

W. E. GASTON.
BOTTLE CLOSURE.
APPLICATION FILED DEC. 11, 1915.

1,276,343.

Patented Aug. 20, 1918.

Fig. 1.

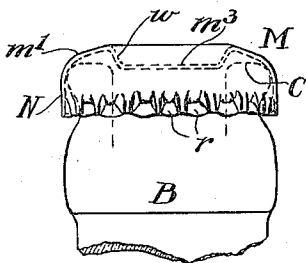


Fig. 2.

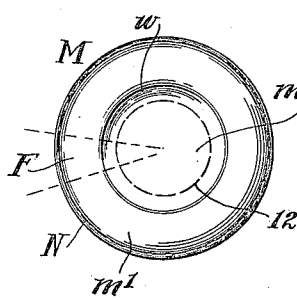


Fig. 3.

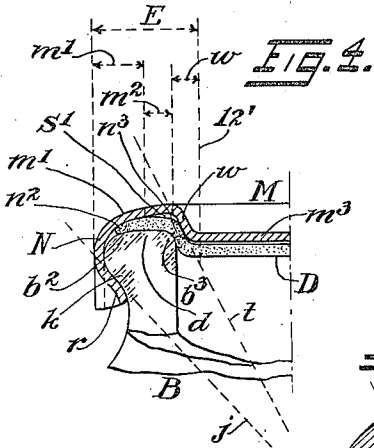
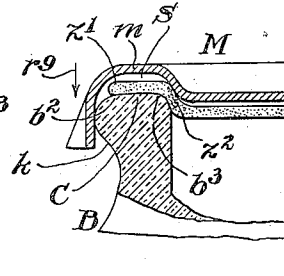


Fig. 5.

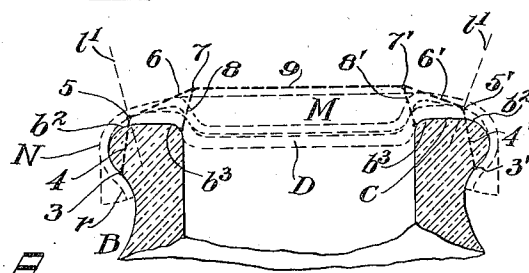


Fig. 6.

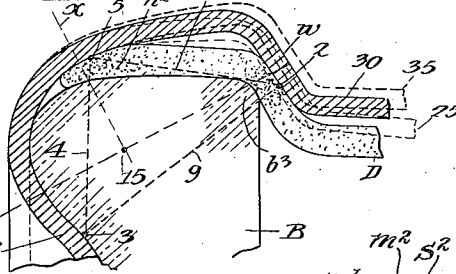


Fig. 7.

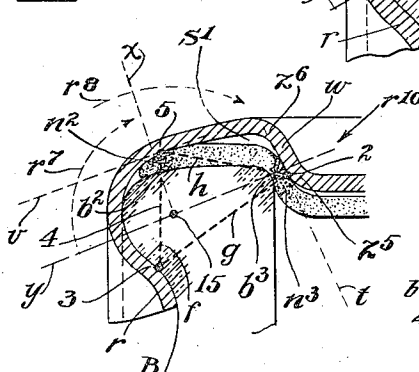


Fig. 8.

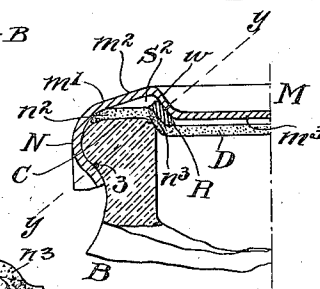
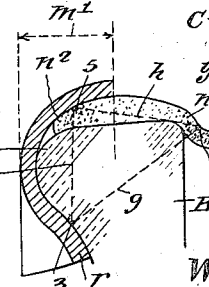


Fig. 9.



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BOTTLE-CLOSURE.

1,276,343.

Specification of Letters Patent. Patented Aug. 20, 1918.

Application filed December 11, 1915. Serial No. 66,238.

To all whom it may concern:

Be it known that I, WILLIAM E. GASTON, a citizen of the United States, residing in Torrington, in the county of Litchfield and State of Connecticut, have invented certain new and useful Improvements in Bottle-Closures, of which the following is a specification.

This invention relates more particularly to that class of bottle-closures in which the sealing effect is secured by the use of, or in connection with, a plurality of concentric bearings, or packing zones; and the invention is in the nature of an improvement in the bottle closure described in Letters Patent of the United States No. 1,123,206, granted to me December 29, 1914; and also in the improved bottle-closures described and claimed in my copending allowed application Serial No. 875,213, filed December 3, 1914, to which reference may be had. A principal object of my present improvements, (which are in part shown and described in my said copending application), is to furnish a closure of the class described, having the concentric packing-zones, or "sealing-pressure" zones, arranged in an improved organization of the closure-members, as hereinafter more fully set forth.

In the drawing accompanying and forming a part of this specification, Figure 1 is a side elevation of a bottle closure made in accordance with my present improvements.

Fig. 2 is a plan view of the closure, as seen from above in Fig. 1.

Fig. 3 is a sectional view similar to the left-hand portion of Fig. 1, but much enlarged, for more clearly illustrating certain features of the closure, and showing an intermediate stage of the setting operation.

Fig. 4 is a similar vertical central sectional view, showing the closure completed, at the end of the setting operation.

