Feb. 25, 1964 F. M. HAGMANN ET AL 3,122,254

CROWN-TYPE SEALING CLOSURE

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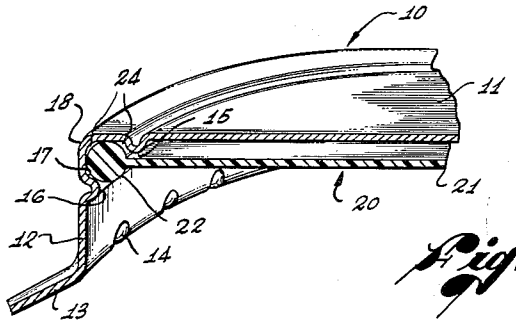


Fig. 1

Fig. 2

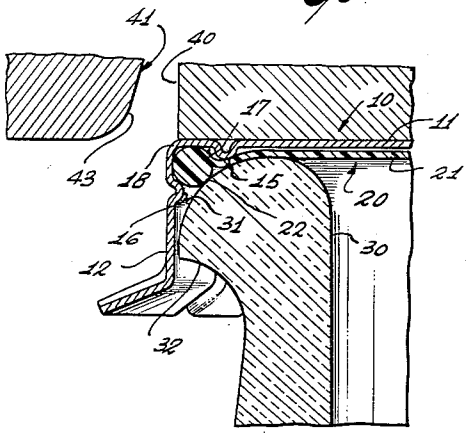
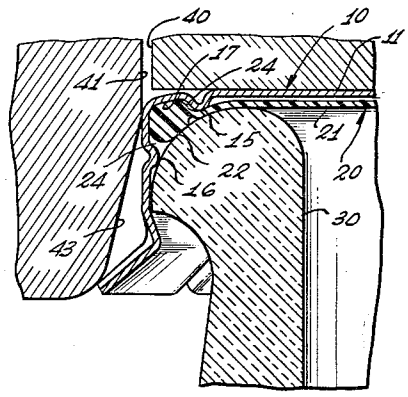


