March 6, 1951

H. Z. GORA

2,543,774

CONTAINER CLOSURE

Filed March 8, 1949

Fig. 1

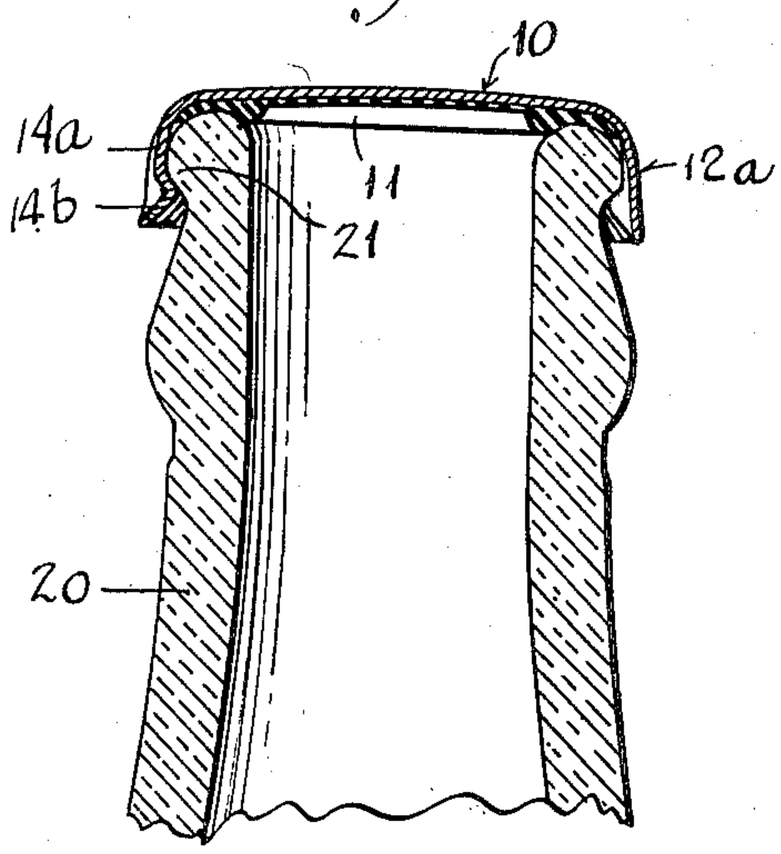


Fig. 2

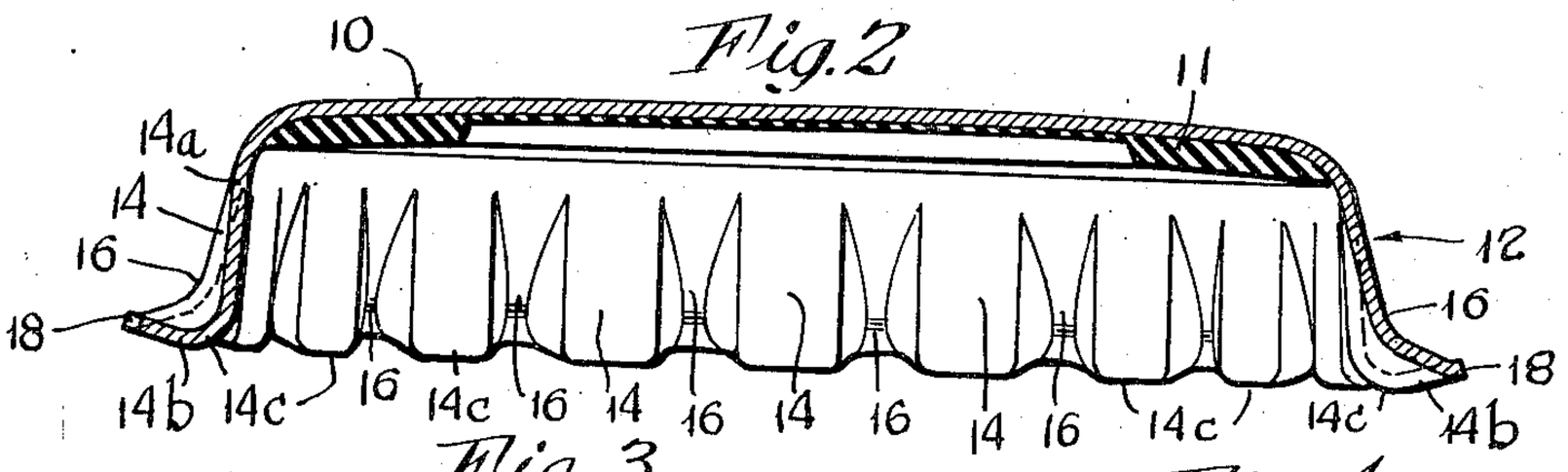


Fig. 3

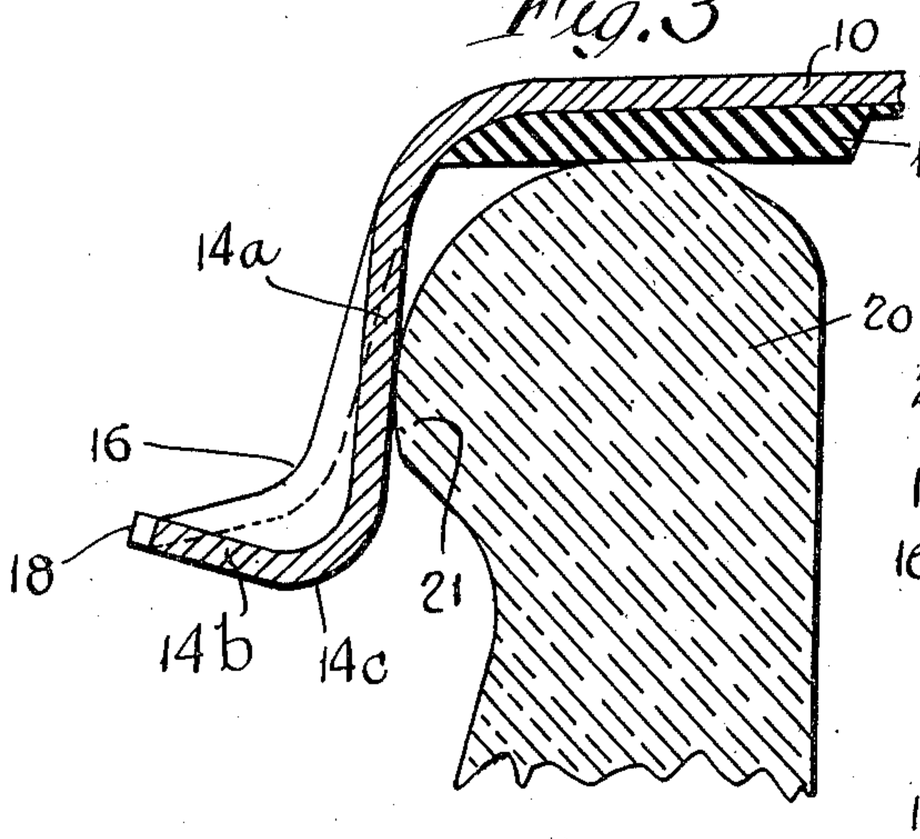
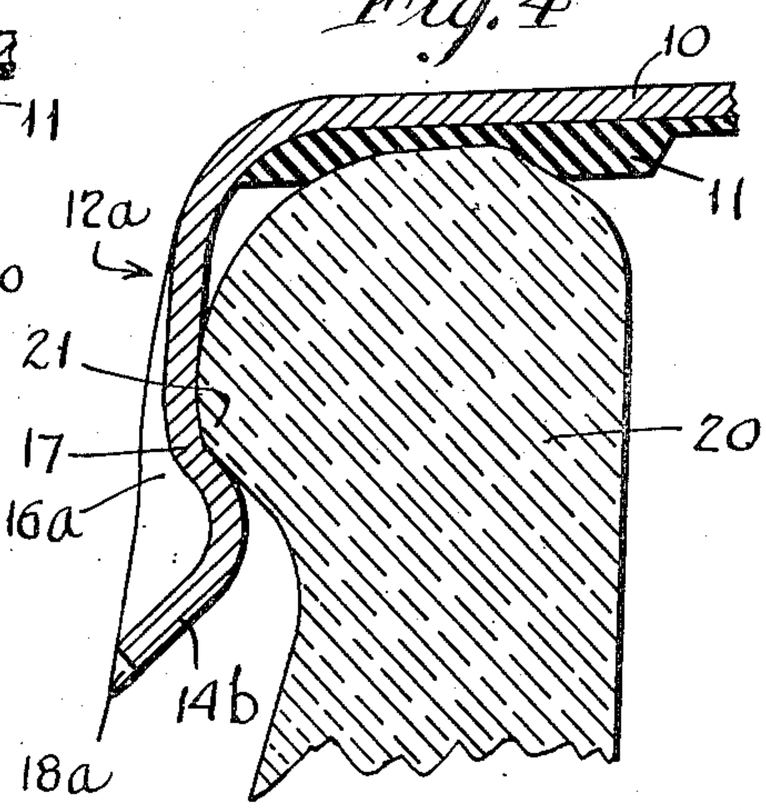


Fig. 4



Inventor

Henry Z. Gora

By

Johnson and Kline

Attorneys

Patented Mar. 6, 1951

UNITED STATES PATENT OFFICE

2,543,774

CONTAINER CLOSURE

Henry Z. Gora, Stratford, Conn., assignor to The Gora-Lee Corporation, Stratford, Conn., a corporation of Connecticut

Application March 8, 1949, Serial No. 80,185

2 Claims. (Cl. 215—39)

1

This invention relates to container closures or caps, and particularly to the type of cap which comprises a top plate and a depending skirt having hook portions bendable into underlying relationship with overhangs or undercuts on the container. Closures of this type are often in the form of a plate the marginal edges of which are deformed to provide a fluted skirt, and are known as crown caps.

