



US 20160107802A1

(19) **United States**(12) **Patent Application Publication**  
**MERINO**(10) **Pub. No.: US 2016/0107802 A1**(43) **Pub. Date: Apr. 21, 2016**(54) **SECOND GENERATION LOW GAUGE  
CROWN CAP****Publication Classification**(71) Applicant: **PACKAGING PRODUCTS DEL  
PERU S.A., Lima (PE)**(51) **Int. Cl.**  
**B65D 41/12** (2006.01)  
**B21D 51/48** (2006.01)(72) Inventor: **Alfredo Abel MERINO, Lima (PE)**(52) **U.S. Cl.**  
CPC ..... **B65D 41/12** (2013.01); **B21D 51/48**  
(2013.01)(21) Appl. No.: **14/436,675**(22) PCT Filed: **May 2, 2013**(86) PCT No.: **PCT/IB2013/000831**

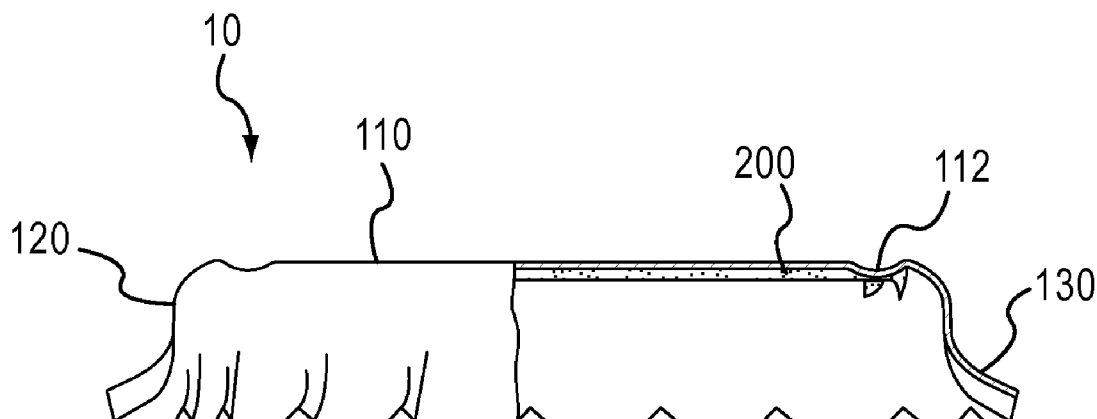
§ 371 (c)(1),

(2) Date: **Apr. 17, 2015**(57) **ABSTRACT**

A lightweight, crimp-type crown cap for application to a glass beverage bottle, comprises a shell formed of a material comprising steel tinplate. The shell includes a round panel having an upper surface, a lower surface and a peripheral edge. A skirt depends downwardly from the peripheral edge of the panel, the skirt having fewer than 21 corrugations, wherein the corrugations are adapted to be crimped to affix the crown cap to a rim of a bottle opening. A circular groove is formed in the panel, defining a downwardly concave portion on the upper surface of the panel and a corresponding downwardly convex portion on the lower surface of the panel, and the circular groove is arranged to align with the rim of the bottle. A liner is disposed on the lower surface of the panel.

**Related U.S. Application Data**

(60) Provisional application No. 61/714,868, filed on Oct. 17, 2012.



