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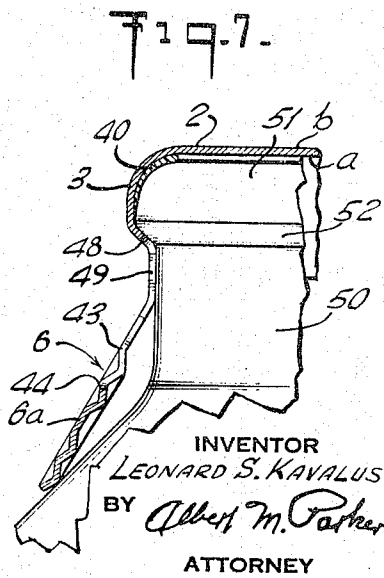
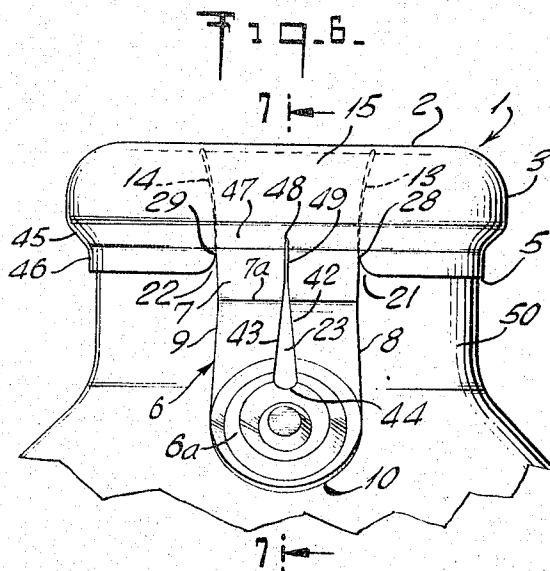
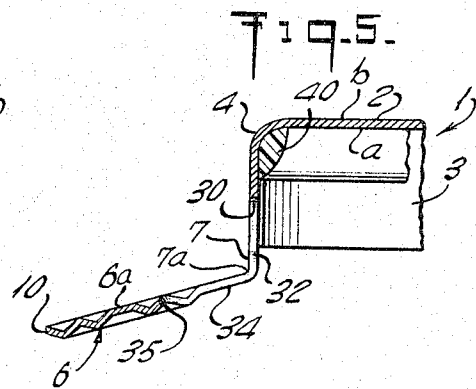
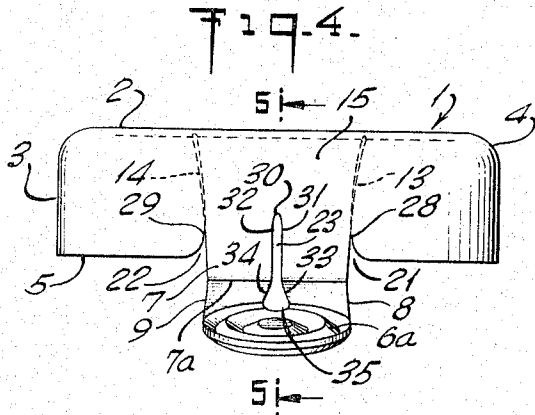
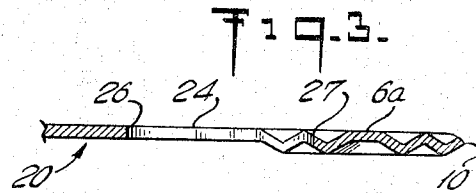
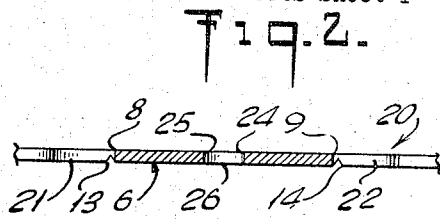
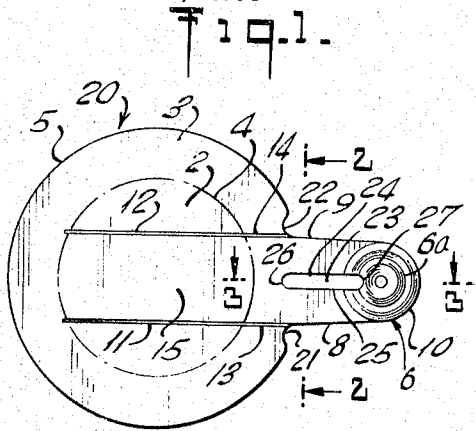
L. S. KAVALUS

