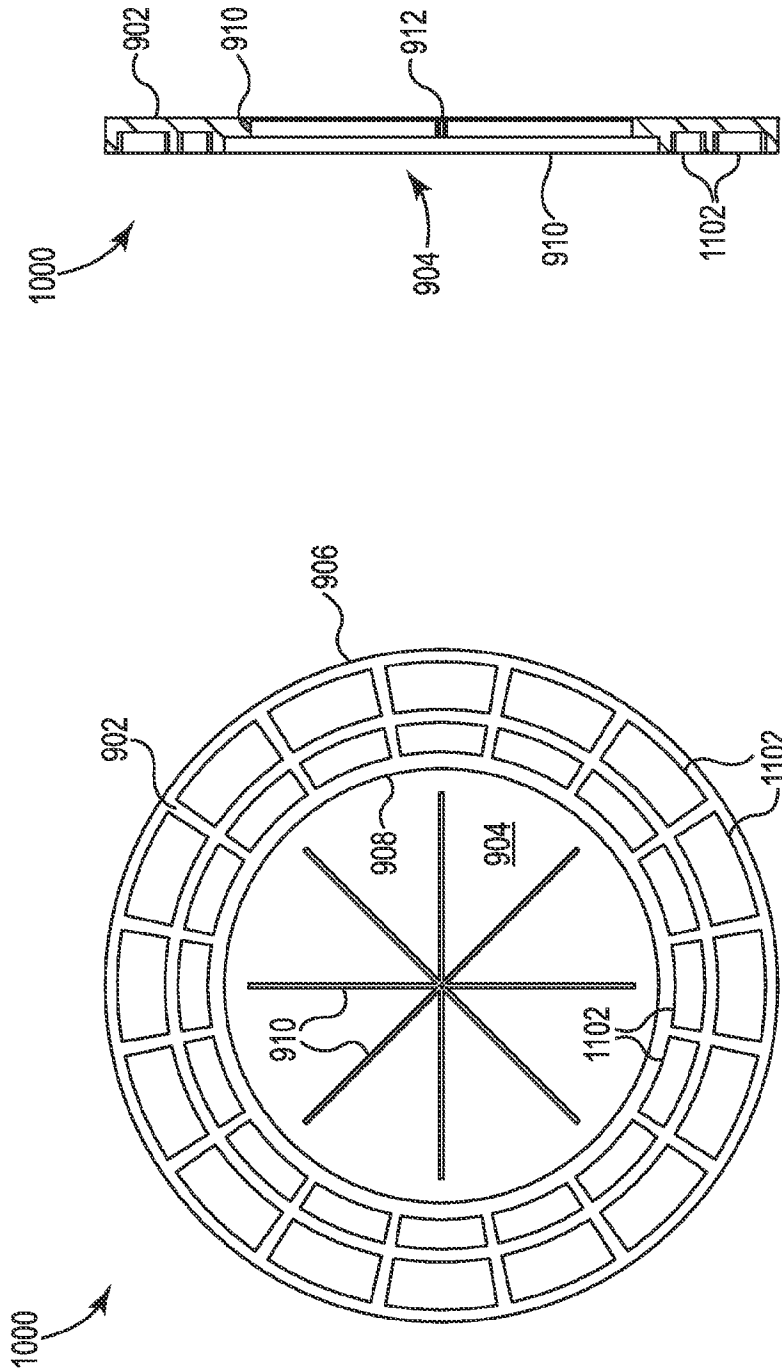


Fig. 11B

Fig. 11A

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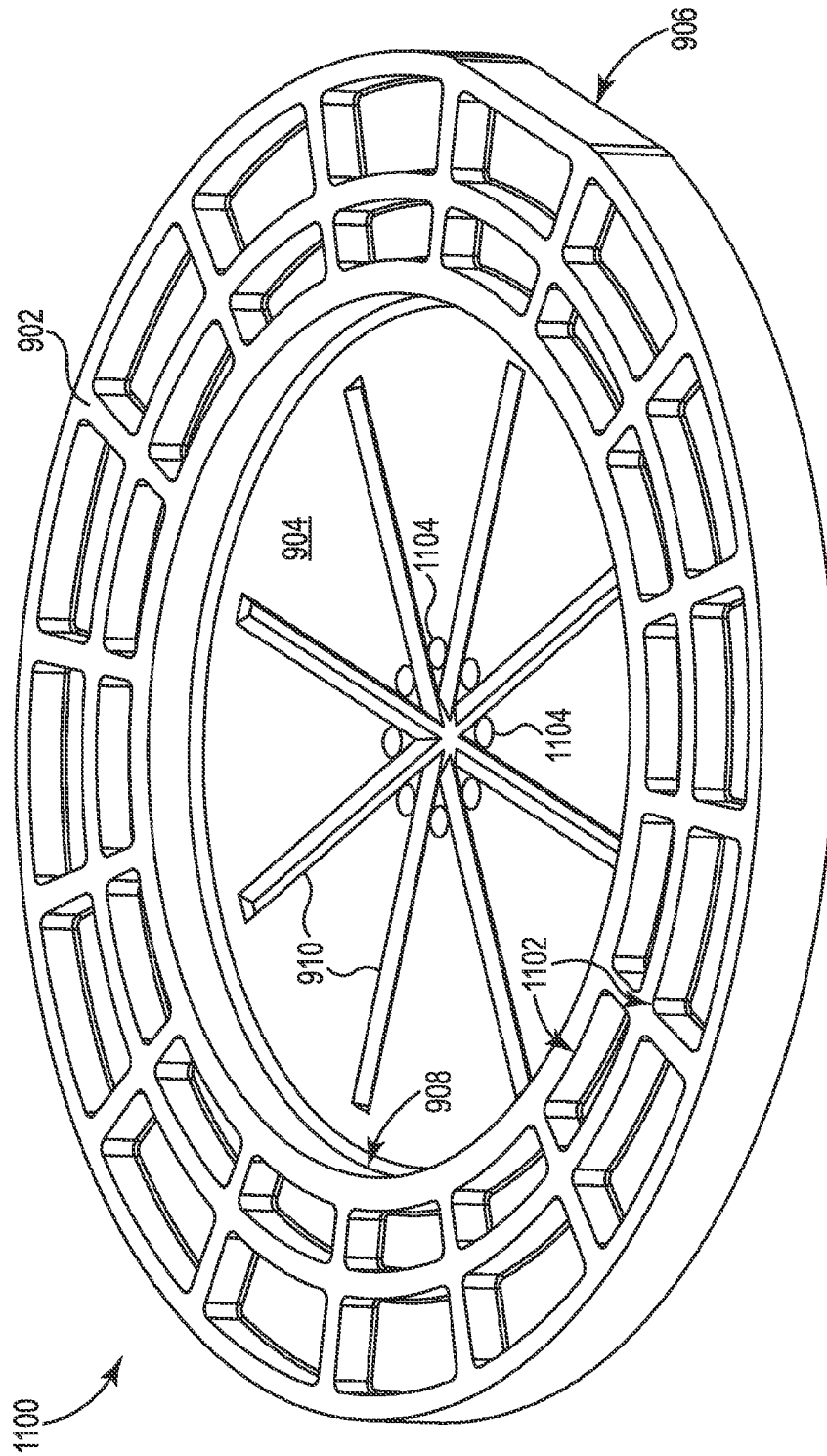


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/066746**A. CLASSIFICATION OF SUBJECT MATTER****B65D 53/04(2006.01)i, B32B 27/08(2006.01)i, B29C 45/14(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65D 53/04; B65D 47/36; B65D 51/00; F16L 13/02; B32B 38/00; B29C 45/00; B65D 5/72; B32B 27/08; B29C 45/14

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: break seal, PTFE, polytetrafluoroethylene, MDPE, mold, and perfluoroalkoxy

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012-0067883 A1 (MONTUORI, DANIEL SALVATORE et al.) 22 March 2012 See paragraphs [0012]–[0021], [0032]–[0034] and figures 1, 3.	1–29
Y		30–32
Y	CN 201245300 Y (YANG, RONG) 27 May 2009 See pages 4–5 and figure 1.	30–31
Y	US 2004-0251634 A1 (SHIMAZU, EIICHIROU et al.) 16 December 2004 See abstract, paragraphs [0071]–[0073], [0088], [0108] and figure 6.	32
A	KR 20-0452250 Y1 (ERE MATERIALS CO.) 14 February 2011 See paragraphs [0014]–[0029] and figures 1, 5.	1–32
A	US 6457613 B1 (PATTERSON, EUGENE ENNALLS) 01 October 2002 See claims 1–7 and figures 2–5.	1–32



Further documents are listed in the continuation of Box C.



See patent family annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

05 February 2014 (05.02.2014)

Date of mailing of the international search report

06 February 2014 (06.02.2014)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City,
302-701, Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

KIM, Jin Ho

Telephone No. +82-42-481-8699



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2013/066746

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