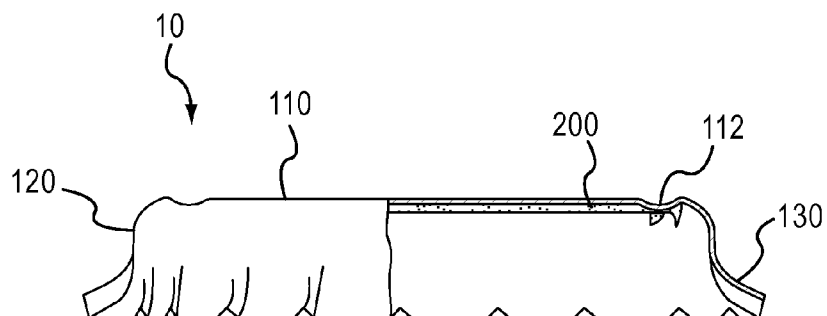


FIG. 1A

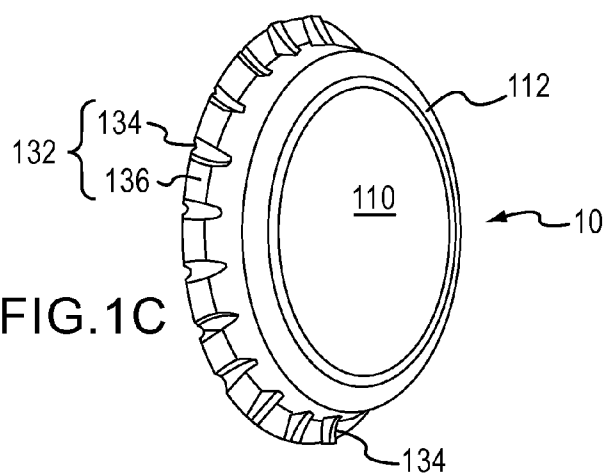


FIG. 1C

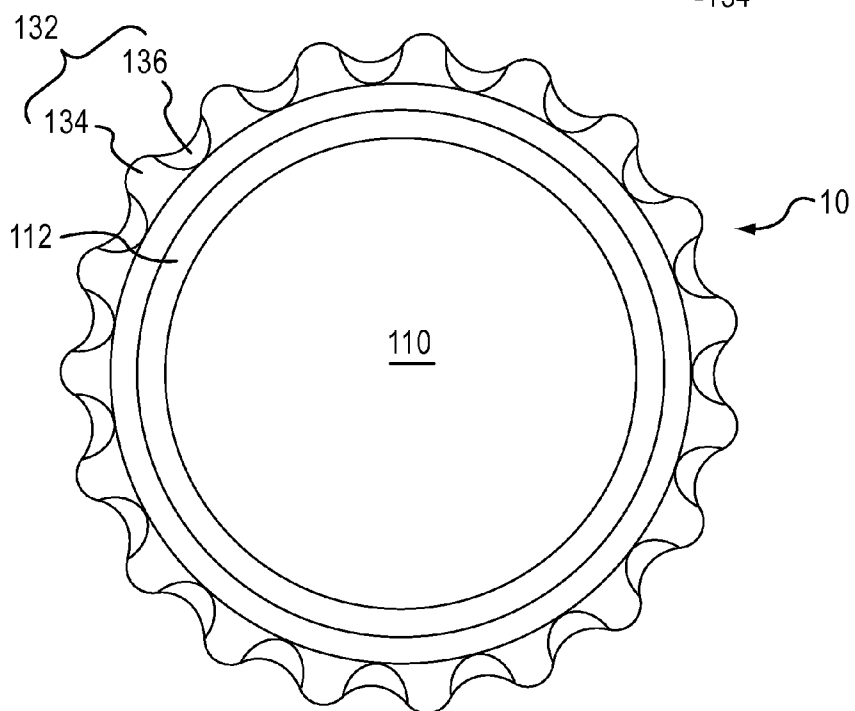


FIG. 1B

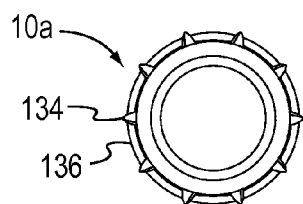


FIG. 2A

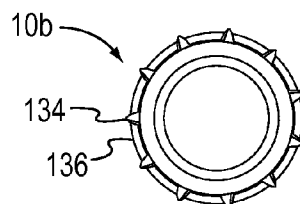


FIG. 2B

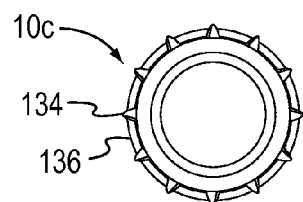


FIG. 2C

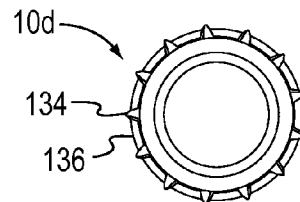


FIG. 2D

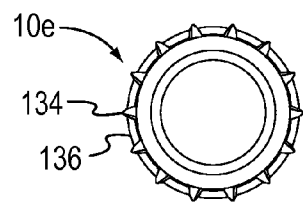


FIG. 2E

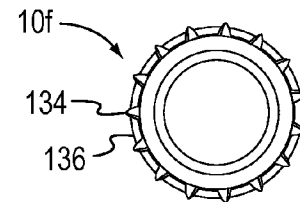


FIG. 2F

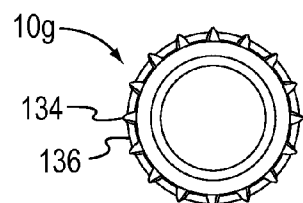


FIG. 2G

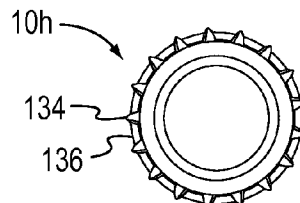


FIG. 2H

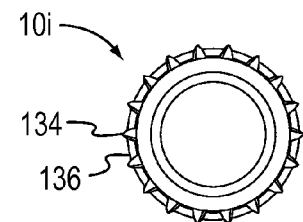


FIG. 2I

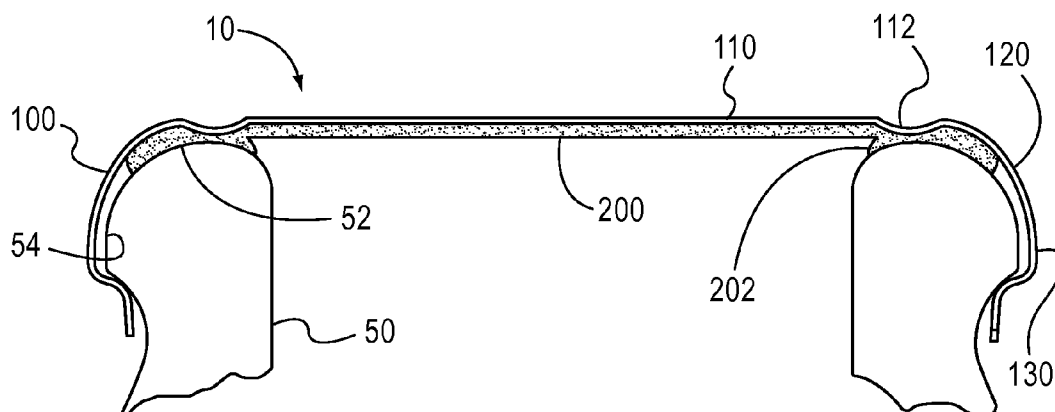


FIG.3

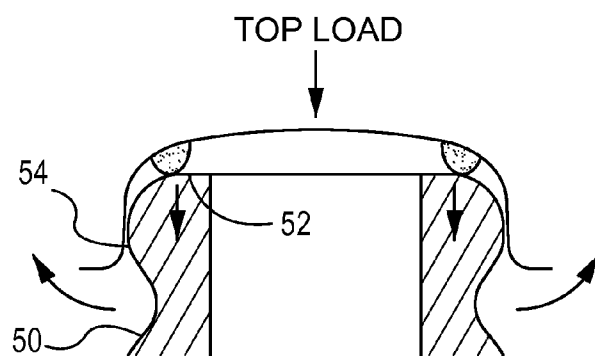


FIG.4A

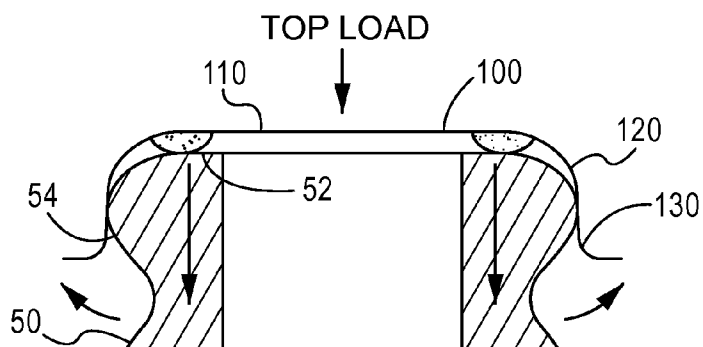


FIG.4B

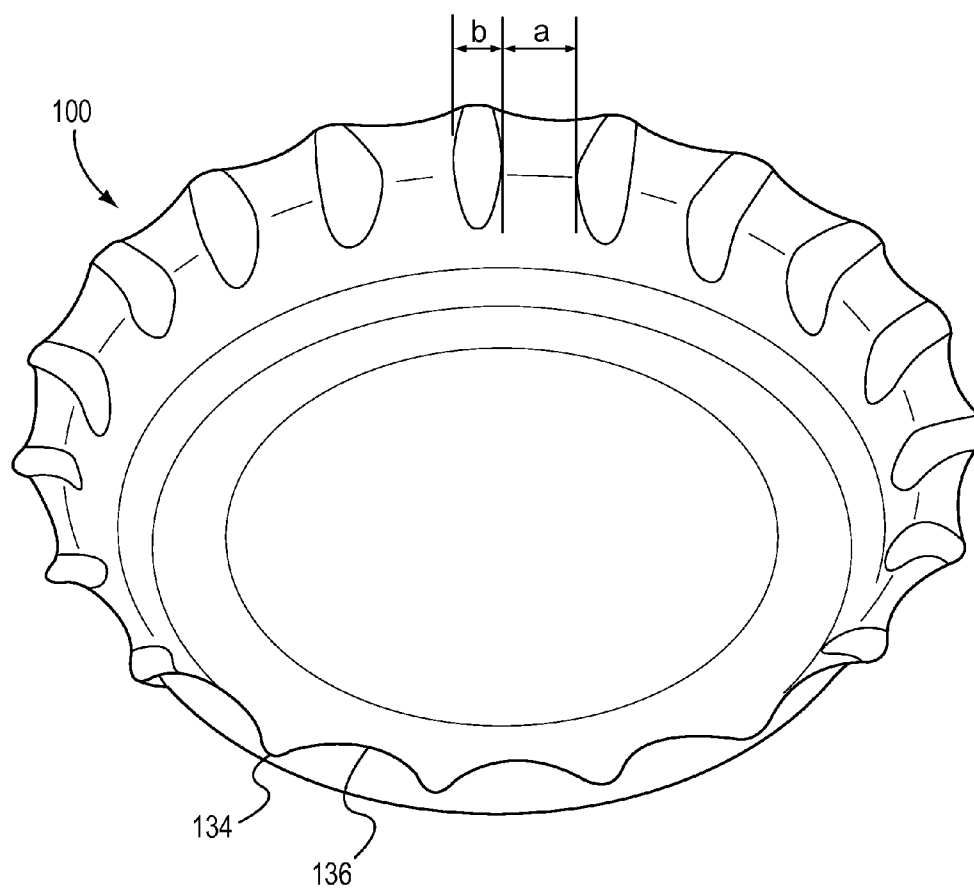


FIG.5

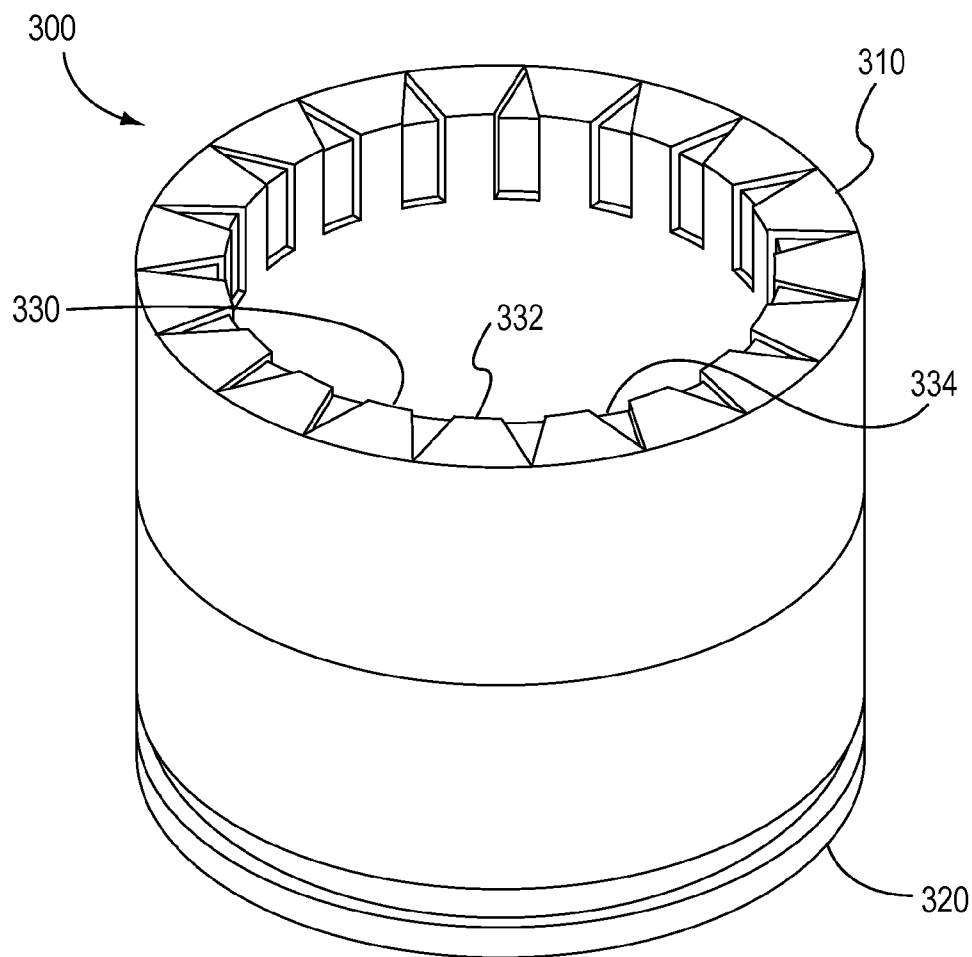


FIG.6

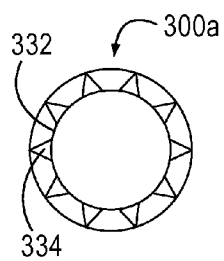


FIG. 7A

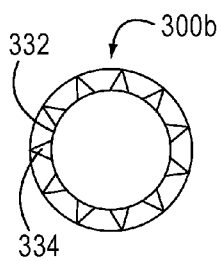


FIG. 7B

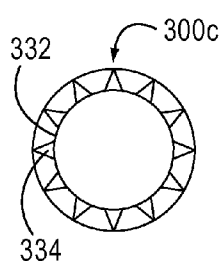


FIG. 7C

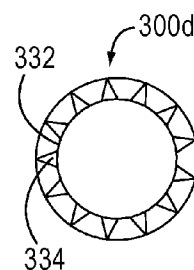


FIG. 7D

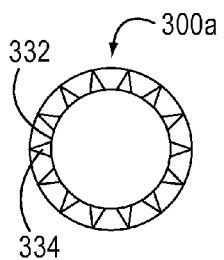


FIG. 7E

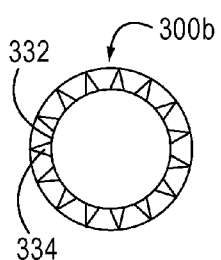


FIG. 7F

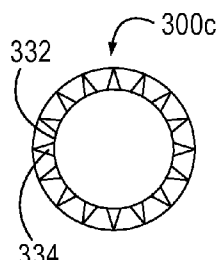


FIG. 7G

