Oct. 25, 1949. E. SIMMONS 2,486,364

BOTTLE CAP OR CLOSURE

Original Filed May 2, 1942

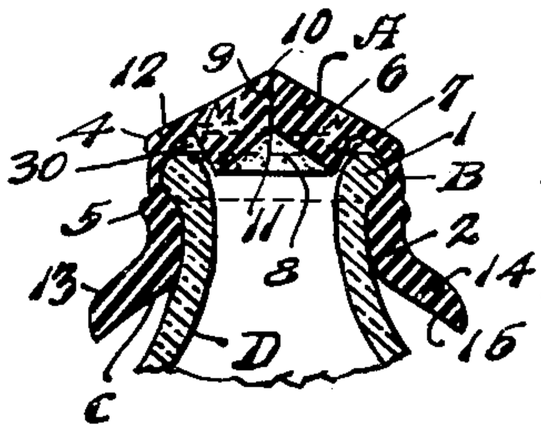

Fig. 2.

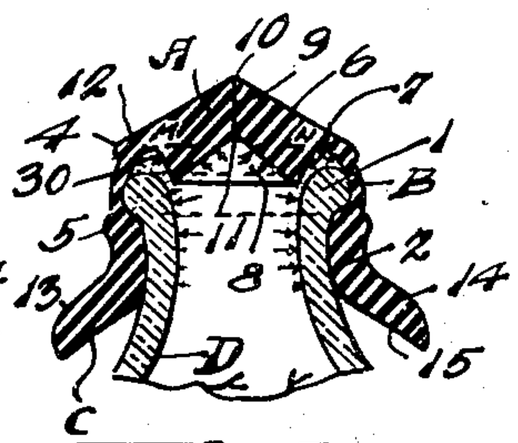

Fig. 3.

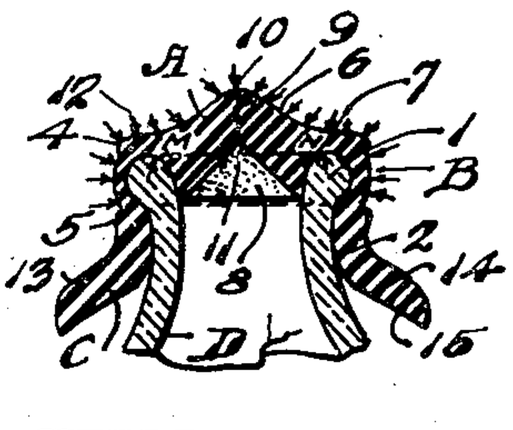

Fig. 4.

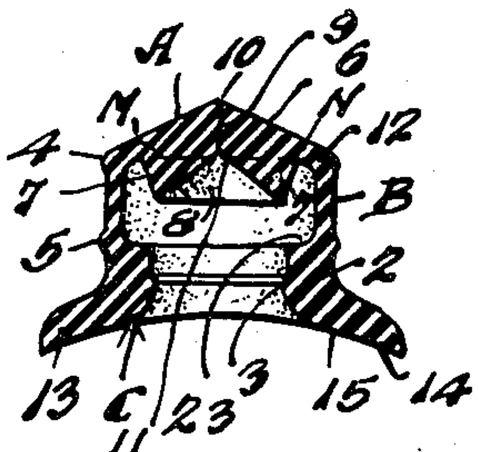

Fig. 1.

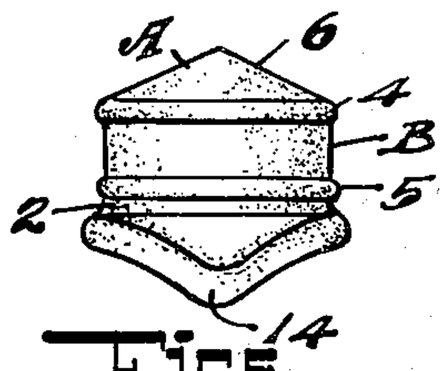

Fig. 5.