3,301,426

CLOSURE CAP

Filed June 5, 1964

2 Sheets-Sheet 1



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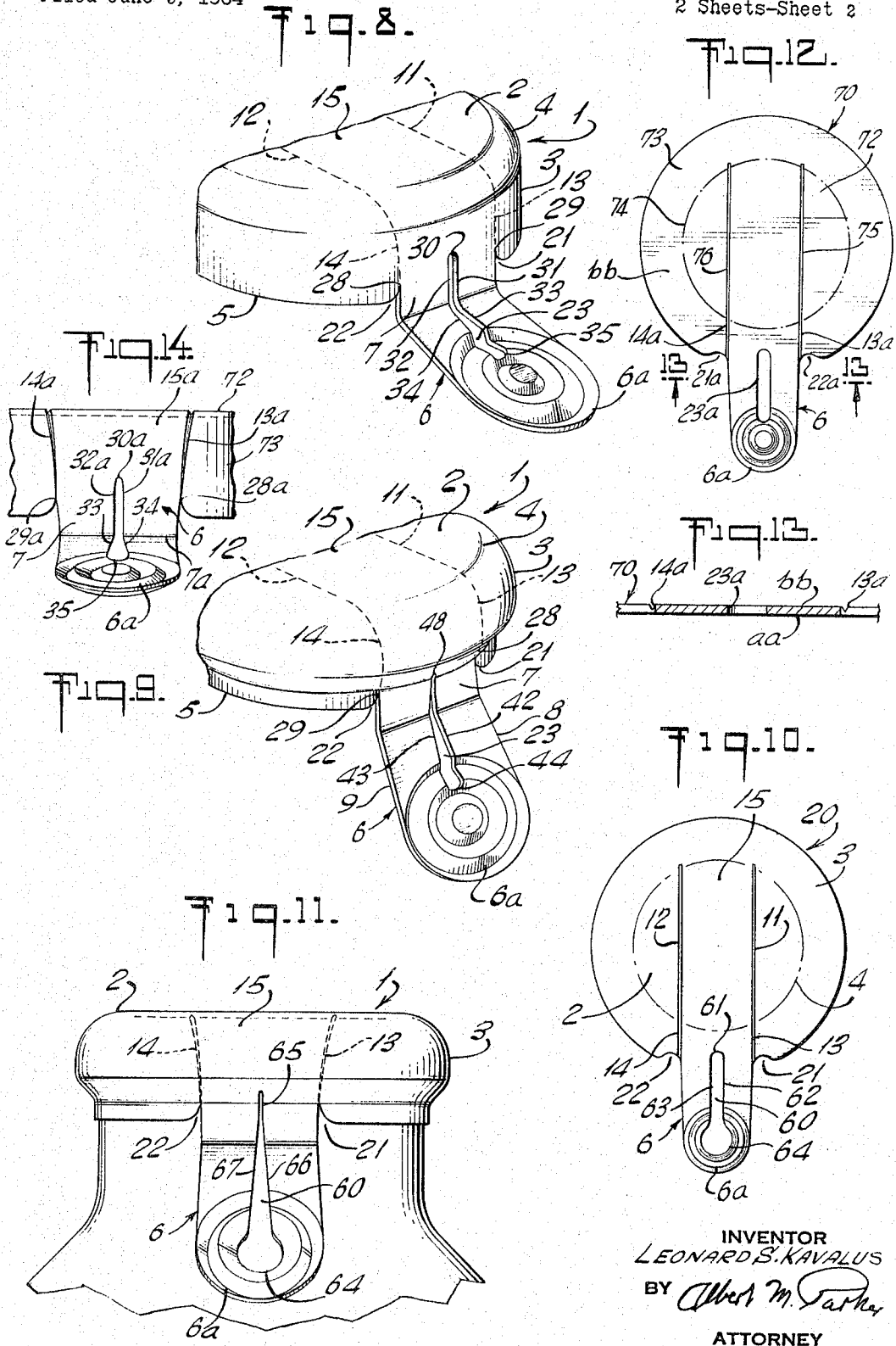
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CLOSURE CAP

