July 4, 1967 M. R. FIELDS 3,329,295

TAMPER-INDICATING CLOSURE

Filed Nov. 29, 1965

FIG. 1

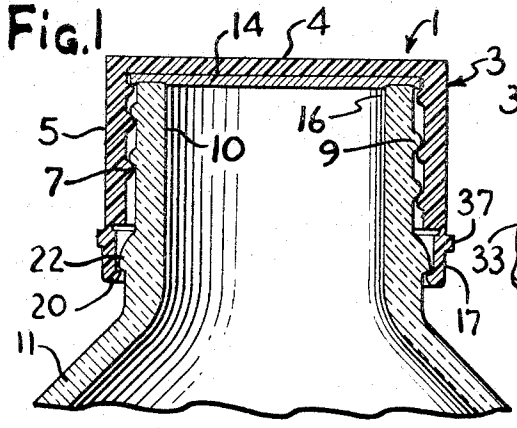


FIG. 8

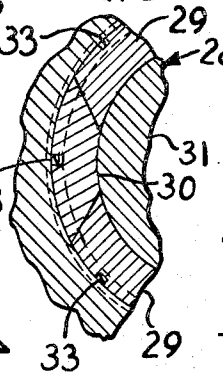


FIG. 7

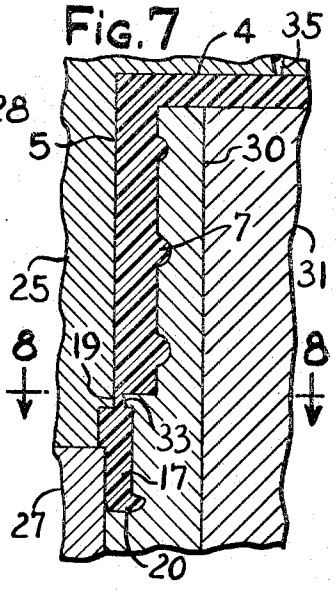


FIG. 2

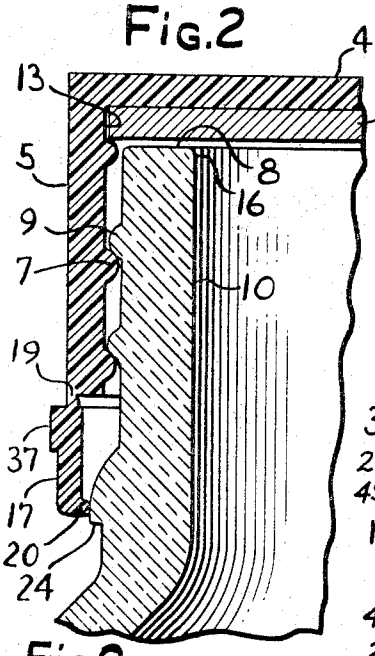


FIG. 3

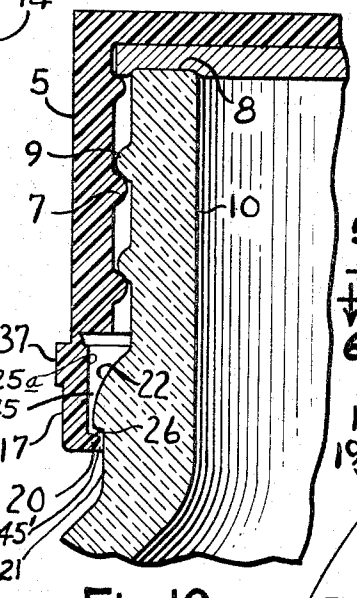


FIG. 4

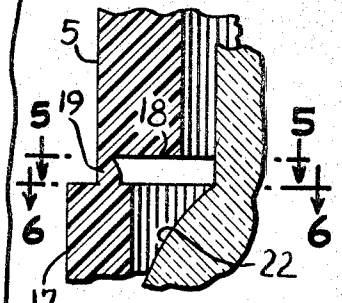


FIG. 9

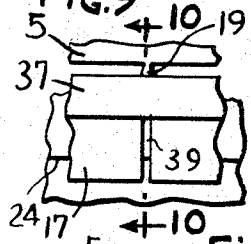


FIG. 10

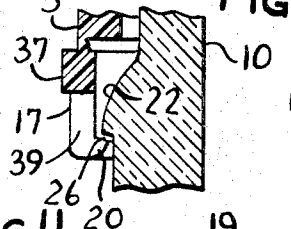


FIG. 5

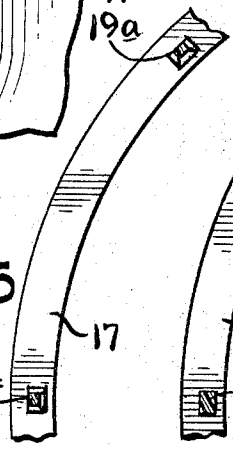


FIG. 6

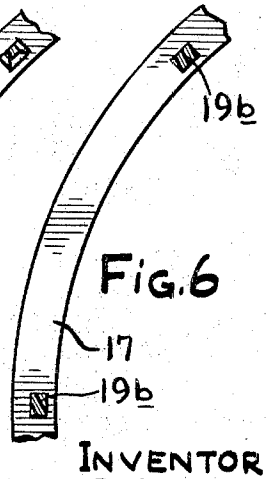
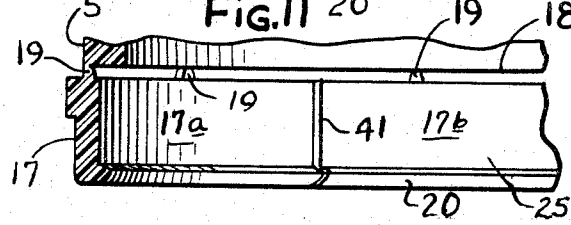


FIG. 11



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ATTY.

United States Patent Office 3,329,295 Patented July 4, 1967

3,329,295

TAMPER-INDICATING CLOSURE

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Filed Nov. 29, 1965, Ser. No. 510,332
14 Claims. (Cl. 215—40)

This invention relates to container closures, and more particularly to improvements in tamper-indicating closures.

It is an object of the present invention to provide a tamper-indicating closure that is screw-threaded over a container neck and has a resilient skirt that is joined to the remainder of the closure by a frangible zone of weakness. The skirt is sufficiently resilient within its elastic limits to expand and allow a preformed lip thereon to pass over an interfering bead or transfer ring on the container as the closure is threaded onto the container neck. After the lip passes the bead, the skirt contracts to its original shape. Upon unscrewing of the closure, the axial interference between the lip and bead retains the skirt against axial movement and the unscrewing torque on the closure ruptures it at the zone of weakness, thereby severing the skirt and indicating that the closure has been removed from the container.