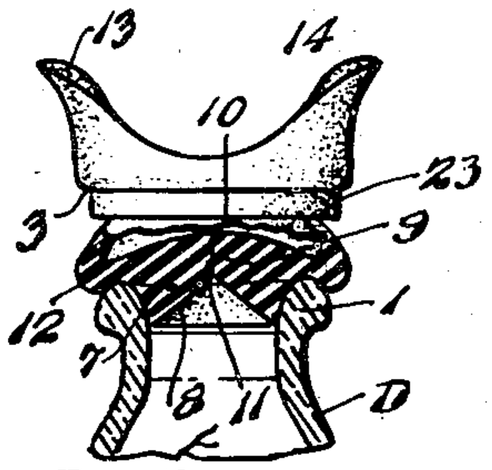

Fig. 6.

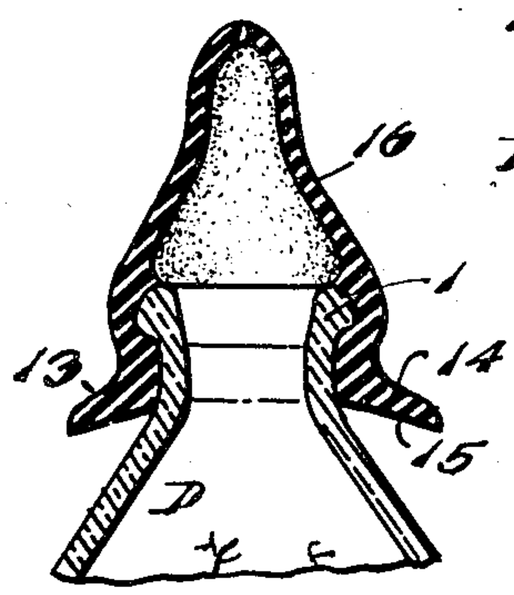

Fig. 7.

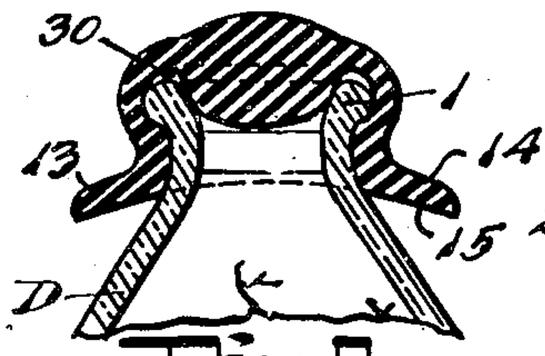

Fig. 8.

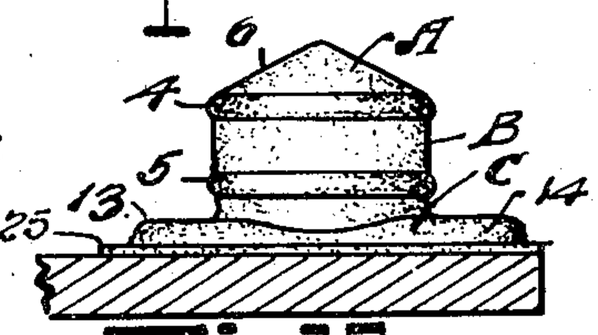

Fig. 10.