Fig. 5 is a diagram similar to Fig. 7 in my said copending application, and is illustrative of the lines of force between certain points and members in the completed closure, for more fully explaining the mode of operation thereof.

Fig. 6 is a view similar to Fig. 4, and is a diagram for illustrating certain features of the cap and packing members, and the kinematical or operative relations of the several parts of the closure.

Fig. 7 is a sectional view corresponding

to Fig. 4, and illustrates a modification in which the packing arrangements at the inner packing-zone, are analogous to the arrangement shown in Fig. 6 of my said copending application.

Fig. 8 is an enlarged diagrammatic view supplementary to, and in the main corresponding to Fig. 6, for more fully illustrating the mode of action of the closure under certain varying conditions, as hereinafter more fully explained.

Fig. 9 is a detail view,—mainly a reproduction of the left-hand portion of Fig. 6,—for illustrating the normal stability on the bottle top, of the outer ring-like portion of the cap M, when and if the inner bearing zone, *w*, of the cap should be removed.

Similar characters designate like parts in all the views.

In my present invention,—as in my said inventions disclosed in prior applications,—the bottle closure operates in accordance with the principle of augmenting the sealing effect by reducing the area and thereby increasing the intensity of the high-pressure contact; and, also, by dividing this high-pressure area into a plurality of relatively non-contiguous, narrow and concentric bearing-zones which are the sealing-pressure zones; so that the principal part of the total stress or pressure exerted upon the bottle face is concentrated upon a relatively small area and is therefore of a relatively greater intensity and consequent higher sealing-effect, than would otherwise be the case.

The application of my improved closure to bottles of the style of formation herein illustrated, may be made by means of instrumentalities which are already well known and readily adaptable to the form of cap-member herein described, and therefore I have not deemed it necessary to herein illustrate or particularly describe the same.

In the drawings, my improved closure is shown applied to a well known form of bottle-top, B, having a top-face, as C, which, in section, is of a well known non-circular form, and also having the lock-face, or lock-rim, *k*. The cap is designated in a general way by M, and is herein shown provided with a depending outer flange N which surrounds the crown disk and is preferably furnished at its lower edge with some suitable retaining means,—as for instance, the

lock-rim-engaging hooks at r ,—for engaging under the lock face or rim k , when the cap M is in its fully set position, as in Figs. 1, and 4. In practice, however, the lower edge of the flange N may, if preferred, be simply spun under the face k , in a well-known manner; this permits the use of a plainly formed or unserrated lower edge for the flange N . In some cases,—as herein illustrated,—the flange N may have the well-known indented formation, whereby the locking-on of the cap is effected in a well-known manner by closing in the lower edge of the flange N to a smaller diameter during the pressing down of the cap, so that the indents or hooks, r , are engaged directly under the rim or face k . Between the bottle face C and cap M , a packing member D , (see Figs. 3, to 7), is located for coacting with those other members in a peculiar manner, which I will now, by the aid of the sectional-views and diagrams, more fully describe.

The packing-face C , (Fig. 3) may be considered as comprising a medial or top-zone d , (Fig. 4) located between the outer, annular bearing-zone b^2 and the inner, annular bearing zone b^3 ; in Figs. 4, and 6, these two bearing-zones are distinguished by shaded portions. The zone b^2 inclines downwardly and outwardly, while the zone b^3 is shown with little if any inclination inwardly from said medial zone d . Said outer zone, b^2 , is also shown so located on the outer side of the bottle-face, C , that the fully applied packing member D , may be said to have an outward wedging action while pressed upon the annular bearing-zone or surface b^2 . (See Fig. 6).

The cap and packing member being first assembled on the bottle top and pressure being then suitably applied over the crown or top of the cap and to the flange N thereof, the said closure members are gradually forced downward and reshaped from their initial positions to the successive positions illustrated, respectively, in Figs. 3 and 4. During this progressive operation, the compression applied to the inner packing-zone z^2 of the member D , (Fig. 3), begins the formation of the pressure-ring or zone, n^3 in and of the substance of this member and directly above and against the bearing zone b^3 , as indicated in Fig. 4. On continuing this cap-setting operation, the outer-zone z^1 , Fig. 3, is similarly formed into the outer pressure-ring, n^2 , Fig. 5.

The cap M when provided with the rim-gripping flange N , has this flange of a depth sufficient for engaging under the bottle-rim at k , and for then extending upwardly and over the relatively thin packing-zone z^1 , of the packing-member D , while the crown disk or top m of the cap (Fig. 3) is adapted to be drawn down or reformed by the setting-

pressure into an elevated annular bearing-disk m^1 (Fig. 4) and thus impart to the inner annular sealing-seat or zone b^3 , an amount of pressure corresponding to that required for so re-forming said cap.

The crown disk m of the cap M is shown in Fig. 3 of a preferred form in which the zone m of the disk closely approximates a plane, while in Fig. 5 the outer portion or zone m^1 of this disk is shown drawn downwardly to a line or angle coinciding with the upper surface of the completed pressure-rings or zones, n^2 and n^3 of and in the packing member D . This construction provides a considerable initial space at S , Fig. 3, which space is progressively reduced somewhat in the succeeded stages of the setting-operation, as indicated at S^1 , in Figs. 5 and 6. Thus the initial provision in the cap of a zone at m^1 adapted to be re-formed substantially as set forth during and by the setting operation, also provides for beginning the formation of the pressure-ring n^3 well in advance of the formation of the pressure-ring n^2 , as indicated in Fig. 4.