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2 Sheets-Sheet 2



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1

3,301,426
CLOSURE CAP

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2 Claims. (Cl. 215-46)

This invention relates to finger grip tear-off closure caps for container openings and to methods for forming the same and is particularly concerned with such caps formed of thin lightweight metal which caps, when secured over the openings of bottles, jars, cans and the like, effectively close and seal those openings, even against substantial pressure, but are nevertheless easily hand destructible for removal.

In closure caps as heretofore devised, formed out of lightweight sheet material and provided with gripping ears to be gripped between the fingers for ready destruction and removal of the caps, and in the method of manufacturing such caps, various problems have arisen. Probably the most serious and most difficult to overcome is the provision of scoring defining a tear strip which will leave sufficient metal of the cap to assure against failure under the pressures encountered in capping bottles of fluids, such as beer and soda water, but will still enable the consumer, by grasping a tearing ear between the thumb and forefinger, to pull and thus tear along the score lines with comparative ease so as to destroy the cap and get at the container contents. Uniformity of pull for cap removal from one bottle to the next is also desired.

The scoring may be most exactly applied to the cap, in the flat blank, but then comes the initial distortion, closing up, or stiffening, of the score when a substantial peripheral portion of the flat blank is drawn into a cylinder to form the cap skirt. In this drawing action peripheral portion has its diameter progressively reduced from the greatest diameter of the initial blank at the bottom of the skirt to substantially that of the cap top portion where the skirt departs from the top.

It will be evident from what has just been said that the crowding of the metal gets progressively greater towards the free edge of the formed cylindrical skirt and thus the crowding and blocking, or other deformation of the scores, takes place in similar progression. It is not quite as simple as this, however, for the presence of the ear extending away from the edge at one position has been found to introduce other factors interfering with ease of tearing. Additionally, even minute variations in manufacturing facilities, sometimes hardly detectable, render the blocking or disruptions in the scoring different from one cap to the next.

Other disturbing factors difficult of determination are introduced when such caps, after having been applied over the container openings are then acted on to secure them in place. This is done by forming the cylindrical necks radially inwardly to a cylindrical or other formation of still smaller diameter. This forming is commonly done by capping tools, operating on a spinning principal. Here, again, minor variations in settings of such things as spinning rolls introduce unexpected variations. At this stage, however, another source of variation comes into the picture, particularly if the container be of glass. This is because the necks, or finishes, on bottles, or other glass containers, though formed to certain standards, are

2

not normally formed with the precision of machine made metal parts.

In seeking to overcome this difficult problem, it has been necessary to keep in mind that retention of uniform easy tearing cannot be achieved at a sacrifice of tight securing for pressure retention. Thus the efforts at a solution have largely been devoted to such aspects as modification of the scoring and to the extent and direction of it, and to the notching of the cap skirt in various manners in an effort to absorb the disruptive factors by one or more of these corrective factors without reducing the securing beyond what is needed. However, none of them, nor any combination of them, have so far provided a solution of the problem. Some of these prior art developments have made the caps too weak in pressure retention. Others have made them too hard to remove and none of them, no matter how carefully they have been worked out, have succeeded in providing uniformity of removability, particularly in the range of the few pounds pull that must be the criterion if the product is to be universally acceptable to the general public. None of them, until the advent of the instant invention, have given full appreciation to the part the tearing ear plays in interfering with the desired removability. Certainly none of them have had any appreciation of how the tearing ear can be employed to provide a solution.

The cap and method of forming and applying same, in accordance with the invention, provides a real and complete solution to this overall problem. It does so by taking the stresses and strains right away from the scored area through providing an absorption area where they can spend themselves without detracting from any of the advantageous aspects of the cap. It has, in accordance with the invention, surprisingly been found that when the tearing ear and the commencement of the tear strip aligned therewith have an absorption area imparted thereto neither in the initial stage of forming the cap out of the flat blank to a member with a flat top and a cylindrical skirt, nor in the securing stage involving contracting that cylindrical skirt to secure the cap onto the bottle, are the provisions for tight securing and easy tearing interfered with to any material extent.

