LEAK-PROOF CLOSURE FOR A LIQUID CONTAINER

Inventor: Gary Van Montgomery, Evansville, Ind.
Assignee: Sunbeam Plastics Corporation, Evansville, Ind.
Filed: May 3, 1973
Appl. No.: 356,913

U.S. Cl. .................................................. 215/9
Int. Cl. .................................................. A61J 1/00, B65d 55/02
Field of Search ........................................ 215/40, 43, 9

References Cited
UNITED STATES PATENTS

ABSTRACT
A leak-proof closure for a liquid container having a threaded neck. A cap for the closure has internal threads which mate with those on the container neck. The cap has an annular skirt portion above or below the threaded section. The container neck has at least one annular sealing ring on its outer surface at such a level that the cap skirt portion fits circumjacent the ring when the cap is threaded onto the neck into closed position. The outer diameter of the ring and the inner diameter of the cap skirt are such that an interference fit therebetween is established. Preferably the sealing ring or rings have a sharp edge in order to provide substantially a line contact with the skirt portion. In a preferred and illustrated embodiment, cooperating means are provided on the cap and the container to make the closure child-proof.

11 Claims, 11 Drawing Figures
LEAK-PROOF CLOSURE FOR A LIQUID CONTAINER

BACKGROUND OF THE INVENTION

The use of threaded caps or caps having bayonet type lugs for liquid containers is, of course, wide spread and, in order to close such containers tightly, it is necessary to provide a liner positioned in the interior of the cap and which is tightened against the end of the container neck to seal the container. Thin disks of cork have frequently been used for this purpose in the past because of the high resiliency of the cork which enables it to withstand sealing pressures of varying types without tanking a "set". In a threaded container, if the liner takes a "set", the cap must be turned on to the container a greater distance with each successive removal and replacement in order to seal the container. In a bayonet type the liner may gradually be compressed beyond sealing thickness and, of course, cannot be sealed against leakage if it has taken a "set".

In more recent years, because the price of cork has risen so astronomically, substitute materials such as plastic foams or the like have been used for fabricating liners for threaded and other types of container caps but most of the substitute materials are less resilient than cork and, in many instances, they do take a "set" which means that the container may leak after continued use.

The problem resulting from the lack of resiliency of the substitute materials is even more severe when the means for retaining the cap on the container neck are not threads but are bayonet-type lugs and lugs threads or similar means which have only one closed position, i.e. which cannot be tightened on to the container a little more in successive replacements to compensate for the "set" or less thickness of the liner resulting from repeated use.

The same problem exists when a cap is initially placed on a container neck by automatic capping machines which place the cap on the neck, even if threaded, with a certain predetermined torque which may or may not be greater or less than the torque applied to the cap by a user who is replacing the cap.

Even greater problems exist when a cap of the so-called "child-proof" or safety type is utilized and the cap is threaded on to the container beyond its position wherein it is rendered difficult of removal. When a child is attempting to remove a cap of this type it may be able to turn it, for example, to the child-proof position, and while the child cannot remove the cap, this will reduce the pressure on the liner. If the liner has been squeezed more tightly during a capping procedure, and if it is a cap that will take a "set", the partial loosening of the cap by the child seeking to remove the cap, may destroy its leak-proof ability and result in the container leaking even though the child has been unable to remove the cap.

It is, therefore, the principal object of the instant invention to provide a leak-proof closure for a liquid container comprising a cap having auxiliary means which cooperate with means on the container neck to continue the cap as leak-proof even though it may be loosened somewhat.

It is another object of the instant invention to provide a closure for a liquid container which can be equipped with an inexpensive cap liner, the closure comprising co-operating means on the container neck and the cap which maintain the closure leak-proof even after the liner has been compressed to a degree beyond its normal thickness, thus compensating for unequal capping pressures or the tendency of the liner to take a "set".