During the formation of the inner pressure-ring n^3 , (Fig. 3), and until this formation is well advanced for driving downwardly the central portion of the disk D , the outer zone, z^1 , is still free of any substantial compressive force, and is therefore readily conformable to the conditions produced by the described forcing action. But later, after said inner ring n^3 is nearly formed, the cap zone m draws down upon the outer edge of said zone z^1 , and by a sliding and compressive action thereon forces said packing zone or flange against the bearing-line b^2 , and thus draws and forms said zone or flange z^1 outwardly and downwardly, (see Fig. 5).

This peculiar action when properly performed, has the effect, in practice, of first seating the packing disk firmly against the inner corner-zone or bearing b^3 , then drawing or wrapping that disk over the medial zone d of the face C , and finally seating the outer edge z^1 firmly against said outer bearing-line b^2 . Thus the said pressure rings, n^3 and n^2 , are begun in succession but are completed substantially simultaneously. In this operation the packing-disk D is subjected simultaneously to the sealing-pressure and to a diametrical contraction from a larger initial dimension; this tends to produce an inwardly sliding action between the contracting surfaces of the sealing-disk and the bottle face, and thus tends to draw the sealing sheet, as D , while under an increasing pressure, into a perfect fit or contact over the whole area of the contacting surfaces, but having said mid-zone portion of the disk or sealing sheet with any material amount of compression.

The diameter desirable for the disk D , in

order that its outer zone z^1 may properly wrap down over the bearing b^3 , will usually be such as to make this disk edge impinge within the flange N of the cap M, when the parts are assembled ready for setting. Such an initial excess-diameter of the zone z^1 over the inside diameter of the flange N, provides a convenient means for a prior assembling of the caps M and disks D, so the closure device may be handled by the bottling operators, and in machines, as a single article, and also may be supplied to the trade in that complete form, as explained in my said copending application. In practice, the disks D may be made of various kinds of sheet material according to the service required, as may be readily ascertained by trial in any particular instance. When used for packing liquids, the sealing-member D may have on the underside thereof a thin protecting coating of suitable material; or said disk D may have applied thereunder a thin sheet of resistant material, as set forth, for instance, in my said Patent No. 1,123,206. For the more common uses, the closure-disk D may be made of some one of the fiber-stock sheet-materials now well known in this art as being suitable for use in bottle-closures. Said disks, however, are preferably made of a material which is slightly, but only slightly, moldable under the pressure of the cap, for thereby more effectively graduating the sealing action throughout the circuit of each of the concentric bearing-zones.

The operation of the closure members as between each other and the bottle-top, gives focal points or bearing points and lines-of-force ("triangulation" lines) according to a system which is illustrated in Fig. 7 of my aforesaid patent, and which, is further shown in Fig. 5 of this application, as applied in my present invention. From the anchorage point 3 (on the face k) in the diagram, Fig. 5, the tension line, or line of force, 4, may be considered as extending directly upwardly to the outer focal point 5, which is located on a line l^1 , which is about vertical to the surface of the outer bearing-zone b^2 ; this bearing line or surface then forms the basis of resistance against the further inward movement, or downward movement, of the said focal point 5. The tension line next turns toward the upper focal point 7, as indicated at 6, the point 7 being on a line, 8, extending downwardly to the inner bearing line or zone b^3 ; from the point 7 the tension line, as 9, extends directly across the closure and connects at the point 7' with the similar system of triangulation lines on the opposite side of the closure. Thus the triangulations on opposite sides, respectively of the closure, when observed in a sectional view, together constitute a system in which an effective

balance of the described opposing forces is obtained. In the present instance, however, that system of coaction is combined with and supplemented by a further and peculiar arrangement of coacting features which are more fully illustrated in the diagram, Fig. 6.

Usually, as is well-known, bottle-closure caps of general class herein referred to, may have some tendency (when made, as usual and preferable, of resilient metal) to retract upwardly by a slight amount, following their release from the closure-applying machine or tool. This tendency and mode of action is compensated for, in the closure-constructions shown in my said patent and in said copending application, by means of combinations therein described and claimed; but in my present invention I have provided a further improvement, and one having a different or modified mode of action, whereby not only to improve the sealing effect, but also to compensate and guard against any injurious results otherwise arising from such retractive tendency. From these explanations and a comparison of the aforesaid diagrams as described, it will now be evident that while the complete closure when fully applied, may be regarded as a static device,—as compared, for instance with a mechanical movement or like operative device,—nevertheless the forces set into action as between the different members or component portions, in the finished or closed-on cap, are active forces in the sense that said forces continue in a ready-to-act state, so that on any moderate yielding taking place in any part, other parts instantly become active and so move and readjust themselves, and thereby continue the closure in an effective condition.