By slotting or removing a relatively narrow elongated portion of the tearing ear and of the tear strip continuing therefrom, the invention has provided a place in which the crowding of the metal of the skirt can be taken up. The invention has also removed the heretofore unappreciated disturbing effects caused by the presence of the ear itself. It has done so in a manner and by means whose yieldability is such, with regard to the scored part of the skirt, that the deleterious deformation of the scores, as found in the prior art, is substantially eliminated. Instead, when equipped with the scoring designed to leave sufficient metal to withstand the pressures imposed on the cap and yet to enable removal to be effected by a pull within the poundage range acceptable to the public, the cap of the invention, after forming and securing, will perform as designed. In addition, it has incorporated in it a sufficient margin of flexibility that, regardless of normal variations in the surface of the container to which the cap is to be applied, the cap of the invention will provide a tight seal and will be easily removable in the manner desired.

It is accordingly the principal object of this invention to

provide new and improved tear-off closure caps for containers.

Another object is to provide a novel method for manufacturing such caps.

Another object is to provide a novel method for securing such caps over container openings.

Still another object of the invention is to provide such caps which though scored for removal by destruction through tearing, will withstand with a minimum of weakening or variation the action of securing them to container openings.

Still another object of the invention is to provide such caps which are uniformly readily removably by destruction through tearing by the exertion of pulling power in a range which the public generally is capable of exerting.

A further object is to incorporate in such caps safeguards against undesirable variations in their removability resulting from variations in such things as manufacturing, applying and surfaces to which they are applied.

A further object is to provide flat scored cap blanks with adequate safeguard to minimize detrimental effects on the scores caused by the drawing of the cap skirt portion away from the top and/or the subsequent contracting of the cap skirt in the applying of the cap.

A further object is to provide such safeguards, whether scored on its internal or external surface.

A still further object is to provide such caps with enhanced gripping facility in the tearing ear.

Further and more detailed objects of the invention will in part be obvious and in part appear as the description of the invention, taken in conjunction with the accompanying drawing proceeds.

In that drawing:

FIG. 1 is a bottom plan view of the cap blank for use in forming the closure cap of the presently preferred form of the invention.

FIG. 2 is an enlarged fragmentary vertical sectional view taken on line 2—2 of FIG. 1 termed upside down and looking in the direction of the arrows:

FIG. 3 is an enlarged fragmentary vertical sectional view taken on line 3—3 of FIG. 1 and looking in the direction of the arrows:

FIG. 4 is a front elevational view of the completed cap in accordance with the invention:

FIG. 5 is a fragmentary vertical sectional view taken on line 5—5 of FIG. 4 and looking in the direction of the arrows:

FIG. 6 is a front elevational view of the cap of the invention shown as secured in place on a container neck:

FIG. 7 is a vertical sectional view taken on lines 7—7 of FIG. 6 and looking in the direction of the arrows:

FIG. 8 is a fragmentary perspective view of a completed cap as shown in FIG. 4 taken from the tearing ear side thereof:

FIG. 9 is a similar view but showing the cap as it appears when sealed in place on a container neck or bottle finish as shown in FIG. 6.

FIG. 10 is a bottom plan view of a modified form of cap blank:

FIG. 11 is a view similar to FIG. 6 of a cap formed from the blank of FIG. 10.

FIG. 12 is a view similar to FIG. 1 of a cap blank scored on the opposite surface from that of FIG. 1.

FIG. 13 is an enlarged fragmentary section taken on line 13—13 of FIG. 12 and looking in the direction of the arrows, and

FIG. 14 is a view similar to FIG. 4 but showing an exteriorly scored cap as formed from the blank of FIG. 12.