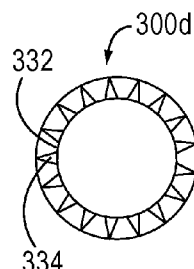


FIG. 7H

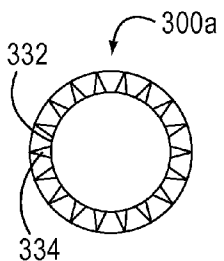


FIG. 7I

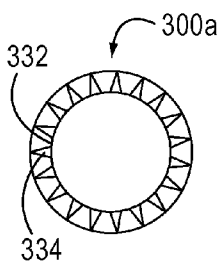


FIG. 7J

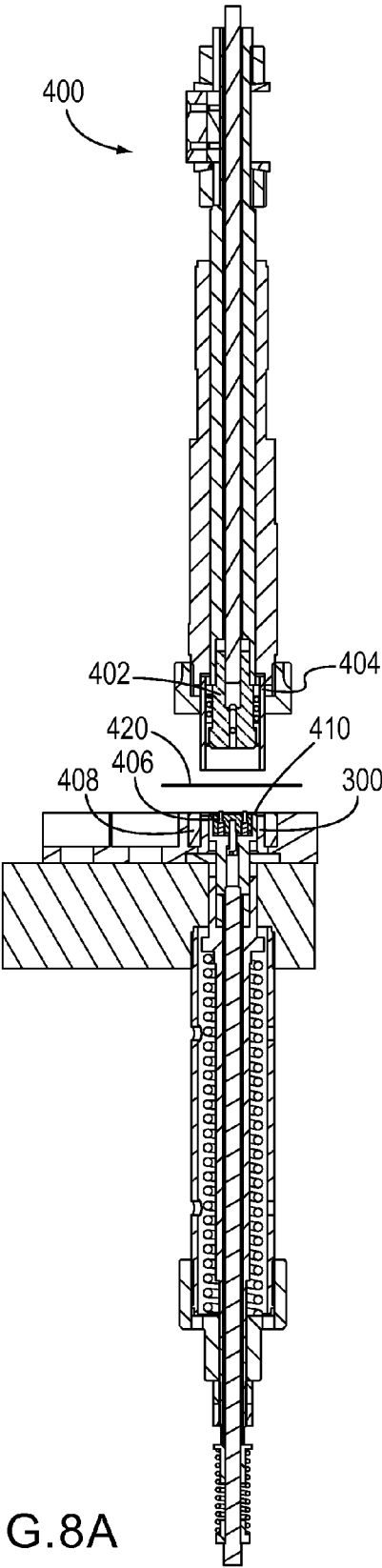


FIG. 8A

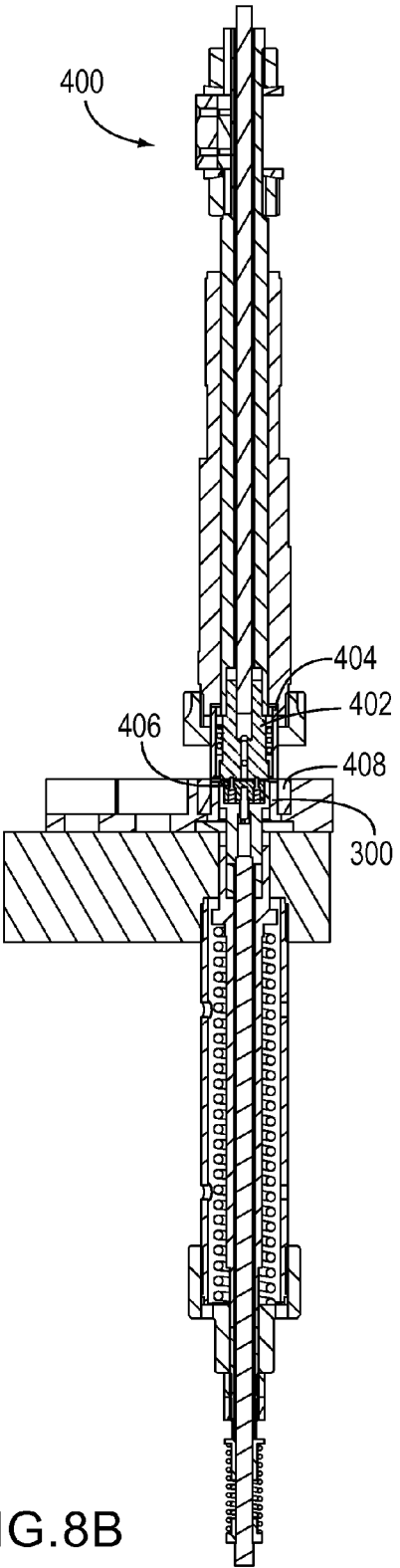


FIG. 8B



## SECOND GENERATION LOW GAUGE CROWN CAP

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of filing date of U.S. Provisional Application Ser. No. 61/714,868, entitled "Second Generation Low-Gauge Crown Cap" filed Oct. 17, 2012 under 35 USC §119(e)(1) which is incorporated herein by reference in its entirety.

### FIELD OF THE INVENTION

[0002] The present invention relates to closures for containers, and more particularly to a fluted crown cap for sealing a bottle or container opening.

### BACKGROUND

[0003] The bottle cap was first produced in the 1890's, based on the invention of William Painter of Baltimore described in U.S. Pat. No. 468,226. Painter's invention was a circular steel closure, characterized by circular top, a circular skirt depending downwardly from a periphery of the top, and a downwardly and radially outwardly extending flange extending from a periphery of the skirt. The flange was formed originally with 24 teeth (or corrugations) to enable crimping of the crown to the bottle