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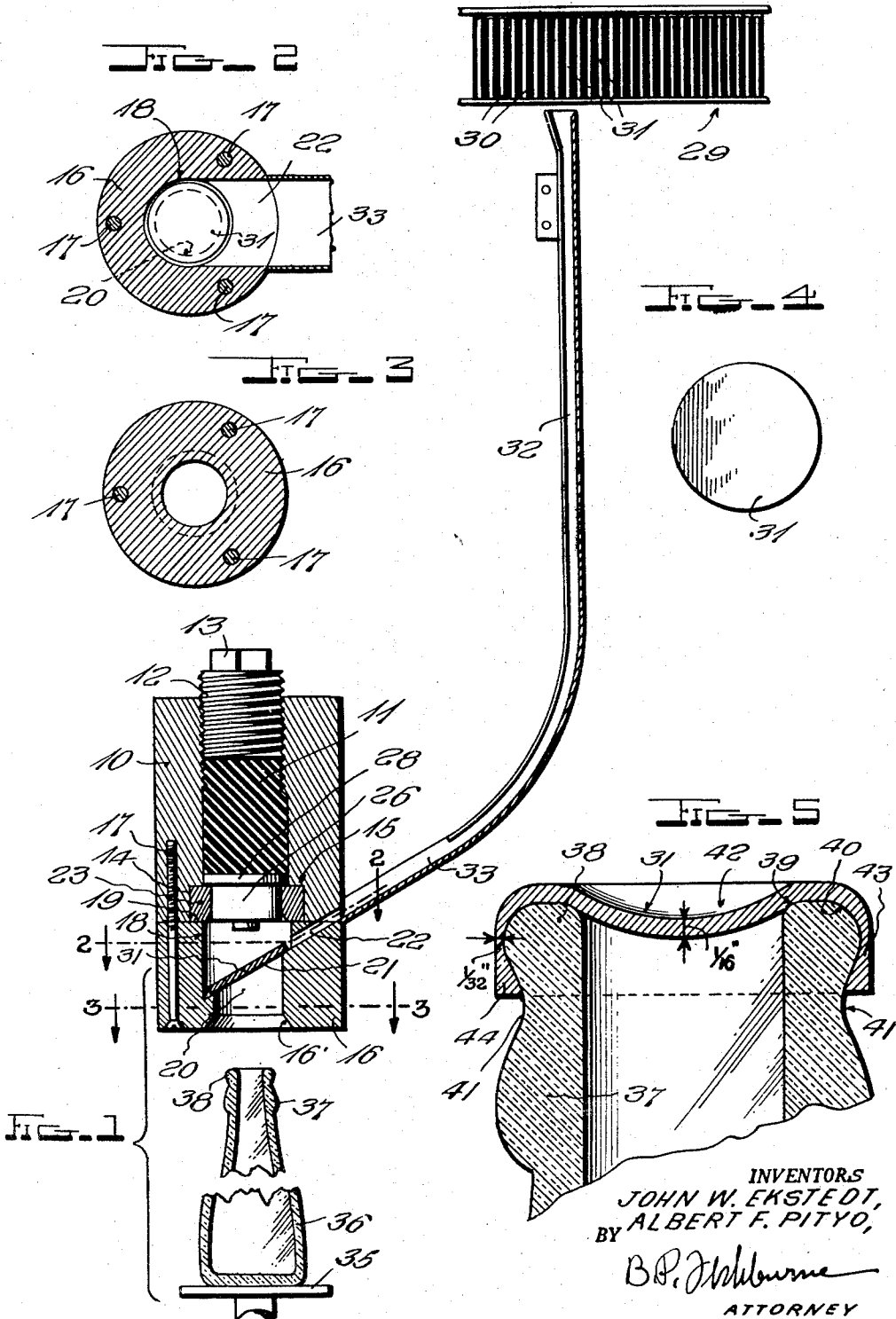
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METHOD OF FORMING CROWN CAPS