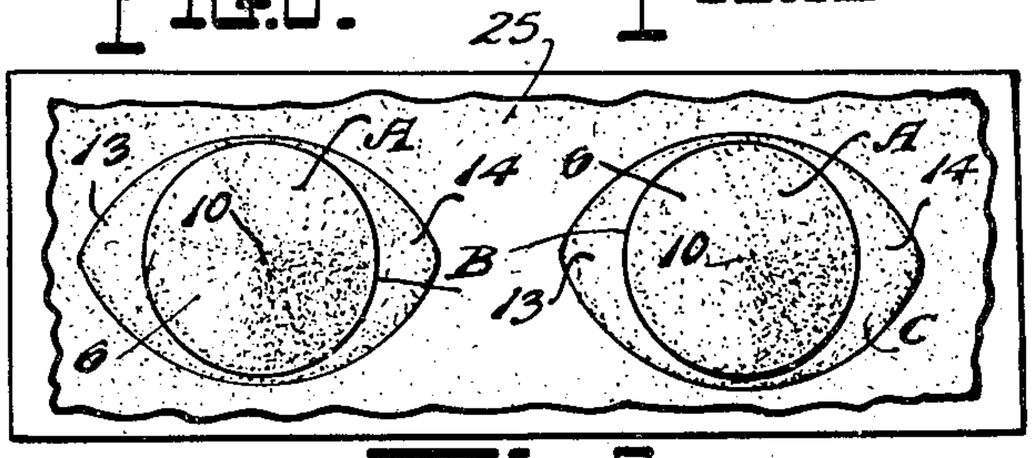

Fig. 9.

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Patented Oct. 25, 1949

2,486,364

UNITED STATES PATENT OFFICE

2,486,364

BOTTLE CAP OR CLOSURE

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Continuation of application Serial No. 441,489, May 2, 1942. This application May 19, 1945, Serial No. 594,681

6 Claims. (Cl. 215—56)

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This application is a continuation of an application filed by me May 2, 1942, Serial No. 441,489, now abandoned.

This invention relates to bottle or jar caps or closures and to nipples for nursing bottles, but primarily to valve caps.

A primary object has been to improve upon the type of construction disclosed in my previous Letters Patent No. 2,070,377 issued February 9, 1937 with relation particularly to the formation of the valve structure of the cap and to the base by which the cap or nipple is manipulated in its application to and removal from the bottle or jar.

The cap or nipple of the present invention is made of a resilient, elastic and somewhat flexible material, preferably of what is commercially known as "soft rubber." The soft rubber material may be either natural or synthetic rubber or other plastic, and may be compounded with such fillers as are usually employed in making rubber articles. Where the term "soft rubber" is used in the claims it is intended to designate materials of this nature having the properties of elasticity and flexibility.

A primary object of my invention as disclosed in Patent No. 2,070,377 and of my present invention has been to design a sealing cap or closure wherein a valve structure is molded integrally with the crown of the cap so as to permit the partial or complete sterilization of the contents of the bottle, flask, jar or other receptacle with the cap in place, and allowing for the expansion of the liquid and gaseous contents of the receptacle, the valve structure serving as a safety exhaust for the steam pressure and on completion of the thermal processing or sterilization of contents to instantaneously seal itself hermetically to maintain a vacuum and to prevent entrance of air and spoilage micro-organisms.

The principal object of my previous invention was to provide a vented valve cap with a relatively stiff arched and internally recessed crown concentric with and shaped to rest on the mouth of a bottle to resist the pull of a vacuum created in the bottle after processing of the contents and also provided with an interior downwardly projecting circumferential rib for engaging the interior of the bottle mouth so as to prevent lateral shifting of the crown.

In my present design I have taken advantage of natural forces instead of resisting them as will be more fully hereinafter described and claimed.

Another object of my previous invention as disclosed in Patent No. 2,070,377 and in my present invention has been to design a base for the caps

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or nipples when made for use with a conventional nursing bottle with a lip or undercut rim, which will facilitate their application to or removal therefrom.

In my previous invention I made use of a tab or tabs extending downwardly from the retaining bead of the cap in such direction as to lie against the neck of the bottle and necessitating a projecting knob on the under side near its lower end adapted to space the lower end of said tab away from the bottle neck so as to provide a ready finger hold to enable the tab to be grasped when the cap is to be removed.

The portion of the mold which formed these tabs was very difficult and expensive to make and in production of the articles, the flash or fin of rubber would have set up a very difficult trimming operation involving a burdensome expense in the manufacture of such articles.

In my present invention the base has been designed with a preferably elliptical contour, the transverse surfaces of which on its upper and under side are cylindrical, so as to render the mold construction simple and inexpensive, thus allowing the base as a whole to be pressed to a flat surface for efficient and inexpensive trimming and to more easily facilitate the application to and removal of the caps or nipple from the bottle.

Although the valve cap, plain cap and nipple have been designed with a base and internal retaining bead for use with the conventional nursing bottle made with a lip or undercut rim, I do not wish to be confined thereby to the embodiment shown.