neck, later reduced to a standard of 21. A cork seal with a paper backing was provided as liner on an inside surface of the crown, to prevent contact between the metal cap and a liquid enclosed in the bottle. To remove the crown cap, a bottle opener was required to pry the cap from the bottle. In general, the basic metal crown cap has not conceptually changed from that time.

[0004] For over a hundred years following Painter's invention, few minor improvements have been made to the conventional crown cap. These minor improvements include variations of the original crown cap, allowing plastic material instead of metal; increasing the number of corrugations in order to ease the opening of (such as in a twist-off cap), and changes in the material of the cap liner.

[0005] More recently, it has been conceived by the inventor of the present invention to reduce the thickness of the sheet metal of the crown cap in order to reduce the manufacturing cost. U.S. Patent Application Publication 2010/0326949 describes the inventor's earlier effort to produce a low-gauge crown cap, resulting in a crown cap that can be produced with a tinplate steel of a thickness between 0.16 mm and 0.18 mm.

[0006] In seeking further improvements, the inventor of the present invention has identified certain characteristics or effects which impact on the ability to fashion a crown cap from thinner material.

[0007] Among these characteristics or effects is an effect which the Inventor refers to as a "spring back effect." As a result of an increase of the steel temper, steel tinplate will have a tendency to always recover (or to "spring back") to its original state in view of high memory and very low "elasticity" characteristics, impacting on the "tightness" of fit of the crown cap onto a bottle. That is, the crown cap will always have a tendency, to some degree, to revert to its pre-crimped shape resulting in a tendency toward loosening after being affixed to the bottle. In the case of bottle crown caps, this effect is always present with any manufactured thickness-temper combination. However, this characteristic is increased with the use of "double reduction" materials or materials of

very low thicknesses and high tempers. This increase in "spring back effect" presents a limit on the ability to fashion a conventional crown cap simply using thinner material.

[0008] Further improvements in the design and structure of a crown cap, including further reduction in material thickness and weight, are desired.