Filed May 11, 1943

2 Sheets-Sheet 1



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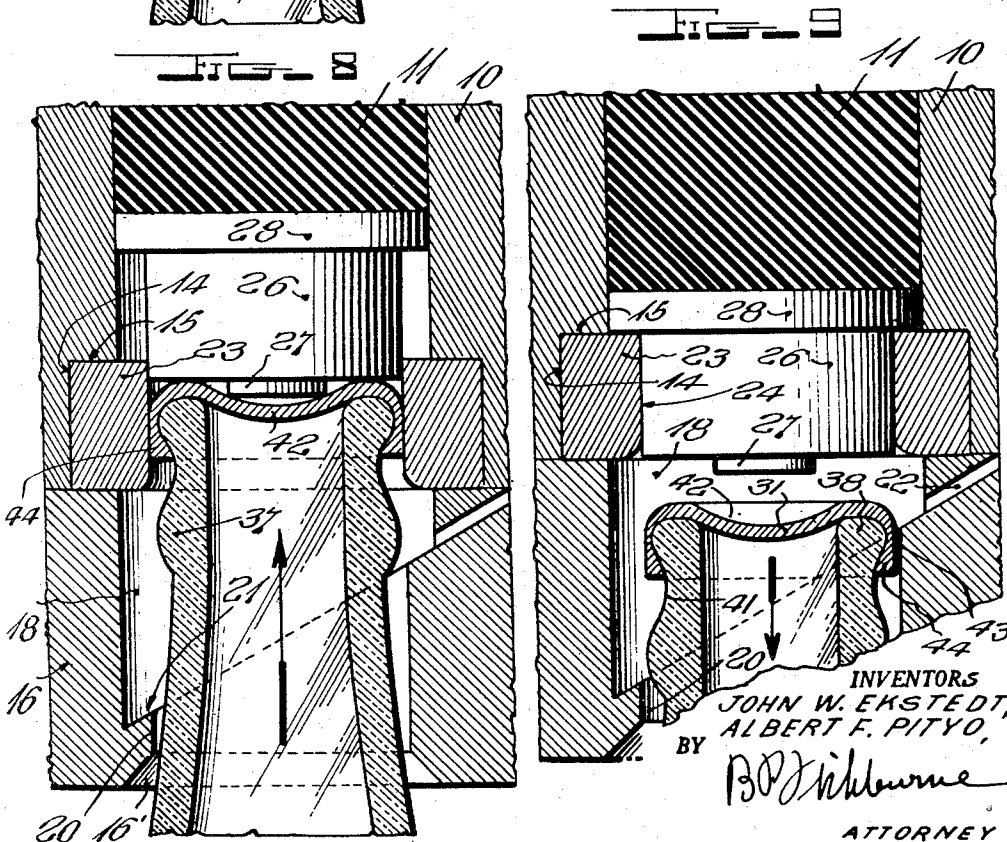
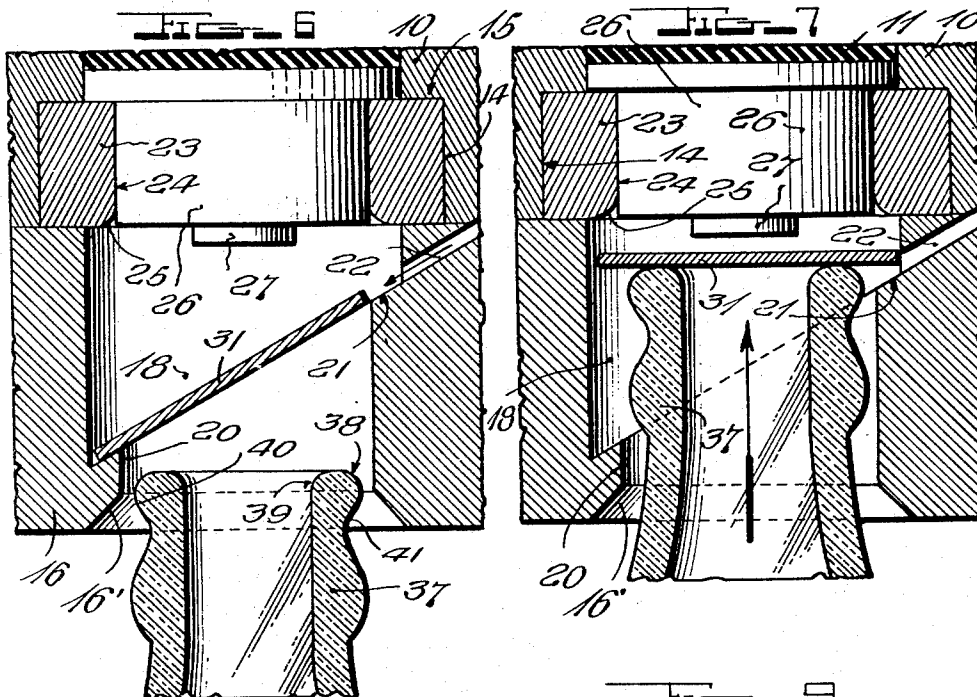
J. W. EKSTEDT ET AL