It is another object of the instant invention to provide a leak-proof closure for a child-proof or safety container wherein the cap and the container neck not only have cooperating means for retaining the cap on the container neck but also are provided with means which render it extremely difficult for a small child to remove the cap from the container; the cap and the container neck having cooperating means which maintain the closure in leak-proof condition even though it may be retracted slightly from its initial closed position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary, diametric, vertical, sectional view of a closure embodying the invention as utilized on a child-proof closure embodying Gach and Leonard Application, Ser. No. 278,101, filed Aug. 4, 1972 now U.S. Pat. No. 3,770,153;

FIG. 2 is a horizontal, partly plan and partly sectional view, taken along the line 2--2 of FIG. 1;

FIG. 3 is a horizontal sectional view taken along the line 3--3 of FIG. 1;

FIG. 4 is a vertical, diametric, sectional view of a cap according to the invention;

FIG. 5 is a fragmentary view in side elevation of a closure embodying the invention, the interior parts being shown in phantom;

FIG. 6 is a fragmentary, isometric view of a container neck embodying the invention as provided with means cooperating with the cap shown in FIG. 4 to render the closure leak-proof;

FIG. 7 is a fragmentary, vertical sectional view of a modified form of closure embodying the invention;

FIG. 8 is a view similar to FIG. 6 but of the neck of the container also shown in FIG. 7;

FIG. 9 is a view similar to FIG. 7 but showing a third modification of the invention;

FIG. 10 is a view similar to FIG. 8 but of the neck of the container also shown in FIG. 9; and

FIG. 11 is a view similar to FIGS. 7 and 9 and showing yet another modification of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

A closure embodying the invention is designed for a container, generally indicated by the reference number 10, having a neck 11 to be closed by an inverted cup-shaped cap 12.

In the embodiment of the invention illustrated in FIGS. 1--6, the container neck 11 and the cap 12 have cooperating disengageable means for retaining the cap 12 on the container 10 which consist of external threads 13 on the container neck 11 and internal threads 14 on the inner side of a cap skirt 15. The cap 12 also has an interior liner 16 which is squeezed tightly against the end of the neck 11 when the cap 12 is on the container in closed position as illustrated in FIG. 1.

The cap 12 has a depending skirt portion 17 which extends downwardly beyond its threads 14 and fits closely circumjacent to one or more sealing rings 18 provided on the exterior of the container neck 11 at a level below its threads 13. The outer diameter of the sealing rings 18 and the inner diameter of the cap skirt
portion 17 are such that when the cap 12 is threaded on to the neck 11 to closed position, the skirt portion 17 engages the sealing rings 18 in what is generally called an "interference fit" in order to establish a seal which in this case, is substantially a line contact between the sealing ring or rings 18 and the skirt portion 17, much in the fashion of a "O" ring. Preferably the sealing rings 18 have sharp edges so as to maintain the line contact.

If the cap 12 is threaded onto the container neck 11 with considerable torque so that it squeezes the cap liner 16 tightly against the end of the container neck 11, either upon initial capping of the container or upon subsequent replacement of the cap 12, the person replacing the cap 12 may not turn it downwardly on the neck 11 as tightly as it was initially closed. In the event that the cap liner 16 takes a "set" as a result of the initial closing, a subsequent replacement of the cap may not turn it down tightly enough to reseal the end of the neck 11 against leakage. In the event of this common occurrence, liquid contents of the container 10 may leak because the compressed liner 16 no longer functions for its intended purpose. If such event occurs, the contents of the container may leak from the container into the interior of the cap 12. However, because of the contact provided by the sealing rings 18 engaging the cap skirt portion 17, this material will not actually leak from the closure.

The advantage accruing from the cooperating rings and annular skirt portion according to the invention also is important upon initial capping of the container on the production line of the establishment at which liquid containers are filled.

Normal industry tolerances in the manufacture of containers, caps and liners are such that a cap placed on a container might compress the liner as much as 0.020 inches beyond nominal or as much as 0.020 inch less than nominal. For example, in a screw type closure having a six pitch thread (6 threads per inch) the manufacturing tolerances of the container and cap may cumulate to result in as much as 80° of rotation between minimum or maximum. This would be plus or minus 40° from nominal sealed position. Because each degree of rotation of the six pitch thread results in 0.0005 inch vertical movement, thus, 40° below nominal results in the liner being compressed 0.020 inch beyond (thinner) than nominal or, on the other hand, results in the liner only barely contacting the bottle neck or not contacting it at all.