It is a further object of the present invention to provide a tamper-indicating closure of the type stated which does not require any forming or shaping operation after it has been threaded onto the container.

It is also an object of the present invention to provide a tamper-indicating closure of the type stated having an all plastic cap body in which the skirt is molded integral therewith and joined thereto by spaced bridges of plastic material that constitute the zone of weakness.

It is a further object of the present invention to provide a closure of the type stated in which the lip on the skirt is axially spaced from the container bead when the closure is fully closed on the container so that the initial unscrewing torque on the closure loosens the grip thereof on the container thread and at the same time moves the lip into contact with the bead whereupon further unscrewing torque ruptures the zone of weakness. Since the torque for rupturing the zone of weakness is applied after the initial or loosening torque rather than simultaneously with the loosening torque, the manual effort required to remove the closure is reduced. Furthermore, by designing the closure so that there is a space between the lip and container bead, it is possible to insure that the lip will always end up beyond the bead when the closure is screwed onto the container, despite variations in dimensional tolerances in the manufacture of the container and the closure.

It is another object of the present invention to provide a tamper-indicating closure of the type stated in which the zone of weakness has a smaller cross sectional area adjacent to the threaded wall of the closure than adjacent to the skirt so that the break will tend to be at the threaded wall. Thus the break will tend to be relatively free of sharp edges at the edge of the part of the closure that will thereafter be used as an ordinary threaded cap.