### SUMMARY

[0009] A lightweight, crimp-type crown cap for application to a glass beverage bottle, comprises a shell formed of a material comprising steel tinplate. The shell includes a round panel having an upper surface, a lower surface and a peripheral edge. A skirt depends downwardly from the peripheral edge of the panel, the skirt having fewer than 21 corrugations, wherein the corrugations are adapted to be crimped to affix the crown cap to a rim of a bottle opening. A circular groove is formed in the panel, defining a downwardly concave portion on the upper surface of the panel and a corresponding downwardly convex portion on the lower surface of the panel, and the circular groove is arranged to align with the rim of the bottle. A liner is disposed on the lower surface of the panel.

[0010] Embodiments of the crown cap preferably include, ten to nineteen corrugations defined by alternate flutes and lands. The flutes and lands define non-contact zones and contact zones, respectively, wherein the contact zones are adapted to make sealing contact with a bead surrounding the rim of the bottle when the crown cap is affixed to the bottle. A ratio of a circumferential length of the contact zone to a circumferential length of a non-contact zone is preferably greater than 1.0.

[0011] A thickness of the tinplate material is preferably less than 0.17 mm, and more preferably less than 0.14 mm.

[0012] These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1A is a partial cutaway side view of an embodiment of a crown cap according to the present invention;

[0014] FIG. 1B is a top plan view of the crown cap of FIG. 1A;

[0015] FIG. 1C is a top perspective view of the crown cap of FIG. 1A;

[0016] FIG. 1D is a bottom perspective view of the crown cap of FIG. 1A;

[0017] FIGS. 2A-2I show a top plan view of further embodiments of crown caps according to the present invention;

[0018] FIG. 3 is a cross sectional view of the crown cap of FIG. 1A crimped onto a bottle.

[0019] FIG. 4A is a cross sectional schematic view showing a top loading effect on a conventional crown cap.

[0020] FIG. 4B is a cross sectional schematic view showing a top loading effect on an embodiment of a crown cap of the present invention.

[0021] FIG. 5 is a detailed partial bottom perspective view of the corrugations of an embodiment of a crown cap of the present invention.

[0022] FIG. 6 is a perspective view of a corrugating die for forming a crown cap to the present invention.

[0023] FIGS. 7A-7I show a top plan view of further embodiments of corrugating dies according to the present invention.

[0024] FIG. 8A is a schematic illustration of a crown press tool for forming crown caps, shown in a “stand-by” configuration.

[0025] FIG. 8B is a schematic illustration of the crown press tool of FIG. 8A, shown in a drawing operation.

#### DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS

[0026] Referring to an embodiment shown in FIGS. 1A-2, a low-gauge crown cap 10 of the present invention includes a shell 100 and a liner 200. The shell 100 includes a circular panel 110, a skirt 120 and a flange 130. The skirt 120 extends downward and outward from a periphery of the circular panel 110, and the flange 130 extends obliquely from the skirt 120. Corrugations 132 are formed on a circumferential portion of the flange 130, the corrugations 132 comprising alternating flutes 134 and lands 136. The skirt 120 and flange 130 are adapted to be crimped onto the neck of a bottle for closing and sealing the bottle.

[0027] The crown cap 10 is shown in the figures as a pry-off type that is opened with a lever or bottle opener. The present invention also encompasses a twist-off type (not shown in the figures) that is opened by twisting, as will be understood by persons familiar with crown cap technology.

[0028] As shown in FIG. 3, a crown cap 10 of the present invention may be crimped onto a bottle top in a conventional manner. Crown cap 10 is shown applied to a bottle 50 having a rim 52 and a bead 54. With the liner 200 disposed on its underside, crown cap 10 is placed on the bottle 50 such that groove 112 is located over the bottle rim 52. Upon crimping of flutes 134 relative to bead 54, the liner 200 is squeezed between and deformed by the underside of groove 112 and rim 52. The crimping process for applying any of the crown caps described herein to a bottle (for either pry-off or twist-off types of shells) preferably is performed by a ring-like crimping tool that contacts the outer edge or edge region of the flange 130, thereby avoiding or diminished scuffing or marring of flange 130 and diminishing force applied to bead 54.

[0029] The circular panel 110 is preferably a substantially flat planar panel. In comparison with a conventional crown cap having an upwardly convex panel or top part, the present inventor as found that the flat planar panel improves performance of the crown cap by reducing the “spring back effect,” which is a tendency of the crimped corrugations to return to their original un-crimped state, creating a tendency for the crown cap to become loosened from a bottle.

[0030] In part, this tendency of the crimped corrugations to return to their original un-crimped state results from material stiffness and poor resiliency characteristics associated with the higher temper material of a thinner tinplate. That is, simply stated, a thinner tinplate may be more spring-like in nature than a thicker material simply owing to material requirements associated with forming the thinner plate, resulting in a greater tendency to some degree of resistance in holding a crimped shape.

[0031] In particular, referring to FIGS. 4A and 4B, the upwardly convex top of a conventional crown cap shown in FIG. 4A contributes to this effect when a load is applied to the top of the crown cap. That is, the material tendency of the crown cap to spring back to its uncrimped state may be exacerbated by a downward force or load applied to the top of

the crown cap. The downward force on the cap results in a “levering” of the crown cap about the bottle rim, tending to urge the corrugations outward and away from the bottle rim, potentially loosening the cap from the bottle or reducing the effectiveness of its seal. By making the panel portion of the crown cap flat as shown in FIG. 4B, this undesirable effect of the downward force or load applied to the crown cap is reduced or eliminated.