Considering first the general aspects of the closure cap of the invention as shown in FIGS. 4 and 5, the cap generally indicated at 1 comprises a flat disc-like top 2, surrounded by a depending skirt 3 with the juncture of the top and skirt being indicated at 4. The skirt 3 terminates in a downwardly facing free end edge 5, which edge, except for the portion from which the gripping ear

6 extends, forms a complete circle. The ear 6 extends directly downwardly from the skirt for a short distance in a neck portion 7 and then turns radially outwardly on a somewhat downward incline away from the cap. The ear side edges 8 and 9 taper slightly inwardly toward each other throughout their extent from the free edge of the skirt to their rounded ear end portion 10.

The cap 1 has either its interior surface *a* or exterior surface *b* as desired, scored along a pair of lines. The score lines may also follow any particular pattern in their extent across the cap, such as diverging outwardly away from each other in either curved or straight lines. For the purpose of illustration, however, the scoring of the cap of FIGS. 4 and 5 is shown as being formed into interior surface *a* of the cap and as having portions 11 and 12 which extend across the cap top and portions 13 and 14 which extend across the skirt 3 lying in substantially parallel relationship as shown in FIGS. 1 and 4. Accordingly a tear strip 15 is formed between the scores as a continuation of the ear 6 which tear strip extends a substantial distance across the cap.

The completed cap blank 20, from which the cap of FIGS. 4 and 5 is made, is shown in full in the bottom plan view of FIG. 1. Enlarged sectional fragments of it are shown in FIGS. 2 and 3 with FIG. 2 being turned upside down from the showing in FIG. 1. The blank 20 is seen to be notched at 21 and 22 at the juncture of the ear sides 8 and 9 with the blank periphery 5. Most important, however, is the fact that the ear 6 has a strip of metal punched out of it to form an elongated opening 23, which is shown here as a slot having parallel sides 24 and 25 and inner and outer curved ends 26 and 27 respectively. Looking at the flat blank of FIG. 1, the elongated slot 23 is seen to have its longitudinal center line coincide with the longitudinal axis of the ear 6. The inner end 26 of the slot extends radially inwardly to a position slightly beyond the innermost extent of the notches 21 and 22. Looking at it another way, the slot 23 extends inwardly so as to lie between the score lines 13 and 14 just inwardly of the position where those score lines meet the notches 21 and 22. The position of the outer end 27 of the slot 23 is not as significant as that of the inner end 26 and is shown as being in the portion of the ear 6 which is suitably embossed at 6*a* to facilitate gripping. Though for the purposes of illustration the elongated opening 23 has been shown and described as a slot having parallel sides it is to be understood that the invention is not limited thereto. Elongated openings of different shape, so long as they are capable of serving the intended purpose, are encompassed within the invention.

Having on hand a scored, notched and punched blank 20 the next step in the forming of the cap of the invention is the cupping or drawing operation wherein the peripheral skirt portion 3 of the flat blank 20 is drawn laterally with respect to the central or top portion 2. The result of this is depicted in FIGS. 4, 5 and 8. In the forming or cupping of a cap out of the flat blank 20, the metal of the skirt portion 3 is rather severely worked or crowded by the varied reduction of its diameter from the turning line 4 out to the blank periphery 5 as the skirt portion is moved into lateral position. What has not heretofore been appreciated is that the metal in the part of the skirt from which the ear extends is placed under considerably greater stress than the remainder of the skirt. Considering then the fact that in its scored areas the skirt has been thinned out and weakened before the cupping step is carried out, it can be appreciated that if no effective safeguard is introduced the effects of the working are most seriously manifest in the score areas.

In prior art caps such effects as the deformation, distortion, closing up or side overlapping of the scoring or various combinations of those effects, increased in severity as the movement of the metal increased toward its maximum at the free edge of the skirt. These effects prevailed at both sides of the tearing ear though not neces-

5

sarily to equal extent. This condition gave rise to unpredictable, non-uniform tearing characteristics. Commonly these run toward too great resistance to tearing but then the contrary also takes place.