The attainment of the above and further objects of the present invention will be apparent from the following description taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing, wherein like reference numbers indicate like parts:

FIG. 1 is a sectional view taken through the central axis of the closure constructed in accordance with the present invention and with the closure being mounted on a container neck;

FIG. 2 is a sectional view similar to FIG. 1 and showing, on an enlarged scale, a portion of the closure after it has been partially threaded onto the container neck;

FIG. 3 is a sectional view similar to FIG. 2 showing the closure in its fully closed position on the container neck;

FIG. 4 is an enlarged sectional view of a portion of FIG. 3 and showing one of the bridges of material that forms the rupturable zone of weakness;

FIGS. 5 and 6 are fragmentary sectional views taken along lines 5—5 and 6—6, respectively, of FIG. 4;

FIG. 7 is a fragmentary longitudinal sectional view showing a method of making the closure of the present invention;

FIG. 8 is a fragmentary sectional view taken along lines 8—8 of FIG. 7;

FIG. 9 is a fragmentary elevational view of the lower end of a modified form of closure constructed in accordance with the present invention;

FIG. 10 is a fragmentary sectional view taken along line 10—10 of FIG. 9; and

FIG. 11 is a fragmentary sectional view of the lower end of another modified form of closure constructed in accordance with the present invention.

Referring now in more detail to the drawing, 1 indicates a closure having a cap body 3. In the present embodiment of the invention, the body 3 may be a one piece member of molded plastic material. A commercial grade of high impact polystyrene is suitable for this purpose.

The body 3 includes an end wall 4 and an integral cylindrical side wall 5 that extends axially from the end wall 4. The side wall 5 is formed with an internal thread 7 for threaded engagement with an external thread 9 on the neck 10 of a container 11, for instance a glass bottle. Adjacent to the end wall 4 the side wall 5 is molded with an undercut cylindrical groove 13 for receiving a disc-like sealing liner 14 which bears against the rim 8 of the container neck 10 to seal the neck opening 16 when the closure is in closed position on the neck 10.

At the lower or free end of the side wall 5 is a depending cylindrical skirt 17 that is joined to the open end 18 of the side wall 5 by circumferentially spaced fracturable bridges 19 of the plastic body material. In the present embodiment of the invention, there are eight equally spaced bridges, but it will be apparent that a greater or lesser number of bridges may be used. As best seen in FIGS. 4–6, the cross sectional area of each bridge is greater at its junction 19*a* with the skirt 17 than at its junction 19*b* with the free end 18 of the side wall 5.

At its lower or free end, the skirt 17 is molded with a preformed radially inwardly directed annular lip 20 which, when the closure is in closed position on the neck 10, radially overlaps an annular bead 22 that is integrally formed on and projects radially outwardly from the neck 10 and is axially spaced from the neck thread 9. The bead 22 progressively increases in diameter in a direction axially away from the neck thread 9 to a shoulder 24 thereon and below which the lip 20 is located and with there being a gap 26 between the shoulder 24 and lip 20, for purposes presently more fully appearing. If the container is a glass bottle, the bead 22 may be the so-called transfer ring used to handle the glass bottle during removal thereof from its mold.

The body 3 may be molded with apparatus of the type shown in copending application Ser. No. 198,107, filed May 28, 1962, now Patent No. 3,247,548, in which I am one of the joint inventors, and to which reference may be had. Suffice it to say that such molding apparatus includes mold members 25, 27 and a core 28 that is longitudinally divided into circumferentially spaced expandable and collapsible sections 29, 30 that are held in firm abutting

relationship in their expanded positions by a center pin **31**. The core sections, when in molding position, define surfaces that are counterparts of the surfaces of the body **3** to be molded. As is more fully explained in the aforesaid application Ser. No. 198,107, the core sections are designed to be capable of radially inwardly collapsing when the center pin **31** is axially withdrawn from supporting relationship with the sections. The amount of collapse is sufficient to clear the lip **20** and other molded undercuts in the body **3** so that the body **3** may be axially separated from the core **19**. For purposes of the present invention, the core sections are formed with longitudinal slots **33** at which the solidified plastic becomes the bridges **19**. Thus, when plastic is injected into the mold through the gate **35**, the slots **33** form, in effect, secondary gates through which the plastic flows to fill the part of the mold cavity that defines the skirt **17**.

The closure is initially threaded onto the neck **10** until the lip **20** makes contact with the bead **22** above the shoulder **24**, as shown in FIG. 2. At this time the rim **8** is spaced from the liner **14** and the threads **7**, **9** are still in relatively loose engagement. Because the threads **7**, **9** are in loose engagement, an axial force may be applied to the closure to snap the lip **20** past the shoulder **24**, whereupon the application of torque to the closure will then tighten threads **7**, **9** and seal the rim **8** against the liner **14**. During threading of the closure **1** on neck **10**, the chuck or other device used for this purpose must grip both the skirt **17** and the portion of the closure thereabove to rotate the two parts as a unit. Otherwise the engagement of the lip **20** with the bead **22** will tend to impede the movement of the skirt **17** with the result that the torque will rupture the bridges **19**. The upper portion of the skirt **17** may have a radial enlargement or flange **37** at which it may be gripped.

