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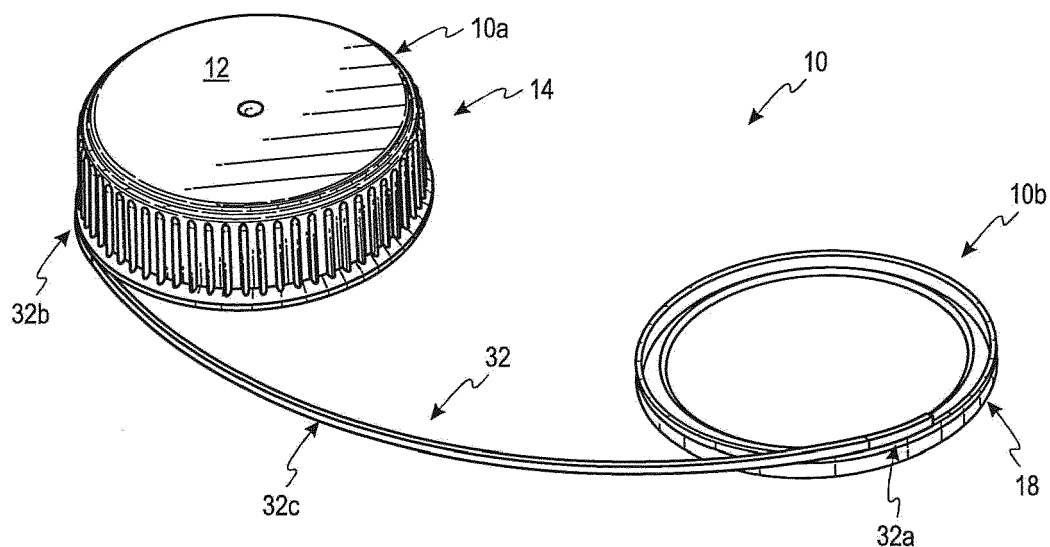
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(54) **TETHERED CLOSURE**

(57) A one-piece closure (10) includes first and second closure portions. The first closure portion includes a top wall portion (12) and a skirt portion (14) with a first frangible connection (22) that partially detachably connects first and second sections of the skirt portion. The second closure portion includes a tamper-evident band (18) that is partially detachably connected to the skirt

portion by a second frangible connection (24). When the first and second frangible connections are broken, a tether (32) is exposed. The tether is attached to a portion (32a) of the second closure portion and a portion (32b) of the first closure portion. The length of the unattached tether portion (32c) extends greater than about 300 degrees around the circumference of the closure.



*Fig. 2A*

## Description

### CROSS-REFERENCE TO RELATED APPLICATION

**[0001]** This application claims priority to U.S. Patent Application No. 62/683,870, filed June 12, 2018, which is hereby incorporated by reference herein in its entirety.

### FIELD OF THE INVENTION

**[0002]** The present invention relates generally to a polymeric closure for a package. More specifically, the present invention relates to a tethered one-piece polymeric closure to assist in preventing or inhibiting the closure from being separated from the container.

### BACKGROUND OF THE INVENTION

**[0003]** Polymeric closures have been used in many applications over the years in conjunction with containers. One type of polymeric closure that has been used with containers is a tamper-evident polymeric closure. Tamper-evident closures are used to prevent or inhibit tampering by providing a visible indication to a user if the closure has been opened. This visual indication typically divides the closure into two separate components after the tamper-evident feature has been broken. The top portion of the closure is then removed from the container to gain access to the contents of the containers. One drawback of tamper-evident closures being separated into two individual components is that the top portion may not be recycled along with the remainder of the closure and container. This scenario raises potential environmental concerns with so many containers having tamper-evident features that can be separated into two individual components.

**[0004]** It would be desirable to provide a closure that has tamper-evident features that address these above-noted environmental concerns, while still performing all of the desirable properties of a closure.

### SUMMARY

**[0005]** According to one embodiment, a one-piece closure comprises a first closure portion and a second closure portion. The first closure portion includes a polymeric top wall portion and a polymeric annular skirt portion depending from the polymeric top wall portion. The annular skirt portion includes an internal thread formation for mating engagement with an external thread formation of a container. The polymeric annular skirt portion includes a first frangible connection that partially detachably connects to a first section and a second section of the polymeric annular skirt portion. The second closure portion includes a polymeric tamper-evident band. The tamper-evident band depends from and is partially detachably connected to the polymeric annular skirt portion by a second frangible connection. When the first and sec-

ond frangible connections are broken, a tether is exposed. The tether is attached to a portion of the second closure portion and a portion of the first closure portion. A length of the unattached tether portion extends greater than about 300 degrees around the circumference of the closure. When the internal thread formation of the first closure portion is not in mating engagement with the external thread formation of the container, the first closure portion is adapted to be spaced from the second closure portion via the unattached tether portion.