Turning now to FIGS. 4 and 8, one can see how the provision and position of the elongated opening or slot 23 provide the solution to the prior art problems. This is rather graphically illustrated by the shape which the slot 23 has taken in FIGS 4 and 8 as distinguished from its initial form in the blank of FIG. 1. Basically it is seen that the side walls 31 and 32 of the slot have yielded to the stress created in the whole of the skirt and particularly in the portion thereof from which the ear extends in the forming of the skirt out of the flat. As illustrative of where the stresses act it is seen that the top part of the slot at 30, as viewed in FIG. 4, is closed in into somewhat of a point instead of being rounded as seen at 26 in FIG. 1. Continuing on down from that the slot is narrowed with its sides 31 and 32 being moved in toward each other down through the neck portion 7 of the ear to about the position 7a where the ear bends laterally. Going back to FIG. 4 it is seen that the top 30 of the slot lies substantially above a horizontal line passed through the lower end portions of the score lines. This then assure that, at the outset, there is an open slot lying in opposition to the position where the slits 21 and 22 are closed up and also in opposition to the position where the scores 28 and 29 commence. The fact that this slot has been narrowed shows graphically that the stress in the skirt in the zone of these positions is taken up in collapsing the sides of the slot toward each other.

Though the portions of the skirt which have been thinned down in the scoring are less capable of resisting the distortive forces created by the stress in the skirt than is the unscored portion, the scored portions are, nevertheless, able to resist those forces to a greater extent than are the side walls of the slot. Thus before the scores are altered in formation to such an extent as to make any material difference in the tearing characteristics, the forces are transmitted to and act upon the walls of the slot closing the same up to a certain extent.

The fact that the slot 23 extends down the tearing ear to the position 35 which, as seen from FIG. 5, is a considerable distance beyond the bend line 7d provides a further easing of the stresses on the lower end of the scores. This is because the increased length of the slot beyond the stress position enables the sides of the slot to be bent in more easily through the stress position. Fortunately the extension of the slot downward provides no detrimental effect in the ear and may in fact enhance the gripping of the ear but to do that to any substantial extent it is preferable to continue the slot further down as is illustrated in FIGS. 10 and 11. The elimination of restriction against collapsing the sides of the slot gives more room for the metal of the tearing ear, at least the portion 7 thereof, to flow away from the ends of the scores and accordingly provides a greater safeguard against a closing or other interference with those scores.

Though the metal in all of the skirt is rather severely stressed in the forming of the skirt 3 from the flat blank into the cylinder, it appears, from graphical studies that have been made in connection with the invention, that the stress is not as severe in the remainder of the skirt 3 as it is in the narrow portion thereof from which the tearing ear 6 extends. The extension of the ear from a portion of the skirt appears to prevent flow of the metal in that portion of the skirt which would, to a certain extent, relieve the stresses. Apparently, also, in the absence of an elongated opening or slot such as 23, the stress in the portion of the skirt between the scores 13 and 14 and from which the ear 6 extends has a reactive effect which has been causing the disturbance or blocking of the scores in the positions 28 and 29, as seen in FIG. 4, where the scores extend into the closed up ends of the notches 21 and 22.

6

It is then this different flow path of the metal in the portion within the score lines, as against that outside of the score lines, which seems to have been causing the trouble in the prior art. This condition, however, as just pointed out and as shown by the shape that the slot 23 adopts when the blank is cupped, is taken care of by, or one might say that the action of it is absorbed, in closing in the sides of the slot rather than disturbing the score. This does not interfere with the strength of the ear 6 as needed for pulling on it to break the scores and tear out the tear strip 15 so, as against all the prior art efforts to solve the problem, the solution here is a real solution and one which is unaccompanied by any drawbacks.

Turning now to consideration of the condition of the cap after it is secured in place on the bottle finish by spinning or other securing action, attention is directed to FIGS. 6, 7 and 9. The cap 1, as indicated in FIG. 4, has of course been provided with a suitable lining or gasket as indicated at 40, which, as seen in FIG. 7, is sealingly engaged with the bottle bead or finish 51, being deformed and spread over that finish in the course of the securing action. To effect the securing of the cap calls for further reduction of the diameter of the previously formed skirt. Also this reduction will normally be in stepped annular zones since the skirt of the cap will be drawn in underneath the bead of the bottle finish and will have its lowermost portion secured against the neck of the bottle underlying such bead. With the bead and neck as shown in FIGS. 6 and 7, the major portion of the bead 51 has an inclined undersurface 52 which extends into the bottle neck 50 here shown as substantially cylindrical. It is, of course, to be understood that though this bead and neck formation is intended to be illustrative of a form which is standard in the soft drink and beer bottle industry, the cap of the invention can be satisfactorily secured to a variety of other finishes.