Other objects will be apparent from the following description taken in conjunction with the accompanying drawing, in which

Figure 1 is a cross-sectional view of the valve cap or closure of my invention;

Figure 2 is a cross-sectional view of a conventional nursing bottle equipped with the valve cap of my invention, showing the relationship of the valve structure of the cap to the bottle before thermal processing of the contents;

Figure 3 is a cross-sectional view of a conventional nursing bottle equipped with a valve cap of my invention showing the relationship of the valve structure of the cap to the bottle during thermal processing of the contents, the internal forces being indicated by the small black arrows;

Figure 4 is a cross-sectional view of a conventional nursing bottle equipped with the valve cap of my invention, showing the relationship of the valve structure of the cap to the bottle after ther-

mal processing of the contents, the external forces being indicated by the small black arrows;

Figure 5 is an end view of the valve cap;

Figure 6 is a view, partly in section, of the valve cap reversed in the process of removal from the bottle;

Figure 7 is a cross-sectional view of a conventional nursing bottle and nipple 16 with the same base as the caps;

Figure 8 is a cross-sectional view of a conventional nursing bottle and a plain or valveless sealing cap utilizing the base structure of my invention;

Figure 9 is a plan view showing a section of a sheet of caps as it comes from the mold, with the caps connected by a thin fin of the material from which the caps are molded;

Figure 10 is a side view of a cap illustrated in Figure 1, showing a cap flattened on a plate to facilitate removal or trimming of the flash.

The closure and nipple inventions, as presented in the accompanying drawings, are illustrated in conjunction with a nursing bottle structure, though, as previously indicated, the principles of the invention embodied in different constructions may enable use in conjunction with different kinds of bottles, flasks, jars or other receptacles.

As also previously indicated, the caps and nipples are designed to be made wholly of what is commercially known as "soft rubber."

As seen in Figs. 1 and 2, disclosing cross-sectional views of my valve cap off and on a bottle D, and as seen in Fig. 5 showing an end view of the exterior of the cap, the structure is composed of a valve structure A and side walls B connecting the valve structure with the base portion C of the cap. The base portion C of the bottle cap has a thickened section 2 provided interiorly with a standard circumferential bead 23, the upper part of said bead being adapted to be engaged by the lip 1 of the bottle and dimensioned so as to grip the bottle neck securely and form an airtight seal. The base and the side wall B of the cap curve downwardly and outwardly to merge tangentially with a flange which is preferably formed with an elliptical contour of greater length than the diameter of the cap body, although it can be formed with any desired contour.

In the direction of the transverse axis of the ellipse, the surfaces of the flange are cylindrical. The upper cylindrical surface of the flange curves downwardly to meet the lower cylindrical surface 15 and form the parting or trimming line of the cap. Because the flange is preferably formed with an elliptical contour of greater length than the diameter of the cap body, the two ends of the ellipse form tabs 13 and 14 for easy and sanitary application and removal of the cap, and, because the under surface 15 of the flange and base is cylindrical, the base as a whole can not only be pressed to a flat surface for trimming while being manufactured (Figs. 9 and 10), but in use can serve as a guide in drawing or pushing the cap over the mouth of the bottle. The under surface 15 of the base, flange and tabs, preferably formed as a continuous cylindrical surface, has a large radius relative to the diameter of the cap, and is preferably smooth and unbroken except for the central opening into the interior of the cap. The lower part of the wall of such central opening is preferably rounded so as to merge into the cylindrical under surface 15. The curvature of the surface 15 should be large enough so that a flattening out of the base for trimming can be readily accomplished. Furthermore, the curvature is such that when the cap or closure is stretched over the neck of the bottle the tabs while becoming curved or inclined at a somewhat steeper inclination than they occupy in the cap before application to the bottle, still stand free from the walls of the bottle so that they may be readily grasped for removal of the cap. This change in inclination of the tabs is clearly shown in Figs. 2, 3, and 4.

