

CLOSURE SYSTEM**BACKGROUND OF THE INVENTION****(1) Field of the Invention**

[0001] The present invention relates generally to closure systems for
5 containers.

(2) Description of the Related Art

[0002] Container closures are devices that seal the contents of a
container, thereby protecting the container contents from contamination,
oxygen, moisture, spillage and evaporation. Many types of closure
10 systems have emerged to serve these functions. For example, two-piece
closure systems have frequently been employed in canning and other food
product applications. A two-piece closure system, also known as a
composite closure, is typically made up of a screw band and a disk. The
disk fits inside the band, between the band and the container. The disk
15 often has a peripheral raised bead with an underside adapted to contact
the land of the container. The disk may also have an annular ring of heat-
sensitive adhesive or sealant disposed on the underside of the peripheral
raised bead. This sealant provides a sealing contact between the disk and
the land of the container and can prevent lateral movement of the disk.

[0003] The container is typically filled with a food or beverage product
before sealing the closure system. The food or beverage product may be
commercially sterile. The closure system can then be applied to the
container. To close a container using a two-piece closure system, the disk
20 is typically placed upon the container to be sealed and a screw band is
loosely screwed over the disk onto the finish of the container. The screw
band often remains loose enough so that as the container is heated and
sterilized, venting of gases may take place under the disk. After heat-
processing, the screw band is tightened and the sealed container is
25 cooled. By virtue of the slow cooling of the container and its contents, the

pressure within the container is reduced. This produces a partial vacuum within the container, causing the disk to be firmly retained against the land of the container and a hermetic seal to be formed. This type of closure is beneficial because it can maintain product seal integrity during sterilization and allows the container to be resealable by the consumer without the need for a secondary inner seal.

SUMMARY OF THE INVENTION

[0004] Briefly, the present invention is directed to a novel closure system comprising a container having a finish and a land located at the top of the finish. The outer wall of the finish, just below the land, is vertical and the land slopes downwardly, toward the outside of the container, at an angle of between about 1° and 10°.

[0005] Also present is a band adapted to be received onto the finish of the container. The band has a top portion and an annular lip extending inwardly from the top portion. Additionally present is a disk adapted to be received between the band and the container land. The disk has a raised peripheral bead, the underside of the raised peripheral bead presenting a downwardly facing channel which contains a gasket material. The ratio of the width of the channel to the width of the container land is in the range of about 2:1 to 1:1. When the disk is inserted into the band, the annular lip of the band extends inwardly beyond the raised peripheral bead of the disk and has a hook portion that engages the top and inside edge of the raised peripheral bead.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] For a more complete understanding of the present invention, reference is now made to the following descriptions taken in conjunction with the accompanying drawings.

[0007] Figure 1 illustrates a cross-sectional view of a closure system of an embodiment of the present invention in which the band is engaged with

the disk and container land but not tightened onto the disk and container land.

5 **[0008]** Figure 2 illustrates an exaggerated cross-sectional view of an embodiment of a closure system of the present invention in which the band is engaged with the disk and container land but not tightened onto the disk and container land.

10 **[0009]** Figure 3 illustrates an exaggerated cross-sectional view of an embodiment of a closure system of the present invention in which the band is engaged with the disk and container land but not tightened onto the disk and container land. In this embodiment, exemplary angles of the land, channel, and top portion of the band are illustrated.

15 **[00010]** Figure 4 illustrates an exaggerated cross-sectional view of an embodiment of a closure system of the present invention in which the band is tightened onto the disk and container land, forcing the container land into sealing contact with the gasket material.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 **[00011]** Reference now will be made in detail to the embodiments of the invention, one or more examples of which are set forth below. Each example is provided by way of explanation of the invention, not a limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment, can be used on another embodiment to yield a still further embodiment.

25 **[00012]** Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents. Other objects, features and aspects of the present invention are disclosed in or are obvious from the following detailed description. It is to be understood by one of ordinary skill in the

art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention.

5 **[00013]** As used herein, the term “finish” means the top portion of a container which surrounds the opening of the container and is configured to accommodate a closure. For example, a finish is shown as **22** in the Figures.

10 **[00014]** As used herein, the term “land” means the lip portion of the finish which makes contact with the gasket material of the disk and forms a seal. For example, a land is shown as **21** in the Figures.

[00015] The term “skirt” refers to the vertical wall of the band, extending downwardly from the top portion of the band. For example, a skirt is shown as **14** in the Figures.

15 **[00016]** The terms “raised peripheral bead” refer to a raised ring around the circumference of the disk. For example, a raised peripheral bead is shown as **32** in the Figures.