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METHOD OF FORMING CROWN CAPS

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2 Sheets-Sheet 2



INVENTORS
JOHN W. EKSTEDT,
ALBERT F. PITYO,

BY

B. P. Wilkerson

ATTORNEY

UNITED STATES PATENT OFFICE

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METHOD OF FORMING CROWN CAPS

John W. Ekstedt, Union, and Albert F. Pityo, Clifton, N. J.

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2 Claims. (226—83)

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This invention relates to a method of forming a thermo-plastic crown cap upon a bottle or the like.

An important object of the invention is to provide a method of the above mentioned character, for forming a thermo-plastic cap in place upon a bottle, from a flat blank, and effecting the operation quickly and economically.

A further object of the invention is to provide a method for rapidly feeding by gravity the heated thermo-plastic blank to a position to be engaged by the bottle when the bottle rises, and to compensate for the rebounding action of the falling blank, prior to its engagement with the bottle.

A further object of the invention is to provide a method of the above mentioned character which produces a pressing and drawing action upon the skirt of the thermo-plastic cap being formed, thereby causing the cap to retain accurately its shape upon hardening and preserving its binding or contacting engagement with the bottle.

A further object of the invention is to provide a method to force the inner portion of the cap into contact with the inner portion of the bottle, when the cap is formed and applied to the bottle.

A further object of the invention is to provide a method having a drawing action upon the skirt of the heated thermo-plastic cap whereby the thickness of the skirt is reduced and a thickened extension formed at or near the bottom of the skirt, for interlocking engagement with the bead of the bottle.

A further object of the invention is to provide a method of the above mentioned character which strips the hardened formed cap upon the bottle from within the forming die, after the completion of the operation.

A further object of the invention is to provide a thermo-plastic cap which will be securely held upon the bottle and afford a gas tight joint.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this application and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a central vertical section through apparatus employed in the practice of the method.

Figure 2 is a horizontal section taken on line 2—2 of Figure 1.

Figure 3 is a similar view taken on line 3—3 of Figure 1.

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Figure 4 is a plan view of a blank from which the cap is formed.

Figure 5 is an enlarged transverse vertical section through the completed cap as applied to a bottle.

Figure 6 is a central vertical section through the cap forming means, parts broken away, showing the blank held in the inclined position, prior to engagement with the bottle.

Figure 7 is a similar view, showing the bottle raised and the blank shifted to the horizontal position, prior to the forming operation.

Figure 8 is a similar view, showing the blank forced upwardly into the forming die, and showing the forming and drawing step.

Figure 9 is a similar view, showing the cap formed upon the bottle and stripped from the forming die.

In the drawings, wherein for the purpose of illustration is shown a preferred form of apparatus for the practice of the method, the numeral 10 designates a vertical stationary cylindrical sleeve, receiving therein a resilient element 11, which may be in the form of a rubber plug, having the desired stiffness to exert a suitable downward force. This force may be from 10 lbs. to 250 lbs. per square inch. The tension of the rubber plug may be varied by adjusting a plug 12, having screw threaded engagement within the top of the sleeve, and having a polygonal head 13 by means of which it may be turned. The sleeve 10 is preferably formed of metal and is provided at its lower end with an annular recess 14, forming a horizontal shoulder 15. Arranged beneath the sleeve 10 is a centering or holding device, including a vertical sleeve 16, also preferably formed of metal, and secured in the sleeve 10 by screws 17 or the like. This sleeve 16 has an upper cylindrical bore 18, which is considerably smaller in diameter than the bore of the recess 14, and hence the sleeve 16 forms a shoulder 19, arranged opposite the shoulder 15. The sleeve 16 has a lower cylindrical bore 20, having a considerably smaller diameter than the bore 18, and forming a vertically inclined shoulder 21. This vertically inclined shoulder extends downwardly in the direction of travel of the blank, to be described. The sleeve 16 has a downwardly flaring recess 22, leading into the bore 20, as shown. A vertically inclined slot 23 is formed in the sleeves 10 and 16 and leads into the bore 18, at the high end of the shoulder 21 and the bottom of this slot is a continuation of the shoulder 21.