[0032] A circular groove 112 is formed in the panel 110, defining a downwardly concave portion 112a on the upper surface of the panel 110 and a corresponding downwardly convex portion 112b on the lower surface of the panel 110. Stated differently, the circular groove 112 may be considered to be a downwardly protruding circular bead. The circular groove 112 is generally concentric with the outer perimeter of the crown cap 10, and the circular groove 112 is arranged to align with top surface of the rim 52 of the bottle 50 when the crown cap 10 is crimped onto the bottle 50. More particularly, the groove 112 presses the liner 200 against the top surface of the rim 52 increasing the contact surface between the liner 200 and the rim 52, and thereby increasing the sealing, and increasing the bottle cap performance. The circular groove 112 is preferably arranged to coincide with the sealing portion 202 of the liner 200 if such is provided.

[0033] The liner 200 is provided on the inside surface of the circular panel 110. A sealing element 202 may be formed on the liner as a downwardly protruding feature or features arranged to contact with a top surface of the rim 52 of the bottle 50. After crimping the crown cap 10 onto the bottle top, the liner 200 contacts and seals against the rim 52 of the bottle 50. The liner 200 may be a conventional, thermoformed, single or dual lip or bead liner such as is available from SACMI IMOLA (as shown in the figures), as will be understood by persons familiar with crown cap technology. The present invention is not limited to the choice or presence of a liner, and encompasses other liner configurations, such as a conventional, single bead liner (not shown in the figures) or no bead, as well as other materials, such as PVC and conventional PVC substitutes. The sealing element 202 of the liner 200 as shown includes an inboard and outboard lip for contact with an inboard and outboard portion of the bottle. In embodiments using a single bead liner, the bead of the single bead liner preferably engages the inboard portion or corner region of the rim 52 of the bottle 50.

[0034] The crown cap 10 of the present invention is formed with fewer than the conventional 21 corrugations, preferably having ten (10) to nineteen (19) corrugations. In the embodiment of FIGS. 1A-1C, the crown cap 10 is shown embodied with nineteen (19) corrugations. In the embodiment of FIG. 2, the crown cap 10 is shown embodied with ten (10) corrugations.

[0035] A reduction in the number of corrugations has been found to reduce the “spring back” effect described above, and increases the surface contact between the lands 136 and the bead 54. That is, by reducing the number of corrugations 132, the surface contact between the land 136 and the bead 54 surrounding the rim is increased. Increasing the contact surface will improve the “bite” of the metal of the shell and the bottle, hence the internal pressure resistance of the crown cap.

[0036] As a consequence of reducing the number of corrugations 132 to increase the surface contact, since the perimeter of the rim is a constant, the ratio of the circumferential length of the contact zone (the lands 136) to the circumferential length of a non-contact zone (the flutes 134) increases,

and will be greater than 1.0. Stated differently, increasing the relative length of the lands **136** (versus the flutes **143**) will increase the contact perimeter between the cap and the bottle. Hence, we will be able to continue reducing the shell thickness by reducing the number of corrugations even further. The crown cap **10** may be formed of a harder or higher temper tinplate, in turn allowing a thinner gauge of tinplate to be used, resulting in a reduction in the material required and a corresponding reduction in cost to manufacture the crown caps **10**.

[0037] In concert with advantages gained by the planar top panel, a substantial reduction in the thickness of the tinplate may be achieved. In preferred embodiments, the crown cap **10** may be formed with ten (10) to nineteen (19) corrugations, and may be formed of a high temper tinplate material of a thickness less than 0.17 mm (more preferably between 0.12 mm and 0.15 mm), such as a double reduction tinplate having a temper of DR9 (according to the ASTM A623-83 Standard Specification for TIN MILL PRODUCTS) or higher.

[0038] Referring to FIG. 5, the corrugations **132** comprising alternating flutes **134** and lands **136** are shown in greater detail. The flutes **134** and lands **136** form alternately disposed non-contact zones (the flutes **134**) and contact zones (the lands **136**), wherein the contact zones (lands **136**) are adapted to make sealing contact with the a bead **54** surrounding the rim **52** of the bottle **50** when the crown cap **10** is affixed to the bottle **50**. To adequately affix the crown cap **10** to the bottle **50**, and to ensure a good closure and seal, a ratio of a circumferential length *a* of the contact zones to a circumferential length *b* of the non-contact zones is greater than 1. That is, the contact zone is longer in its extent along the bottle top bead than the non-contact zone.

[0039] Turning to FIGS. 6, a corrugating die **300** for forming a crown cap is shown. The corrugating die **300** is a die element configured for forming the skirt and corrugated flange of a crown cap of the present invention. The corrugating die **300** is a generally cylindrical die element having top **310**, a bottom **320** and a cylindrical inner wall **330** defining a hollow interior. A top rim of the corrugating die **300** and an adjacent portion of the inner wall **330** are formed with a plurality of notches **332** separated by teeth **334**, corresponding to the flutes and lands of a crown cap that will be formed by the corrugating die **300**. The corrugating die **300** is configured to form, in a pressing operation, a crown cap having a substantially planar top surface, a circular notch formed proximately to an outer periphery of the planar top surface, and a skirt depending downwardly from the planar top surface and having a plurality of flutes and lands defined by the plurality of teeth and notches.

[0040] The corrugating die **300** shown in FIG. 6 is configured to form nineteen (19) corrugations or flutes. Additional embodiments are shown in FIGS. 7A-7I, having ten (10) to eighteen (18) corrugations or flutes, respectively.

[0041] Generally speaking, a corrugating die **300** is used in conjunction with a crown press tool **400** for forming the crown caps. The corrugating die **300** can be considered as the most important element of the crown press tool, as it is the corrugating die **300** which defines the shape of the crown caps which are formed. The corrugating die **300** should be made from a non-deforming steel and should be pack hardened to avoid scaling of the die.

