March 6, 1951 H. Z. GORA 2,543,775

CONTAINER CLOSURE

Filed April 1, 1949

Fig. 1

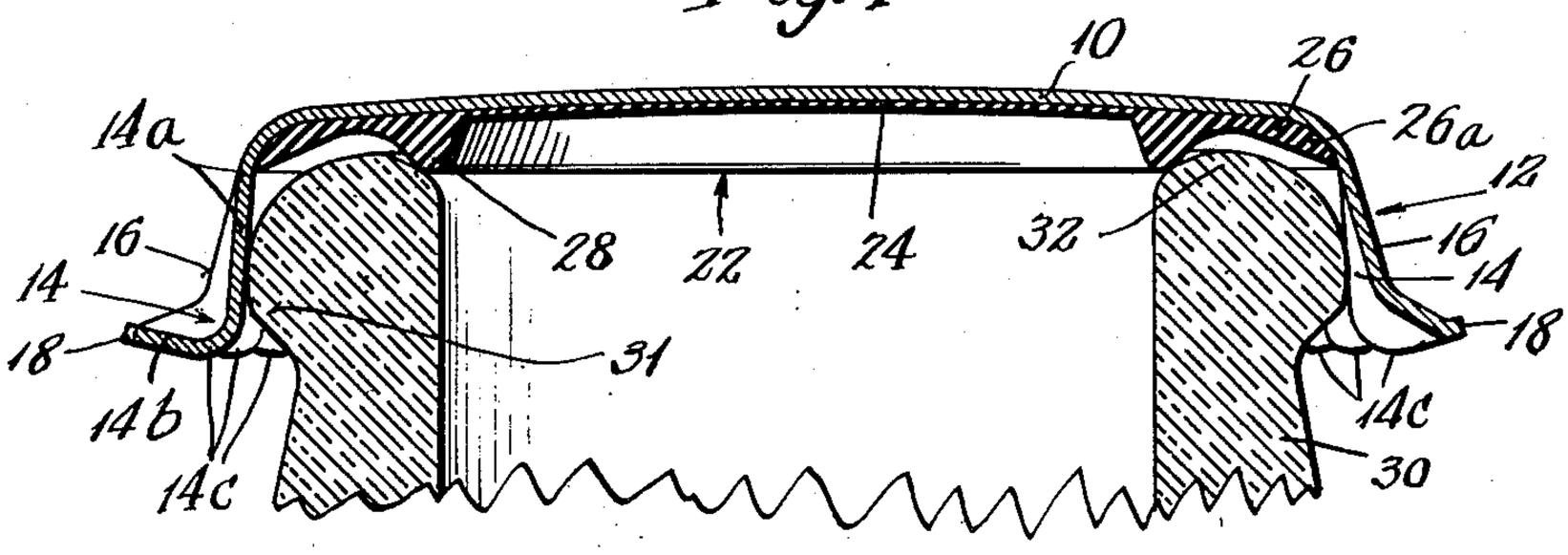


Fig. 2

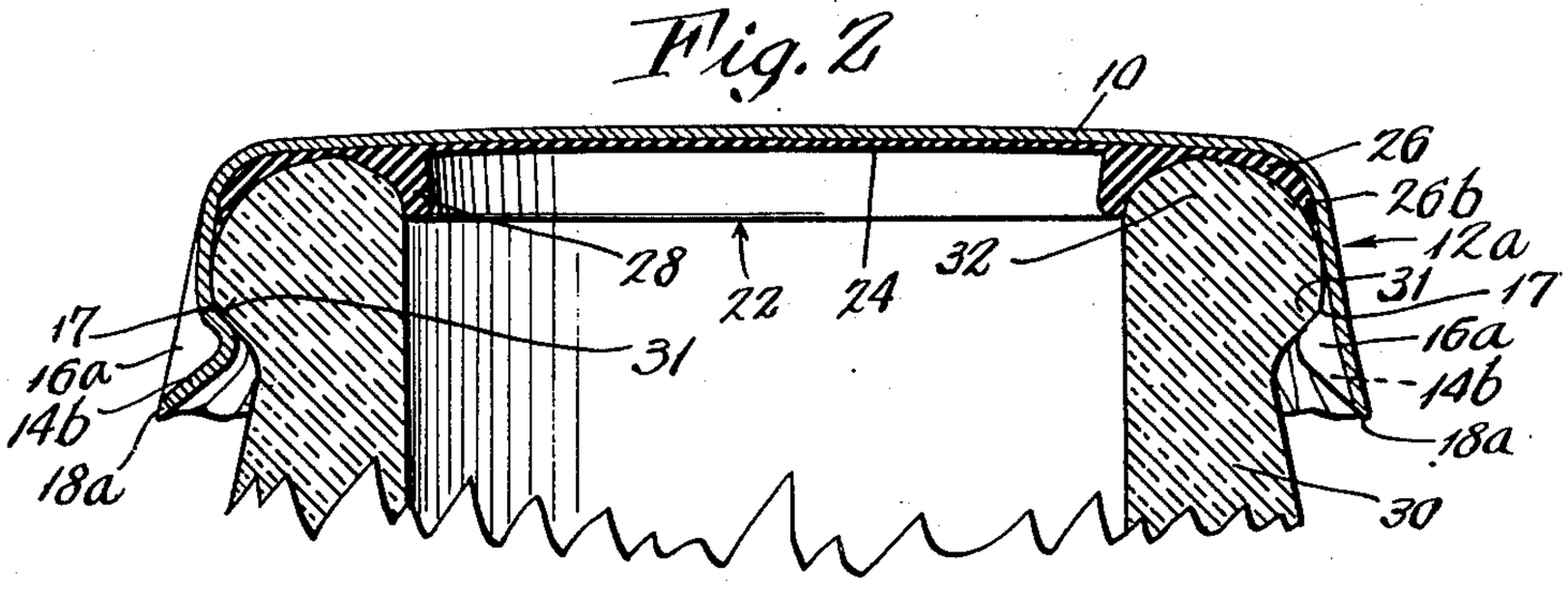
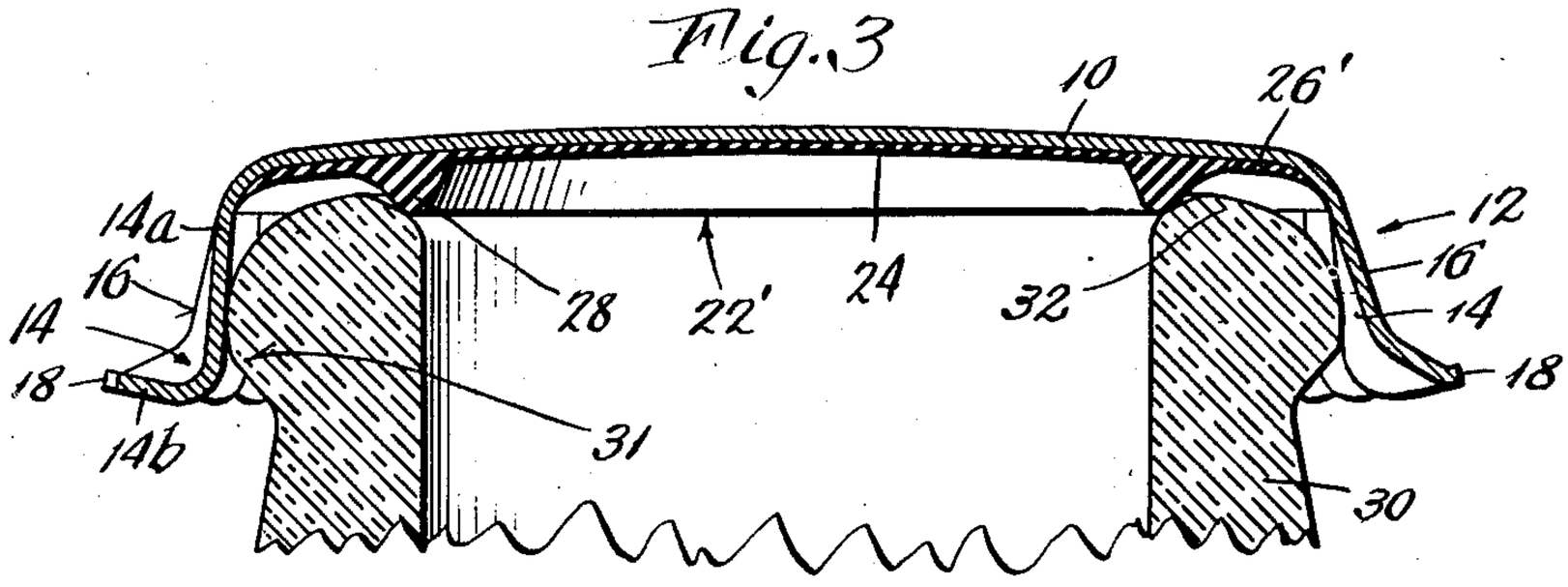


Fig. 3



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CONTAINER CLOSURE

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3 Claims. (Cl. 215—40)

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This invention relates to container seals and, in the form illustrated herein, particularly to beverage crowns.

