

[54] **THREADED CONTAINER CLOSURE**
[72] Inventor: **William A. Baugh**, Overland Park,
Kans. 66204
[73] Assignee: **Ethyl Development Corp.**, Kansas
City, Mo.
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[58] Field of Search.....215/43 R, 1 C; 220/39 R,
Dig. 14

[56] **References Cited**

UNITED STATES PATENTS

3,297,185	1/1967	Plymale.....	215/43
3,295,708	1/1967	Wathen	215/43
3,297,213	1/1967	Henderson.....	215/43 X

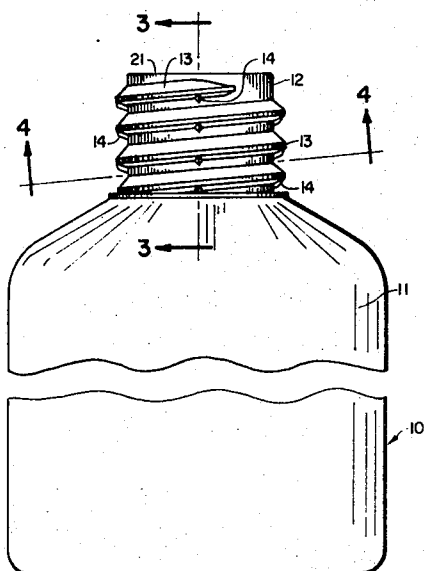
3,405,831	10/1968	Hudson	215/43
3,556,334	1/1971	Howard.....	215/43

Primary Examiner—Lloyd L. King
Assistant Examiner—Thomas C. Culp, Jr.
Attorney—Donald L. Johnson, John F. Sieberth, E.
Donald Mays and Arthur G. Connolly

[57] **ABSTRACT**

A threaded container closure assembly having at least one element made of a resilient plastic material. Threads are provided on one element which are received in corresponding recesses provided on the other closure element. A plurality of integrally formed projections are provided on one of the elements to provide increased frictional engagement between the closure elements.

