April 26, 1966 R. D. LURIE 3,248,000

PLASTIC CONTAINER

Filed Aug. 30, 1963

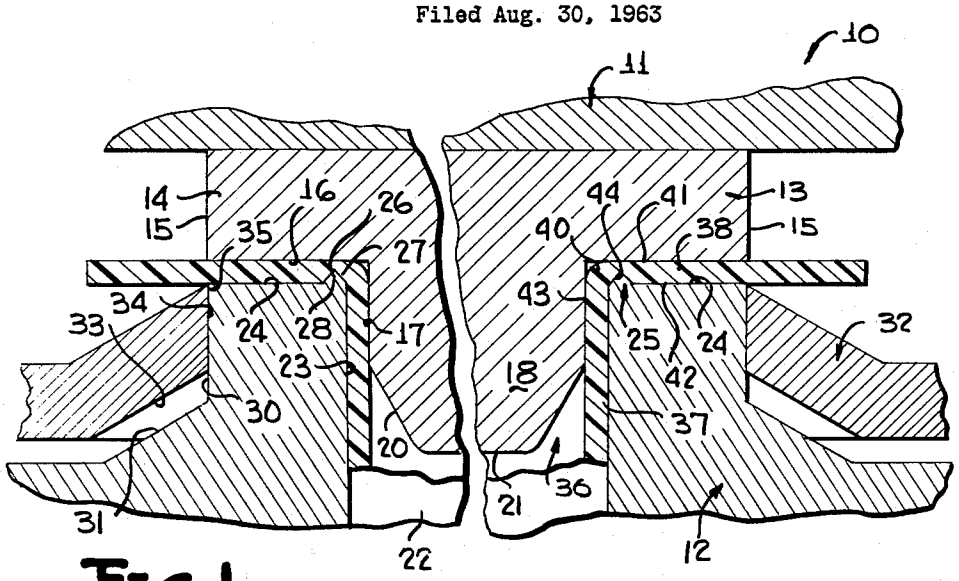


FIG. 1

FIG. 2

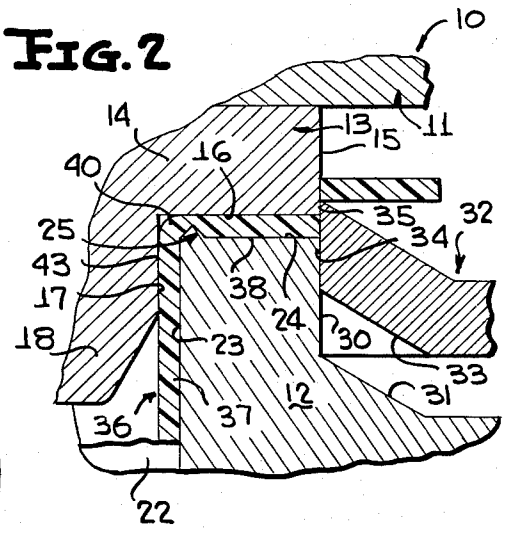
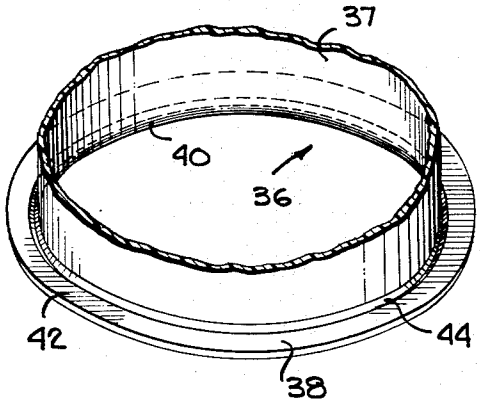


FIG. 3



INVENTOR

RANDOLPH D. LURIE

BY Mason, Porter, Dilla & Stewart

ATTORNEYS

United States Patent Office 3,248,000 Patented Apr. 26, 1966

3,248,000

PLASTIC CONTAINER

Randolph D. Lurie, Park Forest, Ill., assignor to Continental Can Company, Inc., New York, N.Y., a corporation of New York

Filed Aug. 30, 1963, Ser. No. 305,804
3 Claims. (Cl. 220—72)

This invention relates to a novel method of and apparatus for deep-drawing plastic container bodies possessing high dimensional stability and excellent end seaming characteristics by subjecting a flange of a drawn container body to a force which balances internal stresses set up in the flange by prior drawing and redrawing operations.