The annular outer portion of the cap M, comprising the part N, the zone m^1 and the wall or zone w , may be regarded (when applied as in Figs. 4 and 6) as constituting a clamp-ring of a special character, and this whether or not a center zone, as m^3 , shall be omitted from the cap M; in Fig. 2, such a central area is indicated within and by the dotted circle 12, and, in Fig. 4, by the line 12'. Considering, now, some assumed radially-disposed portion of such clamp-ring, as for instance the part F, between the radial dotted lines in Fig. 2, it will be obvious that this part F is shown in section in Fig. 4, at the left-hand of the line 12'. And in the preferred construction here illustrated of said clamp-ring portion of the cap M, it will be seen that by reason of this construction in the combinations herein set forth, said portion F engages over the bottle-top and packing-member D in such a manner as to constitute, in effect, a kind of clamp so arranged as to normally act by itself and remain in place, and thus, at a local point in the circuit of clamping-action,

continue to hold the sealing-sheet or packing, D, securely in place. By this means, I am able to "seal" the bottle-top by a combination of clamping effects resulting from two systems or kinds of action, one being general, as illustrated by the kinematical relations, as in Fig. 5, while the other involves a continuous circuit of local clamping-increments, as illustrated in Fig. 6.

The closure cap-zone E (Fig. 4) comprises the outer zone m^1 and the inner zone w , (which is shown inclined relatively to the axis of the bottle top, and also transversely non-convex), arranged with an intermediate zone, as m^2 , of a suitable width, which usually will depend somewhat on the width, radially of the closure, of the bottle-face itself. In some instances, and especially with such relatively large bottles as now commonly used for sealing-up and storing milk and beverages, the middle zone m^2 may properly be regarded as consisting of from one-fourth to one-half of the diametrical width of the zone m^1 .

As shown in said diagram Fig. 6, the pressure on the inner packing-zone n^3 is resisted by a combination of forces which diverge from the point, 2, and which are substantially indicated by the dotted lines g and h , of which the line of force g extends between the anchor-line, 3, and said inner point 2; while the line of force h extends from the same inner point 2 to the outer-zone point 5. These two outer points 3 and 5 being now connected by the line f , the dotted triangle is thus formed of lines g , f and h , and is located with the angles thereof at 2, 3, and 5, thus indicating by a diagrammatic representation, how the principal stresses are arranged, or located, and the relatively intricate mode of action by which the complete result is obtained. Also, this diagram supplements the other views as regards the manner in which the forces acting upon the inner line or zone at b^3 , are or may be balanced or resisted by two resistance lines, or zones, one of which is the anchorage line at 3, directly on the bottle top B, while the other is on an outer zone, as n^2 , of the same sheet-form packing member which,—in another part thereof,—is compressed on the said inner-zone b^3 by the described coaction of diverging lines of stress or force. The diagram Fig. 6 also further illustrates by the aid of said triangle g , f , h , how any radially-disposed segmental portion of the cap,—within the zone E of the clamp-ring, (Fig. 4) may be made self-retaining, since the angle formed at the point 5 by the lines h , f , is normally less than a right-angle when the parts are organized as here illustrated. The same features are also indicated by the direction of the divergence of lines j , t , which in Fig. 4 are drawn about tangential to the inner bearing-surfaces of the cap of the points 3 and 2 respectively. Thus the tangential direction of the cap-retaining zone, at 3, of the bottle-top, inclines downwardly and inwardly,—as shown by line j ,—relatively to said tangential direction (shown by line t) in an axial plane of the closure, (Figs. 4, 6) of said corner-zone, as n^3 , of the sealing-disk D, so that each segmental radially-disposed part, as F, of the crown-disk part of the cap M, becomes self-retaining on the bottle-top while bearing on both of said outer and inner zones of the sealing-disk.

In connection with the features of construction here described, other advantages are illustrated in Fig. 6, where the arrow r^{10} indicates the approximate direction of one of the principal lines of force, or stresses, as between the completely applied cap M and the bottle-face. On comparing this feature with the other figures as described, it will be evident that the outer flange N being forced under the retaining face k by the usual setting die (not shown) applied in the direction of the arrow r^9 (Fig. 3) operates to draw downwardly the whole cap. This operation, however, and after the compression, or downward movement, has reached the proper point as regards the zone b^3 , still draws down the outer portion of the cap-zone m^1 , and thereby shifts, or flexes this zone from approximately the initial position thereof in Fig. 3, to the final position thereof in Figs. 4 and 5. During such flexing of the cap to final position, the described descent of the partially re-formed cap-zone m^1 to position Fig. 5, naturally operates to flex,—or turn outwardly,—the said concave wall or zone w , so that this zone may be said to turn or may slightly revolve in an outward direction over and upon the inner compression-zone at n^3 of the packing-member, while at the same time, the lower part, as at 2, Fig. 5, of said wall zone w , is located at or below the line of the bottle-face C, and in a position for operating as a kind of resilient clamp or hook, in the direction of arrow r^{10} , whereby to resist the outward stress upon the cap by a resistance directly against the inner bearing-zone of the bottle-face. Thus the strains due to the flange-retaining engagement at k , in any one part of the circumference of the closure, are directly and largely balanced and opposed by a resistance in the direction r^{10} and against the bottle-face, at b^3 , in that same part of the circumference, thereby materially reducing the amount of the stress which otherwise would be transmitted across the cap and be there received on the outside of the bottle-face, as herein further illustrated in Fig. 5.