20 **[00017]** The term “gasket material” means any type of sealing material that can be placed between the disk and container land in order to prevent the escape of substances such as gas or fluid. For example, a gasket material is shown as **34** in the Figures.

25 **[00018]** As shown generally in the figures, the present invention is directed to a novel closure system **10** comprising a container **20** and a closure engageable with that container **20**. The closure of the invention can comprise a two-piece composite closure. Generally speaking, a disk **30** fits inside a band **11**, between the band **11** and the container **20**. The band **11** has a top portion **12**, an annular lip **13** extending inwardly from the top portion **12**, and a skirt **14** extending downwardly from the top portion **12**. The disk **30** has a center portion **31** and a raised peripheral bead **32** circumnavigating the center portion **31**. The underside of the

bead **32** can present a downwardly facing channel **33** which can contain a gasket material **34**. Under pressure, the gasket material **34** is designed to seal the disk **30** to the container land **21**.

[00019] The band **11** can be screwed onto the container via annular threads **16** and **23**, located on the outer surface of the container finish **22** and the inner surface of the band skirt **14**, respectively. The annular threads **16** and **23** are adapted to receive one another and provide a tight fit between the band **11** and the container **20**, thereby sealing the gasket material **34** of the disk **30** against the land **21** of the container **20**. In some embodiments of the invention the annular threads **16** and **23** are continuous annular threads. A continuous annular thread may be comprised of an uninterrupted protruding helix. In certain other embodiments the annular threads **16** and **23** are interrupted threads or lugs. A lug thread may be designed so the thread segments are disposed equidistantly around the container finish. The closure has matching portions that engage each of the thread segments.

[00020] In an embodiment of the invention, at least one annular bead **40** is present on the upper surface of the top portion **12** of the band **11**. In some embodiments, two or three annular beads **40** may be located on the upper surface of the top portion **12** of the band **11**. The annular bead(s) **40** can be rounded, squared, or any other shape. The annular beads provide the band **11** with additional structure and stability during the tightening of the band onto the container. When the band of a typical two-piece closure is screwed onto a container, uneven force may cause the band to flex. The annular beads **40** located on the upper surface of the top portion **12** of the band **11** provide the band with stability and reduce unwanted flexing of the band.

[00021] In certain embodiments, the container land **21** slopes downwardly, toward the outside of the container, at an angle **A** of between

about 1° and 10° (shown in Figure 3). In certain embodiments, the container land **21** slopes downwardly, toward the outside of the container, at an angle **A** of between about 3° and 7°. In still other embodiments, the container land **21** slopes downwardly, toward the outside of the container, at an angle **A** of about 5° so that the inside edge of the container land is about 5° higher than the outside edge of the container land.

[00022] The underside **19** of the top portion **12** of the band **11** and the channel **33** can also slope downwardly, toward the outside of the closure system, at angles **B** and **C**, respectively, which can correspond generally to the angle **A** of the container land. In an embodiment of the invention, the container land **21**, disk channel **33** and top portion **12** each slope downwardly, toward the outside of the container, at an angle of about 5°.

[00023] In some commercially available containers, the land area has a downwardly sloping angle of about 15°. In contrast, a nearly flat land area, between about 1° and 10°, allows thorough coverage of the gasket material **34** over the container land **21** as the disk **30** is tightened onto the container **20**. Additionally, if the angle of the disk and band corresponds with the angle of the container land, the seal area is further maximized.

[00024] In order to create the particular angle on the container land, the container **20** can be extrusion molded and removed from the rotation wheel, with excess plastic remaining on the finish as a moil. This material can then be removed using a rotating knife blade. The knife blade can be set at any angle, for example at 5° below flat surface. The knife blade then separates the container from the moil at a 5° angle. This creates an angle where the inside edge of the container land is slightly higher than the outside edge of the container land. The nearly flat land area places a more even distribution of the gasket material **34** onto the container land **21**. The disk and band can be manufactured to provide corresponding angles.

[00025] In certain embodiments of the invention, the band **11** has a top-centered opening **18**. In this embodiment, the annular lip **13** defines a peripheral edge **17** of a top opening **18**. The disk **30** of the closure system **10** is inserted between the band **11** and the container land **21**. It can be received into the band **11** just below the inwardly extending annular lip **13** of the band **11**. The disk **30** can be rotatably movable within the band **11**. Similarly, the band **11** can be rotatable while the disk **30** can be frictionally held in place by the gasket material **34** and container land **21**. When the band **11** is tightened onto the container **20**, the disk **30** provides a seal for the container **20** (shown in Figure 4).