Fig. 3



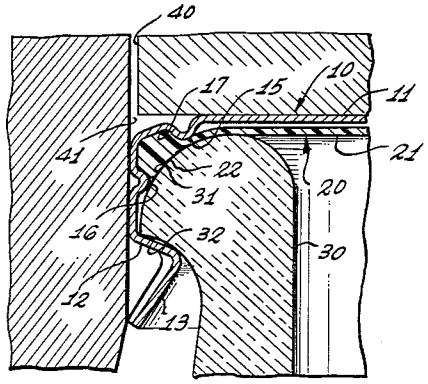


Fig. 4

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Fig. 5

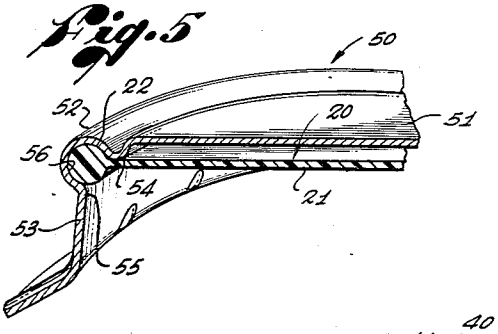


Fig. 6

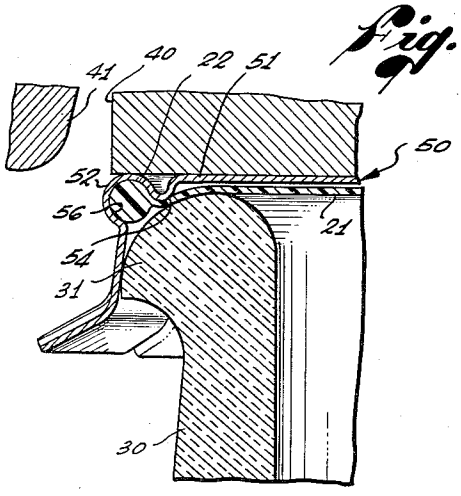


Fig. 7

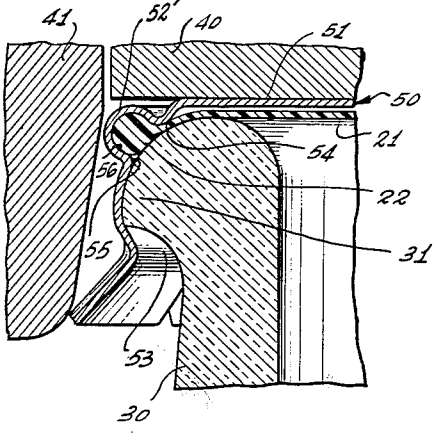
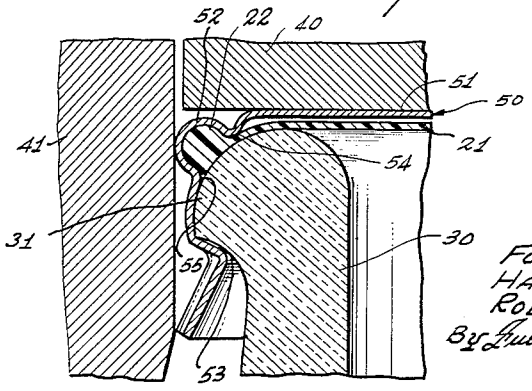


Fig. 8



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CROWN-TYPE SEALING CLOSURE

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This invention relates generally to sealing closures, and more particularly to an improved crown-type sealing closure adapted for use on beverage bottles and the like.

The sealing concepts of the present invention are related to those set forth in our copending application entitled "Seal," Serial No. 61,749, filed October 10, 1960, which in turn is a continuation-in-part of my copending application entitled "Seal," Serial No. 14,707, filed March 14, 1960.

Sealing closures presently in use on crown-type bottles normally include a flat disc or gasket seal made of cork or cardboard. Such seals are of limited utility, particularly from the standpoints of providing an initially effective pressure or vacuum seal and then maintaining that seal over a prolonged period. The inefficiency of these seals limits the shelf life of the product stored in the bottle before initial opening and furthermore, materials such as cork and cardboard have a tendency to contaminate the product.

While the disadvantages of these conventional seals have long been known, more efficient seals, such as precision-fitted types, have not been used because their cost is too great to justify use on containers, such as beverage bottles.

Seals of the O-ring type have many advantages and are well known for use in applications where dependable and durable sealing is required. O-rings will seal effectively under light sealing pressures and in either pressure or vacuum applications. In addition, when constructed of a suitable plastic or rubber material, they are noncontaminating and impervious to most all chemical substances.

However, there are certain heretofore insolvable problems encountered in connection with providing a satisfactory crown-type sealing closure incorporating an O-ring seal.

As previously mentioned, the use of precision-fitted seals of any type, including the O-ring type, has not been economically feasible on beverage bottles and the like. Such precision-sealing is dependent upon an equal void-volume relationship, i.e., an equal relationship between the space or void of the confining groove and the volume of the sealing ring. To achieve such a relationship normally requires close-tolerance fits, closely controlled inspection and testing, and other inherently expensive manufacturing procedures.

Further, a loosely carried O-ring seal, as distinguished from a precision-fitted O-ring seal, is not desirable, especially when it is intended that the sealing closure be reusable. It will be readily appreciated that if the O-ring is merely loosely carried in a confining groove, it will drop free when the sealing closure is removed from the bottle.

For these reasons it has not been thought that O-ring seals could be successfully used in connection with low-cost, crown-type sealing closures.

It is the primary object of this invention to provide an improved sealing closure which is highly effective and durable, yet which can be economically mass-produced.

Another object of this invention is to provide a crown-type sealing closure embodying an O-ring seal and further characterized in that an O-ring confining groove in the cap is volumetrically sized to its associated O-ring to achieve the optimum void-volume relationship during the bottle-capping operation.

A further object of the invention is to provide a sealing closure of the type described which incorporates an O-ring permanently held in assembly with its associated cap, even when the cap is removed from the bottle.

Still another object of the present invention is to provide a sealing closure of the type described which is adapted to provide an effective seal in spite of surface irregularities or tolerances in the beaded lip or sealing surface of the bottle.