This invention provides a closure or cap, the seal of which includes a flexible deformable protuberance engaging the mouth of the container and resiliently deformed thereby, whereby its sealing operation is to a large extent independent of minor variations in the position of the cap on the mouth of the container and lifting movements or spring-back of the cap after application, which is proof against expansion of the area exposed to pressure application upon lifting movements of the cap, and which will thus provide for more reliable sealing of containers while still employing normal capping conditions and procedures.

In the form of the invention illustrated herein, wherein the cap and seal are intended for use on carbonated beverage crowns, the result is attained by giving to the sealing material in the cap, preferably a molded resilient rubbery composition, a configuration such that a portion thereof engages the top of the container mouth while a protruding portion snugly engages the interior surface of the container mouth so as to be constantly forced thereagainst by its own resilient action and by any gas pressure present in the sealed container, said seal being shaped and placed so as to fill all the space when applied to the cap between the top sealing portion and the protruding portion.

A feature of the invention is the provision of the improved seal configuration referred to above together and in combination with a cap having the skirt portion formed in a novel fashion providing greater cap retaining strength, whereby there is achieved a cap having a high degree of reliability against accidental of incidental failures or, where no more than normal reliability is required, a cap in which sheet material of minimum thickness can be successfully used in its construction.

Additional features and advantages will hereinafter appear.

In the drawing:

Figure 1 is a fragmentary cross-section of a container with a closure according to the present invention applied to the neck thereof and resting thereon prior to sealing.

Fig. 2 is a view similar to Fig. 1 but showing the parts in the position occupied after the completion of the capping or sealing operation.

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Fig. 3 is a view similar to Fig. 1, but illustrating a modified form of closure liner.

This invention in its broader aspects is directed to the provision of an improved liner or sealing means found in container closures of many types and will be particularly described with reference to crown caps since this is one usual type normally applied to pressurized containers in which the seal is of primary importance. In the accompanying drawing is shown a crown cap consisting of a plate 10 and a fluted skirt 12. The skirt 12 is of an improved configuration to be more fully described hereinafter. Secured to the inner or underside of the plate 10 is a liner 22 which consists of a layer of compressible resilient material. Preferably the composition used will be primarily rubber or other suitable elastomer so compounded as to be odorless and tasteless, and to be otherwise free from effects on, and to be unaffected by, ordinary food and beverages materials which may be stored in the container 30. The liner 22 consists of a central diaphragm portion 24 which is preferably extremely thin, serving mainly to prevent access of the container contents to the interior surface of the plate 12, the same being normally of sheet metal.

Surrounding the diaphragm 24 is an annular zone 26 which is thin but may be somewhat thicker than the diaphragm. The zone 26 preferably extends to the periphery of plate 10 and is positioned to engage the rim 32 at the mouth of container 30. The zone 26 of rubbery material is preferably designed to act as a slight cushion between the cap and container, although little if any cushioning action is required of the zone 26 in the present construction as will hereinafter appear.

Spaced from the periphery of the cap by a distance slightly less than the thickness of rim 32, or in other words, located at the juncture of the diaphragm portion 24 and mouth-engaging zone 26 is a sealing ring 28 which projects as a ridge axially of the cap for a substantial distance. The ring 22 has a downwardly tapered cross-section, and at the base is somewhat larger in outer diameter than the internal diameter of the mouth of container 30, the latter being any one of several standard dimensions—approximately .64 inch in carbonated beverage containers of the type shown.

The liner 22 is firmly attached to the plate 10, preferably by pressure molding the same against the surface thereof. In this way the extremely thin portions of the liner are formed in place,

requiring no handling which might damage the same, and the whole liner is firmly bonded to the cap without the necessity for adhesive. However, it is considered that a liner of somewhat similar configuration may be formed separately and adhered in place if desired within the general principles of this invention.