Arranged within the recess 14 and held therein

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against movement is a forming and drawing die 23, preferably formed of metal. This die is annular and has a vertical bore 24 which is circular in cross section and tapers slightly upwardly. The taper extends from the top of the bore 24 to a rounded outwardly flaring shoulder 25. The extent of the taper is preferably .010" (ten thousandths of an inch).

Mounted for movement within the die 23 is a forming plug 26, preferably formed of metal, and this plug has substantially a sliding fit within the die 23. The plug is provided at its bottom with a reduced cylindrical extension 27. At its top, the plug 26 has an enlarged portion or flange 28, which engages the top of the die, to limit the downward movement of the forming plug. The elements 27 and 28 are preferably formed integral with the plug 26. The enlarged portion 28 is engaged by the rubber plug 11.

Arranged at a suitable elevation above the sleeve 10 is a heating unit 29, preferably horizontally disposed. This heating unit has a plurality of spaced fins 30, forming pockets to receive blanks 31 of the thermo-plastic material. This heating unit is turned or indexed so that the heated blanks, one at a time, are discharged in succession into the upper end of a vertical chute 32 having a lower inclined portion 33, in communication with the inclined slot 22.

Arranged beneath the sleeve 16 is a vertically movable plunger 35, supporting a bottle 36 to be raised and lowered thereby. This plunger is included in the conventional bottle capping machine, wherein the plunger is raised to elevate the bottle during the crowning or capping operation. The bottle has a neck 37 and is provided at its upper end with a bead 38. This bead has an inner transversely convex surface 39 and an outer transversely convex surface 40 and a reduced portion or recess 41 beneath the bead.

The blank 31 is formed of thermo-plastic material, and we preferably form the blank 31 of cellulose acetate, or a cellulose acetate compound, although other thermo-plastic materials may be used, such as those recited in our copending application for Thermo-plastic crown caps, method of forming the caps, and method of applying the caps to the bottles, filed November 11, 1942, Serial No. 465,258 which became abandoned on October 12, 1947.

The practice of the method is as follows:

The bottle 36 is placed upon the plunger 35 and is held in the lowered position. The heater 19 is preferably maintained at a temperature of substantially 340° F. and is filled with the cellulose acetate blanks 31 which are heated to substantially 340° F. The heater 19 is then turned a step and the circular blank 31, at substantially 340° F. drops from the heater and is supplied to the chute 32 and falls by gravity instantly through the chute and passes through the inclined slot 22 and enters the sleeve 16 and rests upon the inclined shoulder 21. The invention is not restricted to heating the blank 31 to 340° F., as the temperature may vary from 250° F. to 340° F. for the cellulose acetate blanks, and for the other thermo-plastic blanks. It is sufficient to heat the thermo-plastic material so that it will be moldable. There is some tendency for the blank 31 to rebound slightly, when reaching the lower end of the shoulder 21, and when this occurs, the blank instantly returns to the lowermost position by gravity, since it slides down the inclined shoulder. As soon as the heated blank 31 is in

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the lowermost position upon the inclined shoulder 21, the plunger 35 is moved upwardly. As the bottle is elevated its neck enters the bore 20, beneath the blank 31, and the bore 20 will serve to center the bottle, if necessary, Figure 6. As the bottle continues to move upwardly, the bead 38 engages with the heated blank 31 and shifts the blank to a horizontal position, Figure 7, and causes the blank to move upwardly with the bead, the bore 18 serving to center the blank upon the bead. Further upward movement of the plunger 35 and bottle 36 causes the marginal portion of the blank 31 to engage with the rounded edge 25, whereby such marginal portion is folded or formed downwardly about the outer face 40 of the bead. The continued upward movement of the bottle and blank 31 causes the bead 38 and blank 31 to pass into the bore 24 of the die 23, Figure 8.