Figure 6 shows how the cap is removed from a bottle when the contents were previously treated as set forth. By grasping each tab between the thumb and index finger, thumbs on top and with their butt ends pressed against the side wall of the cap, the nurse can easily remove the cap by swinging the tabs upward, rolling the butt ends of her thumbs up over the side wall of the of the cap. The tabs are thus brought into the upright position shown in this figure, with the cap turned inside out. This is most easily done if the side wall of the cap is relatively thin. The projection or annulus 7 on the under side of the crown is held to the inner wall of the neck of the bottle by the vacuum while the cap is being turned preventing the cap from slipping off the bottle and any loss from spilling, while the cap is being turned. The cap is turned to this position without contacting the bead of the bottle, which would cause contamination. The vacuum is then broken by pulling the cap upwardly.

Reverting to the phase of the manufacture of my cap, and/or nipple structure, it is notable that articles of this class must for economical manufacture be produced by multiple cavity molds. Thus, when they are removed from the mold, they are connected together by means of the usual flash of rubber or whatever equivalent substance is used, this flash being the customary thin web or fin of rubber constituting the overflow resulting from the production of the articles themselves.

Figure 9 shows a plurality of the caps of my invention in the sheet in which they are removed from the mold, attached by the flash 25 and previous to the mechanical cutting of the vent or opening 9 in the crown portions of said caps. It is necessary, of course, to trim the flash from the base portions of the caps in completing the articles and separating them from the flash into the individual units. By the peculiar formation of my base structure C, including the tabs 13 and 14, it is possible to dispose the flash and caps as withdrawn from the mold, upon a flat surface, press downwardly upon the caps against said surface, and thereby flatten the base portion in the manner of the illustration of Figure 10. In this way, the whole series of caps as removed from the multiple mold, emplaced upon a flat base and pressed there against in the manner stated, will be conditioned by the flattening action for enabling simultaneous trimming of the base portions from the flash, or they can be trimmed individually very quickly and economically, or in various multiples as regards the number that may remain attached to the flash.

As illustrating, furthermore, the advantage of the construction of my improved valve cap, plain sealing cap, and nipple articles, it is to be drawn to attention that these articles may all be produced in two-part vertical molds with the base portion formed or molded by the cavity portion of the mold. The under surface of the arch portion of the cap formed by the core portion of the mold. The parting line between the core and

cavity portions is located so as to lie at the periphery of the lowest surface of the arch.

The method of molding and trimming the caps herein described is not claimed in this application as the same forms part of the subject matter of an application filed by me on May 11, 1945, Serial No. 593,135, now abandoned, which is a division of the application of which this application is a continuation.

Because of the elliptical contour and the cylindrical surface of the under side of the flange, the points of contact of the bead **23** with the bottle are not circumferentially uniform at the tangent points of union between the bead and flange. Therefore I have added for a more uniform seal of the bead an internal circumferential rib **3** at this point merging it into the downward curve of the flange. On the outer wall of the cap at a point opposite or preferably slightly below a line marking the top of the internal bead I have another circumferential rib or bead **5** which also gives a tight or reinforcing seal by pushing the edge of the bead up into the corner formed by the juncture of the neck and lip of the bottle.

The flange or tab construction described is useful not only in connection with valved caps as shown in Figs. 1 to 6, 9 and 10, but may also be applied to other forms of receptacle closures such as the nursing nipple **16** as shown in Fig. 7, or to a non-vented cap as shown in Fig. 8.

The valve structure of my cap may be designed and constructed in various ways, as will be mentioned hereafter, but for simplicity of mold construction and ease of manufacturing the cap the design shown in the drawings is preferable.

The principles of this design of the crown or valve structure can be compared to those principles operative in a cantilever bridge with a central conical arched span. From this conical arched span is suspended an inverted frustum of a cone **7** within which is a conical recess **8**.

Referring to Figure 1, between the apex **11** of the conical recess **8** and the vertex **10** of the external conical arch **6** is a vent or steam port **9**. The external arched span is a means of spanning the opening of the bottle by resolving vertical pressure into horizontal or diagonal thrust against the abutment formed by the side walls B reinforced by the external rib **4**. The portions of the cone frustum **7** at the sides of the vent and the cantilever beams, when in compression, rest on the fulcrum supplied by the top of the bottle lip and are anchored through the side wall B by the bead **23** under the lip of the bottle.