A still further object of the invention is to provide an efficient and economically mass-producible sealing closure incorporating a noncorrosive and noncontaminating sealing-lining element.

These and other objects and advantages of our invention will be more fully understood by referring to the following detailed description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a fragmentary perspective view of the crown-type sealing closure of the invention;

FIGURE 2 is a half section showing the sealing closure illustrated in FIGURE 1, in place on a crown-type bottle and the elements of a capping press at the completion of the first stage of the bottle-capping operation;

FIGURE 3 is a half section similar to FIGURE 2, except that the sealing closure and the elements of the capping press are shown in their relative positions at the completion of the second stage of the capping operation;

FIGURE 4 is a half section similar to FIGURES 2 and 3, except that the sealing closure and the elements of the capping press are shown in their relative positions at the completion of the capping operation;

FIGURE 5 is a fragmentary perspective view of a slightly modified form of sealing closure;

FIGURE 6 is a half section illustrating the sealing closure shown in FIGURE 5, in place on a crown-type bottle and the elements of a capping press at the completion of the first stage of the capping operation;

FIGURE 7 is a half section similar to FIGURE 6 with the various parts and elements of the capping press being shown at the completion of the second stage of the capping operation; and

FIGURE 8 is a half section similar to FIGURES 6 and 7 showing the various parts and elements of the capping press at the completion of the capping operation.

Referring to the drawings, and in particular to FIG. 1, the sealing closure in the invention may be seen to comprise a crown-type cap 10 and an associated sealing-lining element 20.

The cap 10 includes generally a flat central closure portion 11 and a skirt portion 12 depending from said closure portion at approximately a right angle relative thereto. For reasons that will later be explained, the radius of curvature at the junction 18 of the closure and skirt portions 11 and 12 is relatively small. That is to say, the bend at the junction 18 is fairly sharp. The marginal edge 13 of the skirt portion 12 is flared outwardly and serrated, as at 14 and, as will also be explained, is adapted to be crimped inwardly during the bottle-capping operation.

The closure portion 11 is formed with an annular, downwardly facing, first or inner pressure ridge adjacent the junction 18. An annular, inwardly facing, second or outer pressure ridge 16, similar to the ridge 15, is formed in the skirt portion 12 adjacent the junction 18. Because of the previously described relationship of the closure and skirt portions, the outer ridge 16 is spaced outwardly and downwardly of said inner ridge 15 and cooperates with the inner ridge to form or define the

boundaries of an annular groove 17 in the corner of the cap 10.

The integral sealing-lining element 20 is formed of a resilient, deformable, and substantially incompressible material such as polyethylene, vinyl, or rubber. The element 20 includes an annular sealing ring 22 and a flat liner portion or disc 21 closing the central space of said ring. In order to effect optimum sealing, the lower or bottle-contacting sector of the ring 22 has (in cross section) an arcuate peripheral shape. For convenience of manufacture, the ring 22 is here shown as toroidal in overall shape.

In order that the cap 10 in the element 20 cooperate to serve their intended function, the maximum outside diameter of the ring 22 is substantially equal to that of the groove 17 of the cap 10. Further, the diameter of the ring 22, in cross section, is such that the ring may be seated in the groove 17 without causing the ring to appreciably deform. In this same regard, it will be noted that the volume of the ring 22 is initially somewhat less than the void of the groove 17, so that unfilled spaces 24 initially remain in the groove 17.

Relatively large deviations in the sizes and shapes of the cap groove 17 and the sealing ring 22 from their respective standards or norms can be compensated during the capping operation which is described in detail below. Because of this feature of the invention, it is not necessary to specify the sizes and shapes of the associated ring and groove within a close tolerance range. Instead, it is merely necessary, as noted above, that the void of the groove 17 be initially greater than the volume of the ring 22.