[00026] The gasket material-containing channel **33** is designed to form a seal with the land **21** of the container **20**. In an embodiment, the gasket material **34** can be plastisol. Plastisol is a liquid mixture of resins and plasticizers that is solidified with the application of heat. In an embodiment of the present invention, a plastisol-lined disk forms an airtight seal against the container land to prevent the ingress of oxygen or other contaminants.

[00027] In some embodiments of the invention, when the disk **30** is inserted into the band **11**, the annular lip **13** of the band **11** extends inwardly beyond the raised bead **32** of the disk **30** and has a hook portion **15** that engages the top and inside edge of the bead **32**. In typical closure systems, as the band is tightened onto the container land, the down force caused by the application torque pulls to the outside of the disk insert. In the present invention, however, as the band **11** is tightened onto the container land **21**, the hook portion **15** of the lip **13** applies force downwardly on the top and inner edge of the bead **32**, thereby creating an equal downward force on the top, outer and inner surface of the land **21** of the container. The container land can then create a channel in the gasket material, forcing the gasket material to be distributed evenly across the inside, top and outside of the container land. This provides a better seal

for the gasket material on the container land and prevents the ingress or egress of gaseous or liquid substances.

[00028] In certain other embodiments of the invention, the ratio of the width of the channel **33** to the width of the container land **21** is in the range of about 2:1 to 1:1. In particular embodiments the ratio of the width of the channel **33** to the width of the container land **21** is in the range of about 1.75:1 to 1:1. In further embodiments the ratio of the width of the channel **33** to the width of the container land **21** is in the range of about 1.5:1 to 1:1. In yet another embodiment the ratio of the width of the channel **33** to the width of the container land **21** is about 1.48:1. In these embodiments, the width of the channel **33** is slightly larger than the width of the land **21** of the container with which it engages. A relatively narrow channel **33** is beneficial because as the disk **30** is pushed downwardly onto the container land **21**, the coverage area of the gasket material **34** in the channel **33** is thoroughly distributed on the top, inside, and outside of the container land **21**.

[00029] In a particular embodiment of the invention, the outer wall **24** of the container finish **22**, above annular threads **16** and just below the land **21**, is vertical. Oftentimes, the outer wall of the container finish on containers will angle slightly inwardly. This does not provide as a large a contact area for the gasket material seal. Molding the outer wall **24** of the finish **22** as a completely straight vertical wall increases the area of the container land **21** in contact with and covered by the gasket material **34** in the disk **30**. This maximizes the seal contact area and creates a center clamping force by the closure band **11** of equal amount over the top, inside edge and outside edge of the container land **21**.

[00030] In processing and sterilization, the container **20** of the present invention can be filled with a food or beverage product before sealing the closure system **10**. The closure system **10** can then be applied to the

container **20**. The disk **30** can be placed upon the container **20** and the band **11** screwed tightly onto the container **20**. The container **20** can then be heated and sterilized. The closure system **10** of the invention beneficially maintains product seal integrity during sterilization and allows the container **20** to be resealable by the consumer without the need for a secondary inner seal.

[00031] The various components of the closure system of the present invention can be produced from a variety of materials, including metals, plastics or glass. In some embodiment of the invention each of the container, disk and band may each be made of the same material, such as plastic. In certain other embodiments, the container, disk and band may all be made of different materials, such as a glass container, metal disk and plastic band. In a particular embodiment, the container and band may be plastic and the disk may be metal.

[00032] In one embodiment of the present invention the band is plastic. In this embodiment, the band can be prepared from any plastic material, including one or more selected from the group consisting of polyethylene, polypropylene, polystyrene, cycloolefin copolymer, polyethylene terephthalate, polyethylene naphthalate, ethylene-(vinyl alcohol) copolymer, poly-4-methylpentene-1, poly(methyl methacrylate), acrylonitrile, polyvinyl chloride, polyvinylidene chloride, styrene-acrylonitrile, acrylonitrile-butadiene-styrene, polyamide, polyacetal, polycarbonate, polybutylene terephthalate, ionomer, polysulfone, polytetrafluoroethylene, polyester, vinyl ester, polyurethane and polyurea. In a particular embodiment, the band is prepared from polypropylene.

[00033] A plastic band offers advantages in that a plastic band does not rust or corrode and can be reused many times without any deterioration of its appearance. In certain embodiments of the band, the outside of the skirt may have a plurality of vertical ribs or other gripping mechanisms

designed to aid in the grasping and turning of the band. In other embodiments, the band can be provided with tamper indicating means. The band can have a detachable ring and, hinged to the detachable ring along its lower end, a series of upwardly and inwardly projecting ratchet fingers or tabs. In particular embodiments, the band may be injection molded.