The external span and the suspended internal member **7** of the valve structure are designed to resolve the axial and radial forces so that internal pressure, shown by arrows in Fig. 3 causes vent **9** to open and external pressure, shown by arrows in Fig. 4 causes vent **9** to close. When the contents of the bottle with the valve cap applied thereto are being thermally processed with the air outside the bottle at atmospheric pressure, the axial components flex the elastic cantilever beams or web **12** and the arched span **6** upwards due to the pressure of steam generated by the high internal temperature. The valve allows the contents of the bottle to be heated above the boiling point at atmospheric pressure and the air to be exhausted and steam under pressure to emit through the vent **9**. The horizontal components cause the side wall and circumferential rib **4** to expand, stretching the valve radially. The radial tension acting along the diameter of the

conical recess perpendicular to the surface elements thereof and to the vent or steam port **9** causes the walls of the vent **9** to open and allows the exhausting of the air and steam from the bottle.

Since the forces on the cap are caused by a pressure difference, the total force must be the sum of the pressure forces on all elements of the surface of the cap and since the pressure is exerted by a gaseous medium, the pressure on each element of area acts perpendicular to the local surface element. The pressure at which the valve vent opens depends on the design of the individual elements of the valve. The neck **2** of the cap, and the bead **23**, are under initial tension sufficient to maintain the seal around the bottle neck against the internal pressure. The axial push of the pressure forces on the bottle cap is opposed by the lip of the bottle.

The inclination or height of the arched span **6** of the cap affects the pressure differential at which the valve vent opens and closes. Generally speaking if the angle of the arch is steeper the vent will open more quickly and close more slowly than if the angle is less steep. It is usually desirable to make the angle steeper and the arch higher in the case of closures for bottles or jars having openings of large diameter, while on bottles having small openings the inclination of the arch may be less steep.

After the contents of the bottle or jar in combination with my valve cap have been processed or sterilized as desired, and the bottle is removed from the heat, the vent closes instantaneously when the steam stops escaping, and the condensation of the steam in the bottle then causes a partial vacuum inside of the bottle. Horizontal and diagonal arch thrust or pressure at the same time is directed against the abutment bead **4** and against the external wall of the internal member **7**. The cantilever beam or web **12** which is designed to be flexible and to flex upwards, when there is steam pressure in the bottle, opens vent **9** and also helps to compel closure of the valve vent **9** when there is a partial vacuum in the bottle. The cantilever beam or web is now deflected downward against the valve seat or fulcrum supplied by the bottle lip.

The cantilever beam or web portion **12** is thin relative to the thickness of the central part of the valve structure, it being shown as of less thickness than the length of the tapered wall of the tapered member. It is also thinner than the thickened part **2**, it being shown as of approximately the same thickness as that of the side wall B.

The exterior arched span **6** now becomes a compression member of the valve and exerts pressure against the two walls of the vent **9**, sealing it tighter as the valve structure descends and wedges into the bottle mouth due to the suction of the increasing vacuum in the bottle and the external pressure of the atmosphere. The abutment rib **4** of the exterior wall of the valve and the interiorly suspended section **7** serving also as an abutment to receive the various pressures, thereby maintaining an hermetical seal of the vent **9**. This valve cap should preferably be used in combination with a bottle of aforesaid type with the diameter of the interior of the neck opening dimensioned to allow member **7** to wedge at least a part of its length into said mouth opening of the bottle. Although the principles involved in my valve function satisfactorily without any wedging of the suspended section **7**, it

is desired to limit the strain on the elastic cantilever beam or web 12 by wedging and supporting the center members of the valve into and on the valve seat formed by the top opening and lip of the bottle.

This wedging action during the descent of the valve member 7 into the mouth of the bottle also exerts more compressive force on the walls of the vent 9.