In Fig. 7, I have shown a modified form of the closure which is more fully described, in a general way, in my said copending ap-

plication, but as herein shown the wall w , (Fig. 7) is located lower down, thus corresponding with the position and relations thereof in Figs. 3, 4 and 6. In Fig. 7, however, said wall w is shown of a relatively smaller diameter, thereby providing for the insertion of a supplemental and narrow packing-ring, R , so arranged as to press the member D directly against the particular bearing-zone b^3 , while itself bearing firmly against only the lower part or zone of the inner surface of said wall w . This arrangement also provides for a low-pressure zone, in the nature of a space at S^2 , corresponding in position,—and relatively in purpose,—with the space S^1 in Fig. 6. Thus the ring R , when arranged as here explained, may be prevented from changing the mode of action already described, of the "clamp-ring" portion of the cap M .

The central disk m^3 of the cap constitutes one device or form of means for preventing the stresses and pressures from deforming the cap-zone w . The cap M , therefore, may be said to comprise the inclined pressure-zone w and an integral connection with the tensioning-zone m^1 lying outside of said pressure-zone b^3 , and also connected with the central or concentric resistance-zone m^3 which is located in a position, or at a level, considerably below said tensioning-zone.

When seen in a direction vertical, or normal, to a radial plane,—as, for instance in Fig. 6, the cross-section of the annular cap-zone E has, relatively, a hook-form and reaches over the three points or pressure-lines 2, 3, and 5, as already explained. But, usually and preferably, the cap will be formed of metal having some resiliency combined with a considerable resistance to deformation, so that in the applied closure, the desired torsional stress and sealing effect can be maintained for long periods with slight if any impairment by the well-known tendency of ductile metals to slowly yield under a continued strain. These qualities of the metal and of the cap, in connection with inclined wall w and the peculiar relations thereof, normally result, as I apprehend, in the formation of some kind of functional focal point or axial line located at about the point 15 in Fig. 6, and with relation to which the flexing-movements of the cap-zone seem to occur in accordance with the illustration of such movements in Fig. 8. For instance, should the cap be warmed and thus be slightly increased in diameter, the anchorage point 3 would normally move slightly farther up; but this would permit the entire outer zone to flex or rotate inwardly and so tend to maintain the sealing-effect on the corner-zone b^3 . And in these movements of self-adjustment, as involved in subjecting the closure to a wide range of temperatures as necessary in the more recent commercial

practice, my improved closure-cap having the relative hook-form sectional shape and combined with the two bearing-zones located as set forth,—and operating substantially along the described three chief pressure-lines,—is found in practice to meet the exacting requirements in a most complete and effective manner.

From a comparison of Figs. 2 and 3, it will be evident that when the cap M is forced down from its initial or preliminary position in Fig. 2, to the completely applied position in Fig. 3, the entire outer portion within the clamping-zone E , (Fig. 4), becomes in a sense torsionally deflected, or flexed, so that when the attaching flange N is closed under the lock-face k of the bottle, a pressure line will be normally formed at about the point 3, Fig. 6, and will extend entirely around the neck of the bottle. The said point, or line, 3, thus becomes, relatively a focal point or center, around which the torsional reaction naturally will tend to carry inwardly the upper portion of the cap, and also carry downwardly that portion within the zone w . These stresses or flexure-tendencies due to the described reverse flexure produced during the setting operation, are diagrammatically indicated by the curved arrow-lines r^7 and r^8 in Fig. 6, and normally operate for holding the outer packing-zone n^2 , of the sealing-sheet D , in firm contact with the bottle-face, and to hold the inclined inner-zone w of the cap firmly against the inner-zone n^3 of the packing-sheet, and thus hold this packing-zone pressed firmly against the zone b^3 of the bottle-face. But the features here explained, are further developed as I will now more fully point out.

As seen in a plane radial to the closure,—as in the sectional views Figs. 4, 6,—the tangential direction of the inner zone n^3 of the disk D , is shown by the line t to be in a direction transverse to the tangential direction of the outer zone n^2 of said disk; this is also shown by the line v , Fig. 6, where said inner and outer packing zones are also shown separated by an annular low-pressure zone, at S^1 , extending from said outer zone, n^2 , inwardly to the upper line, at z^6 , of said resistance-wall w .

In the diagram Fig. 6, the three points 2, 3 and 5 are shown in such a triangular relation that a functional focal point, (or axial-line as regards the described torsional action), located at about the point 15, will have the same relation, substantially, to each of the bearing-zones b^2 and b^3 , since said point 15 is located at the intersection of the lines y and x , which are normal to lines t and v , at about said points 2 and 5, respectively. Said lines t and v , are therefore about tangential to the high compression areas n^3 and n^2 , of the sealing-disk D . In

the diagram, it will be seen now the tangential line t of said corner-zone compression-area n^3 , may be so located that a line, as y , drawn normal to said line t at the point 2, will pass, when extended, well above the anchorage-point 3, so that a circular-arc (not shown) passing through the three said points 2, 5 and 3, may have an arc-length greater than 180 degrees, and thereby make any radial-zone portion, as F, of the cap M to be normally self-retaining on the bottle-top. Thus as shown in said diagram and in the sectional views, it may be said that in the fully applied closure, the annular packing-zone, as n^2 , of the packing disk D, is diametrically supported against said inclined wall w ,—which for this function acts as a resistance-wall,—and that the closure has the several members thereof arranged for forming a relatively low-pressure zone which is located over a medial-zone of the packing-face of the bottle, and between two concentric high-pressure bearing-zones in which the high-compression areas, (as seen in a plane that is radial to the closure), have a transverse direction, each relatively to the other.