Proceeding with a consideration of the cap as applied to the illustrative finish just referred to, it will be seen that in the securing of the cap in place on the bead one portion 45 of the skirt thereof is drawn in on an incline underneath and against the surface 52 of the bead, while the remaining portion 46 of the skirt is drawn in to the greatest extent being formed against the bottle neck 50.

The inward forming of the portions 45 and 46 of the skirt 3 which, of course, includes the neck portion 7 of the tearing ear, a strip 47 of which is inclined inwardly the same as the portion 45, is preferably achieved by the use of spinning rollers which move the metal inward progressively. This, of course, further reduces the radius of the inwardly formed skirt portions additionally stressing the metal thereof beyond the stresses imposed in the forming of the cap skirt 3. This action can be quite severe and, as pointed out in the foregoing, the results may be very considerable, depending upon such things as the setting of the forming rollers and the quite commonly encountered variations in the glass finish and neck. It can be readily appreciated then that, in the prior art, it may have been possible to construct a cap which would be satisfactory down to this securing action. It has been more difficult to control what happens in the actual securing and thus what the final condition will be with regard to the destruction and removal of the cap by grasping the tearing ear and tearing along the score lines.

Looking now at FIGS. 6 and 9 it will be seen, however, that the elongated opening, or slot, in the ear introduced by the instant invention also provides a preventative against these variations disturbing the reasonable range of pull required for commencing and continuing the tearing away of the tear strip. From these showings it will be seen that the elongated opening, or slot, in the ear has been closed in further. The upper end 48 thereof lies part way up the surface portion 47 which is part of the overall cap portion 45, which lies against the locking surface 52 of the bottle finish. This upper end

48 which is done to almost a point, lies far enough below the lowermost end of the gasket 40, as seen in FIG. 7, that no weakening of the pressure retention can result. Then a portion 41 of the slot extending down from the end 48 is seen to be narrowed down to a slit which continues down to a position 49 below the free end edge 5 of the skirt. Then the slot, or opening, opens out with diverging sides 42 and 43 to the remote end 44 which still retains substantially its original width.

Again the manner in which the slot and the ear is further reduced in width by the securing of the cap on the bottle finish gives graphic illustration of the manner in which the stress in the skirt, created by the securing, is absorbed in the slot, thereby protecting the scores and particularly the lower ends 28 and 29 thereof, against distortion or closing up to sufficient extent to materially interfere with the tearing action. Here, also, the shape of the slot illustrates the manner in which the forces act down through the commencing portion, or neck, 7 of the tearing ear. As seen, these forces act to close in the slot to a position a little below the bead and then still close in the sides of the slot on the inclines as seen by the sides 42 and 43.

It will also be seen that the notches 21 and 22 have been closed slightly further than in the unapplied form of the cap as seen in FIG. 4. Nevertheless these are not quite closed up nor is the portion 41 of the slot so that safeguards still remain against the bead and bottle neck being so undersized that complete closing could take place, with the stress then being centered in the score ends 28 and 29.

It is believed to be apparent, from the showings in FIGS. 6 and 7, that all one needs to do to remove the cap 1 from a bottle is to grasp the gripping portion 6a of the ear 6 and, in moving it away from the bottle neck, start to tear along the scores at 28 and 29 and then continue that tearing more easily as the scores open up in their upward extent. One important aspect of this form of removal is that once the tear strip is free, part way across the gasket 40, relief of the pressure within the container will commence. This acts as a safeguard against results such as are achieved in some of the prior art hand removable closures, where the pressure is not relieved until the cap is destroyed to sufficient extent to cause it to blow off with consequent chance of injury to the consumer.