The lower wall of the beam or web portion 12 which seats on the top of the bottle lip when the pressure is reduced in the bottle, is preferably inclined upwardly from its juncture with the side wall of the cap to the point where it joins the wall of the depending member 7. This permits greater freedom of movement to the member 7 in response to changes in pressure inside and outside of the bottle.

The position of the point or line where the under side of the web portion 12 joins the wall of the depending member 7 is indicated by the dotted line M—N in Figs. 1 to 4. The apex 11 of the recess 8 is preferably located slightly above this line. The side wall B between the bead 23 and the under side of the web portion 12 is preferably approximately half as thick as the section 2 and long enough to extend slightly above the top of the lip 1 at the mouth of the bottle when the cap is in place and the pressure in the bottle is not less than atmospheric. This leaves a space 30 between the top of the bottle and the under side of the flexible web portion 12 which also facilitates freedom of movement of the valve structure (see Figs. 2 and 3).

The use of the relatively thin web portion 12 and the provision of space between the web and the lip at the mouth of the bottle insures that no lateral stress will be applied to the valve body by the application of the cap to the bottle which might tend to force open the slit before pressure builds up in the bottle. Any such stress tending to open the slit or to hold it open due to the positioning of the cap upon the mouth of the bottle would tend to interfere with the proper and quick closing of the slit and sealing of the bottle upon the cooling of the contents thereof. This might permit some objectionable leakage into the bottle upon the occurrence of sub-atmospheric pressures therein.

In the form of cap which I have illustrated, the conical recess 8 is as large at the bottom as the outer diameter of the bottom of the conical cone frustum constituting the depending member 7. Thus the conical surface of the recess meets the conical surface of the member 7, to form an edge which is flexible. Thus when the pressure in the bottle exceeds the external pressure, the flexible walls of the depending member 7 allow the valve structure to yield sufficiently to permit the vent to open. When the external pressure exceeds the pressure in the bottle and forces the depending member 7 down against the inside of the neck of the bottle, this flexibility permits the cone frustum to seal properly throughout a greater length of its external wall against the inner wall of the bottle.

As stated previously, the valve may be designed in various ways and still conform to the principles of my invention which are an exterior cantilevered arched span which can be of any shape or contour and which will serve alternately as a tensile or compressive member to receive and direct forces to open and close a vent between its apex and the apex of an interior member which also can be of any shape or divided into

counter wedges of various contours but with a central recess cooperating with the exterior member in the operation of opening a vent to allow exhaustion of gases and vapors from the bottle, and of hermetically closing or sealing a vent to prevent entrance of air and spoilage micro-organisms into the vacuumed bottle.

The valve cap is also intended to be used in auto-claving or pressure cooking processes.

What is claimed is:

1. In combination, a bottle having a mouth formed with an external bead at the open extremity thereof, and a soft rubber cap for closing said bottle, said cap comprising a body including a valve structure and a base structure connected to the body, the base structure being formed with a flange to fit beneath the bead at the bottle mouth and retain the cap on the bottle during use, said valve structure having a conical outer surface and including an inverted substantially conical projection on the under side of the value structure, said conical projection adapted to project into the mouth of the bottle, and being of less diameter at its smaller end than the interior diameter of the mouth of the bottle, and tapering outwardly to a size sufficient to wedge tightly within the mouth of the bottle when the value structure is displaced downwardly by the action of external pressure on the cap greater than the pressure within the bottle, said cap body being formed to position the valve structure spaced away from the mouth of the bottle sufficiently to free said inverted conical projection from wedging engagement in the mouth of the bottle when the internal pressure in the bottle is equal to or greater than the external pressure on the valve structure, said valve structure having a central conical recess in its lower surface and having a valve vent formed therethrough communicating with the top of said recess and adapted to open to permit the escape of pressure from the bottle, said valve vent being held in a sealed condition when the valve structure is displaced inwardly of the bottle by the wedging of said inverted conical projection in the mouth of the bottle, the top of the recess in the valve structure with which the valve vent communicates lying close to the plane of the mouth of the bottle when the valve structure is displaced inwardly, whereby such inward displacement closes the vent and does not permit leakage.