When the liner 22 is in place in the cap, the cap is rested on the mouth of a container 30 as shown in Fig. 1, the edge of the sealing ring 28 being the portion of the liner 22 to engage the mouth of the container 30 and support the cap thereon. As the cap is pressed home and crimped, or otherwise secured to the container, the sealing ring 28 is forced into intimate engagement with the upwardly and outwardly curving bore of the container mouth and is deflected radially inward so that its tendency is to press outwardly against the adjacent portion of the lip or rim 32 and maintain a radial pressure which provides an initial intimate contiguity between the ring 28 and the rim 32 of the container.

Upon consideration of the showing in Fig. 2 it becomes apparent that when the contents of the bottle is such as to exert a gas pressure in excess of atmcspheric, the ring 28 operates in the manner of a check valve flap, and its seal becomes more effective due to its being pressed more and more tightly against the rim 32 by the container pressure as it increases.

From another standpoint also, the liner of this invention provides a seal more reliable than those hitherto employed. Let it be considered that the rim 32 having a flared internal surface is opposed by and slightly imbedded in the usual flat gasket. Under these circumstances, any minute lifting or bulging of the cap due to internal pressure, exposes a slightly larger piston area of the cap to the effect of the container pressure, thus increasing the cap lifting force, which then raises the cap a little further, and so on until a leak has been opened by the susceptibility of such conventional structure to progressive failure. An inspection of Fig. 2 reveals that when any slight lifting of the cap takes place, the sealing ring 28, due to its stressed condition moves radially outwardly to fill the space thus formed and maintains a fixed value of piston area substantially equal to the bore of the neck of container 30, since the ring 28 is designed to fill entirely the flare of said neck and extend down just perceptibly onto the cylindrical bore. In this fashion the raising tendency of the cap is held proportional to container pressure, and no aggravation due to increased piston area is introduced to expedite failure.

While liners 22 in accordance with the foregoing description are adapted for use with several types of closures, and particularly with crown caps of any description, a crown cap having an improved skirt construction as shown in the drawing, in combination with which the above-described liner 22 is particularly proposed for use in order that the fullest advantage may be taken of both features. In this form of cap the depending marginal skirt 12, which is deformable to provide the retaining skirt 12*a*, has flutes, grooves, or depressions 14 alternating with rib-forming pleats 16, the innermost portions of depressions 14 being formed by portions 14*a* and 14*b* related substantially at an angle of 75°, as seen in Fig. 1, instead of the usual value in the neighborhood of 120°, and giving to the cap the general appearance of having a radial flange.

Another way of stating this relationship is to

point out that the conically disposed portions 14*b* lie on a cone the axis of which is coincident with the cap axis and the apex of which lies beyond that end of the cap opposite to the end plate 10. The apex angle of this cone is shown as substantially 150°.

In either of the foregoing statements the angular relationship of the parts is not necessarily limited to the exact figures given. It has been found, for example that so long as the portions 14*b* have any appreciable upward slope away from the cap axis the advantageous results hereinafter pointed out will be apparent in some degree. By experiment the most practical and profitable range from the present manufacturing point of view has been determined as being between 70° and 80° for the angle between portions 14*a* and 14*b* (corresponding to an apex angle of between 140° and 160° for the cone on which portions 14*b* lie) and at the present time the exact values specified above, i. e. 75° (or 150° for the cone) are deemed preferable.

During the process of forming the cap of this invention the ends of the groove-pressing ridges on the cap-forming die draw the metal of the cap blank or disc to points lower than any other portion of the skirt to form downwardly extending protuberances 14*c* which are the connections between the groove portions 14*a* and 14*b*. The ribs 16 are formed in a manner similar to that of the usual cap, but due to the deep drawing at the points 14*c*, assume a curved outline of rapidly changing direction, and merge at last into the skirt periphery 18 without being the cause of any substantial waving or ruffling thereof, although the same has a faintly undulating outline in plan view, being drawn slightly inwardly along radial lines through points 14*c*.

In placing and sealing a crown cap on a container, a hollow die usually descends into engagement with the downwardly and outwardly extending pleats or ribs, strikes the flaring portions thereof and bends the ribs inward in response to further downward movement. The ribs thus become bent channels, the inner edges of which together with the bent intervening portions 14*a* form hooks engaging under a ledge or in a notch properly located in the container wall. This general procedure is conventional in the placing of crown caps and is also followed in the placing of the cap of this invention. However, although the steps followed are the same, the initial configuration of the cap is such that the results obtained from the capping operation are unusual.