1 Claim, 8 Drawing Figures



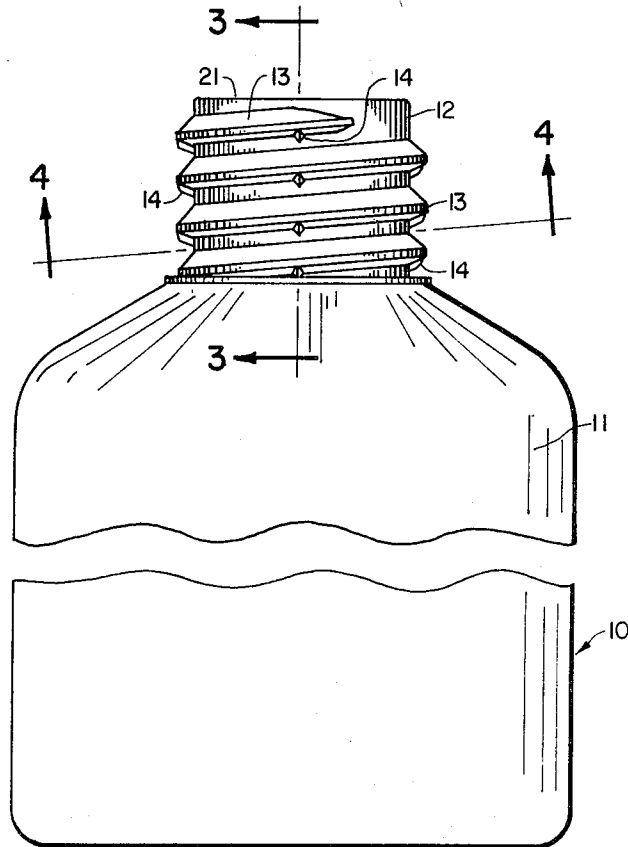


FIG. 1

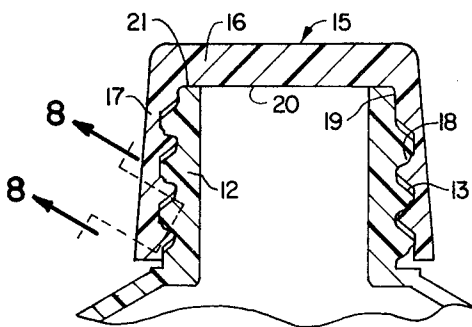


FIG. 2

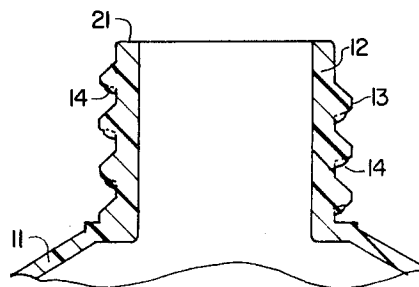


FIG. 3

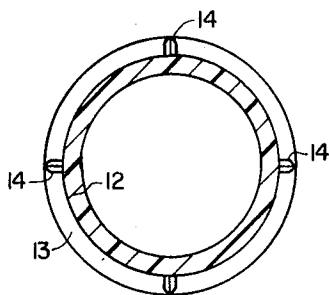


FIG. 4

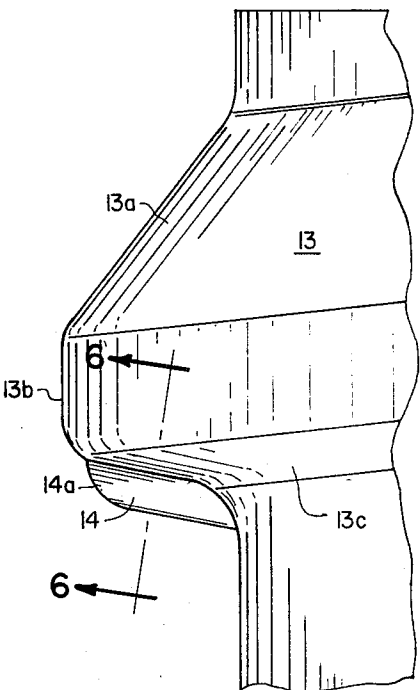


FIG. 5

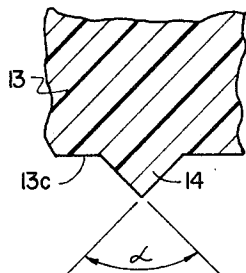


FIG. 6

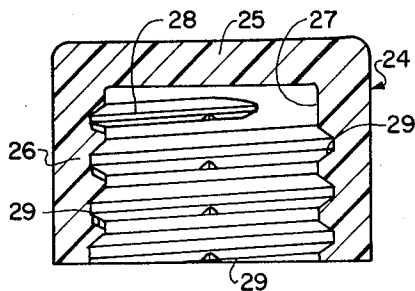


FIG. 7

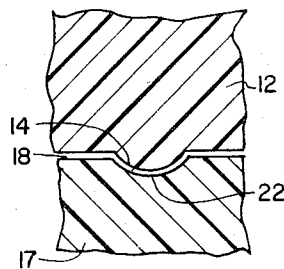


FIG. 8

THREADED CONTAINER CLOSURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to container closures utilizing threads on one closure element and complementary thread-receiving recesses on the other closure element, one of which has small projections or lugs thereon to increase the frictional engagement between the two closure elements.

2. Description of the Prior Art

In containers utilizing threaded closures wherein either the container or closure or both are fabricated from a resilient plastic material such as polyethylene, polyvinyl chloride, or polypropylene, difficulty is encountered in maintaining a fluid-tight closure. Resilient thermoplastic materials inherently possess the ability to cold flow under pressure which results in a gradual loosening of the container cap on the neck of the container. Additionally, the low coefficient of friction possessed by many of the commercially used plastic materials increases the tendency of the container closure to gradually become loosened.