[0042] Referring to FIGS. 8A and 8B, a crown press tool **400** comprises, in relevant part, an upper forming punch **402**, blanking punch **404**, lower forming punch **406**, a blanking die

**408**, the corrugating die **300** and a presser **410**. A blank, that is a sheet of material for forming the crown cap, such as a tinplate or steel sheet **420**, is placed in the crown press tool **400** as shown, between the upper and lower tool elements. In forming a crown cap from the steel sheet **420**, the upper forming punch **402** is lowered until the steel sheet **420** becomes positioned in the same plane as the blanking die **408**, corrugating die **300** and presser **410**. Once the upper forming punch **402** makes contact with the steel sheet **420**, the upper forming punch **402** presses the steel sheet **420** against the corrugating die **300** and the presser **410** to form the crown cap corrugations. At this point, the crown is embossed into the steel sheet **420**, although the crown cap is not yet "cut out" from the sheet.

[0043] Once the correct depth for the crown cap is reached, blanking punch **404** is pressed downward to cut the formed crown cap from the steel sheet **420**, against the blanking die **408**. That is, the blanking punch **404** and blanking die **408** are used to remove the formed crown cap from the steel sheet **420**. The formed and cut crown cap is then expelled from the crown press tool **400**, by operation of a lower spring system in conjunction with air jets.

[0044] It will be understood that the above-described embodiments of the invention are illustrative in nature, and that modifications thereof may occur to those skilled in the art with the benefit of the teachings of this specification, without departing from the scope and spirit of the invention as defined by the appended claims. Accordingly, this invention is not to be regarded as limited to the embodiments disclosed herein, but is to be limited only as defined in the appended claims.

1. A lightweight, crimp-type crown cap for application to a glass beverage bottle having a body, a neck extending up from the body and a rim formed at a top of the neck, the crown cap comprising:

- a shell formed of a material comprising steel tinplate, the shell including:
- a round panel having an upper surface, a lower surface and a peripheral edge;
- a skirt depending downwardly from the peripheral edge of the panel, the skirt having fewer than 21 corrugations, wherein the corrugations are adapted to be crimped to affix the crown cap to the bottle;
- a liner disposed on the lower surface of the panel; and
- a circular groove formed in the panel defining a downwardly concave portion on the upper surface of the panel and a corresponding downwardly convex portion on the lower surface of the panel, wherein the circular groove is arranged to align with the rim of the bottle and the liner.

2. The crown cap of claim 1, wherein said skirt has 10 to 19 corrugations.

3. The crown cap of claim 1, wherein corrugations define alternately disposed contact zones and non-contact zones, the contact zones being adapted to make sealing contact with the neck of the bottle when the crown cap is affixed to the bottle.

4. The crown cap of claim 2, wherein a ratio of a circumferential length of said contact zones to a radial width of said non-contact zones is greater than 1.

5. The crown cap of claim 1, wherein a ratio of a circumferential length of said contact zones to a radial width of said non-contact zones is 1.27.

6. The crown cap of claim 1, wherein said round panel is a flat planar panel.

7. The crown cap of claim 1, wherein said steel tinplate has a thickness of less than 0.17 mm.

8. The crown cap of claim 1, wherein said steel tinplate has a thickness of less than 0.14 mm.

9. The crown cap of claim 1, wherein said steel tinplate has temper of at least DR9.

10. The crown cap of claim 1, wherein the groove presses the liner against the top surface rim the rim to increase the contact surface between the liner and the bottle.

11. A die for forming a crown cap for application to a glass beverage bottle, comprising:

a substantially cylindrical die body having a top, a bottom and a substantially cylindrical inner wall defining a hollow interior;

a plurality of alternately disposed teeth and notches formed around an inner circumference of a top rim of the die body; and

wherein the teeth and notches are configured for forming in a pressing operation, in conjunction with the top rim and cylindrical inner wall, a crown cap having a substantially planar top surface, a circular notch formed proximately to an outer periphery of the planar top surface, and a skirt depending downwardly from the planar top surface and having a plurality of flutes and lands defined by the plurality of teeth and notches;

wherein the plurality of teeth and notches consists of fewer than 21 teeth and notches.

12. The die according to claim 11, wherein the plurality of teeth and notches consists of 10 to 19 teeth and notches.

13. The die according to claim 11, wherein a ratio of a circumferential length of said teeth to a radial width of said non-contact notches is greater than 1.

14. A method of forming a crown cap for application to a glass beverage bottle, comprising:

providing a material blank;

forming in said blank a substantially planar circular crown top;

forming in said crown top a circular groove disposed proximately to an outer periphery of said crown top;

forming in said blank a circular skirt depending downwardly from a periphery of the crown top, and a downwardly and radially outwardly extending flange extending from a periphery of the skirt;

forming in said skirt a plurality of corrugations, the plurality of corrugations consisting of fewer than 21 corrugations; and

cutting from said blank a formed crown top comprising the circular crown top, skirt and corrugated flange.

15. The method of claim 14, further comprising affixing a liner to an inner surface of the circular crown top.

16. The method of claim 14, wherein said corrugations define alternately disposed contact zones and non-contact zones, the contact zones being adapted to make sealing contact with the neck of the bottle when the crown cap is affixed to the bottle.

17. The method of claim 16, wherein a ratio of a circumferential length of said contact zones to a radial width of said non-contact zones is greater than 1.

18. The method of claim 14, wherein said plurality of corrugations consists of 10 to 19 corrugations.

19. The method of claim 14, wherein said circular crown top, said skirt and corrugated flange are formed in said blank by a corrugating die in a pressing operation.

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