The upward movement of the blank 31 is opposed by the forming plug 26, pressed downwardly by the rubber plug 11. This forming plug 26 therefore exerts a downward yielding pressure upon the heated blank 31 and securely presses the upper portion of the blank against the top of the bead 38, while the extension 27 produces a depression or recess 42 in the top of the blank and causes the outer portion of this depression to be forced into engagement with the inner convex face 39 of the bead 38. As the heated blank 31 is forced upwardly into the forming and drawing die 23, while applied to the bead 38, its marginal portion is folded downwardly over the outer convex face 40 of the bead, forming a skirt portion 43, of reduced thickness and providing at the bottom of the skirt portion a locking portion 44 of increased thickness. The upward movement of the bottle and blank 31 into the stationary die 23, causes the material of the skirt portion 43 to be drawn axially and downwardly, as well as forced inwardly against the convex face 40 of the bead. This downward drawing of the material at the skirt portion 43 in some way changes the molecular arrangement or condition of the heated thermo-plastic material whereby the formed cap, upon cooling, will retain its precise shape, particularly at the skirt portion 43, and this skirt portion will remain in firm contact with the outer face 40, thus insuring a gas tight fit, and holding the cap in place upon the bottle. It may be that the phase of the thermoplastic material at the skirt portion 43, due to the drawing action, has been somewhat changed, or it may be that the thermoplastic material at the skirt portion has been drawn or stretched beyond its limits of elasticity. Whatever may be the reason, it has been found that the drawn skirt portion 43 will retain its identical shape and size upon cooling, or becoming solid. This is an important feature of the invention, as the difficulty encountered in the use of the ordinary pre-formed thermoplastic crown cap, is that after the cap is heated and applied to the bottle, and pressed against the bottle without the drawing action, that such cap upon cooling tends to resume its original shape, to some extent, and accordingly moves at its skirt from the bottle, providing a joint which is not gas tight. Since the transverse thickness of the skirt 43 is reduced by the drawing action, the excess thermoplastic material is drawn downwardly below the maximum exterior diameter of the bead 38 or convex face 40, providing a locking portion or shoulder 44 of increased thickness, upon the lower end of the skirt portion. This thickened lock-

ing portion 44 beneath the bead 38, serves to securely attach the crown cap to the bottle. As clearly shown in Figure 5, the formed cap has a thickness at its top of substantially $\frac{1}{4}$ of an inch, while the thickness of the skirt portion 43 is reduced to $\frac{1}{8}$ of an inch, and the locking shoulder or portion 44 is tapered and increases in thickness downwardly and may be substantially $\frac{1}{4}$ of an inch in thickness at its bottom. The locking portion 44 may have a thickness greater than that of the top of the cap, which would depend somewhat upon the contour of the neck of the bottle. In order that the top of the cap would have a thickness of $\frac{1}{4}$ of an inch the original blank 31 would have a thickness of $\frac{1}{2}$ of an inch. The die 23 is provided with a bore 24 having a diameter equal to the maximum exterior diameter of the bead 38 plus one thickness of the blank 31. The cellulose acetate blank 31 is heated to substantially 340° F. and applied to the bottle and formed thereon at substantially this temperature to produce the crown cap. The forming operation is effected continuously and quickly by the upward movement of the plunger 35 and the associated forming means. The upward movement of the bottle is effected by the same means and in the same manner as occurs in the conventional crown capping machine. When the bottle is moved upwardly there is a relative axial movement between the die 23 and the bottle which is inwardly toward the longitudinal center of the bottle. Since the diameter of the bore 24 of the die 23 is equal to the maximum exterior diameter of the bead 38 plus one thickness of the blank 31, the reduced portion of the skirt will be half the thickness of the original blank. Before the blank 31 is formed it is flat and extends radially beyond the maximum exterior diameter of the blank. When the diameter of the blank is reduced, such reduction in the diameter adds to the thickness of the blank at its marginal edge, and since the blank is folded to produce the skirt at the same time that its diameter is reduced, the increase in thickness occurs in the skirt and this thickness increases toward the marginal or free edge of the skirt. The skirt is pleated or folded but the pleats or folds do not show since the material is plasticized and the skirt appears integral. The thickened portion 44 is formed to some extent by the material which is obtained by the thinning of the reduced portion of the skirt. The thickened portion 44 remains considerably beneath the maximum exterior diameter of the bead. The drawing action is axially or longitudinally of the bottle, and inwardly or toward the longitudinal center of the bottle. When used in the description and claims the term "axial" means longitudinally of the bottle. The term "axially inwardly" means longitudinally of the bottle toward its longitudinal center. After the forming operation is completed, the plunger 35 has a dwell at its top position for about 3 to 3½ seconds, which is sufficient to allow the thermo-plastic material to cool and harden. After this, the plunger 35 is moved downwardly and the forming plunger 26 is moved downwardly by the rubber plug 11 and follows the formed cap. The forming plug 26 now moves into the die 23 and strips the formed cap from the die. The completed cap is therefore applied to the bottle and separated from the die. The die 23, plunger 26 and contacting elements are all at atmospheric or room temperature.