Numerous locking or friction-increasing devices for container closures having plastic elements have been proposed for solving this problem. In U.S. Pat. No. 3,295,708 a threaded closure is provided which includes a small projection or lug upon the top surface of the upper end of the thread on the plastic container. U.S. Pat. No. 3,435,978 discloses a closure system for containers wherein the threads on the bottle and the cap are interlocked by means of a detent or by means of offset segments in the threads. The container closure system as shown in U.S. Pat. No. 3,405,831 has flexible protrusions extending radially outward from the threads of the container neck to provide a jamming action in the thread-receiving grooves of the cap when the cap is screwed onto the container neck.

While the foregoing and other closures have proved satisfactory in many respects, nevertheless, there is still a need for a container closure which provides for long-term retention of the initial torque used to apply the cap. The present invention provides a closure assembly which resists subsequent loosening of the cap from either internal pressure of the packaged product or from normal relaxation and cold flow of the resilient plastic of the container or closure.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a threaded closure construction which provides a tight, leakproof closure.

It is also an object of the present invention to provide a threaded closure construction which resists loosening during shipment yet which can be readily separated by hand.

It is a further object of the present invention to provide a threaded closure assembly having components which are readily formed in the manufacture of the container and the closure caps.

The foregoing objects are provided for in a threaded joining means including a male element having spiral threads on its exterior surface. A female element is provided having complementary means on its interior surface for engaging the spiral threads of the male element. At least one of the elements is formed from a

resilient plastic material. A plurality of spaced apart projections are integrally formed on one of the elements and frictionally engage the other element to resist relative movement between the elements.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a container having a neck section embodying the present invention;

FIG. 2 is a vertical sectional view of the threaded neck section of a container with a cooperating cap assembled thereto utilizing the present invention;

FIG. 3 is a vertical sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is a cross sectional view taken along line 4—4 of FIG. 1;

FIG. 5 is an enlarged, perspective, elevational view of a portion of the thread of the container of FIG. 1;

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5;

FIG. 7 is a vertical sectional view of a container cap for use in the present invention; and

FIG. 8 is an enlarged cross sectional view taken along line 8—8 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, a container, designated generally by the reference numeral 10, is provided with a body portion 11 and a generally cylindrical neck portion 12. While the body portion of the container is generally depicted as cylindrical, it is understood that the body may have any form desirable, e.g., elliptical, spherical, or any other desired shape. The neck 12 is provided with an integrally formed, external, helical thread 13. While the thread illustrated in the drawing is a buttress thread, it is understood that any shape thread desired may be used in conjunction with the present invention. As can be seen more clearly in FIG. 5, the thread 13 is provided with a downwardly inclined top surface 13a, a substantially vertical side surface 13b, and an inwardly inclined lower surface 13c. The thread may extend from the top of the container neck to the lower extremity of the container neck as depicted in FIG. 1. However, if desired, the thread may be provided only over the intermediate portion of the container neck. Also, instead of a continuous thread, interrupted threads may be utilized.

The container may be formed of a rigid material such as metal or glass or a flexible or resilient material such as plastic. In the event that the container is made by blow molding or injection molding a thermoplastic material such as polyethylene, polypropylene, or polyvinyl chloride, the neck and threads may be integrally formed on the container. However, the neck and thread section may be separately formed and attached to the container top by conventional means such as utilized in the manufacture of plastic squeeze tubes.

In the container depicted in FIGS. 1—4, the thread 13 is provided with a plurality of integrally formed projections or lugs 14 extending downwardly from the lower surface 13c. As may be seen in FIG. 4, each convolution of the thread 13 is provided with four evenly spaced apart projections 14. The projections are arranged in four vertically aligned rows. However, it is

not essential that the projections be aligned or that they be evenly spaced. Any number of projections can be utilized at any desired position.