As previously mentioned, another desirable feature of sealing closures is that the sealing element be maintained in assembly with its associated cap prior to installation on and after removal of the cap from the bottle. Such retention is here accomplished by the outer pressure ridge 16, which is of a lesser diameter than the maximum outside diameter of the ring 22. In assembling the elements 20 and the cap 10, it is merely necessary to spring the ring 22 over the ridge 16 and into the groove 17, whereupon the element is resiliently maintained in assembly with the cap 10.

The sealing closure comprising cap 10 fitted with the sealing-lining element 20 is adapted to be applied to a standard crown-type bottle 30. Referring to FIGURE 2, it will be noted that the size of the cap 10 in relation to the size of the bottle lip is such that the closure portion 11 has a diameter substantially equal to the maximum diameter of the lip 31 and the skirt portion 12 extends down well below the lip 31. As illustrated in section in FIGURES 2–4, the bottle 30 has a beaded lip 31 presenting an annular shoulder 32 facing oppositely from the top of the lip. The radius of curvature of the lip 31 is relatively large as compared to the radius of curvature of the cap 10 at the junction 18. In essence, it is this difference of curvatures that provides the groove or void in cap 10 for confining the sealing ring 22 during the bottle-capping operation.

The capping process is schematically shown at the completion of successive stages of progress in FIGURES 2, 3 and 4. A capping press, including a pressure foot 40 and a crown block 41, is shown for applying the sealing closure to the bottle 30. The pressure foot 40 is cylindrical in shape and has an outside diameter substantially equal to the maximum outside diameter of the lip 31 of the bottle. The crown block 41 is concentrically mounted and adapted for vertical movement relative to the pressure foot 40. The lower end of the crown block 41 is flared or tapered outwardly as at 43 to accommodate the outwardly flared marginal edge 13 of the skirt portion 12 of cap 10.

In the initial step of the capping operation, illustrated in FIGURE 2, the cap 10 is placed over the lip 31 of the bottle 30, and the pressure foot 40 is lowered into engagement with the closure portion 11 of the cap. This engagement of the pressure foot 40 causes the inner pressure ridge 15 of the cap to urge a limited area of the liner disc 21 of the element 20 into pressural contact with the lip 31. Direct contact of the ridge 15 and the lip 31 is, of course, prevented by the intermediate disc 21. However, since the disc 21 is formed of a deformable and relatively thin material, a high unit pressure exists at the region of contact, and for purposes of description, the pressure ridge 15 will be considered to be pressurally engaged with the lip. The unit pressure at the region of engagement is sufficiently high to prevent extrusion of the element 20 between the opposing surfaces of the ridge and the bottle lip, and hence the ridge 15 effectively functions as a dam.

During the second stage of the capping operation, as illustrated in FIGURE 3, the crown block 41 partially descends around the stationary bottle 30 and pressure foot 40 and engages the skirt portion 12 of the cap. Such crown block descension causes the portion of the cap 10 outwardly of the inner pressure ridge 15 to pivot downwardly about that ridge as a fulcrum. Pivoting continues until the outer pressure ridge 16 is urged into pressural engagement with the lip 31. As in the case of the inner ridge 15, the region of contact is relatively small so that a high unit pressure is applied, this pressure being sufficiently high to prevent extrusion of the element 20 between the opposing surfaces of the ridge 16 and the lip 31.

It should be noted at this point that the pressure ridges 15 and 16 in the broad sense need not be actual depressions in the cap 10, so long as they maintain annular areas of pressural engagement between the cap and lip.

Referring to FIGURE 3, it will be noted that at the completion of the second stage of the capping operation the sealing ring 22 is confined entirely within the groove 17 by virtue of the ridges 15 and 16 pressurally engaging the lip 31. It will also be noted that the void, i.e., the space enclosed by the walls of the groove 17 and the cooperating surface of the lip 31, is greater than the volume of the sealing ring 22. That is to say, unfilled spaces 24 remain in the groove 17 at this stage of the capping operation.

The sealing closure, the elements of the capping press, and the bottle are shown in their relative positions at the completion of the capping operation in FIGURE 4.

During the final stage, the crown block 41 further descends around the pressure foot 40. As such descent takes place, the outer ridge 16 is pulled slidably down over the beaded lip 31 to reduce the void of groove 17, thereby deforming the lower arcuate sector of the ring 22 against the lip and effecting sealing.