If the liner takes a "set" in the first instance, later replacement of the cap would result in a leak. If the cap is rotated to only to 40° short of nominal, a leak may immediately result.

The leak-proof feature of a cap embodying the invention is particularly useful when the closure is of the so-called child-proof type, for example, a closure such as that disclosed in the Gach and Leonard application. A closure of this type comprises a pair of depending locking lugs 19 on an outer cap skirt 20 which are engageable in two square ended recesses 21 formed in a shoulder 22 on the container 10. When this embodiment of the invention is threaded onto the container neck 11, the locking lugs 19 engage cam 23 on the shoulder 22 of the container and are urged outwardly as the cap 12 is rotated to closed position, finally snapping into the recesses 21.

In order to remove a cap 12 thus designed, it is necessary to squeeze the outer cap skirt 20 inwardly on the two opposed sides indicated by the open narrow lines in FIG. 3, thus to flex the lugs 19 outwardly a sufficient distance to clear the square shoulders in the recesses 21, thus whereupon the cap can be unscrewed in the usual fashion.

The cap structure according to the mentioned Gach and Leonard application has been proven to be substantially child-proof. However, if the cap is screwed onto the container to a degree such that the locking lugs move any distance beyond the square shoulders of the cooperating recesses 21, the cap liner 16 may be compressed to a degree such that it will not restore to its original thickness. If the liner 16 has thus been compressed, for example by the capping machine having turned the cap 12 too far onto the container neck 11, or by a subsequent adult who has actuated the release mechanism and opened the cap and then turned it back onto the container neck 11 beyond the engagement of the lugs 19 with recesses 21, when a child is endeavoring to remove the cap by turning it backwardly he will not be able to turn it beyond the engagement of the lugs 19 with the recesses 21. However, by merely turning it backward a sufficient distance to engage these cooperating child-proof elements, he may relieve the pressure on the liner 16 to such a degree that liquid material may leak out of the container 10 into the interior of the cap 12. Again, the cooperation of the sealing rings 18 with the inner skirt portion 17 of the cap 12 will prevent the contents which may have leaked into the interior of the cap 12 from leaking out of the container closure itself.

FIGS. 7 and 8 illustrate how a closure embodying the invention may be arranged so that one or more sealing rings 25 are located at the upper end of a container neck 26 for cooperation with an annular skirt portion 27 of a cap 28.

While the container neck 26 and its container 29 and the cap 28, are illustrated in FIGS. 7 and 8 as being the same type as that shown in FIGS. 1-6, inclusive, with respect to the child-proof design of the cap, these features of child-proof construction are the subject matter of the mentioned Gach and Leonard application and are not the basic subject matter of the instant application. The combination of such child-proof features with the leak-proof features of the instant invention, however, does constitute an improvement over the mentioned Gach and Leonard application.

A third embodiment of the invention is illustrated in FIGS. 9 and 10 where a single sealing ring 30 is formed on a neck 31 of a bottle 32, or other container, at a level below the cap retaining means, i.e. bottle neck threads 33. As in the case of the embodiment of the invention illustrated in FIGS. 1-6, a cap 34 as shown in FIG. 9 has an annular skirt portion 35 below its internal threads 36. The annular skirt portion 35 and the flat, cylindrical ring 30 cooperate with each other when the cap 34 is in closed position on the bottle 32 to provide the leak-proof feature according to the invention in the same fashion as the sealing rings 18 of FIGS. 1-6, inclusive, cooperate with the cap skirt portion 17 shown in those figures.