Independent of the final shape of a deep-drawn article, such as a container body, a conventional deep-drawing process might generally consist of three basic operations.

The first operation performs the combined function of cutting a blank of suitable material, such as plastic, to proper size and drawing this blank into a shallow container body. A flat sheet of plastic material is placed between upper and lower portions of a die assembly and the plastic material is clamped between a draw punch and a draw ring of the die assembly. Simultaneously, with this clamping action the plastic material is trimmed into a blank by the cutting action of the draw punch which forces the plastic material passed a shear fitting closely around the outside of the draw punch, thus causing the plastic material to be cut cleanly and uniformly.

The portion of the blank which forms the container wall is drawn from the material which is clamped between the draw punch and the draw ring. The downward progress of the draw punch and the draw ring causes this material to be drawn into a narrow space between the draw punch and a die center pad of the die assembly. The clearance between the draw punch and the die center pad determines the wall thickness of the finished container body. At the completion of this first operation, the container body is withdrawn from the die assembly for subsequent operations. At this time the container body comprises a generally shallow container wall which may terminate in a flange formed from the material clamped between the draw punch and the draw ring.

The second operation performs the function of converting the shallow container body to a container body of greater depth and smaller diameter. The second operation redraws, to a greater depth, the container body which has already been formed.

In this second operation, the shallow container body is placed over a draw ring and die center pad of another die assembly.

The portion of the plastic material which is to form the wall of the redrawn container body is drawn from the plastic material clamped between the draw punch and the draw ring, and that material extending outside the die not clamped between the draw punch and draw ring. During the progress of the redrawing operation, as the draw punch is forced downwardly pushing the draw ring ahead of it, material is drawn from the clamped material between the draw punch and the draw ring into the space between the draw punch and the die center pad, thus forming the wall of the redrawn container body. As material is drawn from between the draw punch and the draw ring, new material is drawn from outside the draw ring into this clamped area to replace the material which has been removed. This new material drawn into the clamping area of the draw punch and the draw ring comes from that material which had been used to form the container wall during the first operation.

This process usually continues until all of the material outside of the draw ring has been drawn into the area between the draw punch and the draw ring.

At the completion of this second redrawing operation not all of the plastic material has been drawn into the space betwen the draw punch and the die center pad, and a flange remains around an open mouth of the redrawn container body. This is the flange to which an end or closure is subsequently attached by a seaming operation.

For all practical considerations, the flange material is virtually identical to the original sheet material prior to the first operation. However, in the absence of ideal or theoretical material flow during the drawing or redrawing operations, the bending of the plastic material to form the radius between the container wall and the flange sets up undesirable internal stresses in the plastic material. That is, the bending of any solid body causes the material at the inside of the bend to be put into compression and the material on the outside of the bend to be put into tension. The net result of this is that the bend ends to straighten out after the applied bending forces have been removed. This applies to the radius of the container body during the drawing and redrawing operations. The inside of the radius is subjected to compression stresses while the outside of the radius is placed under the influence of tension stresses. These tension and compression stresses do not generally compensate one another with the result that the stresses in the flange of the redrawn container cause the plastic material to "creep" if unrestrained by some balancing force. The radius tends to straighten out due to this creep and the desired angle of the flange with respect to the container wall (generally 90 degrees) cannot be maintained.

