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(54) **STEP TWIST ZIPPED VISUAL TAMPER-EVIDENT CAP AND NECK FINISH**

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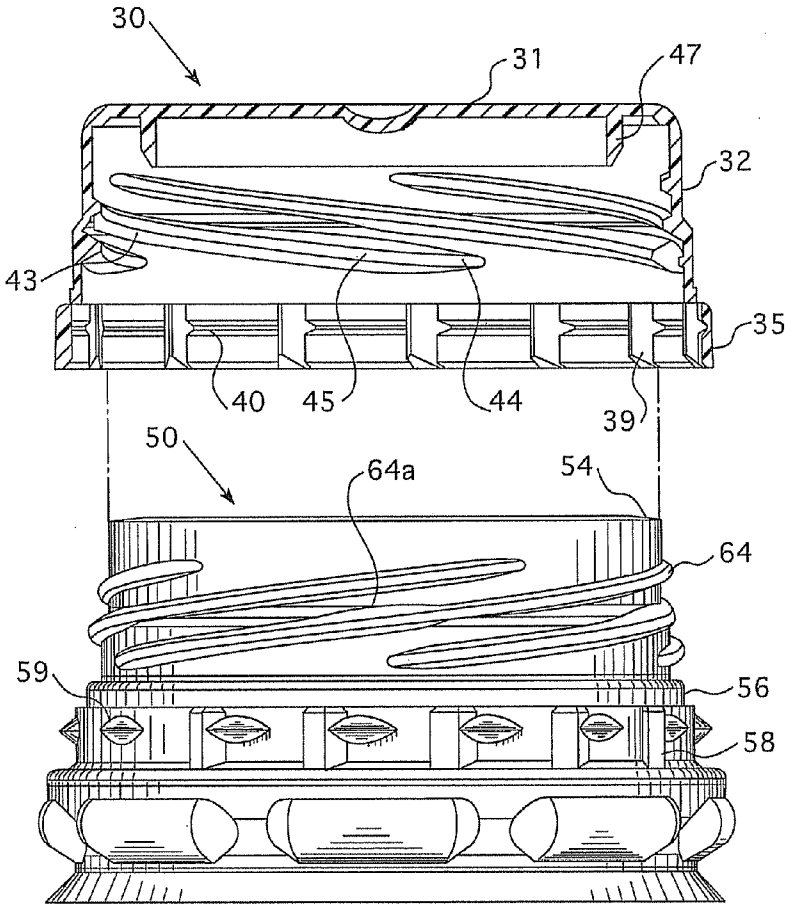
(57) **ABSTRACT**

A tamper-evident cap is disclosed having a circular closure member, a cylindrical annular wall depending generally from the periphery of the closure member terminating with a base and having a plurality of serrations, and a tamper-evident band circumferentially positioned around the base having teeth and attached to a portion of the base. The tamper-evident band may be mounted to the base by at least one of the teeth or attached by at least one of the serrations extending below the base. The interior and/or exterior of the cylindrical wall may be stepped. The tamper-evident band may have a groove between the teeth for retaining the tamper-evident band on a neck finish. A neck finish having at least one set of teeth and optional raised portions for securing the tamper-evident band in place is also disclosed. The neck finish may be stepped to correspond with a cap having a cylindrical wall with a stepped interior. A cap and neck finish combination for a container is also disclosed.