We also find that by the use of a thermo-

plastic material, such as cellulose acetate, that beer held in bottles provided with crown caps formed from such material, may be pasteurized as the pasteurizing temperature is about 140° F. which is not sufficiently high to cause the formed cap to be deformed.

It is thus seen that we have provided a cap formed of thermo-plastic material having a skirt which is drawn and reduced in thickness and that the cap upon becoming solid will not change its shape or size at the skirt and that the skirt will retain its close hugging or contacting relation with the bead 38. Further, the downward drawing action which reduces the thickness of the skirt provides excess thermo-plastic material which moves downwardly and forms the thickened locking portion 44 of the cap, which locking portion is arranged within the recess 41, and securely holds the cap to the bottle. Further, the extension 27 forms the recess 42 at the top of the cap, which recess stiffens the cap, and this also causes the outer portion of the recess to be pressed outwardly and firmly engage the inner convex face 39 of the bead. The invention is not restricted to the use of the cellulose acetate blank or thermoplastic blank having a thickness of $\frac{1}{4}$ of an inch, as this thickness may vary somewhat. The thinness of the skirt is not restricted to $\frac{1}{8}$ of an inch or half of the thickness of the blank, as the thinness of the skirt may vary, but there is a reduction in thickness at the skirt, which results from the drawing action, and produces the excess material to provide the thickened locking part.

It is to be understood that the form of our invention herewith shown and described is to be taken as preferred examples of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of our invention or the scope of the subjoined claims.

Having thus described our invention, what is claimed is:

1. The herein described method of forming a blank to apply a cap upon a bottle or the like provided with a bead having a maximum exterior diameter, comprising taking a substantially circular blank formed of thermoplastic material and having a greater diameter than the maximum exterior diameter of the bead and heating such blank so that it may be formed and drawn, applying the heated blank to the free end of the bead in substantially concentric relation thereto so that the marginal portion of the blank extends radially beyond the maximum exterior diameter of the bead, forming the marginal portion of the blank about the outer side of the bead to provide a skirt portion surrounding the bead and extending axially and inwardly beyond the maximum exterior diameter of the bead, subjecting the skirt portion adjacent to the maximum exterior diameter of the bead to an axial and inward drawing action and thereby reducing the thickness of the skirt portion adjacent to said maximum exterior diameter and maintaining the outer face of the skirt portion substantially cylindrical for providing a thickened locking portion disposed axially and inwardly of the thinned portion at the maximum exterior diameter, and allowing the formed cap to harden.

2. The herein described method of forming a blank to apply a cap upon a bottle or the like provided with a bead having a maximum exterior diameter, comprising taking a substantially circular blank formed of thermoplastic material

and having a greater diameter than the maximum exterior diameter of the bead and heating such blank so that it may be formed, applying the heated blank to the free end of the bead in substantial concentric relation thereto so that the marginal portion of the blank extends radially beyond the maximum exterior diameter of the bead, effecting a relative movement in a direction axially of the bottle between the bottle and a rigid tubular die having a substantially cylindrical bore which bore has a diameter equal to the maximum exterior diameter of the bead plus substantially one thickness of the blank and causing the blank and bead to enter the bore, and allowing the formed cap to harden and removing the cap from within the bore.

JOHN W. EKSTEDT.
ALBERT F. PITTYO.

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