The self-retaining feature of said circumferential zones F,—each considered by itself,—is accomplished by so constructing and combining the several members and their coacting details, that the three points 2, 3, and 5 are located at the angles of a triangle which is formed by the described lines 4, g , h , and which has each the said angles thereof less than a right-angle; and, it should be noted, this feature of the segment F is combined with the stabilized form and support of the ring-like outer portion of the cap M, as described in connection with Fig. 9.

The curve or bend indicated at b^3 in the bottle-top and inner surface cap-zone w is arranged in a non-conforming shape or relation, or both, for thereby bringing into action a peculiar stress or resilient mode of action, whereby the circuit of attachment, at 3, holds the outer clamp-zone m^1 , so far downwardly as to also press downwardly the inner-zone w , by a kind of torsional movement of the clamp-ring or "crown-disk" of the cap. In Fig. 6, I have indicated this mode of action in an approximate manner, by the curved arrow-lines n^7 and n^8 , which are drawn as circular arcs about a point, 15, which in practice should be assumed as being at about the center of the outer zone n^2 and the lower zone or line where the cap is anchored, so to speak, under the retaining flange, k , of the bottle-top. The described torsional movement is also further shown by the position of the entire clamp-zone, as indicated in Fig. 3, where said inner-zone is less elevated in relation to the zone m^1 than is shown in Fig. 4.

This difference will, of course, be increased by the use of a thicker packing sheet, (not shown), or when applying the cap to a bottle-top of some abnormal proportions, as for instance when the inner-zone, as b^3 , of the bottle face shall be made higher, or of less internal diameter than the proper average. In the preferred construction herein illustrated, it will be seen that the zone b^3 is shown of a convex form which has the described non-conforming relation to the inner surface of said wall w .

The annular crown-disk may be regarded as comprising all that part of the cap M which is located within the annular-zone E, and as being provided on the outer circumference thereof with some suitable bottle-engaging or attaching means, as the depending flange N, which may constitute the retaining means whereby to removably attach the cap to one of the bottles to which the caps, in any given instance, are to be applied. The inner portion or zone, as w , of said annular zone E, is shaped and arranged for constituting a combined resistance-wall and packing-wall which is located with the transverse section thereof located in an inclined position, and in a position so that when applied to the bottle-top, the inner, or corner-zone, as b^3 , Fig. 6, of the top, will mold the sealing-disk, as D, into such conformity with a zone of said inclined cap-wall, as to form a highly perfect packing or seal. A further feature of the packing-wall w as shown in the drawing, is that the inner and lower edge, at z^5 , of said wall w is of a less diameter, while the upper and outer edge at z^6 is of a greater diameter than the said corner-zone b^3 of the bottles to which the caps are to be applied.

A further feature of the closure in the preferred form thereof herein shown, is that the upwardly and outwardly inclined zone w is made of such a relative diameter and the inner surface thereof is located in such a position relatively to the corner-zone b^3 of the bottle-top, that the direct line of action,—as the line y , Fig. 6,—between said corner-zone and said inner surface, brings the sealing sheet D against said inclined inner wall-surface along a lower portion or zone thereof with an intense force, or pressure, while a lesser pressure, if any, will normally be exerted against the zone at z^6 , which is contiguous to the space or low-pressure area or zone s^1 .

In the operation of applying the cap M to the bottle-top, as will now be evident, the outer zone m^2 is at once forced down to its final, or permanent position, (Fig. 6), and this is done under a force, or pressure, sufficient to "set" or condense the outer edge n^2 of the packing disk, into a firm border-zone (this is indicated by the shading at n^2 , Figs. 4, 6, 8), and while so held, the re-

5 taining rim N is forced from its open position in Fig. 3 to its closed position in Figs. 4, 6, 8, thereby fixing the distance between the points 3 and 5 (see Fig. 6), and also making permanent the relation to the bottle top and to the disk of the retaining rim h (Figs. 3, 4), and of all that portion of the cap M which is within said zone m^1 . In said cap-applying operation, however, that
 10 part of the cap which is within the zones m^2 and w , is forced down to a relatively lesser extent, so that that portion of the material of the disk D which is in contact with said face b^3 of the bottle-top and
 15 the inner face of cap-zone w , is not normally subjected to so high a degree of pressure as said outer disk-zone n^2 . Accordingly said disk-material at n^3 is left (at the end of said cap-affixing operation) in a condition of only a partial condensation, but is
 20 held under a constantly-acting and downwardly-acting stress or pressure due to the upwardly-flexed cap-zones m^1 and m^2 . This downward pressure tends, of course, to
 25 further and constantly compress said disk-material at n^3 to a smaller thickness, and on any such reduction of thickness,—which naturally must normally occur in course of time,—then the cap-zone w follows down
 30 automatically to thereby maintain the required pressure-contact, and this is done without in any way materially affecting the aforesaid outer-zone m^1 of the disk, since the shift or readjustment of position of the
 35 cap-zones m^2 , w , is chiefly affected by the described "torsional" flexure of that annular portion of the cap which is comprised in said zone m^1 , and which is in a relatively stabilized condition.
 40 The features and operations just described are specially and diagrammatically illustrated in Fig. 8 in which the cap is shown (by the solid lines) in section, and in a position corresponding to Fig. 6; this
 45 position is a medial one, and is designated by 30. When, as already explained, the disk zone at n^3 shall have become reduced in thickness, then the entire cap-zone E, (of Fig. 4), will swing downwardly and inwardly,—substantially as if turning about
 50 a point at or near 15,—and thereby bring the inner zones of the cap to the lower position indicated by the dotted lines at 25. Conversely, whenever,—after the cap is once
 55 fully applied,—the disk-zone n^3 shall become thickened, the shifting of the zone w will be in a reversed, or upward direction, so that the position of the cap will then be more elevated, as indicated, for instance, by
 60 the dotted lines at 35; these operations, of course, are permitted and favored by the open space at S^1 , and by the portion of relatively uncondensed annular zone of packing material located in the zone m^2 , and between
 65 said-zones of condensed packing material at