The reduction of groove void and sealing ring deformation continue during the final stage of the capping operation until the optimum void-volume relationship is established. As previously discussed, the optimum relationship is when the void, i.e., the space within the groove 17, is equal to the volume of the sealing ring 22.

When the ridge 16 is pulled down sufficiently over the lip 31 to establish an equal void-volume relationship, the crown block 41 wipes or slides over the skirt portion 12 of the cap and crimps it inwardly against the annular shoulder 32 at the lower edge of the lip to lock the cap 10 on the bottle 30 and maintain sealing pressure.

Deviations in the sizes or shapes of any or all of the groove 17, the sealing ring 22, and the lip 31 from their respective standards or norms are compensated by either more or less of the skirt portion 12 being pulled down below the lip 31 and crimped inwardly against the annular shoulder 32 at the lower edge of the lip. Thus, an optimum void-volume relationship is achieved in spite of such deviations. For example, if the sealing ring 22 is undersize, a greater extent than usual of the skirt portion

12 is pulled down over the lip 31 and crimped against the shoulder 32.

As previously noted, it is desired that the sealing ring 22 have an arcuate peripheral shape in its lip-engaging sector or region. Such a peripheral shape is desired for two reasons. First, it insures maximum sealing under optimum conditions when an equal void-volume relationship has been achieved. Since the sealing ring 22 is formed of a resilient material it has a memory factor or a tendency, when deformed, to return to its original shape. This force exerted in attempting to return to its original shape is applied against the lip 31 of the bottle 30, and hence may properly be considered as sealing pressure.

The other reason for providing a sealing ring 22 with an arcuate peripheral shape in its lip-engaging region is that it serves to achieve effective sealing in a case where, for any reason, an optimum void-volume relationship has not been established. When the sealing ring 22 has the preferred arcuate shape, deformation of the ring 22 and the area of contact between the ring and lip vary in accordance with the sealing pressure applied. For instance, when a light sealing pressure is applied, deformation of the ring and the resulting area of contact between the ring and the lip are small so that the unit pressure is relatively high, thereby insuring maximum sealing for a given sealing pressure. On the other hand, as greater sealing pressure is applied, deformation and the area of contact increase, yet a relatively high unit sealing pressure is maintained.

A modified form of sealing closure comprising a cap 50 in cooperation with the sealing-lining element 20 is illustrated in FIGURE 5. The cap 50 includes a central closure portion 51, a peripheral groove portion 52, and a depending skirt portion 53. Annular inner and outer pressure ridges 54 and 55, respectively, are located at the inner and outer extents of the groove portion 52, thereby defining the boundaries of a seal-confining pocket or groove 56 in the corner of the cap 50. The groove portion 52 of the cap is cylindrically curved so as to conform generally to the contour of its associated sealing ring 22.

The cap 50 may be conveniently manufactured by starting with a flat metal disc and first forming an annular groove of semicylindrical cross section therein. This groove corresponds to the groove 56 of the finished cap 50. The portion of the disc outwardly of the inner pressure ridge, i.e., the inner extent of the groove, is then bent downwardly about that ridge to provide the finished cap 50 having a clearly defined pocket or groove in its corner.

An important difference between the previously described cap 10 and the present cap 50 is that cap 50 has a more definite or pronounced seal-confining groove or pocket than the former. In this regard, cap 50 is particularly advantageous as there is virtually no possibility of the element 20 inadvertently separating from its associated cap 50. To illustrate the importance of this feature, consider the fact that the assembled sealing closure may encounter extremely cold temperatures during shipment from the manufacturing plant to the bottle-capping plant. Depending, of course, on the difference in coefficients of expansion of the cap and element materials, the element may shrink relative to its cap and tend to separate therefrom. In the case of the present embodiment, such an occurrence is prevented by virtue of the definite or pronounced groove configuration of cap 50.

The process of applying the present sealing closure, comprising a cap 50 assembled with element 20, to the bottle 30 is illustrated at successive stages of progress in FIGURES 6, 7 and 8. The process and the sealing concepts are essentially the same as those described and set forth in connection with the previous embodiment and, therefore, they are not here repeated in detail.

