Aug. 14, 1934. J. P. BURKE 1,969,777

METHOD OF MAKING CLOSURES

Original Filed Oct. 23, 1931

Fig. 1

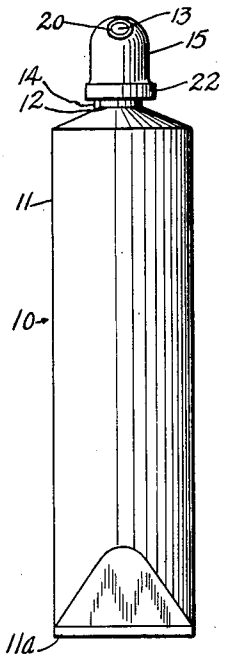



Fig. 2

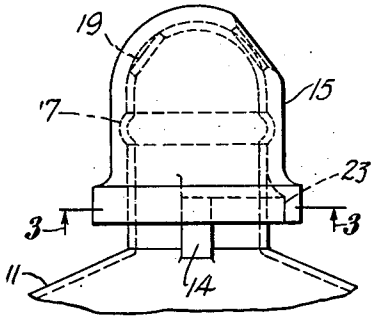



Fig. 4

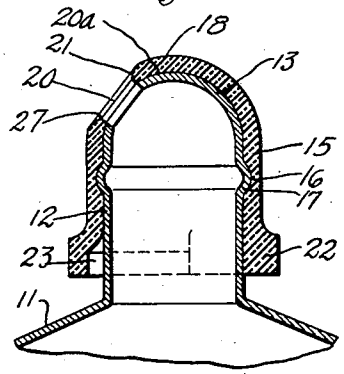



Fig. 3

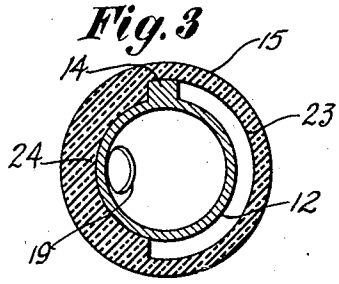



Fig. 6

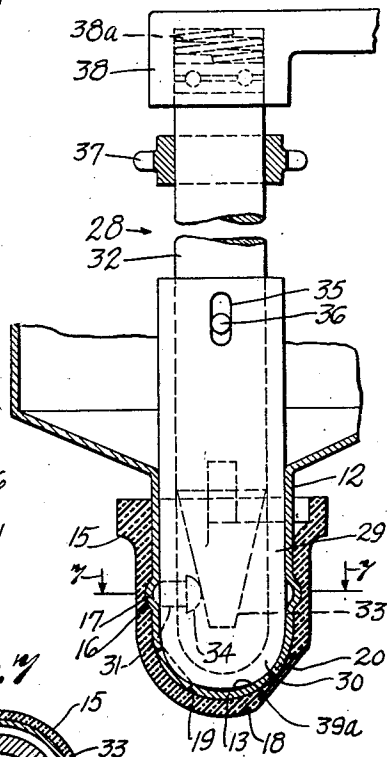



Fig. 8

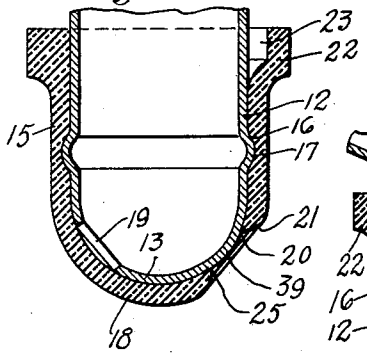



Fig. 5

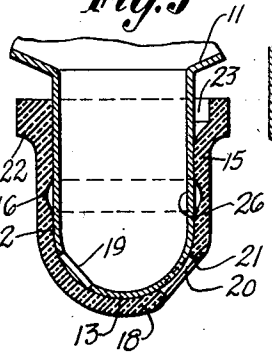



Fig. 9

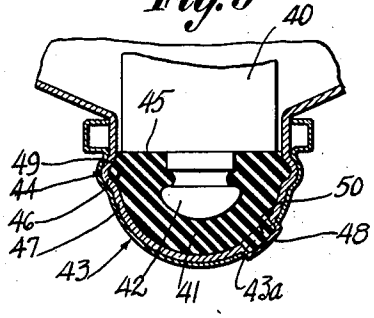
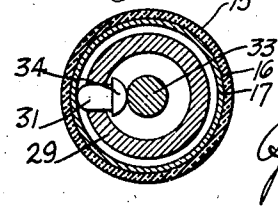