When a standard capping die descends on the cap of this invention the reaction is somewhat different from that of the usual cap in several respects. In the first place, the periphery 18 of the skirt is smooth and unruffled, providing a relatively inexpansible reaction ring against which the ends of conically disposed driving portions 14*b* impinge. The toggle action of portions 14*b* will first tend to enlarge the periphery 18 of the skirt, and finding the same extremely resistant to enlargement because of its unruffled configuration, will be concentrated in an opposite vector inwardly along said driving portions 14*b* resulting in a quick and effective kinking and hooking of the edges of ribs 16 and the intervening portions 14*a* about axes 17 as the portion 14*b* passes through a substantially horizontal position under the influence of the capping die. The numeral 17 as seen in Fig. 2 represents the point at which such a kinking axis, perpendicular to the

drawing, intersects the plane of the drawing. Such an axis lies horizontally in the plane of each of the portions 14*a* at about the level indicated. This action is quite different from that occurring when the conventional cap is applied and provides a sharp bend at 17 with snug container engagement therebelow. In the usual case of the conventional cap, the ribs are gradually cammed inwardly and embrace the retaining surfaces of the container with a relatively long radius bent around the tip of the overhang 31, thus providing a shape which is markedly less resistant to spreading by a camming action under the influence of container pressure than is that illustrated in Fig. 2.

As the capping die continues downward the skirt will be forced into its final shape as shown in Fig. 2. Prior to this condition, the periphery 18 of skirt 12 may possibly take on a very slightly irregular or ruffled configuration at the very tips of the ribs, which ruffling, if any existed has then been pressed out and merged in the periphery 18*a* by the swaging action of the capping die. The portions 14*b* in the flutes are disposed approximately at the angle shown in the drawing, i. e. 45° downwardly away from the cap axis. A simple comparison will show that this angle is much nearer the horizontal than is found in the usual cap. The most readily available visual or tactile test for an applied crown cap having the novel shape above-described, is to inspect the bottom periphery of the skirt. Where the usual cap displays deeply recessed flutes or a pronounced gear tooth plan outline at this point, after application, the present cap has a substantially circular plan outline at the corresponding location, the tips of portions 14*b* lying between and filling in the gaps between the tips of the hooked ribs 16*a*. This is a graphic indication of the fact that the outward and downward slope of portions 14*b* in final position is much less steep than in the case of the conventional cap.

There is thus a ring of thrust members 14*b* provided which repose at a suitable angle such that they have a high horizontal strength value, the same being backed up by a reinforcing ring consisting of the skirt periphery 18*a* which is, if at all, only faintly expansible. This structure serves as a brace for the sharp hooks formed by the edges of ribs 16 and portions 14*a* in bending under the cap retaining overhang 31 of container 30 about axes 17, and furnishes a structure of improved and stiffened character which renders still more difficult any spreading of said hooks in response to a lifting tendency of the cap due to internal pressure.

The unique cap structure set forth above provides a retaining skirt of improved strength such that increased pressure can be retained with a normal gasket in place of the improved liner 22, and when sheet metal of normal thickness is used in its construction. On the other hand, when light weight and more ductile sheet metal usually considered unsatisfactory for any given standard pressure capping problem is used, it may be made to serve creditably and meet all requirements of the trade.

These advantages are not only equally present when the liner 22 is formed or inserted in a cap having the unusual skirt above-described, but they are in fact extended by the very presence of the liner 22 as will now be pointed out.

Let it be considered that in reducing the thickness of the cap material for a given working pressure, which reduction is permitted by making the

skirt in the novel manner described, the cap is subject not only to the usual lifting tendency under excess pressure, but also takes on an increased inclination to bulge and deform since the stiffness of the top plate 10 is reduced with the reduction in material thickness. This bulging tendency, acts in addition to and in the same general direction as the cap-lifting tendency in so far as causing an increase in piston area is concerned, which action is defeated by the presence of the improved liner 22 in the manner described above. It can thus be seen that the thickness or weight of sheet metal may be even further reduced since the adverse effects of any bulging which might appear when more than normal pressure is present in the bottle are overcome, and still further savings in material cost result.