[00034] In an embodiment of the invention, the disk is metal. In a particular embodiment, the disk is made from stainless steel. Optionally, the disk can be semi-rigid. In this embodiment, the disk can have a central portion sufficiently flexible to be drawn partially inward into the open mouth of the container when the pressure within the container is less than the pressure outside the container. The deflection of the central portion of the disk provides a visual indication of the existence of a hermetic seal.

[00035] In certain embodiments, the container of the present invention can be extrusion blow molded and can comprise any suitable plastic material known in the art. The container can be of any size and should be adapted to receive the corresponding two-piece closure system. In an embodiment, the container may comprise a jar. In some embodiments, the container may comprise a bottle, such as an infant or baby bottle. The bottle may be filled with cow's milk, human breast milk or infant formula. Once the closure of the present invention is applied to the bottle, the system may be sterilized or otherwise processed.

[00036] If the bottle is used for cow's milk, human breast milk or infant formula, the bottle may be filled and the disk of the system replaced with a nipple. The band can then be tightened onto the nipple and container, securing the nipple in place. The container and closure system can then be used to feed an infant.

[00037] The closure system of the present invention is suitable for multiple filling processes, including hot fill, cold fill, dry seal, pasteurization

and retort. The closure can be produced in a variety of sizes for a wide range of food and beverage applications, such as pickled products, sauces, jams, jellies, nuts, juices, milk-based beverages, and infant formulas.

5 **[00038]** In certain embodiments, the disk and band may be made of different colors improving the esthetics of the product package. Additionally, the disk and/or band may be produced in a manner so that they can be labeled for commercial purposes.

10 **[00039]** All references cited in this specification, including without limitation, all papers, publications, patents, patent applications, presentations, texts, reports, manuscripts, brochures, books, internet postings, journal articles, periodicals, and the like, are hereby incorporated by reference into this specification in their entireties to the extent that they are consistent with the disclosures herein. The discussion of the
15 references herein is intended merely to summarize the assertions made by their authors and no admission is made that any reference constitutes prior art. Applicants reserve the right to challenge the accuracy and pertinence of the cited references

20 **[00040]** These and other modifications and variations to the present invention may be practiced by those of ordinary skill in the art, without departing from the spirit and scope of the present invention, which is more particularly set forth in the appended claims. In addition, it should be understood that aspects of the various embodiments may be interchanged both in whole or in part. Furthermore, those of ordinary skill in the art will
25 appreciate that the foregoing description is by way of example only, and is not intended to limit the invention so further described in such appended claims. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred versions contained therein.

WHAT IS CLAIMED IS:

1. A closure system comprising:
 - a) a container having a finish and a land located at the top of the finish, wherein:
 - i) the outer wall of the finish, just below the land, is vertical; and
 - ii) the land slopes downwardly, toward the outside of the container, at an angle of between about 1° and 10°;
 - b) a band adapted to be received onto the finish of the container, the band having a top portion and an annular lip extending inwardly from the top portion; and
 - c) a disk adapted to be received between the band and the container land, the disk having a raised peripheral bead, the underside of the raised peripheral bead presenting a downwardly facing channel which contains a gasket material, wherein:
 - i) the ratio of the width of the channel to the width of the container land is in the range of about 2:1 to 1:1; and
 - ii) when the disk is received into the band, the annular lip of the band extends inwardly beyond the raised peripheral bead of the disk and has a hook portion that engages the top and inside edge of the raised peripheral bead.
2. The closure system of claim 1, wherein the land slopes downwardly, toward the outside of the container, at an angle of about 5°.
3. The closure system of claim 1, wherein the ratio of the width of the channel to the width of the container land is about 1.48:1.
4. The closure system of claim 1, wherein annular threads are located on the outer surface of the finish.
5. The closure system of claim 1, wherein a skirt extends downwardly from the top portion of the band.
6. The closure system of claim 5, wherein annular threads are located on inner surface of the skirt.

7. The closure system of claim 1, wherein at least one annular bead is present on the top portion of the band.
8. The closure system of claim 1, wherein the underside of the top portion of the band slopes downwardly, toward the outside of the band, at an angle corresponding to the angle of the land.
9. The closure system of claim 1, wherein the channel slopes downwardly, toward the outside of the band, at an angle corresponding to the angle of the land and the underside of the top portion of the band.
10. The closure of claim 1, wherein the gasket material comprises plastisol.