Fig. 7




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1,969,777

## METHOD OF MAKING CLOSURES

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Original application October 23, 1931, Serial No. 570,741, now Patent No. 1,910,378. Divided and this application April 26, 1933, Serial No. 668,004

12 Claims. (Cl. 29—148.2)

This invention relates to methods of making and assembling closures with particular reference to collapsible tubes.

The object of the invention is to provide an improved method of making or interengaging a plurality of relatively rotatable elements such as a tubular element and a valve cap thereon, whereby the element is pressed or spun into snug seating contact with the cap and/or an outward projecting annular portion formed in the element for snugly engaging throughout in a corresponding recess or undercut in the cap, whereby to afford a liquid tight locking engagement for the cap, or a severable orifice forming projection.

Other objects and advantages of the invention will become apparent as the specification proceeds.

With the aforesaid objects in view, the invention consists in the novel combinations and orders of method steps hereinafter described in their preferred embodiments pointed out in the subjoined claims, and illustrated on the annexed drawing, wherein like parts are designated by the same reference characters throughout the several views.

In the drawing:

Figure 1 is a view in elevation showing a device made according to the invention.

Fig. 2 is a fragmentary view in elevation of the device taken at an angle to Fig. 1.

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is an enlarged sectional view of the device.

Fig. 5 is a sectional view showing a step in the method of making the device.

Fig. 6 is a view with parts in section showing a subsequent step in the method of making the device, and the apparatus employed, with parts removed.

Fig. 7 is a sectional view taken on line 7—7 of Fig. 6.

Fig. 8 is a still further enlarged sectional view showing the device in course of manufacture.

Fig. 9 is a further modification of an application of the method.

The advantages of the invention as here outlined are best realized when all of its features are combined in one and the same process, but, useful methods may be produced embodying less than the whole.

It will be obvious to those skilled in the art to which this invention appertains, that the same may be employed to produce several different constructions. The accompanying drawing, therefore, is submitted as showing the preferred product of the invention.

This application is a division of application, Serial No. 570,741, filed October 23rd, 1931, on Containers.

It has heretofore been known to provide rotatable valve closures for collapsible tubes, with the closures held on by a detent or sprung over a suitable projection on the tube. In such devices, auxiliary means are found necessary to prevent occurrence of leakage between the closure and the part of the tube sleeved therein, as, for example, special resilient inserts at the valve opening, or cams for drawing the closure snugly against the tube part in the closed position. By my invention these features are eliminated, whereby the device may be much more cheaply made, in quantity production, and without permitting leakage, and so as to be substantially liquidtight for the materials handled in the collapsible tubes.

Generally described, I utilize my novel method to provide a collapsible tube having a substantially cylindrical portion of reduced diameter provided with a closed hemispherical end. Upon this is placed a cap of similar contour and having an internal annular coaxial groove. The tube part is interiorly expanded as by spinning concentrically or eccentrically to force a ridge into said groove, the expansion causing the tube part to uniformly snugly seat in the cap in a liquid tight manner. Simultaneously the hemispherical end may also be spun or expanded to snugly contact the inside face of the cap to afford a tight valve seat at the outlet openings that may be provided at a suitable step in the manufacture of the device. Thus in one operation the cap is permanently rotatably secured to the collapsible tube and caused to be individually fitted thereto in a tight manner, eliminating the effects of any possible variations in size or form of the cap or tube or both, in course of their separate manufacture, and due to the different natures of the materials employed. However, hydraulic pressure or the pressure caused as by a deformable or rubber head may also be utilized to practise the process, by causing the desired expansion, with or without spinning. According to another exemplification of the invention, the method may also be practised with a device wherein the port is subsequently formed, as by piercing a portion of the hemispherical end, or by forming the latter with a projection adapted to be sheared by the cap to afford a port. The said projection may be formed separately or simultaneously, but in each case

the cap may be seated and attached in one operation.