As seen more clearly in FIGS. 5 and 6, the projection 14 extends a short distance below the lower surface 13c of the thread and terminates short of the sidewall 13b of the thread. The projection is depicted as having the general form of an equilateral triangle; however, it is understood that other shapes may be used such as semicircular, elliptical, rectangular, or other suitable shapes. The outer end 14a of the projection is generally rounded and blends into the lower wall 13c of the thread short of the outer wall 13b. Thus, the projection has a length less than the depth of the thread 13. While as mentioned above the projection 14 can have any shape desired, the triangular shape shown in the drawing is preferred. The triangle may have an included angle alpha from about 45° to about 90°. However, a 90° angle is preferred.

The closure cap designated generally by the numeral 15 may be formed of either rigid or flexible material such as metal or plastic. When the cap is used with a rigid container such as glass, the cap should be formed of a resilient material such as high density polyethylene, polypropylene or other suitable semirigid plastic material which has the ability to deform under pressure. When the cap is used with a container having a neck and threads made of a deformable plastic, the cap may be formed from metal or from a rigid plastic material such as a phenolformaldehyde resin, polycarbonates, polyacetals, acrylonitrilebutadiene-styrene resins and others. It is essential that at least one of the elements, i.e., the threaded container neck or the cap, utilized in the closure of the present invention be formed of a resilient material having the ability to deform under pressure. If desired, both the cap and the neck and threads of the container may be formed from plastic material. However, at least one of the elements should be formed from a thermoplastic material having the ability to deform under pressure.

The cap of FIG. 2 includes a top 16 and an integrally formed depending side skirt 17. A continuous spiral thread-receiving groove 18 is provided in the interior wall 19 of the cap. If desired, instead of utilizing a groove in the interior wall, the cap may be made with an integrally formed, raised, matching thread on its interior wall which will mesh with the thread 13 provided on the container neck. The groove 18 is of the same general size and shape as the thread 13 to provide a close sliding fit.

In the embodiment of the invention seen in FIGS. 2 and 3, the neck 12, integrally formed threads 13, and the cap 15 are formed of resilient plastic material. When the cap is screwed onto the container neck, the thread-receiving grooves 18 deform to permit the projections 14 to slide therethrough as the cap is screwed onto the neck. Additionally, the lugs 14 will be slightly compressed and flattened into the undersurface 13c of the thread when the cap is screwed onto the container. As seen in FIG. 2, the cap is screwed onto the container neck until the peripheral portion of the inner top wall 20 is in abutment with the planar top edge 21 of the container neck to provide a liquid and vapor-tight seal between these surfaces. As may be seen in FIG. 8, the projections 14 force a cold flow of the plastic material

in the cap at their points of contact resulting in a depression 22 in the lower wall of the thread-receiving groove 18 provided in the cap skirt 17. The interlocking between the projections 14 and the depressions 22 prevent loosening of the cap after it is screwed down tight on the container neck.

A different embodiment of the cap is depicted in FIG. 7. The cap, designated generally 24, has a top wall 25 and a depending skirt sidewall 26. The interior wall 27 of the skirt is provided with a continuous thread-receiving groove 28. A plurality of projections 29 are integrally formed on and project upward from the lower wall of thread-receiving groove 28. The projections as shown in FIG. 7 are arranged in four evenly spaced vertical rows on the interior sidewall of the cap. However, as in the case of the threads on the container neck, it is not required that the projections be evenly spaced or arranged in rows. The cap 24 is formed from a resilient plastic material such as high or medium density polyethylene, polypropylene, semirigid polyvinyl chloride or other plastic material which has sufficient resiliency to deform or cold flow under moderate pressure. The cap may be made by injection molding, vacuum forming, blow molding, thermoforming or any other suitable means. This embodiment of the cap of the present invention is particularly adapted for use on containers having threaded necks made from a rigid material such as glass or metal. However, this embodiment of the cap may also readily be used on containers having necks and threads made from a resilient plastic material such as high or medium density polyethylene or polyvinyl chloride. While the closure of the present invention provides satisfactory results when only one of the closure elements is made from a resilient plastic material, it is preferred for best results to fabricate both the container neck and threads and the cap from a resilient plastic material. Particularly suitable combinations are achieved by forming the container from medium or high density polyethylene and the cap from low density polyethylene or polypropylene.