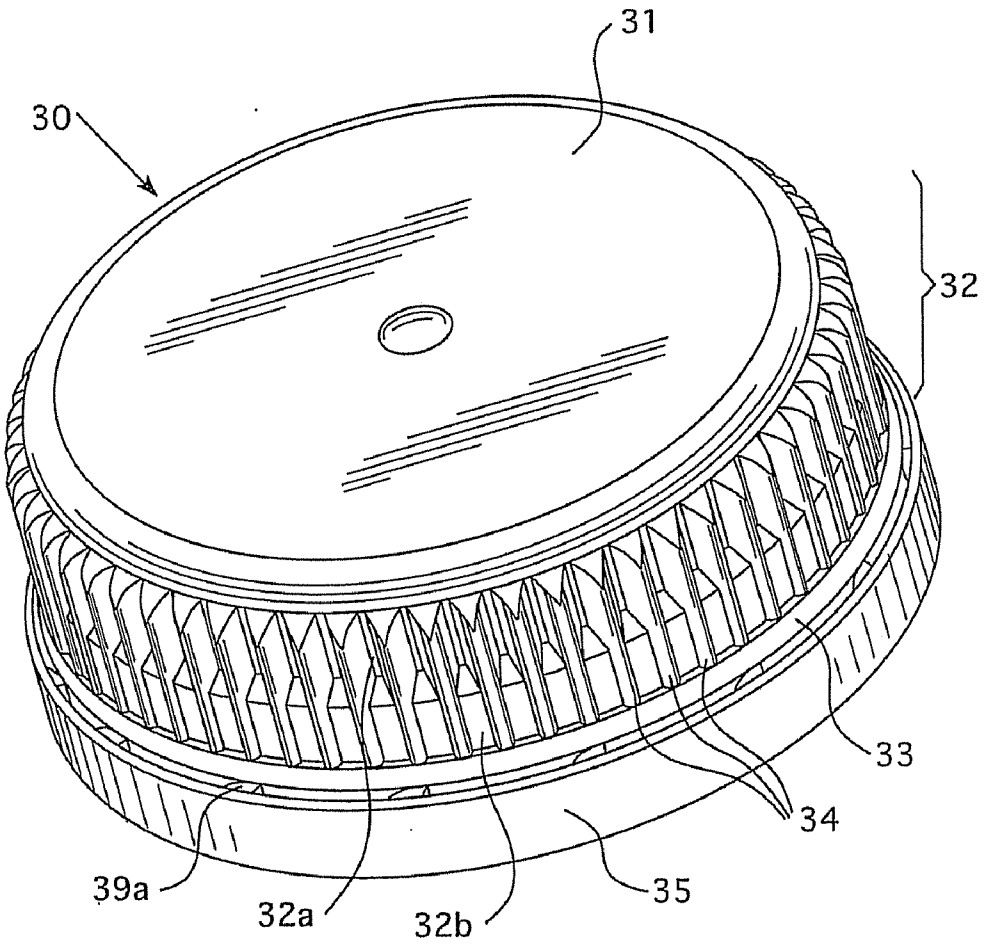


FIG. 1A

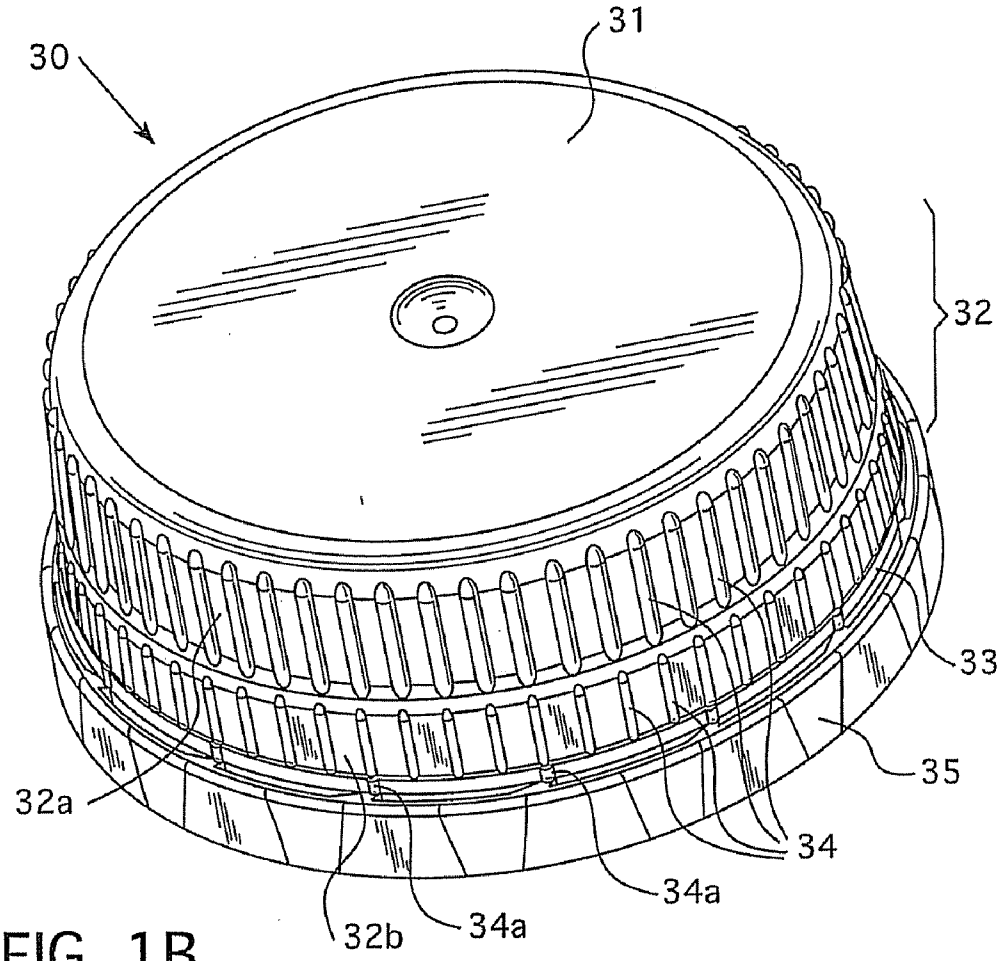


FIG. 1B

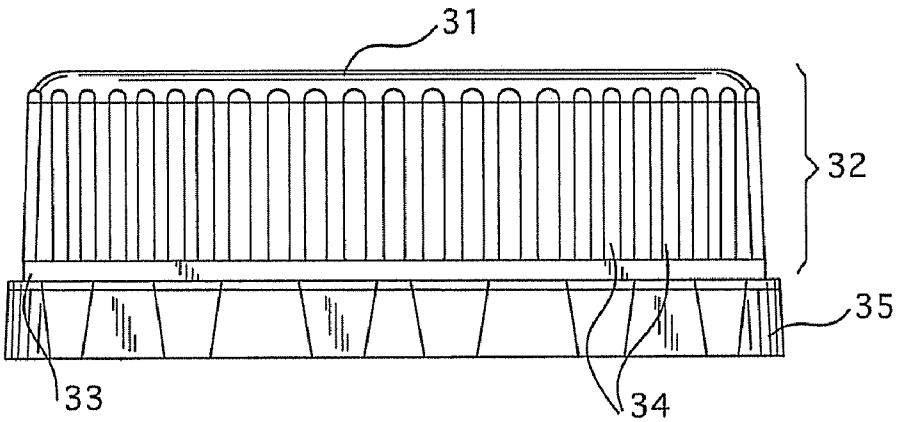


FIG. 1C

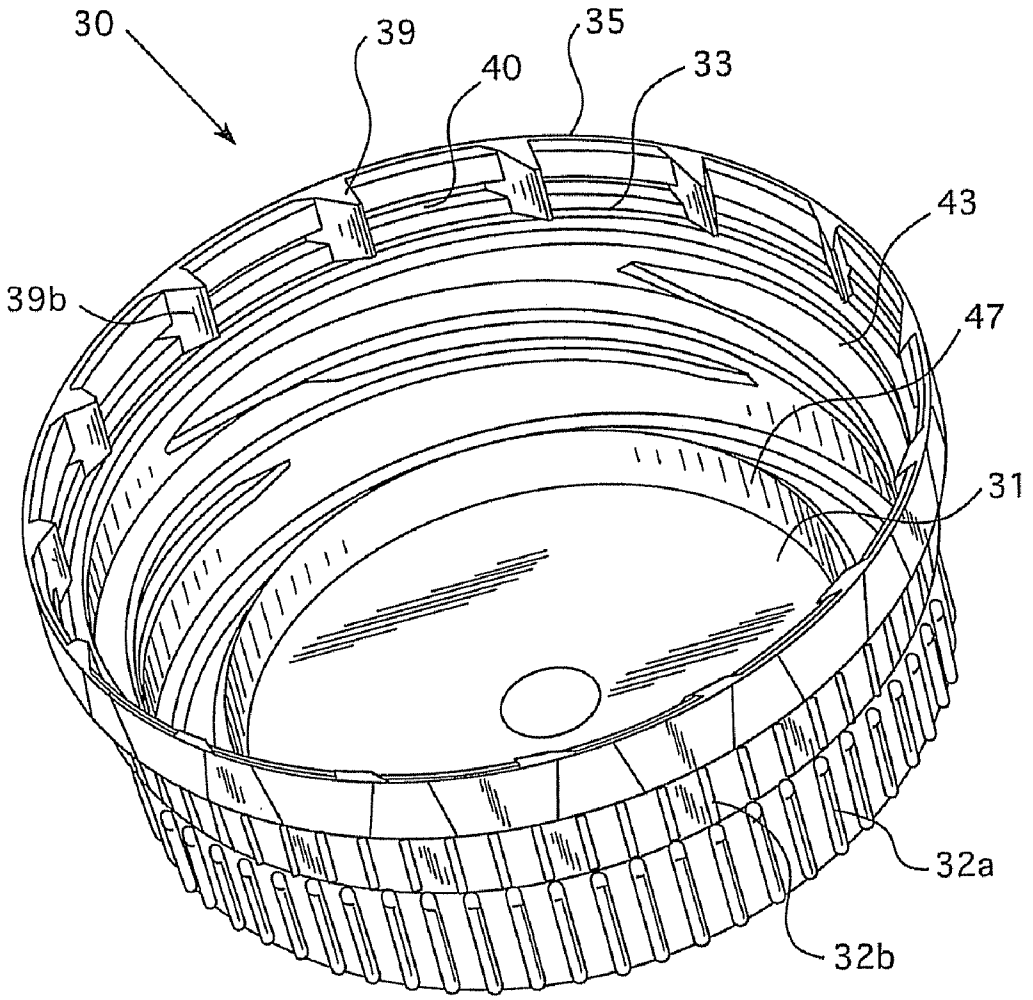


FIG. 1D

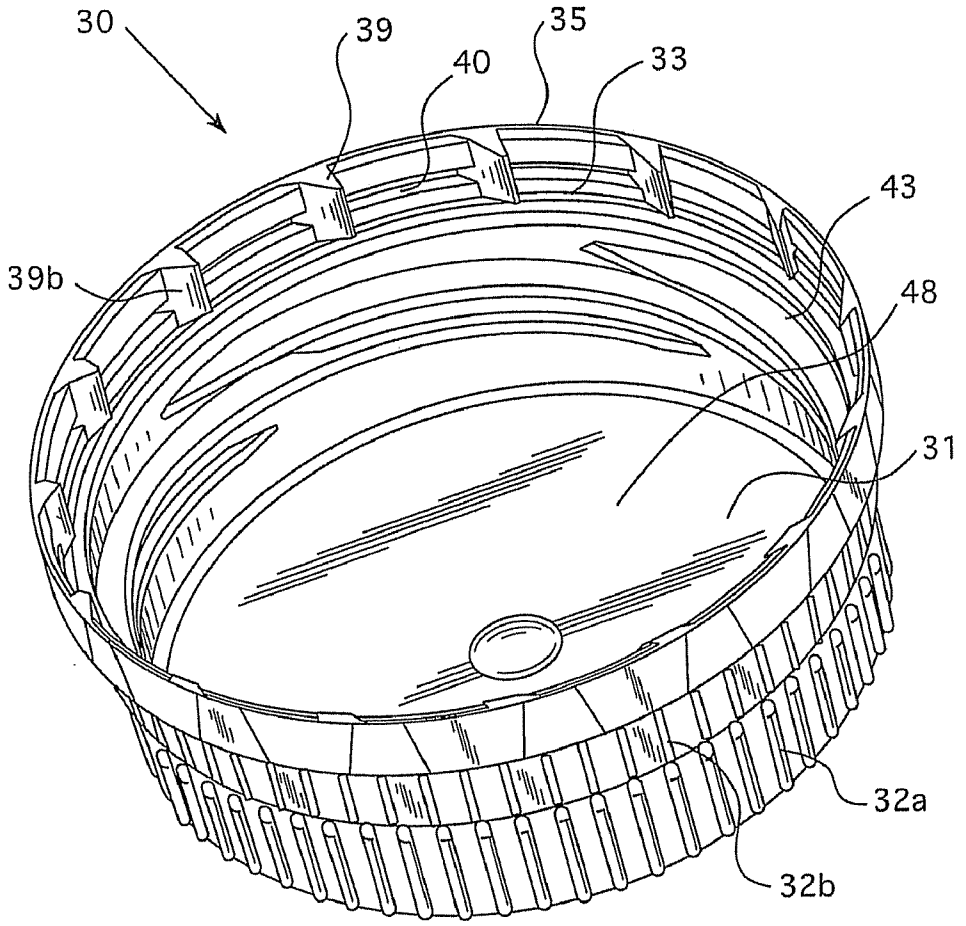


FIG. 1E

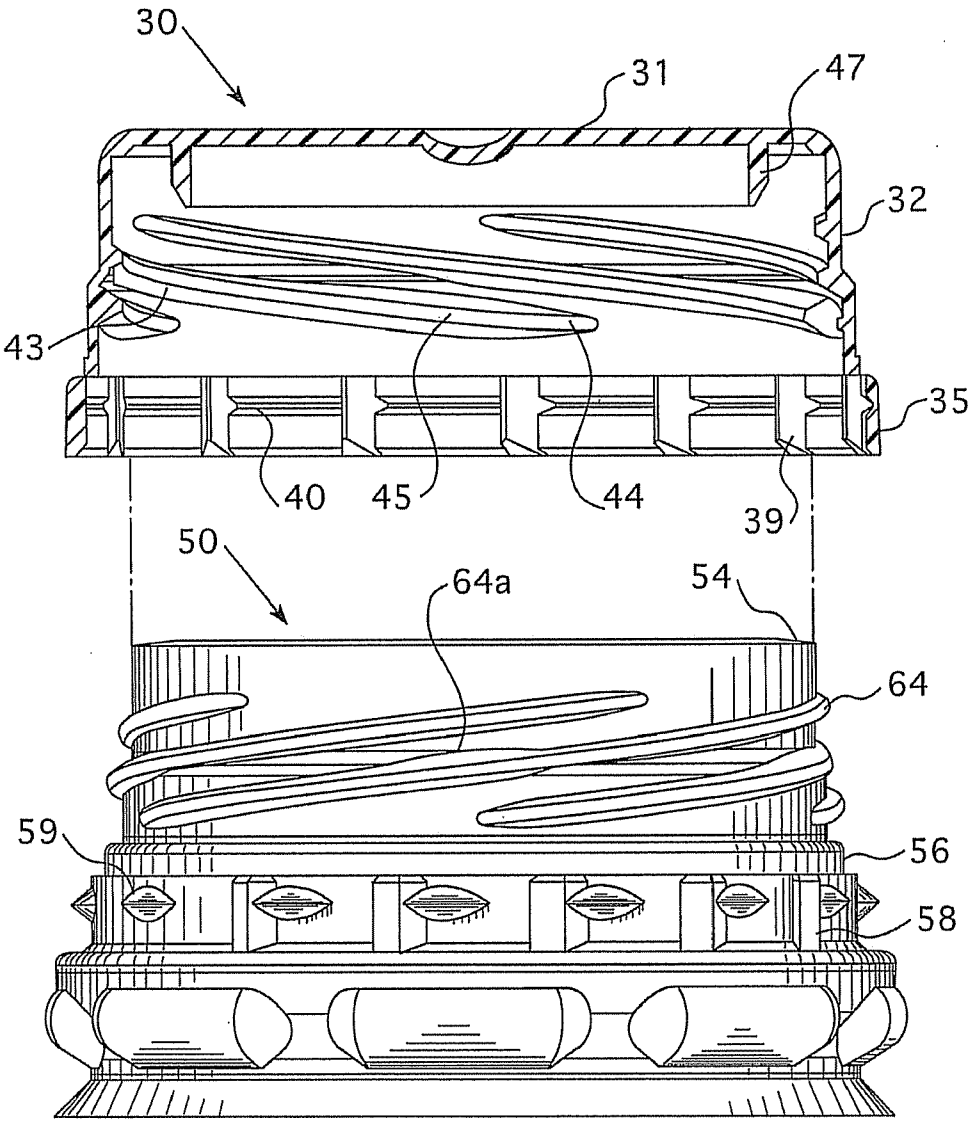


FIG. 2

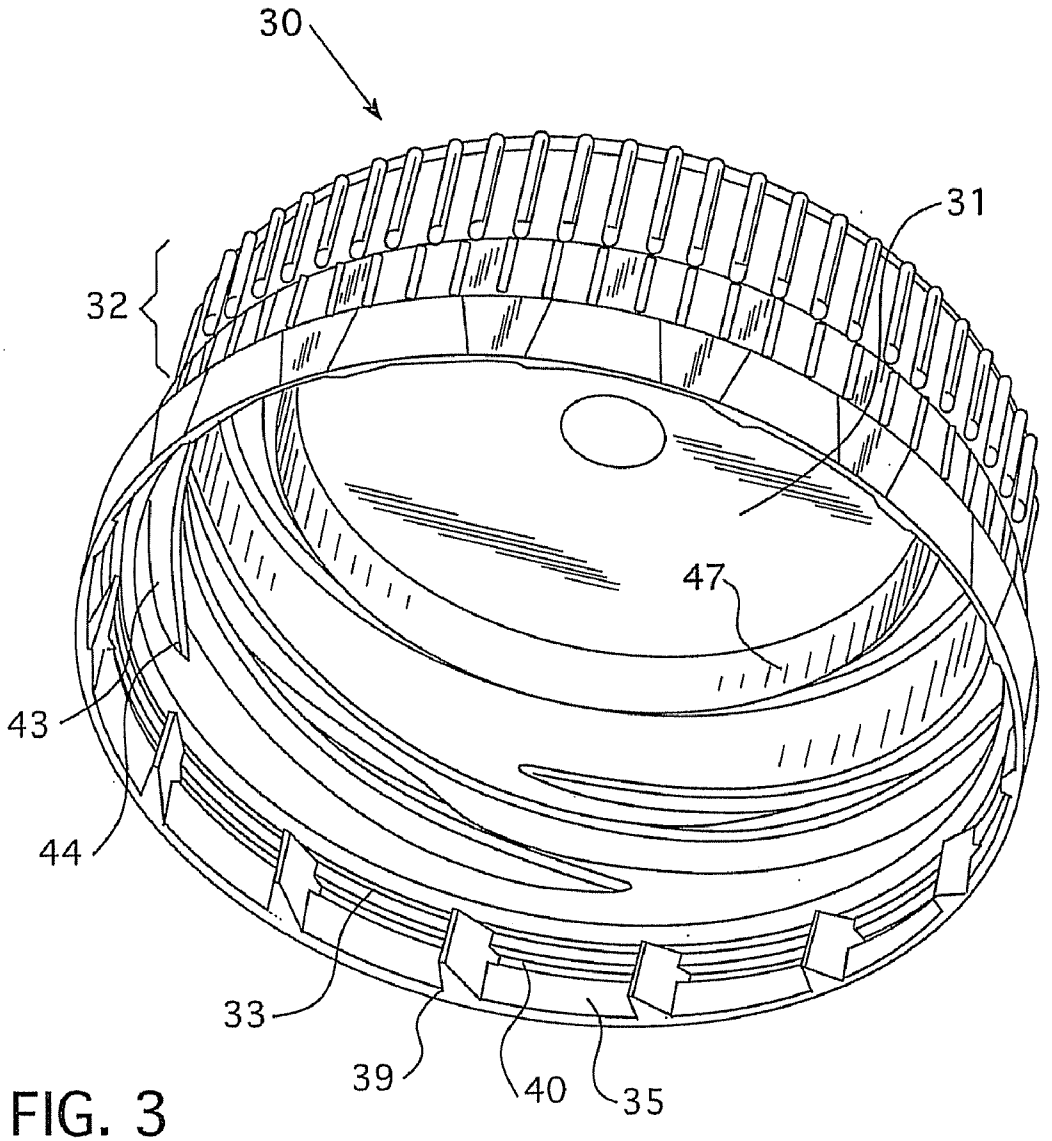


FIG. 3

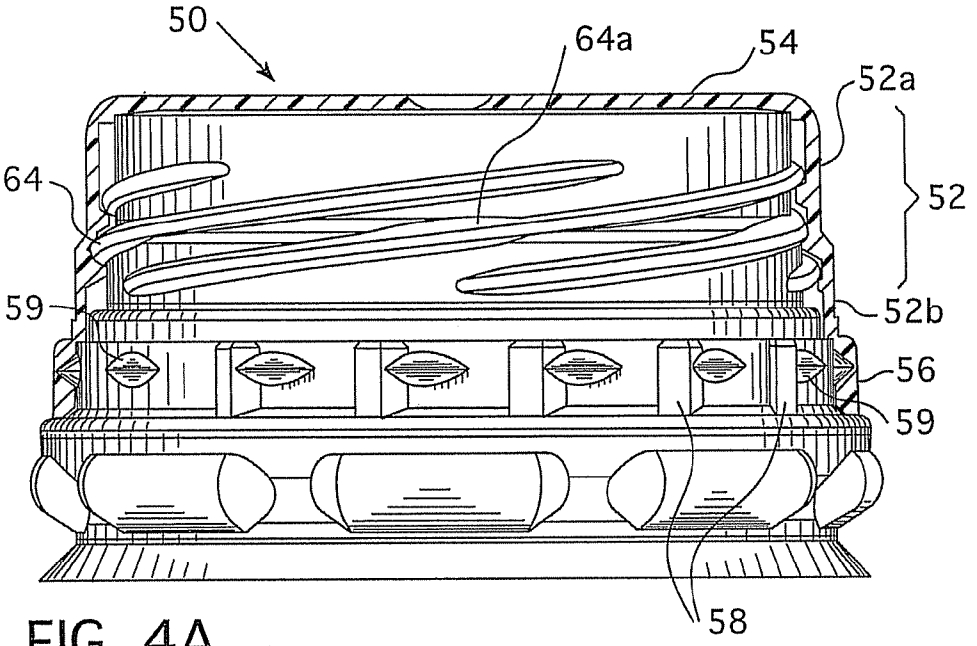


FIG. 4A