Referring in detail to the drawing, 10 denotes a device produced by the invention. The same may include a tubular device such as a collapsible container 11 having a neck portion 12 of reduced diameter. The container and its neck portion may be of any conventional construction and may consist of a soft ductile or pliable metal. Preferably the neck portion is of substantially cylindrical form, and may terminate in a portion 13 of reducing size, of taper form, or merely hemispherical as shown. At the base of the neck portion there may be a stop member 14 which may be integral therewith.

Rotatably mounted on the tubular or neck portion 12 there may be a coacting tubular device such as a cap 15. This may be relatively rigid and made of any material, such as metal, bakelite, or other relatively strong or nonductile material. Interiorly the cap fits the neck portion snugly. To retain the cap on the neck portion, the cap may have an internal preformed undercut or annular groove 16 into which a corresponding annular flange or ridge 17 of the neck portion may be spun or depressed for a snug and somewhat resilient engagement. The location of this line of engagement may be intermediate of the ends of the closure 15, and preferably in suitable proximity to the end 13 which may act as a re-enforcement for the ridge 17. In this manner, moreover, the closure may be made with a minimum length. The groove and ridge engagement also serves to retain the curved end 18 of the cap in snug contact with the corresponding part 13. It will be noted that the ridge and groove have a plurality of curves forming substantially a U in shape to assure a uniform and ample area of contact.

The end portion of the neck may have an opening 19 offset from the center, and the closure may have a corresponding opening 20 adapted to register therewith. Between the portions 13 and 18 is the snug valve seating surface 20*a* for the openings 19 and 20. At 21, the closure may be outwardly flared from the opening 20.

The lower part of the closure may have an enlarged finger grip portion 22. Within the same there may be an arcuate recess 23 for receiving the stop 14 and the ends of the recess defining stop faces of an angularly elongated shoulder 24, for abutment with the stop 14, and whereby the open and closed positions of the cap are determined.

The device above described is particularly characterized by the fact that the interlocking engagement at 16, 17 forms a seal which supplements the seal at the surface 20*a*. The latter is likewise rendered snug preferably by outward pressing or spinning of the hemispherical portion 13 simultaneously with the formation of the annular projection 17. Thus, not only is any tendency overcome of collapsing the part 13 downward due to the outward pressure at 17, but the part 13 is actually positively outwardly pressed for an individual fit with the cap.

In manufacturing the device, the cap may be initially provided with the opening 20 bounded by an angular edge 25 terminating in the flare 21. A tubular neck portion 12, having a uniform side wall 26 is placed therein. Then the neck portion is interiorly spun to expand the same to form the ridge 17 and simultaneously to press the hemispherical part 13 for a good valve seat with the corresponding cap part 18. The opening 19 may have been previously formed or may now be drilled, and the opening 20 reamed to eliminate any burr and thereby form the straight edges 27 for the opening 20.

Any suitable means such as 28 may be used to effect the spinning of the neck portion. Thus a tool may be utilized having a head 29 provided with a centering or tapering end 30 that may be hemispherical and of suitable size to snugly fit the end of the neck portion. This head may be hollow and may have a laterally projectible element or pin 31 slidably fitted in a hole in the wall thereof. Suitable means may be provided for actuating the head and pin. Thus a spindle 32 may extend into the head and may have means such as a tapering end or cone 33 for actuating the pin by laterally bearing on a head 34 thereof as a result of relatively longitudinal sliding movement of the head 29 and the stem 32 or a part thereof. The provision of the head 34 prevents the element 31 from leaving the head 29. To limit the relative movement of the parts 29, 32, the former may have a slot 35 and the latter a pin 36, movable therealong. In this manner rotation may be imparted to the head 29 by the spindle.