n^2 and n^3 . However, during any such shift-ings of the cap from any one to another of said positions 25, 30, and 35, the firm grasp of the cap at points 3 and 5 remains practically constant and unchanged. Thus the
 70 automatic regulation of the position of the cap-zone w relative to the bearing zone b^3 , is effected without any substantial modification, and with no impairment, of the packing, in the narrow zone at n^2 , and so that
 75 the inward pull normally due to the pressure at n^3 will be properly resisted (in the directions of the force-lines at h and g), by the cap bearing against the bottle (at point 3) and against the highly condensed packing
 80 material at n^2 . Such an upward shift or movement as above described, of said zone w , may be caused in some instances by an increase of gas-pressure within the bottle, after the cap is applied.
 85

By reason of the outer bearing-zone the sealing-disk extending inwardly to and between the inclined resistance wall w and the corner-zone b^3 of the bottle-top, the cap itself is thereby upheld so as to produce in
 90 the annular crown-disk the torsional stress required or proper for maintaining an effective sealing-pressure upon that part of the packing-member which is between said inclined wall and said corner-zone. In this
 95 particular organization of said members and features, the peculiar relation of the said incline wall inner-surface to the corner-zone b^3 , produces a molding-effect on the sealing-disk and in a narrow annular zone thereof,
 100 while the relatively conical form of said wall w causes this part of the cap to operate after the manner of a forcing member for depressing, by such molding action, the central portion of said sealing-disk and for wedging,
 105 so to speak, the said annular zone of this disk, both downwardly upon and outwardly against the surface of said corner-zone b^3 .

When the central-zone m^3 of the cap is omitted, this provides a relatively greater
 110 torsional flexure or rotative action, of the remaining portion under a given stress. In this case, however, the packing disk D should have a strength and stability sufficient for holding any pressure within the
 115 bottle or other container to which the closure shall be so applied. Also, in some instances, should it be desirable to reduce the rigidity of the cap at or along the outer line 12 of the central zone, a row of holes may be made
 120 along that line; or, the metal at that line may be grooved or otherwise reduced in thickness, (not herein shown). Also, if desired, a central portion of the disk D, corresponding to or smaller than the said cap-
 125 zone m^3 , may be omitted or removed. One object of such a perforation of the disk D, is to increase the facility with which the zone n^3 thereof will be molded into proper shape and fit,
 130

Having thus described my invention, I claim:

1. In a bottle closure of the class described, in combination, a bottle-top having
 5 an upper packing face and provided with cap-retaining means for engaging a closure-cap, and having in said upper face a pair of concentric bearing-zones comprising an
 10 outer bearing-zone and a concentric inner bearing zone which is a corner-zone and which is separated from said outer zone by an intervening flat zone, of a closure-cap comprising an annular crown disk provided
 15 on the outer circumference thereof with a depending outer portion and arranged for engaging said cap-retaining means of the bottle-top, and provided on the inner circumference thereof with a depending resistance wall consisting of a depending and
 20 conically-shaped sealing-pressure zone located in a position above said corner-zone and having in the radial cross-section thereof a downwardly and inwardly inclined position, and having on the upper line thereof
 25 a diameter greater than the inner diameter of said corner-zone, and a packing member consisting of a sealing disk having an outside diameter corresponding with said outer bearing-zone, and held impinged thereon
 30 by an outer zone of the cap, and also extending inwardly between said inclined resistance wall and said inner corner-zone, and thereby upholding the said resistance wall and producing a stress in the annular crown-disk for maintaining a sealing-pressure
 35 upon the packing member between said inclined wall and said corner-zone.

2. In a bottle closure of the class described, in combination, a bottle-top having an
 40 upper packing face and provided with cap-retaining means for engaging a closure-cap, and having in said upper face a pair of concentric bearing-zones comprising an outer bearing zone and a concentric and convex
 45 inner bearing-zone and which is separated from said outer zone by an intervening flat zone, of a metal closure-cap comprising an annular crown disk which is provided on the outer circumference thereof with means
 50 for engaging said cap-retaining means of the bottle-top, and is provided on the inner circumference thereof with a depending and transversely non-convex sealing-pressure zone in position directly above said inner
 55 bearing-zone and having in section a downwardly and inwardly inclined position, and a packing member consisting of a sealing disk having an outside diameter corresponding with said outer bearing-zone, and held
 60 impinged thereon by an outer zone of the cap, and also extending inwardly between said inclined sealing-pressure zone and said inner corner-zone for thereby upholding the said inclined zone and producing a stress in
 65 the annular crown-disk, and having the tan-

gential direction thereof in said corner-zone in a direction (in an axial plane of the closure) transverse to the tangential direction of said outer packing-zone.