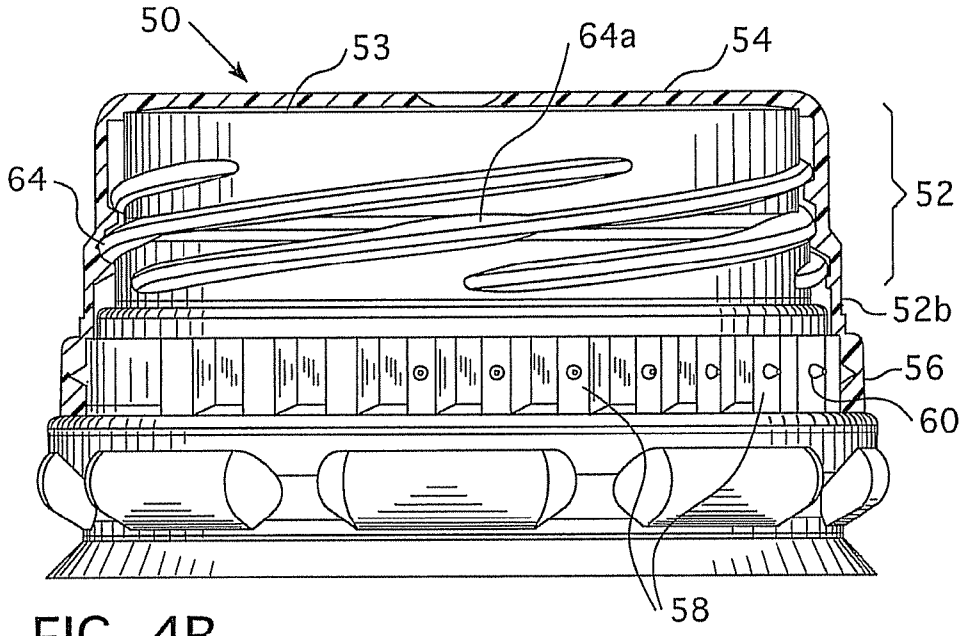


FIG. 4B

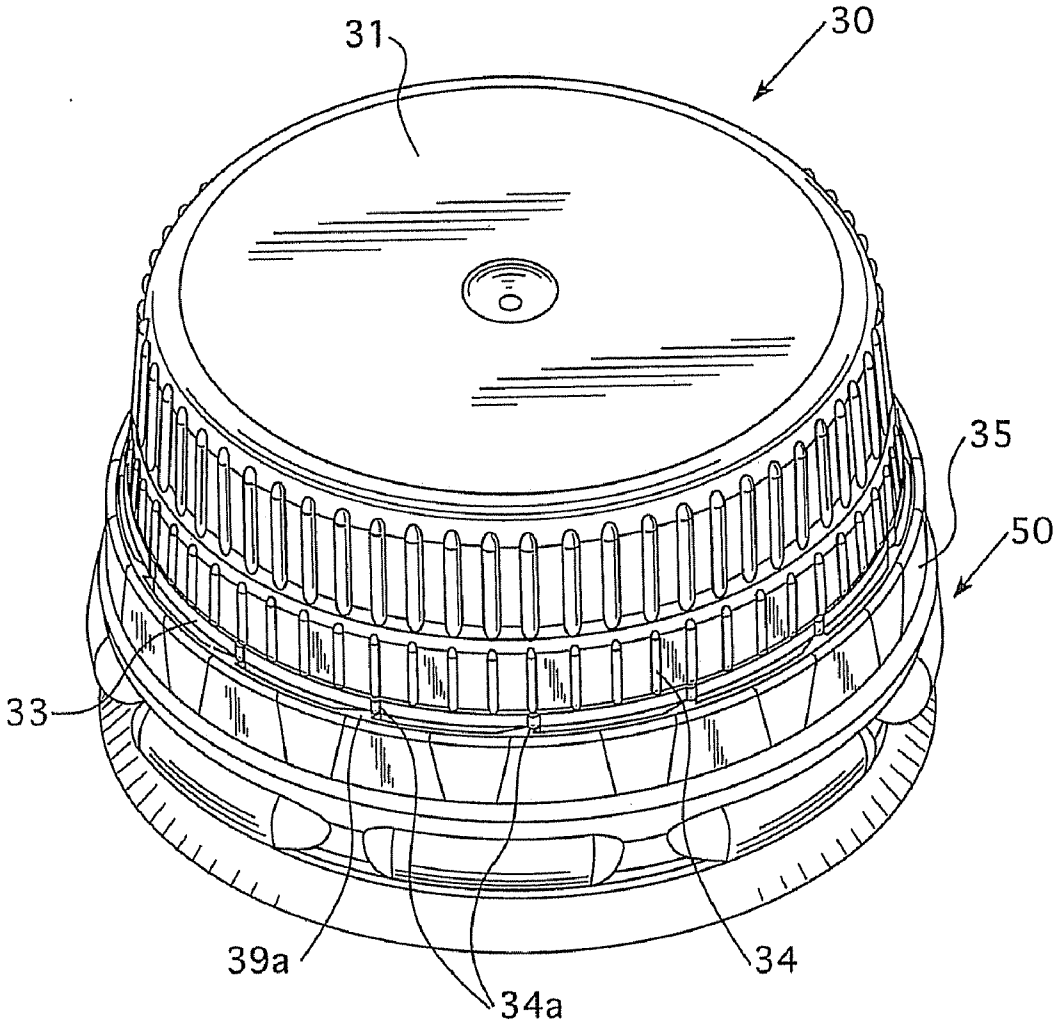


FIG. 5A

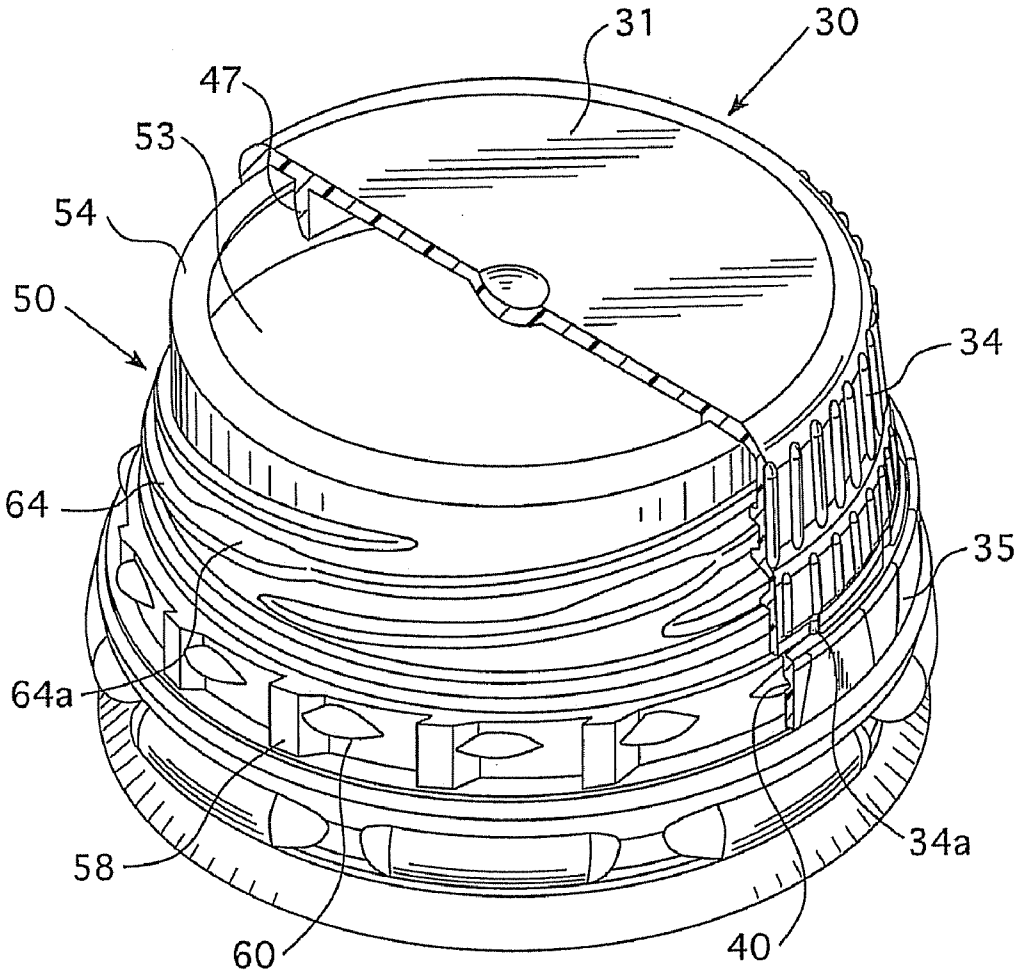


FIG. 5B

STEP TWIST ZIPPED VISUAL TAMPER-EVIDENT CAP AND NECK FINISH

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Application Nos. 61/370,656 filed on Aug. 4, 2010 and 61/414,680 filed on Nov. 17, 2010.

TECHNICAL FIELD

[0002] The present invention relates to closure devices and, more particularly, to tamper-evident caps for containers.

BACKGROUND

[0003] Various types of caps have been used for removably sealing containers, such as blow molded or injection molded bottles. One such cap has spiral threads extending along an interior surface which threads match corresponding threads along an exterior surface of a bottle neck. Such caps may also have a tamper-evident band projecting outward along a lower rim of the cap to show evidence if the cap has been removed or otherwise tampered with. The rim can be helpful for positioning the band circumferentially around the cap, but it can also add to the bulk and weight of the cap. Further, the threads along the cap interior surface can be long thus requiring significant rotation to securely apply and attach the cap to the bottle neck.