Any well known means such as a gear 37 may be utilized for rotating the head 29. Longitudinal pressure on the head may be caused by an end thrust bearing 38 suitably actuated for the purpose, and including preferably an expansion coil spring 38*a* whereby a resilient pressure is maintained for uniform spinning action. It will be noted that rotary and axial force may be simultaneously applied. Moreover, due to the application of axial pressure on the stem 32, the pin 31 is outwardly projected under a desired force and a pressure simultaneously exerted on the hemispherical end of the neck portion. As the ridge 17 is being formed the pin 31 moves outward from the head 29, and the stem 32 moves downward while rotating. Hence the neck portion is at the same time expanded laterally and longitudinally for a uniform continuous fit with the cap. Since the head 29 substantially fills the neck portion, any collapse of the latter due to pressure of the pin 31 at a point, is prevented, nor can the end 13 recede from the end 18 of the cap. After the spinning operation is completed the head 29 may be withdrawn, the stem 32 moving upward relatively thereto, and the pin 31 backing up into its head.

In fact, I have found in actual practise that a portion of the neck 12, such as 39 shown in Fig. 8, may in course of the spinning operation be forced slightly into the opening 20 in the cap. This will happen to an imperforate part of the neck that will be adjacent to said opening, and the degree of such projection may be extremely slight, but sufficient to cause a very tight seal. The position of the part 39 is such that every time that the cap is closed, the part 39 comes into registry with the opening 20 of the cap. The base 11*a* may thereafter be suitably fastened to the device 10.

Expansion may also be caused by the action of hydraulic pressure or by inserting a yielding or resilient head of any suitable material such as rubber in the neck 12 and exerting pressure thereon. In order to limit the expansion at the bulge portion 39, the same may be suitably backed up externally in any desired manner, as by placing an obstacle at the opening 20 of the cap and extending thereinto or flush with the beveled surface at 21. Thus the bulge may have the shape of a spherical segment or it may be in the nature of a shallow cylindrical projection as may be desired, the latter being adapted to be sheared off

by the cap or otherwise removed as by a pushing action of the cap on rotation thereof to form a port to replace the port 19. If desired the head 30 may be of slightly oblate form at 39*a* to increase the size of the bulge 39.

In Fig. 9 is shown an embodiment 40 exemplifying a different application of the expansible tool and the method of making closures, as more particularly described in my application, Serial No. 639,803, filed October 27, 1932. In this case, a shank 40 having a head 41 of rubber or other elastic material is used. If rubber is used, the same may be of any required hardness consistent with the work to be performed. This head may be secured to or molded around a headed end 42 of the shank. The cap 43 which may be strong and rugged may consist of metal, bakelite, or the like. It may have an opening 43*a* and an internal annular recess 44. Upon inserting the tool 41 and exerting pressure thereon at the shoulder 45 of the shank, an annular ridge 46 is outwardly pressed in the soft metal of the collapsible tube neck 47. Simultaneously, a bulge such as 39 may or may not be formed, depending on whether the neck is externally supported at the opening 43*a*. If sufficient expansive pressure be exerted, a closed ended projection 48 may be forced from the neck into the opening 43, which projection shall have walls of such thinness as to be readily pushed or sheared off by the cap on rotating the same after removal of the tool. If the projection 48 were preformed, the neck and closure would nevertheless acquire a fluidtight seating engagement while being simultaneously attached to the tube neck, and allowance being thus automatically effected for possible irregularities in the size or shape of the cap.

It will be understood that the head 41 may be of regular substantially hemispherical contour as in the case of head 30, and that the bulges at 49 and 50 are produced solely by the yield of the neck against the cap. However, in view of the elastic quality of the head 41, the shape thereof may vary from the internal contour of the cap, and yet function efficiently for the intended purpose.

It will be appreciated that various changes and modifications may be made in the device as shown in the drawing, and that the same is submitted in an illustrative and not in a limiting sense, the scope of the invention being defined in the following claims.