FIG. 11 is a view similar to FIGS. 1, 7 and 9 and illustrates how a leak-proof closure according to the invention can be designed for use on a bayonet-type closure. In FIG. 11 a bottle or other container 37 has a neck 38.
provided on its outer surface with a plurality of under-cut recesses 39 and axially extending slots 40. In this embodiment, four of the slots 40 and the recesses 39 are shown. At a level just below the bottoms of the recesses 39, one or more sealing rings 41 are also formed on the exterior of the bottle neck 38. These rings may be substantially identical with the rings 18 of FIGS. 1-6, or the rings 25 of FIGS. 7 and 8. Similarly, of course, and if desired, instead of a plurality of rings 41 as shown in FIG. 11, a single cylindrical ring such as the ring 30 of FIG. 10 may be employed with a bayonet-type closure as shown in FIG. 11.

A cap 42 has a plurality of inwardly extending lugs 43 which are of such size and so positioned as to be movable downwardly through the slots 40 and, when the cap 42 is rotated in a clockwise direction, to enter the recesses 39 to retain the cap 42 on the bottle 37. At this point, of course, the sealing rings 41 engage the inner surface of an annular skirt portion 44 of the cap 42.

In common with the other illustrated embodiments of the invention, FIG. 11 also shows how the child-proof feature of the mentioned Gach and Leonard application may be employed on a bayonet-type cap embodying the instant invention.

Although threaded plastic caps have a tendency to "back off" as a result of vibration during handling and shipping, the sealing ring provided by the instant invention substantially eliminates this problem. The interference fit between the sealing ring or rings and the annular cap skirt portion provides enough frictional resistance to prevent the backing off or unscrewing which might otherwise result.

In addition, the sealing ring and cooperating annular cap portion of the invention overcomes an additional problem often encountered. When filled containers having either threaded or bayonet type caps are stacked in warehouses or during shipping, especially those containing heavy liquids, the caps are pressed down tightly against the liners to the full extent of any tolerance or possible vertical movement. This gives the liners the undesirable "set" so that when the top pressure is removed, leakage may result. Because the horizontal seal provided according to the invention is not affected by such vertical pressure, the resistance to cap removal and secondary seal against leakage of a closure according to the invention remain effective.

What I claim is:

1. A leak proof safety closure comprising a container and a cap, and said container having a bottom, a sidewall, a neck and an annular shoulder extending between said neck and said cap, and at least one lug recess in said container adjacent the periphery of said shoulder, said cap having a top, an inner wall depending from said top, cooperating means on said closure neck and said inner wall for retaining said cap in closed position on said container, at least one annular sealing ring on said container neck, said sealing ring having an outer diameter fitting tightly within said inner cap wall when said cap is in closed position, and an outer skirt depending from said top in concentric relationship to said inner wall, said skirt including at least one depending lug having a lower portion extending below the bottom of said inner wall and engageable in said lug recess.

2. A closure according to claim 1 and camming means on said shoulder for guiding said lug toward said lug recess.

3. A closure according to claim 1 wherein said cap includes two diametrically opposed lugs depending from said skirt and said container shoulder has two opposed lug recesses.

4. A closure according to claim 1 and a resilient liner in the cap that is engageable with the end of the container neck when said cap is in closed position.

5. In a closure according to claim 1, the improvement comprising a circumferentially extending series of lug recesses in the container shoulder which are sequentially engaged by the locking lug when the cap is screwed more tightly onto the container neck.

6. A closure according to claim 1 in which there are a plurality of spaced annular sealing rings on said container neck.

7. A closure according to claim 1 in which the annular sealing ring has a sharp outer edge for establishing substantially a line contact with the inner surface of said cap skirt.

8. A closure according to claim 1 in which the cooperating means are mating threads.

9. A closure according to claim 1 in which the sealing ring is below the threads on the container neck.

10. A leak proof safety closure comprising a container and a cap, said container having a bottom, a sidewall, a neck and an annular shoulder extending between said neck and said sidewall, at least one lug recess in said container adjacent the periphery of said shoulder, said cap having a top, a wall depending from said top, cooperating means on said closure neck and said wall for retaining said cap in closed position on said container, and at least one integral annular sealing ring between said wall and said container neck, said sealing ring having an interference sealing fit when said cap is in its closed position, said wall depending from said top and including at least one lug adjacent its lower edge engageable in said lug recess.

11. A closure according to claim 10, wherein said sealing ring is integrally formed on said container neck.