**[0006]** According to another embodiment, a one-piece closure comprises a first closure portion and a second closure portion. The first closure portion includes a polymeric top wall portion and a polymeric annular skirt portion depending from the polymeric top wall portion. The annular skirt portion includes an internal thread formation for mating engagement with an external thread formation of a container. The polymeric annular skirt portion includes a first frangible connection that partially detachably connects to a first section and a second section of the polymeric annular skirt portion. The second closure portion includes a polymeric tamper-evident band. The tamper-evident band depends from and is partially detachably connected to the polymeric annular skirt portion by a second frangible connection. When the first and second frangible connections are broken, a tether is exposed. The tether is attached to a portion of the second closure portion and a portion of the first closure portion. A length of the unattached tether portion is greater than about 50 mm. When the internal thread formation of the first closure portion is not in mating engagement with the external thread formation of the container, the first closure portion is adapted to be spaced from the second closure portion via the unattached tether portion.

**[0007]** According to a further embodiment, a package is formed that includes a container and a one-piece closure. The container has a neck portion defining an opening. The container has an external thread formation on the neck portion. The one-piece closure is configured for fitment to the neck portion of the container for closing the opening. The one-piece closure includes a first closure portion and a second closure portion. The first closure portion includes a polymeric top wall portion and a polymeric annular skirt portion depending from the polymeric top wall portion. The annular skirt portion includes an internal thread formation for mating engagement with the external thread formation of the neck portion of the container. The polymeric annular skirt portion includes a first frangible connection that partially detachably connects to a first section and a second section of the polymeric annular skirt portion. The second closure portion includes a polymeric tamper-evident band. The tamper-evident band depends from and is partially detachably connected to the polymeric annular skirt portion by a second frangible connection. When the first and second frangible connections are broken, a tether is exposed. The tether is attached to a portion of the second closure portion and a portion of the first closure portion. A length of the un-

attached tether portion extends greater than about 300 degrees around the circumference of the closure. When the internal thread formation of the first closure portion is not in mating engagement with the external thread formation of the container, the first closure portion is adapted to be spaced from the second closure portion via the unattached tether portion.

**[0008]** According to another embodiment, a package is formed that includes a container and a one-piece closure. The container has a neck portion defining an opening. The container has an external thread formation on the neck portion. The one-piece closure is configured for fitment to the neck portion of the container for closing the opening. The one-piece closure includes a first closure portion and a second closure portion. The first closure portion includes a polymeric top wall portion and a polymeric annular skirt portion depending from the polymeric top wall portion. The annular skirt portion includes an internal thread formation for mating engagement with the external thread formation of the neck portion of the container. The polymeric annular skirt portion includes a first frangible connection that partially detachably connects to a first section and a second section of the polymeric annular skirt portion. The second closure portion includes a polymeric tamper-evident band. The tamper-evident band depends from and is partially detachably connected to the polymeric annular skirt portion by a second frangible connection. When the first and second frangible connections are broken, a tether is exposed. The tether is attached to a portion of the second closure portion and a portion of the first closure portion. A length of the unattached tether portion is greater than about 50 mm. When the internal thread formation of the first closure portion is not in mating engagement with the external thread formation of the container, the first closure portion is adapted to be spaced from the second closure portion via the unattached tether portion.

**[0009]** According to one method, a one-piece closure is formed. A first closure portion and a second closure portion are molded. The first closure portion includes a polymeric top wall portion and a polymeric annular skirt portion depending from the polymeric top wall portion. The annular skirt portion includes an internal thread formation for mating engagement with an external thread formation of a container. The second closure portion includes a polymeric tamper-evident band. A lower portion of the annular skirt portion is slit along a first general line and along a second general line. The first general line forms a first frangible connection that partially detachable connects a first section and a second section of the annular skirt portion. The second general line forms a second frangible connection that partially detachable connects the annular skirt portion and the tamper-evident band. When the first and second frangible connections are broken, a tether is exposed. The tether is attached to a portion of the second closure portion and a portion of the first closure portion. A length of the unattached tether portion extends greater than about 300 degrees

around the circumference of the closure. When the internal thread formation of the first closure portion is not in mating engagement with the external thread formation of the container, the first closure portion is adapted to be spaced from the second closure portion via the unattached tether portion.

**[0010]** The above summary is not intended to represent each embodiment or every aspect of the present invention. Additional features and benefits of the present invention are apparent from the detailed description and figures set forth below.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0011]** Other advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

FIG. 1A is a top perspective view of a closure in a closed position according to one embodiment.

FIG. 1B is a cross-sectional view taken generally along line 1B-1B in FIG. 1A.

FIG. 1C is a side view of the closure of FIG. 1A.

FIG. 2A is a top perspective view of the closure of FIG. 1A in an open position.

FIG. 2B is a top view of the closure of FIG. 1A in the open position.

FIG. 3A is a top perspective view of a package including the closure of FIG. 1A and a container in a closed position according to one embodiment.

FIG. 3B is a cross-sectional view taken generally along line 3B-3B in FIG. 3A.

FIG. 3C is a side view of the closure of FIG. 3A.

FIG. 4 is a top perspective view of the closure and container of FIG. 3A in the open position.

**[0012]** While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

## DETAILED DESCRIPTION

**[0013]** FIGS. 1A-C and 2A-B illustrate a polymeric closure 10 according to one embodiment of the present invention. The closures are configured to be placed on a container or bottle that contain product. The product is typically a liquid product, but also may be a solid product or a combination of a liquid and solid product. The polymeric closure 10 of FIGS. 1A-C and 2A-B is a one-piece closure assembly. The polymeric closure 10 is generally cylindrically shaped.