The form of the invention illustrated herein includes a further important feature in the cross-sectional configuration of the cushion zone 26 of liner 22. As shown in Fig. 1, before application to the container, this zone has a thickened peripheral portion 26*a* which fills the annular corner formed between the plate and the skirt 12 of the cap. The surface of this thickened portion engages the lip 32 of container 30 as the cap is pressed home during the sealing operation. The final pressure applied during the sealing operation squeezes and extrudes the thickened portion 26*a* and deforms the same into a shape such that it extends well down onto the outer surface of the lip 32, assuming the shape indicated by the numeral 26*b* in Fig. 2, and is strongly urged against the same by its own resilience. When the cap is finally in place, as seen in Fig. 2, the cushion 26, including peripheral portion 26*b* thereof, together with the projecting annulus 28, engage and embrace the lip 32 of the container with intimate resilient sealing engagement over an extensive portion extending continuously from the inside to the outside thereof.

Another form of the invention is illustrated in Fig. 3, in which the thickened portion 26*a* at the periphery of the mouth-engaging zone is dispensed with, and in which similar parts have the same reference characters as in Figs. 1 and 2. Here the mouth-engaging zone 26′ of the liner 22′ is substantially the same thickness throughout, except that it tapers off to a feather edge at the extreme periphery, and is little, if any, thicker at any point than the diaphragm 24. It will be appreciated that a liner 22′ having the configuration shown in Fig. 3 will serve its purpose in substantially the same manner as that of Figs. 1 and 2, for the predominant feature of the flexible protruding ring 28, which is deformable by the mouth 32 of container 30 to have improved sealing contact thereagainst, is likewise a feature of this construction.

Expressions used herein for designating direction, for example, top, bottom, upper, lower and the like, are made to correspond with the directions shown in the drawings. These are adopted for purpose of convenience and brevity only and will be understood as being purely relative terms, since closures of the character herein described can be disposed at any desired angle to the vertical without change in the principles discussed herein.

It is apparent from the foregoing description that the present invention provides an improved liner for a container closure, which liner is capable of providing a firm and reliable seal whose quality is not dependent upon minor lifting

movements of the closure, and in which the seal is, in fact, assisted by increases in internal pressure. The invention further provides a combination of an improved liner with an improved closure member of such advantageous operating characteristics that lighter weight materials can be used in the construction and substantial savings in material can be effected.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

I claim:

1. A cap for a container having a mouth formed with a transversely curved lip thereabout having an end surface with an annular inner edge, said cap comprising a top plate and a skirt depending therefrom to fit over the mouth of the container and grip a retaining ledge on the exterior of the container adjacent the mouth, and a sealing member on the undersurface of the plate and positioned to be interposed between the plate and the lip of the container to seal the mouth: the improvement wherein said sealing member consists of a unitary thin disk of resiliently deformable elastomer completely covering said plate and having an annular contacting surface adapted to engage the end surface of the lip and consisting of a peripheral marginal portion adapted to substantially overlie and engage the outer portion of the end surface of the lip and conform thereto with slight deformation of its material when the cap is secured to the container and an integral preshaped annular ridge, a substantial portion of which is adapted to overlie and engage the inner portion of the end surface of the lip, said ridge having an outer side blending into said marginal portion at a point intermediate the inner and outer edges of the end contacting surface and sloping downwardly and inwardly from said merging point at an obtuse angle with respect to said marginal portion and an inner side extending from the thin central portion of the disk and converging with the outer side at an apex located within the mouth, the ridge being adapted to be flexed inwardly by the lip as the cap is applied to grip the ledge, the resiliency of the flexed ridge, when applied to a container, causing the same to press against an inner portion of the end surface of the lip and the inner edge of said lip in sealing engagement therewith and fill the space between the lip and top plate for various flexed positions of said plate.

2. The invention as defined in claim 1 wherein the top plate and skirt are joined by a curved portion and wherein the peripheral marginal portion of the disk has a preformed annular channel adjacent the merging point of the rib providing an inwardly spaced thin section and a thicker deformable outer section which fills the space between the outer edge of the lip and the curved portion of the cap between the top and skirt when the cap is applied to the container.

3. The invention as defined in claim 1 wherein the thin central portion is thinner than the marginal portion and the inner side of the rib terminates closer to the top plate than the outer side.

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