SUMMARY

[0004] Embodiments of the present disclosure are generally directed to a tamper-evident cap and a corresponding neck finish for a container. In embodiments, the cap includes a circular closure member, a cylindrical wall depending from the closure and having serrations, and a tamper-evident band. In embodiments, the interior and/or exterior of the cylindrical wall may be stepped or stacked. In other embodiments, the tamper-evident band has teeth diverted inwardly to mesh with teeth on the neck finish and is circumferentially positioned around a base of the cylindrical wall with at least one of the teeth mounted to the base. Optionally the band is attached to the base by at least one serration that extends below the base of the cylindrical wall. In further embodiments, the tamper-evident band may have a groove between the teeth to assist with retaining the tamper-evident band on the neck finish of the container. The cap may have a sealing plug or a liner on the underside. The cylindrical wall has a threaded inner surface in a manner to cooperate and removably engage with threads of a neck finish of a container. In one embodiment, at least one of the threads of the interior wall of the cap has a bulbous portion.

[0005] Other embodiments of the invention are directed to an open end portion or neck finish of a container. In embodiments, the neck finish is formed from a cylindrical wall that defines an opening therethrough. The cylindrical wall includes a first end portion that is open to the outside and adapted to fit a cap, a second end portion that terminates at the container body, and at least one set of ratchet teeth positioned around a portion of an outer surface of the cylindrical wall at the second end. The cylindrical wall of the neck finish may be stepped to correspond with a stepped interior of the cap. In one embodiment, at least one of the ratchet teeth has a raised portion either on top or adjacent to aid in retaining the tamper-evident band of the cap. In other embodiments, multiple threads are angularly positioned on the exterior of the cylindrical wall between the first end and the second end to mate with corresponding threads fondled along the interior of the cap. In embodiments, at least one of the threads of the neck finish has a bulbous or wider portion to ease positioning of the cap on the container.

[0006] In embodiments the cap and the neck finish have multiple threads and multiple leads to enable the cap to lock onto the neck finish by rotating the cap less than a full turn. In an example, the cap may be securely fit to the neck finish using less than 75 degrees rotation. The threading may also decrease the amount of resin material needed in the cap construction.

[0007] In embodiments, the tamper-evident band has a scalloped body configured to strengthen support for the cap. The strength may ease automated application of the cap to a neck finish. The scalloped body may be of a smaller overall size and, therefore, may require less resin material.

[0008] A cap and neck finish combination is also embodied herein.

[0009] Those and other details, objects, and advantages of the present invention will become better understood or apparent from the following description and drawings showing embodiments thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The accompanying drawings illustrate examples of embodiments of the present invention:

[0011] FIG. **1** shows a top perspective view of a cap with a stepped exterior cylindrical wall and unbroken serrations (FIG. **1**A), a top perspective view of a cap with a stepped exterior cylindrical wall and broken serrations (FIG. **1**B), a side view of a cap with a straight exterior cylindrical wall (FIG. **1**C), a bottom perspective view of a cap with a sealing plug (FIG. **1**D), and a bottom perspective view of a cap with a liner (FIG. **1**E) according to embodiments of the present invention;

[0012] FIG. **2** shows a cross-sectional view of a cap and a perspective view of a bottle neck finish according to embodiments of the present invention;

[0013] FIG. **3** shows a bottom perspective view of a cap according to embodiments of the present invention;

[0014] FIG. **4** shows a perspective view of a neck finish with scallops at the second end (FIG. **4**A) and pyramids at the second end (FIG. **4**B) according to embodiments of the present invention; and

[0015] FIG. **5** shows a cap secured to a neck finish from a top perspective view (FIG. **5**A) and with the cap partially cut away (FIG. **5**B) according to embodiments of the present invention.

DETAILED DESCRIPTION

[0016] Various embodiments of the invention include a cap **30** that can be used to seal a container. See, for example, FIGS. **1**A-E. The cap **30** has a circular closure member **31** and an annular cylindrical wall **32** depending from the perimeter of closure member **31**. The cylindrical wall **32** has a first portion **32***a* located adjacent to closure member **31** and an adjoining second portion **32***b* that terminates with a base **33**. The base **33** may be the bottom end wall of second portion **32***b* or a solid ring and useful for positioning the cap **30**. See FIG. **1**A-**1**C. The cylindrical wall **32** may have a straight (FIG. **1**C) or a stepped interior and/or exterior shape (FIGS.

1A, 1B, 1D, and 1E), e.g. the second portion **32***b* has a slightly larger circumference than the first portion **32***a*. In examples, cylindrical wall **32** has a stepped exterior shape and a stepped interior shape as illustrated in FIG. **1**D. In other examples, cylindrical wall **32** has a straight exterior (FIG. **1**C) and a stepped interior shape. The straight exterior cylindrical wall may have an outer diameter that is generally uniform or slightly tapered outward from closure member **31** to have a larger diameter near base **33**. The stepped interior shape of the cylindrical wall **32** of cap **30** permits the cap **30** to self-center on a corresponding neck finish **50** of the container during the capping process. See FIG. **2**. The cap **30** may be made from plastic such as high or low density polyethylene, polypropylene or any other resilient material that is suitable for securing the cap **30** to a container.

[0017] A plurality of serrations **34** are positioned along the outer surface of the cylindrical wall **32**. In examples, the serrations **34** are straight (FIG. **1**A), e.g. thicker at the first portion **32***a* and thinner at the second portion **32***b,* or broken (FIG. **1**B) to accommodate a stepped exterior cylindrical wall **32**.

[0018] A tamper-evident band **35** is positioned beneath and attached to a portion of the base **33**. The tamper-evident band **35** includes ratchet teeth **39** aligned along an interior surface shown for example in FIGS. **1**D, **1**E, **2**, and **3**. In an example, a portion of at least one of the teeth **39**, such as the tip or inner most top **39***a,* is mounted directly to the base **33** as shown, for example, in FIG. **1**A. In another example, the tamper-evident band **35** may attach to the cap **30** by at least one of the serrations **34***a* extending down past the base **33** as shown in FIGS. **1**B and **5**A. In an example and as shown in FIGS. **1**B and **5**A, every fourth serration **34***a* extends down to attach the tamper-evident band **35** to the base **33** of cap **30**. The ratchet teeth **39** are adapted to engage the teeth **58** on the neck finish **50**, as shown, for example, in FIG. **2**, thereby retaining and preventing the tamper-evident band **35** from backing off the neck finish **50**. Each tooth **39** has top **39***a* and an inner face **39***b* directed inwardly and positioned at an acute angle relative to the end. See FIGS. **1**A and **1**D.

[0019] The tamper-evident band **35** may also have an annular groove **40** between the ratchet teeth **39** to further retain the tamper-evident band **35** on the neck finish **50**. See FIGS. **1**D, **1**E, and **3**. In examples, groove **40** is an open snap groove. Groove **40** is wide enough to allow the tamper-evident band **35** to move vertically and float on or about raised portions, such as scallops **59** and pyramids **60**, of the neck finish **50**. See, for example, FIGS. **4**A and **4**B. In examples, groove **40** is about 0.01 to 0.3 inches wide, and preferably is about 0.021 inches. Groove **40** forms a snap bead locking the band **35** in place. The tamper-evident band **35** is resilient to slide over the raised portions, e.g. scallops **59** and pyramids **60**, and/or the teeth **58** on the neck finish **50** without breaking. However, once applied to the neck finish **50**, the tamper-evident band **35** should not back off the neck finish **50** of the container. Upon removal of the cap **30**, the ratchet teeth **39** of the tamper-evident band **35** are brought up against the teeth **58** of the neck finish **50**, until the tamper-evident band **35** disconnects from the base **33** or the serrations **34***a* break. See FIGS. **1**A and **1**C. The breaking of the connections may be audible, thereby providing audible evidence of tampering. Once the cap **30** is removed, the groove **40** continues to mate with the raised portions, e.g. scallops **59** and pyramids **60**, and pushes the tamper-evident band **35** down and further prevents it from backing off, thereby retaining the tamper-evident band **35** on the neck finish **50**. Once the tamper-evident band **35** is disconnected, a gap may result between the cap **30** and the tamper-evident band **35** when the cap **30** is reapplied, thereby providing further visual evidence of tampering. Absence of an attached tamper-evident band **35** also provides the user with visual evidence that the cap **30** has been tampered with or removed. This unique assembly of attaching the tamper-evident band **35** directly to the base **33** eliminates the need for a lower rim or lip typically found on container caps. The cap **30** designs allow for a smaller diameter of the tamper-evident band **35**, less resin, easier molding, and therefore an overall cost reduction. The cap **30** can be manufactured by conventional molding, thereby avoiding the need for tools for slide mold.