**[0014]** Referring still to FIG 1A-C and 2A-B, the polymeric closure 10 includes a polymeric top wall portion 12, a polymeric annular skirt portion 14 that depends from the polymeric top wall portion 12, a polymeric continuous plug seal 16 (FIG. 1B), and a tamper-evident band 18 (FIG. 1B). The top wall portion 12 extends across the entire top of the closure without any openings.

**[0015]** The polymeric annular skirt portion 14 includes a first frangible connection 22 that partially detachably connects to a first section and a second section of the polymeric annular skirt portion 14. The polymeric annular skirt portion 14 of FIG. 1B also includes an internal thread formation 30. The internal thread formation includes a plurality of leads in one embodiment. The internal thread formation 30 is configured for mating engagement with a corresponding external thread formation of a neck portion of a container. The internal thread formation 30 depicted in FIG. 1B includes a first closure lead 36 and a second closure lead 38. It is contemplated that the internal thread formation may be continuous in another embodiment.

**[0016]** The first closure lead 36 begins near the polymeric top wall portion 12 at a first position (not shown in FIG. 1B) and extends in a helical fashion to a second position 36a closer to the tamper-evident band 18. Similarly, the second closure lead 38 begins near the polymeric top wall portion 12 at a first position (not shown in FIG. 1B) and extends in a helical fashion to a second position (not shown in FIG. 1B) closer to the tamper-evident band 18. The first and second closure leads 36, 38 are referred collectively as a double lead closure thread. Each of the first and second closure leads 36, 38 is continuous. The first positions of the first and second closure leads 36, 38 are located roughly 180 degrees apart from each other and, thus, begin on generally opposing sides of the closure 10.

**[0017]** It is contemplated that the first and second closure leads may be discontinuous. It is also contemplated that the internal thread formation of the closure may differ from a helical thread formation. It is also contemplated that other internal thread formations may be used in the closure.

**[0018]** The polymeric continuous plug seal 16 of FIG. 1B depends from the polymeric top wall portion 12. The continuous plug seal 16 is spaced from an interior surface of the polymeric annular skirt portion 14.

**[0019]** In another embodiment, the closure may be sealed using a polymeric liner and a polymeric disc being located between a top wall portion and the polymeric liner. It is contemplated that other sealing methods may be used in sealing the closure.

**[0020]** Referring specifically to FIG. 1B, the polymeric tamper-evident band 18 of the closure 10 is located at the bottom thereof (i.e., an end opposite of the polymeric top wall portion 12). The tamper-evident band 18 depends from and is partially detachably connected to the annular skirt portion 14 by the second frangible connection 24. The tamper-evident band 18 works in conjunction

with the container to indicate to a user that the contents of the container may have been accessed. More specifically, the tamper-evident band 18 is designed to partially separate from the annular skirt portion 14 if a user opens the package and gains access to the container as shown, for example, in FIGS. 2A and 2B.

**[0021]** The first and second frangible connections 22, 24 may be formed by molded-in-bridges in one embodiment. The molded-in-bridges are typically formed using a feature in the mold. In another embodiment, the polymeric tamper-evident band may be formed using scoring or scored lines, notches, leaders, nicks or other lines of weaknesses.

**[0022]** When the first and second frangible connection 22, 24 are broken, a tether 32 is exposed as shown, for example, in FIGS. 2A, 2B. The tether 32 is attached to a portion of the second closure portion 10b (including the tamper-evident band 18) and a portion of the first closure portion or main body 10a (including the annular skirt portion 14 and the polymeric top wall portion 12). The tether 32 assists in maintaining the closure 10 as a one-piece assembly after the first and second frangible connections 22, 24 have been broken.

**[0023]** As shown in FIGS. 2A and 2B, the tether 32 includes attached portions 32a, 32b and also includes an unattached portion 32c that is located between the attached portions 32a, 32b. When the internal thread formation of the first closure portion is not in mating engagement with the external thread formation of the container, the first closure portion 10a is adapted to be spaced away from the second closure portion 10b via the unattached tether portion 32c. One non-limiting example of the same is shown in FIGS. 2A, 2B with only the closure 10, while FIG. 4 depicts the same with a portion of the container 108. The length of the attached and unattached portions of the tether may vary from that shown in FIGS. 2A, 2B and 4.

**[0024]** The tether 32 is of a length that assists in spacing apart the first closure portion 10a from the second closure portion 10b. To assist in eliminating or reducing the chances of the first closure portion 10a from interfering with a user while, for example, drinking the contents of a container, the unattached portion 32c of the tether 32 extends greater than about 300 degrees around the circumference of the closure in one embodiment. By having the unattached portion of the tether extending greater than about 300 degrees around the circumference of the closure, the distance of the first closure portion 10a from the neck of the container is increased. In other embodiments, the unattached portion of the tether desirably extends greater than about 320 or about 330 degrees around the circumference of the closure. In a further embodiment, the unattached portion of the tether extends greater than about 340 degrees around the circumference of the closure.

**[0025]** In one embodiment, the length of the unattached portion of the tether is generally at least about 50 mm or even more desirably at least about 75 mm. The

length of the unattached portion of the tether is generally from about 50 to about 120 mm and, more specifically, from about 50 to about 100 mm.