It is the practice in the art to provide those containers which have a standard beverage mouth and are subject to internal pressure, with a cap which has been blanked and formed from tin plate of .012 inch thickness or over, if the reliability of the seal is any consideration. The reason for this is that caps blanked from material of lighter weight and greater ductility have been found by experience to be unreliable in retaining the seal with which they are initially applied to their containers. This results in pressure leaks, for example in carbonated beverage containers, and causes an inadmissably high proportion of containers to have their contents rendered unfit for normal use.

It is an object of the invention to provide a closure of the type above described in which lighter weight material may be employed, e. g., on standard mouth carbonated beverage containers tin plate of only .009 inch in thickness, but having a novel configuration such that a reliable seal can still be effected when sealed by conventional means in a conventional manner. In this fashion, a light weight sheet is made to serve in place of, and to serve as well as sheets of a heavier weight, and substantial savings in material can thus be effected.

The novel configuration which is a feature of this invention and by means of which the foregoing object is attained is most clearly identified in the cross sectional view of the cap skirt taken at the flutes thereof. Whereas the usual skirt flutes are normally formed of portions related to each other at an angle substantially in excess of 90°, the cap of this invention is so shaped that the corresponding angularly related portions are at an angle of less than 90°, and it is an object of the invention to construct a cap or closure provided with this novel configuration.

Additional features and advantages will hereinafter appear.

In the drawing:

Figure 1 is a section of a container with a cap according to the invention applied thereto.

Fig. 2 is an enlarged section of a cap according to the invention and before application to a container.

2

Fig. 3 is a fragmentary section showing details of the cap of Fig. 2 to a still larger scale.

Fig. 4 is an enlarged fragmentary section showing the cap of the invention when applied to a container.

The invention hereinafter described is of particular use in connection with closures known as crown caps and will therefore be described in that connection although not limited exclusively to such use. The improved closure according to the invention consists of a top or end plate 10, usually lined with sealing material 11, and having a depending marginal skirt 12 which is deformable to provide the retaining skirt 12*a*. As is usual with caps of this type, the skirt 12 has a fluted configuration, i. e., there are flutes, grooves, or depressions 14 alternating with rib-forming pleats 16 therein. The pleats 16 are preferably formed as usual by a process wherein a flat metal disc is forced into a shaped female die. Inwardly extending ridges on the die form the grooves 14, while the pleats 16 result when the metal of the flat sheet automatically forms folds or pleats between the ridges in response to the drawing pressure.

The approximate profile of the die ridges used heretofore in making an ordinary crown cap can be seen from the angle which those portions at the innermost part of each flute or depression make with each other in the cap as originally formed before application to a container. While connection between these portions may take the form either of a sharp corner or of a curve, the extremities normally diverge at an angle of between 110° and 150°, the usual value being about 120°. At the same time the margin and edge of the skirt is formed with a pleated or ruffled configuration corresponding to the flutes and ribs.

The cap according to the present invention is formed using a die, the ridges of which are so configured that the flutes 14 will have the shape shown in Figs. 2 and 3. The cylindrically disposed or wall portions 14*a* and the conically disposed or flared portions 14*b* forming the innermost part of each groove 14 are seen to form an angle of about 75° with each other, giving 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 satisfactory 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 the ends of the groove-pressing ridges on the die draw the metal of the 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. For example, the capping of pressure vessels of the standard carbonated beverage type having a mouth whose internal diameter is substantially .64 inch and whose external diameter is substantially 1.03 inches, is almost invariably conducted with caps made from sheets of approximately 103 pound tin plate at least .012 inch in thickness when a reliable result is desired. An equally satisfactory product can be obtained however on such a standard container, by using a cap having the configuration of this invention, but in which the same is made using approximately 80 pound tin plate only .009 inch in thickness. This represents a saving of about twenty-five percent in material costs and the accomplishment of a satisfactory capping operation with material generally conceded to be ineffective for the purpose by those acquainted with the problems and procedures of the art. By subjecting containers having caps shaped according to this invention and made of .009 inch plate to tests, it was determined that the cap is capable of retaining test pressures up at least to 280 p. s. i., a pressure which insures reliable, leak-free operation under actual conditions of use. The significance of the improved structure becomes particularly apparent when a comparison is made with caps of .009 inch plate which are conventionally formed. In this case test pressures can be reached in the neighborhood of 50 p. s. i. only whereas conventionally formed caps made of .012 inch plate leak at pressure in the neighborhood of 210 p. s. i.