I claim:

1. The method of making a container having a rotary type valve cap mounted on a tubular element having a portion for control of an opening in the cap, including the step of expansively spinning a tool substantially rotatably fitted in said tubular element so as to expand a portion of the element into engagement with an internal undercut in the cap, and simultaneously causing the element in the region of said portion to expand into snug fitting nonleaking rotatable engagement with said cap.

2. The method of making a container having a rotary type valve cap mounted on a ductile tubular element having a circular concaved end wall and a portion adapted to form therewith a registering valve opening, including the step of yieldably pressing and spinning an expansible tool rotatably fitted in the end wall of said tubular element so as to expand the element at said portion into uniformly snug circular engagement with the corresponding part of the cap and with an undercut in the cap to prevent disengagement of the latter.

3. The method of rotatably securing on a tubular element a cap having a wall provided with an opening communicable with an opening to be formed in the element, which includes subjecting said wall including the portion thereof at said opening to pressure against the corresponding wall of the cap and simultaneously yieldably laterally expanding said element into snug fitting rotary engagement with the cap.

4. The method of making a closure having a plurality of hollow members journaled upon one another and having opening portions adapted to register with each other, which includes positioning the members in snug uniform engagement with each other, and yieldably pressing the walls of the members against each other so as to cause a wall portion of one of the members to bulge into the opening of the other member.

5. The herein described method of securing and rotatably fitting on the neck of a collapsible tube a cap closure having a recess, which includes internally expanding the neck to snugly fit the internal contour of the cap and expanding a portion of said neck into said recess.

6. The herein described method of rotatably fitting on the neck of a collapsible tube a cap closure having an opening, which includes yieldably expanding the cross sectional area of the neck to fit the cap and simultaneously forming a projection on the neck extending into said opening.

7. The method of making a collapsible tube closure having a soft metal tubular neck with an end dome shaped wall therefor, a cap rotatably fitted thereon and having an eccentric part adapted to control an opening in the neck, which method includes the use of a rubber piston head for internally uniformly expanding the transverse area of the neck and simultaneously yieldably pressing said end wall of the neck snugly against the corresponding wall of the cap, for effecting a snug rotary seating engagement between the side and end walls of the neck and cap about said part.

8. The herein described method of making a tight rotary seating engagement along a hemispherical surface between a collapsible tube neck and a closure cap therefor which includes uniformly continuously internally expanding the neck in a yielding manner along the hemispherical surface for liquid tight engagement at said seating surface.

9. The method of rotatably securing a cap on a tubular element having an end wall provided with an opening communicable with an opening of the cap, which includes subjecting said end wall including the opening portion thereof to pressure against the corresponding wall of the cap and simultaneously laterally expanding said element into snug fitting rotary engagement with the cap.

10. The method of forming a sealing relation between a tubular ductile member and a rigid cap member journaled thereon, which members have similar concave end walls provided with outlet openings, said method including interiorly expansively spinning the end wall of the tubular member into snug seating contact with the end wall of the cap member throughout the end wall of the tubular member and at the opening thereof, by spinning an element having a correspondingly convexed end while pressing said end against the end wall of the tubular member.

11. The herein described method of rotatably securing on the pliable neck of a collapsible tube a nonpliable cap having an annular recess coaxial with the neck and cap and the latter having a normal snug seating rotary assembly relation with the neck, including subjecting said neck in the assembly relation thereof with the cap, to an internal expansive spinning action to form on the neck an annular external rib projecting uniformly into said recess in fitted relation thereto, while controlling said spinning action so that the rib and recess have a final operatively rotatable and sealing interengagement therebetween.

12. The herein described method of movably securing on the pliable neck of a collapsible tube a nonpliable cap having an annular recess coaxial with the neck and cap and the latter having a normal snug seating movable assembly relation with the neck, including subjecting said neck in the assembly relation thereof with the cap, to an internal expansive pressure to press out from the neck an external rib projecting into said recess in fitted relation thereto, and simultaneously causing the pressure so exerted to be of a yielding character so that the rib and recess finally possess a relatively movable operative relation and snug fitting interengagement continuous with the snug seating between the cap and neck.

JAMES P. BURKE.