The closure must be designed for the tolerances in cap molding as well as those in the manufacture of the container. Commercial glass bottles are made to certain tolerances recognized by glass container manufacturers. The diameter of the lip **20**, the diameter of the bead **22**, and the wall thickness of the skirt **17** must be such, throughout the entire range of tolerances of the closure and container, that the skirt **17** flexes radially outwardly within its elastic limits to allow the lip **20** to pass over the bead **22**, without causing the skirt **17** to crack. In addition there must be, within these tolerances, sufficient radial overlap between the lip **20** and shoulder **24** to cause the bead **22** to retain the lip **20** when the closure is unthreaded and has a torque applied thereto that is several times the torque required to unscrew the closure. Finally, the position of the lip **20** relative to the bridges **19** must be such that the lip **20** will be able to pass over and beyond the bead **22**, leaving the gap **26**, on a container in which distance from the shoulder **24** to the rim **8** is of maximum tolerance and the distance from the wall **4** to the lip **20** is of minimum tolerance.

In unthreading the closure from the neck **10**, the initial torque loosens the engaged threads **7**, **9**. Once loosened, the continued torque is negligible for a small fraction of a revolution, say twenty to thirty degrees, whereupon the lip **20** engages the bead shoulder **24**. Upon further unthreading, the bead **22** retains the lip **20** and inhibits axial movement of the skirt **17**, and the applied torque on the closure causes the bridges **19** to rupture. Thus, the torque used to break the bridges is applied after the initial or thread-loosening torque rather than simultaneously therewith. The severed skirt **17** drops downwardly onto the container below the lead **22**, thereby indicating that the closure has been wholly or partially unthreaded from the neck **10**. The bridges **19** will tend to rupture at their smallest cross sections **19***a* so that the break is clean and free of sharp edges at the end **18**.

A modified form of closure is shown in FIGS. 9 and 10. Here the skirt **17** may be longitudinally slit as at **39** in one or more places from the lip **20** up to the flange **37**.

This facilitates flexing of the skirt **17** as the lip **20** snaps over the bead **22**.

In the form of the invention shown in FIG. 11 the skirt **17** is longitudinally slit in two places which are diametrically opposed. One such slit is shown at **41**, and it will be seen that the slit **41** extends completely through the skirt to divide the same into two 180 degree skirt sections **17***a*, **17***b*. Each skirt section is suspended from the wall end **18** by a number of the bridges **19**. When the bridges **19** are cracked upon unthreading of the closure from the neck **10**, the two separated skirt sections **17***a*, **17***b* will either fall away from the container or may be readily slipped away therefrom.

Glass bottles as now manufactured on automatic machines are subject to small dimensional deviations. On a run of bottles the distance between the surface **8** and the surface **24** will vary somewhat. Plastic and molded caps can be made on automatic machines to a much closer tolerance. The vertical gap **26** of FIG. 3 should preferably be within 0.015 inch and 0.035 inch to prevent leakage between the rim **8** and liner **14** when the cap is unscrewed as far as possible without fracturing the bridges **19**. This distance should not be more than twice the minimum horizontal distance between the bottle and the bottom of the cap as measured at **45** or **45'**, whichever is the smaller, to inhibit cocking of the cap when it has been slightly loosened. The numeral **45** is the minimum distance between the cylindrical cap skirt wall **25***a* and the nearest part of the bead **22**, while **45'** is the distance between the surface **21** of the bottle and the nearest portion of the annular lip **20**, in both instances when the cap is in its sealing position illustrated in FIG. 3. This ratio (not more than 2 to 1) is of importance in many instances.

In compliance with the requirements of the patent statutes I have herein shown and described a preferred embodiment of the invention. It is, however, to be understood that the invention is not limited to the precise construction herein shown, the same being merely illustrative of the principles of the invention.