[0020] Several helically spaced threads **43** are positioned on the inner surface of annular cylindrical wall **32**. See FIGS. **1**D, **1**E, **2**, and **3**. Wall threads **43** can be generally tapered at the lead end **44** of a thread **43**. See, for example, FIG. **2**. For example, the cap **30** may have 1-20 threads. In one example, the cap **30** has 5 threads and multiple leads. Optionally, wall threads **43** may have a bulbous or wider portion **45**. In an example of a cap having a stepped interior, the threads may start thinner and end thicker to accommodate the step. In an example, the cap **30** may be securely fit to the neck finish **50** using less than 75 degrees rotation. In examples, the starting thread is at an angle of about 72 degrees and a full thread rotation is about 150 degrees. This unique threading may also decrease the amount of resin material needed in the cap **30** construction.

[0021] In various embodiments, the invention includes a cylindrical neck finish **50** shown for example in FIGS. **2** and **4**. The neck finish **50** includes an annular wall **52** defining therethrough a cylindrical opening **53** (shown in FIG. **4**B and **5**B) having a first end **54** and a second end **56**. The first end **54** provides access to opening **53**. The annular wall **52** of the neck finish **50** may be straight or stepped to correspond to the interior of the cylindrical wall **32** of the cap **30**. In the example of a stepped neck finish **50**, wall portion **52***a* has a smaller inner diameter than a wall portion **52***b,* to assist with location and help prevent cross-threading. See FIG. **4**A. The neck finish **50** may be made of plastic such as high or low density polyethylene, polypropylene, or any material suitable for use with the contents of the container. The material may be the same as that of the container.

[0022] Helically extending along the exterior surface of the wall **52** and generally between the first end **54** and second end **56** are threads **64**. Threads **64** are helically spaced in contiguous relationship as illustrated for example in FIGS. **2** and **4**. In embodiments, each thread **64** extends around the circumference of annular wall **52** at a degree corresponding to that of the threads **43** of the cap **30**. See, for example, FIG. **2**. In examples, such as in FIGS. **4**A and **4**B, threads **64** have a bulbous portion **64***a*. Bulbous portion **64***a* may be formed from a gradual widening at the lead end of thread **64** to about a central location along the thread and fairly abruptly narrow to the end of the thread **64**.

[0023] Positioned at the second end **56** of the neck finish **50** may be at least one set of annular ratchet teeth **58** to provide a grip or cooperatively engage the corresponding teeth **39** of the tamper-evident band **35** of the cap **30** and prevent the tamper-evident band **35** from backing off. See FIG. **2**. Ratchet teeth **58** may be positioned around the entire circumference of the second end **56** of the neck finish **50** or only a portion thereof. In another embodiment, the second end **56** of the

neck finish **50** may have a plurality of raised portions positioned around the entire circumference or a portion thereof. In one example, the raised portion may be scallops **59** and located adjacent and behind the ratchet teeth **58** as shown in FIG. **4**A. In another example, the raised portion is pyramid shaped **60** and located on top of the ratchet teeth **58** as shown in FIG. **4**B. The raised portions may be on top of, as shown with the pyramids **60** in FIG. **4**B, or adjacent to, as shown with the scallops **59** in FIG. **4**A, a corresponding ratchet tooth **58**. Alternatively, the raised portions are positioned on the circumference absent a corresponding ratchet tooth **58**. See the scallops **59** in FIGS. **2** and **4**A. One or more ratchet teeth **58** may be eliminated to accommodate additional raised portions. The raised portions may have a larger diameter than the ratchet teeth **39** of the tamper-evident band **35** to assist with holding the tamper-evident band **35** in place. In an example, the raised portions, such as the scallops **59**, mate with the groove **40** of the tamper-evident band **35** of the cap **30** to allow the tamper-evident band **35** to move vertically and also retain the tamper-evident band **35** on the neck finish after the cap **30** is twisted off. See FIG. **5**B. This allows the consumer visual evidence of tampering. In this example, the ratchet teeth **39** of the cap **30** fit between the scallops **59** and the ratchet teeth **58** on the neck finish **50**.

[0024] In another embodiment, the cap **30** may have an annular valve or sealing plug **47** depending from closure member **31**, which can be press or friction fit. See FIGS. **1**D, **2**, **3**, and **5**B. The diameter of the sealing plug **47** is sized to be larger than the inner diameter of the neck finish **50** of the container such that the first end **54** of neck finish **50** fits between the sealing plug **47** and the cylindrical wall **32**. See FIG. **5**B. The sealing plug **47** penetrates the inner diameter of the container. In an example, the sealing plug **47** may include a taper which facilitates initial engagement of the sealing plug **47** to the inner periphery of the neck finish **50** of the container opening **53**. In an alternate embodiment, the cap **30** may have a liner **48** instead of the sealing plug **47** that covers the underside of closure member **31**. See FIG. **1**E. For example, and without limitation, the liner **48** is a molded or poured-in-liner. In examples and without limitation, the liner may be foam, foil, rubber, etc. In the example of a poured-in-liner, the liner **48** is poured into the cap **30** after molding and dried. Liner **48** provides a seal between the cap **30** and the corresponding neck finish **50**. In one embodiment, threads **43** and **64** engage prior to the sealing plug **47** or the liner **48** engaging the inner diameter of the neck finish **50** when the cap **30** is applied to the neck finish **50**.

[0025] A combination of the disclosed cap **30** and the neck finish **50** is also embodied herein. See FIGS. **2**, **5**A, and **5**B. The threads of the disclosed cap **30** and neck finish **50** may enable the cap **30** to lock onto the neck finish **50** by rotating the cap **30** less than a full turn, for example and without limitation, less than 75 degrees. See FIGS. **2** and **5**B. The ratchet teeth of the disclosed cap **30** and neck finish **50** along with the groove **40** and the raised portions, such as scallops **59** and pyramids **60**, may secure the tamper-evident band **35** and prevent the tamper-evident band **35** from backing off once the container has been opened. The disclosed cap **30** and neck finish **50** combination may be particularly well suited to standard containers, such as blow molded beverage containers. When properly sealed, air will not penetrate through the container opening. Use of the tamper-evident band **35** makes it difficult to tamper with the contents of the container without indicating evidence thereof. The disclosed combination may also use less resin, be easier to mold, and reduce costs.