**[0026]** One non-limiting example of a closure and a container forming a package is shown and discussed in conjunction with FIGS. 3A-3C.

**[0027]** The closures of the present invention may be used with a container 108 used to form a package 100 of FIGS. 3A-3C. A portion of the container 108 is shown in FIGS. 3A-3C and includes a neck portion 102 that defines an opening. The neck portion 102 of the container 108 includes an external thread formation 104 and a continuous outer ring 110. The external thread formation 104 includes a first finish lead 136 and a second finish lead 138 (FIG. 3B). The external thread formation 104 (finish leads 136, 138) engages with the corresponding internal thread formation 30 (closure leads 36, 38) to seal the package 100.

**[0028]** The first finish lead 136 begins near the open end of the container 108 and extends in a helical fashion to a second position that is closer to the closed end of the container. Similarly, the second finish lead 138 starts closer to the open end of the container 108 and extends in a helical fashion to a second position that is closer to the closed end of the container. Each of the first and second finish leads 136, 138 is continuous. The first positions of the first and second finish leads 136, 138 are located roughly 180 degrees apart from each other and, thus, begin on opposing sides of the neck 102 of the container 108. When opening the container 108, the first closure lead 36 is desirably in contact with the first finish lead 136 and the second closure lead 38 is desirably in contact with the second finish lead 138. It is contemplated that the external thread formation of the container may have discontinuous leads.

**[0029]** It is contemplated that the external thread formation of the container may be different than that disclosed with respect to container 108.

**[0030]** The continuous outer ring 110 assists in positioning the tamper-evident band 18 when the first closure portion 10a is unthreaded from the neck 102 of the container 108 by the breaking of the first and second frangible connections 22, 24.

**[0031]** The closures of the present invention may include an oxygen-scavenger material. This oxygen-scavenger material may be distributed within the closure or may be a separate layer. The oxygen-scavenger material may be any material that assists in removing oxygen within the container, while having little or no effect on the contents within the container.

**[0032]** Alternatively, or in addition to, the closures may include an oxygen-barrier material. The oxygen-barrier material may be added as a separate layer or may be integrated within the closure itself. The oxygen-barrier materials assist in preventing or inhibiting oxygen from entering the container through the closure. These materials may include, but are not limited to, ethylene vinyl alcohol (EVOH). It is contemplated that other oxygen-

barrier materials may be used in the closure.

**[0033]** The top wall portion 12 and the annular skirt portion 14 are made of polymeric material. The top wall portion 12, the annular skirt portion 14, the continuous plug seal 16 and the tether 32 are typically made of an olefin (e.g., polyethylene (PE), polypropylene (PP)), PET or blends thereof. One example of a polyethylene that may be used is high density polyethylene (HDPE). It is contemplated that the top wall portion, the annular skirt portion, the continuous plug seal and the tether may be made of other polymeric materials. The tamper-evident band 18 is typically made of the same materials as the top wall portion 12, the annular skirt portion 14, the continuous plug seal 16 and the tether 32.

**[0034]** The closures are typically formed by processes such as injection or compression molding, extrusion or the combination thereof.

**[0035]** In one process, the tether is formed by double slitting using two blades. The double-slitting is formed in one process along general lines 42 and 44 of FIG. 1C and uses scoring or scored lines, notches, leaders, nicks or line of weaknesses to provide separation of the connection along both general lines 42 and 44 via respective first and second frangible connections 22, 24. The general lines 42 and 44 are located on opposite sides of the tether to be formed. The slitting may form this frangible connection or the frangible connection may be formed at a later time. The double slitting in this process does not extend entirely around the circumference of the closure 10. Specifically, the general line 42 extends generally around the circumference of the closure 10 except in the area that eventually forms attached tether portion 32b, while general line 44 extends around the circumference of the closure 10 except in the area that eventually forms attached tether portion 32a. It is contemplated that the lines may be different than those depicted in FIG. 1C.

**[0036]** In other process, the tether may be formed by using molds in the absence of slitting. In one process, general lines 42 and 44 are formed by using bridges (e.g., molded-in-bridges) to provide separation of the connection along both general lines 42 and 44 via respective first and second frangible connections 22, 24. The molded-in-bridges do not extend entirely around the circumference of the closure 10. Specifically, the general line 42 extends generally around the circumference of the closure 10 except in the area that eventually forms attached tether portion 32b, while general line 44 extends around the circumference of the closure 10 except in the area that eventually forms attached tether portion 32a.

**[0037]** The container 108 is typically made of polymeric material. One non-limiting example of a material to be used in forming a polymeric container is polyethylene terephthalate (PET), polypropylene (PP) or blends using the same. It is contemplated that the container may be formed of other polymeric or copolymer materials. It is also contemplated that the container may be formed of glass. The container 108 typically has an encapsulated oxygen-barrier layer or oxygen barrier material incorpo-

rated therein.

**[0038]** To open the container 108 and gain access to the product therein, the closure 10 is unthreaded by turning the closure 10 with respect to the container 108. After the closure has been unthreaded, the closure 10 is spaced apart as shown in FIG. 4.