What is considered new and sought to be secured by Letters Patent is:

1. In combination with a container having a threaded neck, a tamper-indicating closure comprising a body having an annular threaded wall for threading over said threaded neck, said container having a bead adjacent to the thread, and a skirt at an end of said wall and being integrally connected thereto by means forming a rupturable zone of weakness, said skirt having a lip spaced from said means and projceting radially inwardly toward the axis of said threaded wall, the spacing from said means and the radial extent of projection of the lip being such that when the closure is in its fully closed position on the container neck, the lip will be axially spaced from the bead and will have a radial overlap therewith and with the skirt being sufficiently yieldable within its elastic limits to enable the lip to pass over the bead when the closure is threaded onto the neck to the fully closed position, a partial unscrewing of the closure causing the lip to engage the bead and be retained thereby and further unscrewing of the closure causing rupture of the body at said zone of weakness.

2. A combination according to claim **1** in which the zone of weakness is formed by bridges of the body material that are spaced circumferentially about the skirt.

3. A combination according to claim **1** in which the skirt has at least one longitudinal slit that extends from the lip partially over the length of the skirt to enhance the flexibility thereof.

4. A combination according to claim **2** in which the skirt has a plurality of circumferentially spaced slits that are located between bridges and extend for the full length of the skirt to form circumferentially spaced skirt segments each of which is joined to said annular wall by at least one bridge.

5. A combination according to claim 1 in which the cross sectional area of the zone of weakness adjacent to the annular wall is greater than the cross sectional area adjacent to the skirt.

6. In combination with a container having a member that forms an opening into the container, a tamper-indicating closure member, cooperating means on said members for mounting the closure member on the container member and removing the closure member therefrom by rotational and axial movement of one member relative to the other member, said closure member having a wall disposed about said container member, a skirt connected to said wall by means forming a rupturable zone of weakness, said skirt having a lip that radially overlaps and is axially spaced from a part of the container that is between said lip and said zone of weakness and with the radial overlap causing sufficient axial interference to prevent removal of the closure member from said container member without rupturing said zone of weakness, said skirt being sufficiently yieldable within its elastic limits to enable the lip to pass over said container part when the closure member is mounted onto said container member, an initial rotational and axial movement of one member relative to the other member causing said lip and said container part to abut and thereby inhibit axial movement of the skirt, and further rotational and axial movement of one member relative to the other member causing the closure to rupture at said zone of weakness.

7. A combination according to claim 6 in which said initial rotational movement is a fraction of a revolution.

8. A combination according to claim 6 in which said axial spacing is not more than twice the minimum radial distance between the skirt and the adjacent surface of the container.

9. A combination according to claim 6 including means forming a seal across said opening when the closure is in closed position on the container, said axial spacing being such that the seal prevents leakage of contents from the container when the closure and container are axially shifted relative to one another as far as possible without rupturing said zone of weakness.

10. In combination with a container having a threaded neck that forms an opening into the container, a radially outwardly projecting bead that is axially spaced from the thread, the bead having a shoulder that is presented in a generally axial direction away from the opening and with the amount of radial projection of the bead decreasing

from said shoulder in a direction towards said opening, a tamper-indicating closure threaded over said neck, said closure including a one-piece body member having an annular wall disposed about said neck and a skirt integrally connected to an end of said wall that is remote from said opening by body member material that forms a rupturable zone of weakness, said skirt having a radially inwardly projecting lip radially overlapping and axially spaced from said shoulder and with the shoulder being axially between the lip and said opening, the radial overlap causing sufficient axial interference between the lip and skirt to prevent unthreading removal of the closure from the neck without rupturing said zone of weakness, said skirt being sufficiently yieldable within its elastic limits to enable the lip to pass over said bead when the closure is threaded onto said neck, an initial unthreading of the closure causing said lip to abut said shoulder and thereby inhibit axial movement of the skirt, and further unthreading of the closure causing the closure to rupture at said zone of weakness.

11. A combination according to claim 10 in which the zone of weakness is formed by spaced bridges of the body member material.

12. A combination according to claim 10 in which the skirt has at least one longitudinal slit that extends from the lip partially over the length of the skirt to enhance the flexing thereof as the lip passes over the bead during mounting of the closure onto the container.

13. A combination according to claim 10 in which the skirt is circumferentially slit from the lip to the zone of weakness in such manner that after rupture of said zone of weakness and separation of the skirt from said annular wall, the skirt may be separated from the container.

14. A combination according to claim 10 in which the cross sectional area of the zone of weakness adjacent to the annular wall is greater than the cross sectional area adjacent to the skirt.

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