[0026] While presently preferred embodiments of the invention have been shown and described, it is to be understood that the detailed embodiments and Figures are presented for elucidation and not limitation. The invention may be otherwise varied, modified or changed within the scope of the invention as defined in the appended claims.

What is claimed is:

1. A tamper-evident cap comprising:

a circular closure member;

a cylindrical annular wall depending from the closure member and having a first portion and a second portion having a base, wherein the first portion is adjacent to the closure member, an exterior surface having a plurality of serrations, and an interior surface with annular threads positioned to cooperate with threads on a neck finish; and

a tamper-evident band circumferentially positioned around the second portion of the wall and including a plurality of teeth diverted inwardly and adapted to mesh with at least one set of teeth on the neck finish, wherein at least one of the teeth of the tamper-evident band is mounted to a portion of the base.

2. The cap as in claim **1**, wherein at least one serration extends below the base, and at least one of the teeth on the tamper-evident band is attached to the cap by the at least one serration extending below the base.

3. The cap as in claim **1**, wherein at least one of the annular wall threads has a bulbous portion.

4. The cap as in claim **1**, wherein the exterior first portion of the cylindrical wall has a smaller diameter than the second portion of the cylindrical wall.

5. The cap as in claim **1**, wherein the interior first portion of the cylindrical wall has a smaller diameter than the second portion of the cylindrical wall.

6. The cap as in claim **1**, wherein the exterior cylindrical wall is straight.

7. The cap as in claim **6**, further comprising a molded-in liner and a groove between the teeth and wherein the interior first portion of the cylindrical wall has a smaller diameter than the second portion of the cylindrical wall.

8. The cap as in claim **1**, wherein the annular threads are thinner on the interior first portion and thicker on the interior second portion.

9. The cap as in claim **1**, further comprising a sealing plug on the underside of the closure member.

10. The cap as in claim **1**, further comprising a liner on the underside of the closure member.

11. The cap as in claim **10**, wherein the liner comprises a poured-in-liner or a molded-in liner.

12. The cap as in claim **1**, wherein the tamper-evident band has a groove between the teeth.

13. A tamper-evident cap comprising:

a circular closure member;

a cylindrical annular wall depending from the closure member and having a first portion and a second portion having a base, wherein the first portion is adjacent to the closure member and has a smaller interior diameter than the second portion, an exterior surface having a plurality of serrations, and an interior surface with annular threads positioned to cooperate with threads on a neck finish; and

a tamper-evident band circumferentially positioned around and attached to the base of the cylindrical wall and including a plurality of teeth diverted inwardly and adapted to mesh with at least one set of teeth on the neck finish.

14. The cap as in claim **13**, wherein at least one serration extends below the base, and at least one of the teeth on the tamper-evident band is attached to the cap by the at least one serration extending below the base.

15. The cap as in claim **13**, wherein at least one of the annular wall threads has a bulbous portion.

16. The cap as in claim **13**, wherein the exterior first portion of the cylindrical wall has a smaller diameter than the second portion of the cylindrical wall.

17. The cap as in claim **13**, wherein the exterior cylindrical wall is straight.

18. The cap as in claim **17**, further comprising a molded-in liner and a groove between the teeth and wherein at least one of the teeth of the tamper-evident band is mounted to the base.

19. The cap as in claim **13**, wherein the annular threads are thinner on the interior first portion and thicker on the interior second portion.

20. The cap as in claim **13**, further comprising a sealing plug on the underside of the closure member.

21. The cap as in claim **13**, further comprising a liner on the underside of the closure member.

22. The cap as in claim **21**, wherein the liner comprises a poured-in-liner or a molded-in liner.

23. The cap as in claim **13**, wherein the tamper-evident band has a groove between the teeth.

24. The cap as in claim **13**, wherein at least one of the teeth of the tamper-evident band is mounted to the base.

25. A tamper-evident cap comprising:

a circular closure member;

a cylindrical annular wall depending from the closure member and having a first portion and a second portion having a base, wherein the first portion is adjacent to the closure member, an exterior surface having a plurality of serrations, and an interior surface with annular threads positioned to cooperate with threads on a neck finish; and

a tamper-evident band circumferentially positioned around and attached to the base of the cylindrical wall and having a plurality of teeth diverted inwardly and adapted to mesh with at least one set of teeth on the neck finish and a groove between the teeth.

26. The cap as in claim **25**, wherein at least one serration extends below the base, and at least one of the teeth on the tamper-evident band is attached to the cap by the at least one serration extending below the base.

27. The cap as in claim **25**, wherein at least one of the annular wall threads has a bulbous portion.

28. The cap as in claim **25**, wherein the exterior first portion of the cylindrical wall has a smaller diameter than the second portion of the cylindrical wall.

29. The cap as in claim **25**, wherein the interior first portion of the cylindrical wall has a smaller diameter than the second portion of the cylindrical wall.

30. The cap as in claim **25**, wherein the exterior cylindrical wall is straight.

31. The cap as in claim **30**, further comprising a molded-in liner and wherein the interior first portion of the cylindrical wall has a smaller diameter than the second portion of the cylindrical wall and at least one of the teeth of the tamper-evident band is mounted to the base.

32. The cap as in claim **25**, wherein the annular threads are thinner on the interior first portion and thicker on the interior second portion.

33. The cap as in claim **25**, further comprising a sealing plug on the underside of the closure member.

34. The cap as in claim **25**, further comprising a liner on the underside of the closure member.

35. The cap as in claim **34**, wherein the liner comprises a poured-in-liner or a molded-in liner.

36. The cap as in claim **25**, wherein at least one of the teeth of the tamper-evident band is mounted to a portion of the base.

37. A neck finish for a container comprising:

a cylindrical wall having a first end portion and second end portion, defining a cylindrical opening therethrough, and having at least one set of teeth positioned around at least a portion of the exterior cylindrical wall at the second end;

at least one raised portion positioned around at least a portion of the exterior cylindrical wall at the second end with the teeth; and

multiple threads angularly positioned on an exterior surface of the cylindrical wall between the first end and the second end.

38. The neck finish as in claim **37**, wherein at least one of the neck finish cylindrical wall threads has a bulbous portion.

39. The neck finish as in claim **37**, wherein the neck finish cylindrical wall threads have a leading edge that gradually widens into a central wider portion and relatively narrow end.

40. The neck finish as in claim **37**, wherein the raised portion is scallop shaped.

41. The neck finish as in claim **37**, wherein the raised portion is located adjacent the teeth.

42. The neck finish as in claim **37**, wherein the raised portion is pyramid shaped.

43. The neck finish as in claim **37**, wherein the raised portion is on top of the at least one set of teeth.

44. The neck finish as in claim **37**, wherein the first end portion of the neck finish has a smaller diameter than the second end portion.

45. A container cap and neck finish combination comprising the cap of claim **25** and the neck finish of claim **37**.

46. The container cap and neck finish combination of claim **45**, wherein at least one of the teeth and the raised portion of the neck finish has a larger diameter than the teeth of the tamper-evident band of the cap.

47. The container cap and neck finish combination of claim **45**, wherein the raised portion of the neck finish fits inside the groove of the tamper-evident band.

48. The container cap and neck finish combination of claim **45**, wherein upon breaking of an attachment of the tamper-evident band to the base at least one of an audible sound is produced, the tamper-evident band is retained on the neck finish, and the tamper-evident band is pushed down away from the container cap when reapplying the container cap to the neck finish providing evidence of tampering.

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