3. In a bottle closure of the class described, 70 in combination, a bottle-top having an upper packing face and provided with cap-retaining means for engaging a closure-cap, and having in said upper face a pair of concentric bearing-zones comprising an outer bearing-zone and a concentric and convex inner bearing zone, of a closure cap of resilient metal comprising an annular crown disk which is provided on the outer circumference thereof with means for engaging said 80 cap-retaining means of the bottle-top, and is provided on the inner circumference thereof with a depending non-convex or sealing-pressure zone in position directly above said inner bearing-zone and having in section a 85 downwardly and inwardly inclined position, and a packing member consisting of a sealing disk having an outside diameter corresponding with said outer bearing-zone, and at its outer edge held impinged thereon by 90 an outer zone of the cap, and also extending inwardly between said inclined sealing-pressure zone and said inner corner-zone for thereby upholding the said sealing-pressure zone and producing a stress in the annular crown-disk, and having the tangential 95 direction thereof in said corner-zone in a direction (in an axial plane of the closure) transverse to the tangential direction of said outer packing-zone, and having said 100 outer and inner packing-zones of said packing-member separated by an annular low-pressure zone extending from said outer zone inwardly to the upper line of said inclined zone. 105

4. In a bottle closure of the class described, in combination, a bottle-top having an upper packing face and provided with cap-retaining means for engaging a closure-cap, and having in said upper face a pair of separate 110 and concentric bearing-zones comprising an outer bearing-zone and a concentric and convex inner bearing zone, of a metal closure-cap comprising an annular crown disk which is provided on the outer circumference 115 thereof with means for engaging said cap-retaining means of the bottle-top, and is provided on the inner circumference thereof with a depending resistance wall having a non-convex pressure zone in position directly above said inner bearing-zone and having a downwardly and inwardly inclined position, and a packing member consisting of a sealing disk having an outside diameter corresponding with said outer bearing-zone, 120 and held impinged thereon by an outer zone of the cap, and also extending inwardly between said inclined resistance wall and said inner corner-zone for thereby upholding the said resistance wall and producing a stress 125

in, the annular crown-disk, and having the tangential direction thereof in said corner-zone in a direction (in an axial plane of the closure) transverse to the tangential direction of said outer packing-zone, and having said outer and inner packing-zones of said packing-member separated by an annular low-pressure zone extending from said outer zone inwardly to the upper line of said resistance wall, the closure also having the tangential direction of the cap-retaining zone of the bottle-top inclining downwardly and inwardly relatively to said tangential direction (in said axial plane of the closure) of said corner-zone of the sealing disk, whereby each radially-disposed segmental part of the crown-disk becomes self-retaining on the bottle-top while bearing on both of said outer and inner zones of the sealing disk, substantially as set forth.

5. In a bottle closure of the class described, in combination, a bottle-top having an upper packing face and provided with cap-retaining means for engaging a metal closure-cap, and having in said upper face a pair of concentric bearing-zones comprising an outer bearing-zone and a concentric inner bearing zone which is a corner-zone, of a closure-cap of resilient metal and provided on the outer circumference thereof with means for engaging said cap-retaining means of the bottle-top, and also provided with a depending and conically-shaped combined resistance-wall and transversely non-convex sealing-pressure zone located in a position directly above said corner-zone and in section having an inclined position, and having on the lower line thereof a diameter smaller than the inner diameter of said corner-zone, and a packing member consisting of a sealing disk having an outside diameter corresponding with said outer bearing-zone, and held impinged thereon by said sealing-pressure zone of the cap, and also extending inwardly between said inclined packing wall and said inner corner-zone, and thereby upholding the said resistance wall under a stress for maintaining an effective sealing-pressure upon the packing member.

6. The herein described improvement in caps for bottle-closures, it consisting in a metal-cap comprising an annular and torsionally-resilient crown-disk provided on

the outer circumference thereof with a depending outer flange having retaining means, and provided on the inner circumference thereof with a depending and concentrically-located and conically-shaped sealing-pressure wall constituting a combined resistance-wall and packing wall which is located with the transversely non-convex section thereof in an inclined position, and has the lower edge thereof of a diameter less, and the upper edge thereof of a diameter greater than the inner diameter of the inner corner-zone of the bottle faces to which the cap is to be applied, in combination with a sealing-disk having an outside diameter corresponding with the inside diameter of said outer flange and extending under said inclined wall, and consisting of a material moldable by compression without lateral flowage into conformity with a zone of said wall when the cap is applied to the bottle-top.

7. The herein described improvement in caps for bottle-closures, it consisting in a metal-cap comprising an annular and torsionally-resilient crown-disk provided on the outer circumference thereof with a depending outer flange having retaining means, and provided on the inner circumference thereof with a depending and concentrically-located and conically-shaped sealing-pressure wall constituting a combined resistance-wall and transversely non-convex packing-wall and which is located with the transverse section thereof in an inclined position, and has the lower edge thereof of a diameter less, and the upper edge thereof of a diameter greater than the inner diameter of the inner packing-zone of the bottle faces to which the cap is to be applied, in combination with a sealing-disk of uniform initial thickness throughout and having an outside diameter corresponding with the inside diameter of said outer flange and extending under said inclined wall, and consisting of a material moldable by compression without lateral flowage into conformity with a non-convex zone of said wall when the cap is applied to the bottle-top.

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Witnesses:

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