2. The combination of a bottle and cap as set forth in claim 1 wherein the base structure of the cap has an external flange shaped to provide finger tabs, the lower surface of said base structure, flange and tabs being formed as a concave surface of cylindrical curvature of relatively large diameter whereby said cylindrical surface facilitates application of the closure to the bottle, and said tabs are downwardly curved away from the mouth of the bottle when the closure is applied thereto, the base having a rounded corner surface between the surface of cylindrical curvature and the surface of the opening for receiving the bottle mouth, the upper surface of said flange and tabs being smoothly rounded down to its line of intersection with the surface of cylindrical curvature of the under side of the flange and tabs.

3. A soft rubber article having an opening which is adapted for attachment to the mouth of a bottle having a bead at its mouth comprising a body adapted to surround the bottle mouth, and a base structure connected to the body, the base structure being formed with a flange to fit

beneath the bead at the bottle mouth and retain the article on the bottle during use, said base structure also having an external flange shaped to provide finger tabs, the lower surface of said base structure, external flange and tabs being formed as a concave surface of cylindrical curvature of large diameter relative to the diameter of the article, whereby said cylindrical surface facilitates application of the article to the bottle and said tabs are downwardly curved and stand away from the mouth of the bottle when the article is applied thereto, the base having a rounded corner surface between the surface of cylindrical curvature and the surface of the opening for receiving the bottle mouth, the upper surface of the flange and tabs being curved down to a line of intersection with the surface of cylindrical curvature of the underside of the flange and tabs lying in said surface, said surface of cylindrical curvature being substantially smooth and uninterrupted except for the opening therein for receiving the mouth of the bottle, and being of such radius and the article being formed of rubber of such resiliency that said surface of cylindrical curvature may be temporarily flattened out to a plane by pressing the article upon a plane surface so as to facilitate trimming of the margin of the external flange and tabs while so pressed against a plane surface.

4. A soft rubber article for attachment to the mouth of a bottle having a bead at its mouth comprising a body adapted to surround the bottle mouth and a base structure connected to the body, the base structure being formed with a flange to fit beneath the bead at the bottle mouth to retain the article on the bottle during use, said base structure also having an external flange shaped to provide finger tabs, the lower surface of the base structure, external flange and tabs being formed as a concave surface of cylindrical curvature of large diameter relative to the diameter of the article, whereby said cylindrical surface facilitates application of the article to the bottle and said tabs are downwardly curved and stand away from the mouth of the bottle when the article is applied thereto, said surface of cylindrical curvature being of such radius and the article being formed of material of such resiliency that said surface of cylindrical curvature may be temporarily flattened out to facilitate trimming of the article.

5. A soft rubber article for attachment to the mouth of a bottle having a bead at its mouth comprising a body adapted to enclose the bottle mouth and a base structure connected to the

body, the base structure having an opening and being formed internally with a flange to fit beneath the bead at the bottle mouth to retain the article on the bottle during use, the base structure having an external bead thereon at approximately the level of the internal lip engaging flange, the opening in the base structure through which the bottle mouth passes having a circumferential rib therein between the lip-engaging flange and the lower surface of the base structure, said base structure also having an external flange shaped to provide finger tabs, the lower surface of the base structure, external flange and tabs being formed as a concave surface of cylindrical curvature of large radius relative to the diameter of the article whereby said cylindrical surface facilitates the application of the article to the bottle and said tabs are downwardly curved and stand away from the sides of the bottle when the article is applied thereto.

6. A soft rubber article having an opening adapted for attachment to the mouth of a bottle having a bead at its mouth comprising a body adapted to enclose the bottle mouth and a base structure connected to the body, the base structure being formed internally with a flange to fit beneath the bead at the bottle mouth to retain the article on the bottle during use, said base structure also having an externally projecting flange providing finger engaging surfaces, the lower surface of the base structure and external flange being formed as a concave surface of cylindrical curvature of large radius, smooth and unbroken except for the opening for receiving the mouth of the bottle, and serving to facilitate the application of the article to the bottle.

ELTA SIMMONS.

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