**[0039]** The polymeric closures are desirable in both low-temperature and high-temperature applications. The polymeric closures may be used in low-temperature applications such as an ambient or a cold fill. These applications include water, sports drinks, aseptic applications such as dairy products, and pressurized products such as carbonated soft drinks. It is contemplated that other low-temperature applications may be used with the polymeric closures of the present invention.

**[0040]** The polymeric closures may be exposed to high-temperature applications such as hot-fill, pasteurization, and retort applications. A hot fill application is generally performed at temperatures around 185°F, while a hot-fill with pasteurization is generally performed at temperatures around 205°F. Retort applications are typically done at temperatures greater than 250°F. It is contemplated that the polymeric closures of the present invention can be used in other high-temperature applications.

## Claims

### 1. A one-piece closure comprising:

a first closure portion including:

a polymeric top wall portion;

a polymeric annular skirt portion depending from the polymeric top wall portion, the annular skirt portion including an internal thread formation for mating engagement with an external thread formation of a container, the polymeric annular skirt portion including a first frangible connection that partially detachably connects to a first section and a second section of the polymeric annular skirt portion; and

a second closure portion including:

a polymeric tamper-evident band, the tamper-evident band depending from and being partially detachably connected to the polymeric annular skirt portion by a second frangible connection,

wherein when the first and second frangible connections are broken, a tether is exposed, the tether being attached to a portion of the second closure portion and a portion of the first closure portion, a length of the unattached tether portion extending greater than about 300 degrees around the circumference of the closure,

wherein when the internal thread formation of the first closure portion is not in mating

engagement with the external thread formation of the container, the first closure portion being adapted to be spaced from the second closure portion via the unattached tether portion.

2. The closure according to claim 1, wherein the length of the unattached tether portion extends greater than about 320 degrees, preferably greater than about 330 degrees and more preferably greater than about 340 degrees around the circumference of the closure.

3. The closure according to claim 1 or 2, wherein the shape of the closure is generally cylindrical.

4. The closure according to one or more of claims 1-3, wherein the closure further includes an oxygen-scavenger material or an oxygen-barrier material.

5. A one-piece closure comprising:

a first closure portion including:

a polymeric top wall portion;

a polymeric annular skirt portion depending from the polymeric top wall portion, the annular skirt portion including an internal thread formation for mating engagement with an external thread formation of a container, the polymeric annular skirt portion including a first frangible connection that partially detachably connects to a first section and a second section of the polymeric annular skirt portion; and

a second closure portion including:

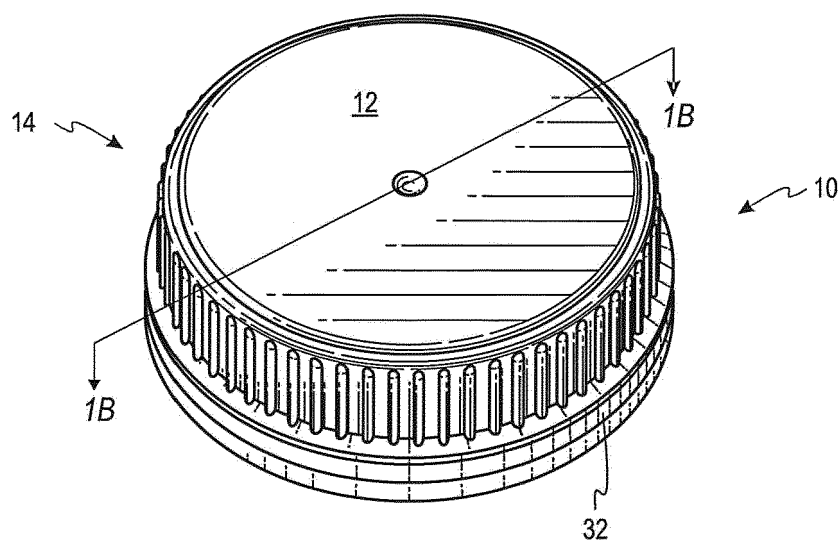
a polymeric tamper-evident band, the tamper-evident band depending from and being partially detachably connected to the polymeric annular skirt portion by a second frangible connection,

wherein when the first and second frangible connections are broken, a tether is exposed, the tether being attached to a portion of the second closure portion and a portion of the first closure portion, a length of the unattached tether portion being greater than about 50 mm,

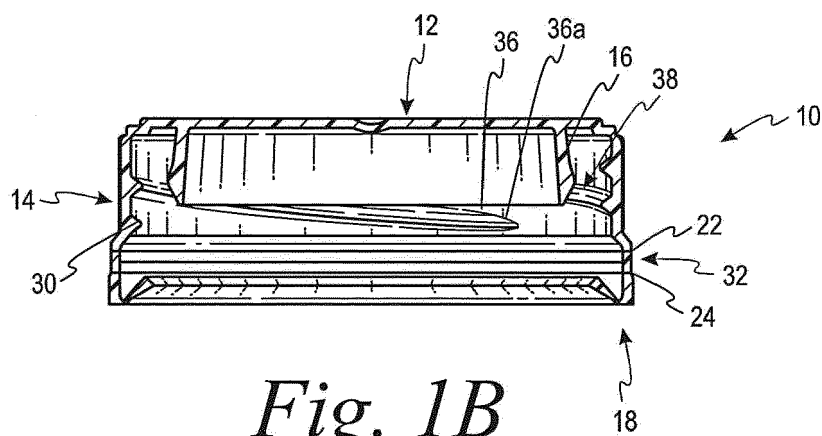
wherein when the internal thread formation of the first closure portion is not in mating engagement with the external thread formation of the container, the first closure portion being adapted to be spaced from the second closure portion via the unattached tether portion.