Briefly, during the initial step of the capping operation, as illustrated in FIGURE 6, the cap 50 is first placed over the lip 31 of the bottle. The pressure foot 40 is then lowered into contact with the lid portion 51 of the cap, thereby urging the inner ridge 54 into pressural engagement with the lip 31. In the next step, as illustrated in FIGURE 7, the crown block 41 partially descends around the pressure foot 40 into contact with the skirt portion 53 of the cap, thereby urging the outer ridge 55 into pressural engagement with the lip 31. The final step of the capping operation, as illustrated in FIGURE 8, involves further descent of the crown block 41. Such descent results in the outer ridge 55 being pulled down over the lip 31 to deform the sealing ring 22 against the lip 31 and to establish an optimum void-volume relationship.

It will be appreciated that we have provided two embodiments of a highly effective yet inexpensive sealing closure. In essence, both embodiments incorporate fitted O-ring seals wherein sizing to achieve the optimum void-volume relationships is accomplished during the bottle-capping operation. Moreover, if for any reason, such as excessive tolerances, the optimum void-volume relationship is not established, an effective seal is nevertheless provided by virtue of the arcuate peripheral shape of the lip-engaging sector of the sealing ring 22. Further, both sealing closures incorporate sealing-lining elements having liner portions which not only prevent contamination of the product stored in the container, but which also prevent corrosion of the metal cap and resulting loss of sealing efficiency.

Although certain embodiments of our invention have been illustrated and described in some detail, it will be understood that various changes in the design, construction and arrangement may be made without departing from the spirit and scope of the invention.

We claim:

1. A sealing closure for a crown-type bottle having a beaded lip with a predetermined radius of curvature adjacent its mouth and an annular shoulder facing oppositely from the top of said lip, comprising: a ductile metal cap having a central closure portion with a diameter substantially equal to the maximum outside diameter of said lip and a depending skirt adapted for locking engagement with said shoulder, the radius of curvature of said cap at the junction of said closure and skirt portions being less than the radius of curvature of said lip, said closure and skirt portions being formed with first and second continuous pressure ridges, respectively, in their lip-engaging surfaces, said ridges defining the boundaries of a continuous corner groove at said junction that opens to the interior of said cap; and a resilient, deformable sealing ring seated in said groove and having a volume initially less than the void of said groove and a flat liner disc closing the central space of said ring, said first and second ridges being adapted to be pressurally engaged with said lip to confine said sealing ring within said groove, and, thereafter, said second ridge being adapted to be moved along said lip to volumetrically size said groove and said sealing ring to one another and deform said sealing ring against said lip during said locking engagement of said skirt with said shoulder.

2. A sealing closure for a crown-type bottle having a beaded lip of a predetermined radius of curvature adjacent its mouth and an annular shoulder facing oppositely on the top of said lip, comprising: a ductile metal cap having a flat central closure portion with an outside diameter substantially equal to the maximum outside diameter of said lip and a depending skirt adapted for locking engagement with said shoulder, the radius of curvature at the junction of said closure and said skirt portions being less than the radius of curvature of said beaded lip, said closure portion being formed with an inner pressure ridge in its lip-engaging surface and said skirt portion being formed with an outer pressure ridge in its lip-engaging surface, said inner and outer ridges defining the boundaries of an annular groove in said cap adjacent said junction; and an integral sealing-lining ele-

ment including a resilient, deformable, and substantially incompressible sealing ring having a volume initially less than the void of said groove seated in said groove and adapted to be deformed against said lip, and a flat liner disc closing the central space of said ring, said inner pressure ridge being adapted to urge a limited area of said liner disc into pressural contact with said lip, and, thereafter, said outer ridge being adapted successively to be pressurally engaged with said lip to confine said ring entirely within said groove and said outer lip being adapted to be moved downwardly over said lip during

the locking engagement of said skirt portion with said shoulder, whereby the void of said groove is reduced until it is substantially equal to but no greater than the volume of said ring and said ring is deformed against said lip.

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