In FIGS. 10 and 11 a modified form of slot is shown and indicated generally at 60. In FIG. 10 the slot 60 is shown as having an inner end 61 and a pair of elongated sides 62 and 63 which structure coincides with the slot 23 in FIGS. 1 to 9. The outer end of the slot 60, however, differs from the previous showing by opening up into a bulbous portion 64, forming the center portion of the gripping embossing 6a. When a cap formed from the blank of FIG. 10 is sealed onto a bottle, it can be seen that the inner end portion of the slot 60 substantially closes up into a slit 65 from which the sides 66 and 67 diverge to the enlarged bulbous end portion 64. In this form of the invention the bulbous portion 64 serves to enhance the grip that may be achieved on the tearing ear by the consumer.

In FIGS. 12, 13 and 14 the application of the invention to a cap provided with scores on its exterior surface *b*, *b* rather than on its interior *a*, *a* is illustrated. To a large extent the blank 70 is the same as the blank 20 of FIG. 1, the only difference being that the skirt 73 is formed downwardly from the circular top portion 72 about the bend line 74 so as to leave the score lines 75 and 76 extending into the metal from the outside instead of from the inside of the cupped blank. The score lines may extend in various directions, such as, but without limitation to, sweeping inwardly toward each other on convex curves, or as straight lines diverging or converging as they extend across the blank from the tearing ear, but for simplicity of illustration the score lines 75 and 76, as here shown, extend in parallel relationship across the blank.

This form of scoring has been found to be quite satisfactory for removal of a cap formed in accordance with the invention.

By reference to the formed cap of FIG. 14 the scores 75 and 76 are seen to have short portions 13a and 14a which extend down the skirt defining the skirt portion of the tear strip 15a. The portions 13a and 14a terminate at positions 28a and 29a closely adjacent the position where the notches 21a and 22a form closed slits.

In prior art caps, formed with external scores but lacking the elongated opening or slot of the invention, the difficulties encountered in the closing up of the scores at the positions 28a and 29a are little if any different from what is encountered when the scores are internal. Thus the need for a solution to that problem is also substantially as great. Again the solution is provided by the inclusion of an elongated opening 23a in the tear strip 15a and ear portion 11, the same as described with respect to FIGS. 1 through 11. Again the solution is graphically shown by the closing up of the upper end 30a of the opening 23a and the closing in of the sides 31a and 32a thereof. The remaining of the tearing ear 6, the neck portion 7 thereof, the bend line 7a and the gripping element 6a, at the end of the tearing ear, need be no different from those of the previous forms, so are illustrated as having the same structure and carry the same reference characters.

Caps formed in accordance with the invention, with a strain absorptive elongated opening in the ear, have been found to perform as designed when secured to various bottle finishes. In the first place the retention of high pressure is not interfered with since the upper end of the elongated slot, in each instance, lies below the gasket and is, in any event, substantially closed up in the securing of the cap to the bottle. The scores, however, are left sufficiently undisturbed to enable one with a normal, or even less than normal, grip to start the tear and complete the tearing within the range of the few pounds pull which bottle users are readily able to exert.

More importantly, however, the various factors above described, which have heretofore introduced variations in the securing which could not be guarded against, have been taken care of by the inclusion of the elongated slot position as it is in the tear strip and tearing ear of the cap of the invention. This introduces a break through in to the hand removable caps for bottles, jars and other containers, so that this convenience, heretofore denied the public by factors which cannot be controlled, now becomes readily available.

Since certain changes in carrying out the above method and certain modifications in the article which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A lightweight metal closure cap adapted to be secured over a lip bordering the opening of a container neck, said cap comprising a disc-like top portion, a laterally depending skirt therearound having a smooth cylindrical surface terminating in a substantially circular lowermost free edge, a pair of weakened tearing lines extending across said cap skirt and into said top portion, said lines defining a tear strip therebetween forming an integral part of said cap skirt and top portion, said tear strip extending downwardly away from said free edge in a short extension of said skirt and then extending radially outwardly away from said skirt in a gripping portion to facilitate tearing, a radially elongated slot formed in said tear strip, said slot disposed within said short extension of said tear strip whereby severe distortion of said weakened lines is protected against through deformation of said slot which deformation reduces the resistance offered by said short skirt extension of said tear strip to circumferential movement of metal in said skirt during initial forming and subsequent applying of said cap.

2. A lightweight metal closure cap as in claim 1, where-
in said slot extends within said tear strip from the area
of said skirt free edge to a point in said radially outwardly
extending gripping portion.

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