Conventionally, plastic caps are applied to plastic containers with a torquing force of about 15-16 inch pounds. Any torquing force in excess of this will usually result in stripping the threads or attaching the cap to the container with such force that it cannot be conveniently removed by hand. After relaxation of the internal stresses in the plastic material, it has been found that the removal torque required to remove a conventionally threaded plastic cap from a plastic container varies from about 3 to about 8 inch pounds.

Tests were conducted with the container closure of the present invention to determine if the closure would prevent leakage and also to determine the torque force required to remove the container cap. The test bottles were blow molded from high density polyethylene and equipped with the buttress threads having integrally formed projections as shown in FIG. 1. The projections were 0.008 inch high and terminated 0.005 inch short of the outer wall of the thread. They were triangular in shape and had an included angle of 90°. The bottles had a nominal fluid capacity of 4 ounces and were generally cylindrical in shape. Commercial caps made from low density polyethylene and having a matching thread-receiving groove were utilized. Ten bottles were filled with 2 ounces of a commercial cream peroxide and the

caps were applied with a torquing force of 15-16 inch pounds. The sample bottles were placed horizontally in a circulating air oven and held at 120° F. ($\pm 5^\circ$ F.) for 24 hours. This time and temperature have been found to be substantially equal to approximately 90 days shelf storage at ambient temperature. Ten control samples were prepared using the same cap on the same size bottle which did not include locking lugs of the present invention of the neck threads. At the end of the test period, it was found that no leakage had occurred in the 10 test bottles equipped with the locking lugs of the present invention. Three of the control samples showed definite signs of leakage. The caps were removed from all bottles and the torquing force required for removal was recorded. The torque force required on the bottles equipped with the device of the present invention ranged from 6.5 to 8.0 inch pounds and had an average of 7.35 inch pounds. The caps were also removed from the 10 control samples and were found to require a torque removal force from 3.5 to 7.0 inch pounds and averaged 5.35 inch pounds.

From the foregoing it can be seen that the closure of the present invention provides a liquid and vapor-proof seal for holding high vapor pressure products. Additionally, the test data indicate that the torque force required to remove the cap from the closure system of the present invention is within the range normally considered acceptable by packagers. The closure system of the present invention is readily adaptable to high speed, large scale manufacture of containers and their closures. Additionally, the closure system can be used with conventional high speed automatic closing equipment without any further modifications to the equipment.

Because of the versatility of the closure of the system of the present invention, it is readily adaptable to containers and closures made from a variety of dissimilar materials.

While there has been described what is at present considered to be the preferred embodiments of the present invention, it will be apparent to those skilled in the art that various modifications and changes may be made without departing from the essence of the invention. It is intended to cover herein all such modifications and changes as come within the true scope of the following claims.

What is claimed is:

1. In a container and closure therefor, the combination comprising: a hollow upstanding neck portion on said container; a spiral screw thread integrally formed on said neck portion; a plurality of integrally formed, triangularly shaped projections having an included angle of from about 45° to about 90° projecting from the underside of said spiral screw thread, said projections having an arcuate shaped outer end; a closure member having a top portion and a depending skirt portion, said skirt portion having a continuous spiral groove in its interior wall adapted to receive said spiral screw thread and said projections; and at least one of the group consisting of said container and said closure member being formed of a resilient plastic material whereby either said projections or said spiral groove in said closure member are deformed by cold flow to produce an interlocking between said container and said closure member thereby preventing leakage between said container and said closure member.

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