6. The closure according to claim 5, wherein the length of the unattached tether portion is greater than about 75 mm.

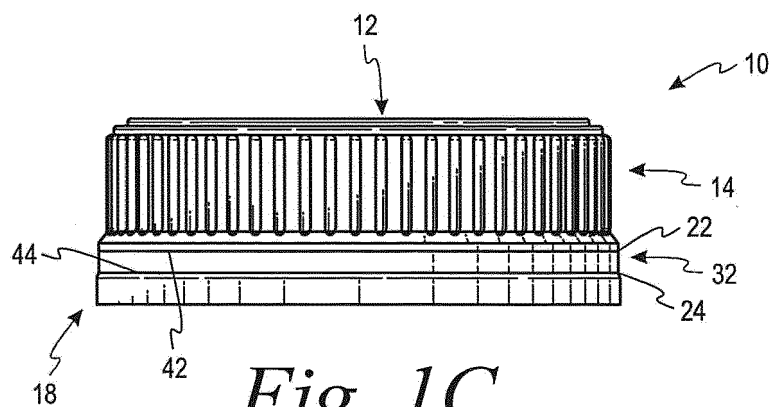
7. The closure according to claim 5, wherein the length of the unattached tether portion is from about 50 to about 100 mm.
8. The closure according to one or more of claims 5-7, wherein the internal thread formation of the annular skirt portions includes at least one helical thread element. 5
9. The closure according to one or more of claims 1-8, wherein the closure comprises polyolefins. 10
10. The closure according to one or more of claims 1-9, wherein the first closure portion further includes a polymeric continuous plug seal depending from the polymeric top wall portion, the continuous plug seal being spaced from an interior surface of the polymeric annular skirt portion. 15
11. A package comprising: 20
- a container having a neck portion defining an opening, the container having an external thread formation on the neck portion; and
- a one-piece closure according to one or more of claims 1-10, being configured for fitment to the neck portion of the container for closing the opening, the one-piece closure including a first closure portion and a second closure portion, wherein the internal thread formation is configured for mating engagement with the external thread formation of the neck portion of the container. 25 30
12. A method of forming a one-piece closure, the method comprising: 35
- molding a first closure portion and a second closure portion of the one-piece closure, the first closure portion including a polymeric top wall portion and a polymeric annular skirt portion depending from the polymeric top wall portion, the annular skirt portion including an internal thread formation for mating engagement with an external thread formation of a container, the second closure portion including a polymeric tamper-evident band; and 40 45
- slitting a lower portion of the annular skirt portion along a first general line and along a second general line, the first general line forming a first frangible connection that partially detachable connects a first section and a second section of the annular skirt portion, the second general line forming a second frangible connection that partially detachable connects the annular skirt portion and the tamper-evident band, 50 55
- wherein when the first and second frangible connections are broken, a tether is exposed, the tether being attached to a portion of the second closure portion and a portion of the first closure portion, a length of the unattached tether portion extending greater than about 300 degrees around the circumference of the closure, wherein when the internal thread formation of the first closure portion is not in mating engagement with the external thread formation of the container, the first closure portion being adapted to be spaced from the second closure portion via the unattached tether portion.
13. The method according to claim 12, wherein the length of the unattached tether portion extends greater than about 320 degrees, preferably greater than about 340 degrees around the circumference of the closure.