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 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. 4 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 bend around the tip of the overhang 21, 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. 4.

As the capping die continues downward the skirt will be forced into its final shape as shown in Figs. 1 and 4. 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 which is the essence of this invention, is to inspect the bottom periphery of the skirt. Where the usual cap displays a continuous series of deeply recessed flutes or a pronounced gear tooth plan outline at this point, after application, the cap of this invention has a substantially circular plan outline at the corresponding location, at least the majority of 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 suitble angle such that they have a high horizontal strength value, the same being backed up by a reinforcing ring con-

sisting 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 ribs 16 and portions 14*a* in bending under the cap retaining overhang 21 of container 20 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.

Another feature of the cap of this invention is the unique profile of ribs 16. While progress from the top to the bottom of a rib on the usual cap results in a change of direction in the neighborhood of 50°, the deep drawing process used to form the depressions 14, produces ribs 16 which have a change of direction of nearly 75° between ends. This rapidly changing slope, apparent from an inspection of Figs. 2 and 3, in company with the resistance resulting from the angular relationship of driving portions 14*b*, appears to bring about a sharp localized resistance at one point in the stroke of the capping die and a corresponding increase in force necessary to move the die. This resistance, in fact occurs at the same time that the ribs 16 are being suddenly and forcefully crimped inwardly to form hooks 16*a*, so that the top plate 10 is at that instant being applied to the mouth of container 20 with a maximum of force. The force is thus captured and held by the hooks and is sufficient to provide an extremely effective seal and insure against incidental leaks due, for example. to minor faults in the container lip.

In comparing caps made of similar material, the capping force mentioned heretofore is substantially greater for a cap having the novel configuration of this invention than it is for one of the conventional type. Another useful comparison can also be made between caps for standard beverage containers in which the conventionally shaped cap is of the usual .012 inch plate and the cap according to this invention is of .009 inch plate. It is found that the pressure required to apply the latter cap is in fact equal to or greater than that required for the former under comparable circumstances and therefore has at least equivalent sealing power from the standpoint of lip defects.

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 drawing. These are adopted for purposes 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.

The phrase "substantially unpleated, unruffled inextensible peripheral edge" as used herein refers to an edge which is substantially continuous as distinguished from the uniformly corrugated edge of the standard crown cap.

It will be seen that the foregoing invention results in a closure or cap which, while of generally standard dimensions and suitable for use with standard equipment in the usual way, is nevertheless of such novel configuration and demonstrates operating characteristics of such proportions, that

a very substantial saving in material can be effected. Conversely, using a material of maximum workable thickness for any given diameter, a cap in accordance with the invention can be used to hold pressures not considered as within the province of crown closures according to previously known constructions.

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 sheet metal cap of the crown type having a sealing gasket carrying shell comprising a top plate and a depending skirt having a wall portion and a connecting outwardly flared bottom portion terminating in a free edge of single thickness, the skirt having spaced pleats in the wall portion and continuing into the flared portion, said pleats increasing in depth to the juncture of the wall portion and flared portion and thereafter decreasing in depth and having downwardly and outwardly sloping outer edges and permitting contraction of the skirt against a retaining ledge on the exterior of a container neck to hold the cap in sealing relation with the end of the container neck upon application of a capping tool to the downwardly and outwardly sloping edges of said pleats: the improvement which comprises having the pleats in the flared portion terminate with no appreciable height at the free edge of the skirt, the material of the flared portion between the pleats extending outwardly and upwardly from the wall portion between the pleats at an acute angle with respect thereto and converging with the pleats and merging with the terminals thereof and forming with the terminals of the pleats a substantially unpleated, unruffled inextensible peripheral edge of single thickness which stiffens the skirt against collapsing when the cap is applied to the container by application of capping force to the profiles of the pleats causing the skirt to be sharply bent around the retaining ledge of the neck of the container, the flared portion when so applied being bent inwardly and the peripheral edge being swaged by the capping tool to restore it substantially to unpleated, unruffled inextensible condition which stiffens the skirt against expansion from its contracted condition on the neck of the container.

2. The invention as defined in claim 1 wherein the acute angle between the material of the flared portion between the pleats and the wall portion between the pleats is approximately 75 degrees.

HENRY Z. GORA.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
888,995	Godman	May 26, 1908
934,072	Hicks	Sept. 14, 1909
954,405	Witmore	Apr. 5, 1910
1,425,349	Taliaferro	Aug. 8, 1922
2,048,062	Elder	July 21, 1936
2,063,454	McManus	Dec. 8, 1936