*Fig. 1A*

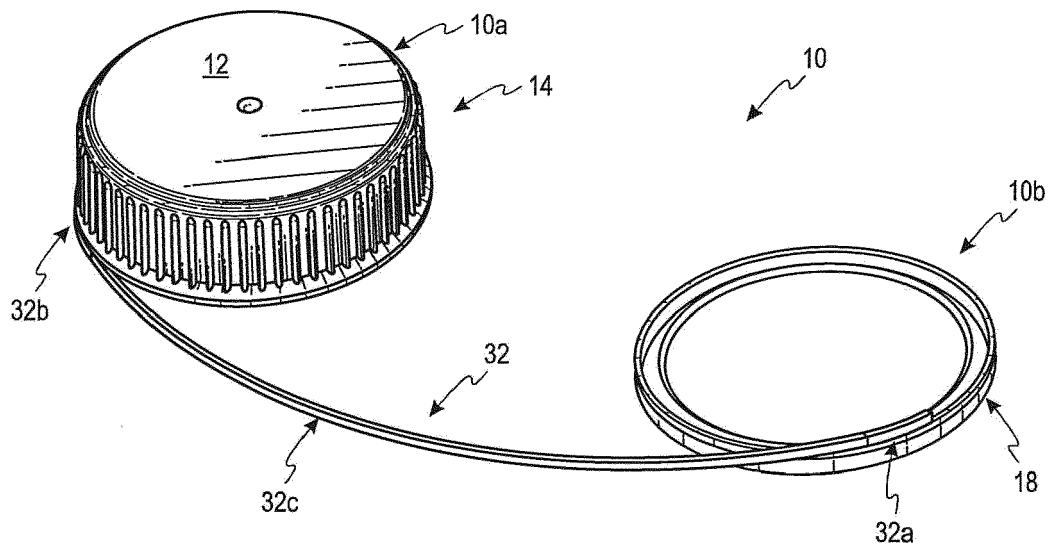


*Fig. 1B*

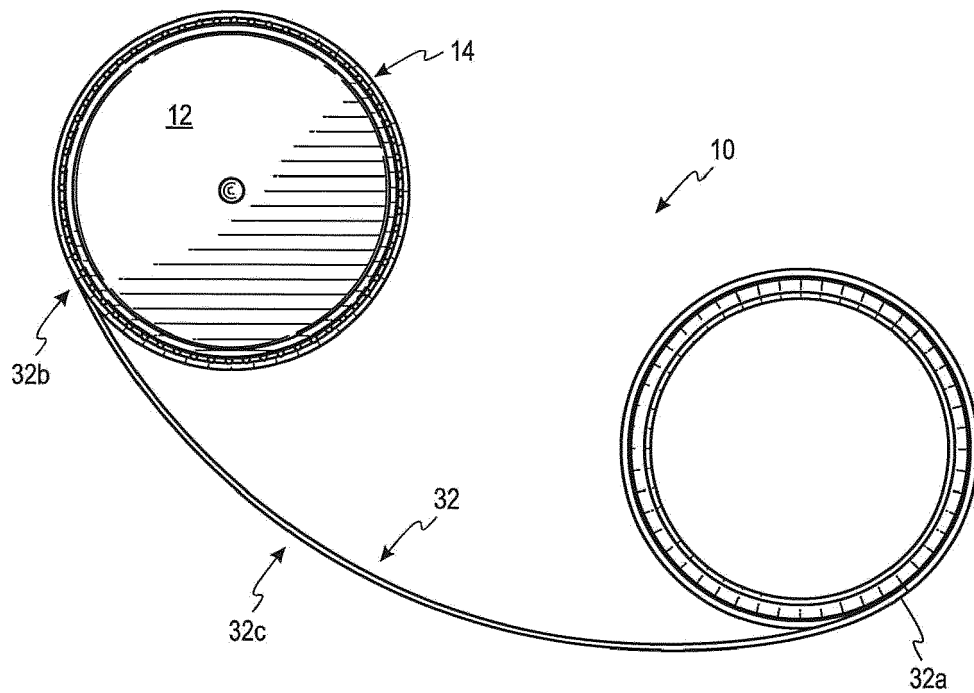


*Fig. 1C*

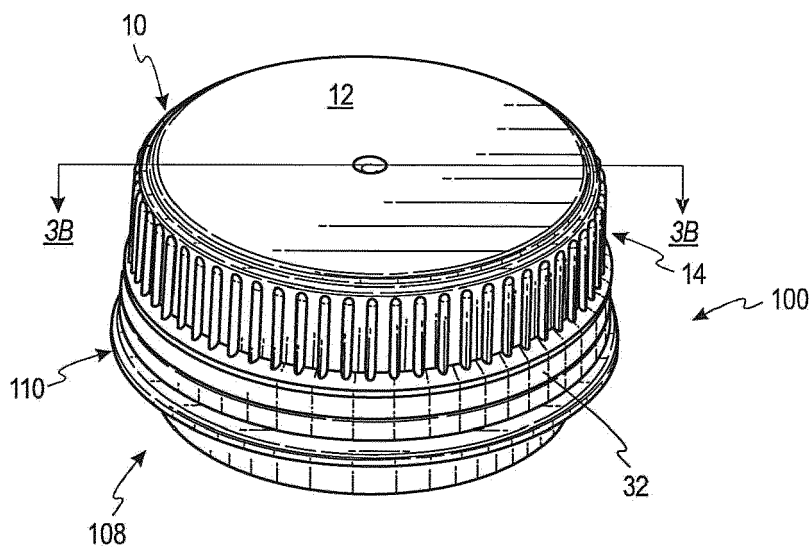




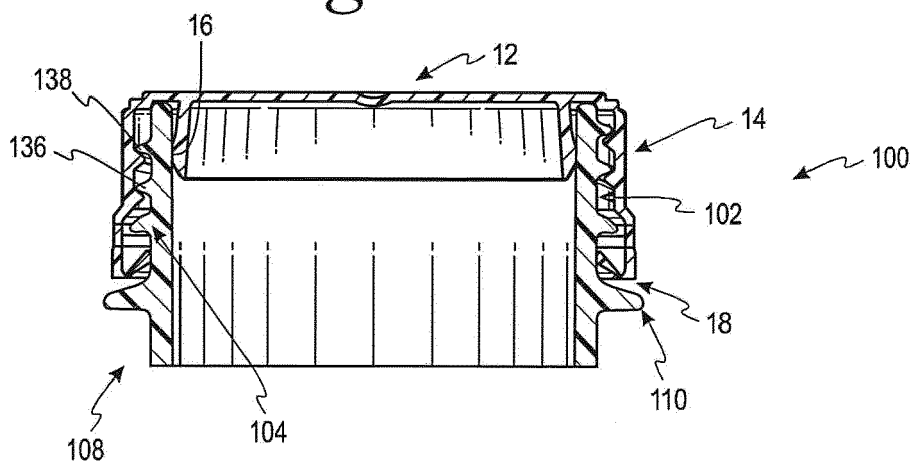
*Fig. 2A*



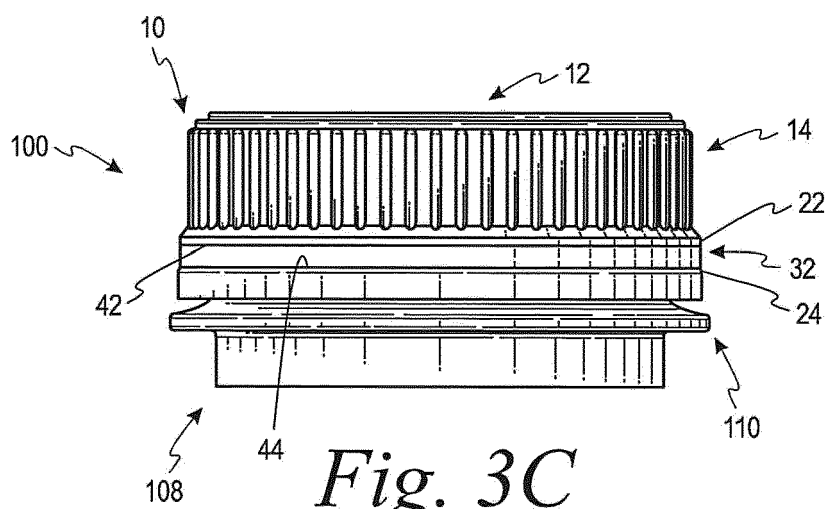
*Fig. 2B*



*Fig. 3A*



*Fig. 3B*



*Fig. 3C*

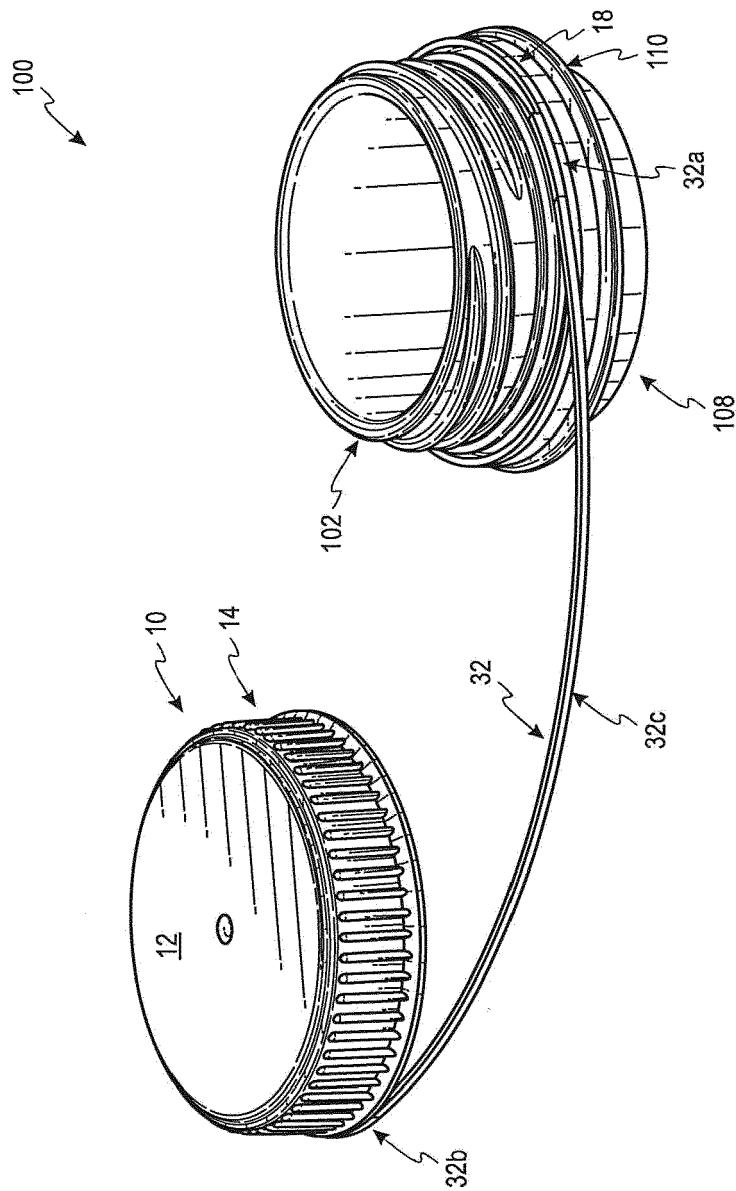


Fig. 4



## EUROPEAN SEARCH REPORT

Application Number  
EP 19 17 9721

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                            |                                                     |                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Citation of document with indication, where appropriate, of relevant passages                                                              | Relevant to claim                                   | CLASSIFICATION OF THE APPLICATION (IPC) |
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| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                                            |                                                     |                                         |

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