These unbalanced forces or stresses in the flange also tend to increase the "plug diameter" of the container mouth. This makes it virtually impossible to seam or otherwise secure a metallic end or closure to the deformed plastic flange of the container body.

Heretofore, the container manufacturing industry had failed to recognize and solve the inherent structural deficiencies in the flange of deep-drawn container bodies. The novel invention herein disclosed solves the problems inherent in conventional plastic container bodies and the flanges thereof in an unobvious manner by a third drawing operation which essentially performs two functions.

First, the flange at the open mouth of the redrawn container body is shaped to a proper contour by a die assembly which simultaneously subjects the flange adjacent the radius of the container wall to a force which balances the internal stresses thereof, and secondly, the flange is trimmed to the exact dimensions required for a desired metallic end or closure after these forces have been balanced. In effect, the redrawn container body is placed into a female die of a die assembly which is closed to complete the shaping of the flange. During this operation there is no drawing per se, but rather, the material of the flange adjacent the radius is subjected to controlled flow by the application of pressure thereto. The flowing of the plastic material of the flange is accomplished by an upstanding annular ridge of the female die which opposes a planar annular wall of a male die. As the male and female dies forceably close against upper and lower surfaces of the flange of the container body, the annular ridge "coins" the lower surface or underside of the flange setting up compressive forces therein which balance and compensate the internal tensile stresses in the area of the radius of the flange. This coining preserves the bending angle of the radius by balancing the internal forces of the radius and prevents the flange from rapidly

creeping or other wise relaxing out of shape. This plastic creep is virtually eliminated by a rather sharp but shallow indentation formed into the underside of the flange near the radius by the annular upstanding ridge. This coining action adjacent the mouth of the container body sets the container mouth to a close tolerance, particularly "the plug diameter" i.e., the inside diameter of the container body.

Various advantages result from this coining or indenting of the undersurface of the container body flange. For example, a conventional plastic flange is not very rigid due to its tendency to straighten out after the completion of the third drawing operation heretofore described and a metal end or closure which is being conventionally double seamed to this flange easily pushes the plastic material aside so that a poor seam or no seam is formed. The novel coined flange of this invention increase the rigidity of the flange so that the plastic material thereof is not pushed out of position by the metal end or closure during the course of a conventional double-seaming operation.

After the coining action is completed no change in the "plug diameter" of the container body can take place. Thus, by trimming the container flange after the flange has been coined, variations in dimensions from container body to container body which would otherwise occur are eliminated since the trimming occurs only after all of the internal forces in the flange have been balanced. All of the container body dimensions can be consistently held to close tolerances from container body to container body and the dimensional stability of the flanges thereof is insured.

It is therefore an object of this invention to provide a novel method of an apparatus for forming a container body by a deep-drawing operation which increases the dimensional stability and end-seaming characteristics of a flange of the container body by balancing the internal stresses of the flange which tend to distort the flange in a manner heretofore unprovided for in the prior art.

Another object of this invention is the provision of a novel method of fabricating a container body by deep-drawing a container body of the type including a tubular wall integrally joined to a flange possessing internal tensile stresses tending to cause the material of the flange to creep and distort, and subjecting the flange to a compressive force by a coining operation which balances the internal tensile stresses of the flange thereby enhancing the dimensional stability and end seaming characteristics of the container body.

Still another object of this invention is to provide a novel method of producing a plastic container body by performing a drawing operation to form a container body of the type including a tubular wall integrally joined by a radius to a flange possessing internal tensile stresses tending to distort the plastic material of the flange, subjecting the flange adjacent the radius to a compressive force by a coining operation which balances the internal tensile stresses of the flange to prevent creep and thereby stabilize the pre-selected dimensions of the container body, and thereafter, severing or trimming the flange to accommodate a metallic end or closure which is subsequently united to the can body by a seaming operation.

Another object of this invention is to provide a novel die including a pair of relatively reciprocal aligned members, a first of the members including a bore and a second of the members having a projection aligned with the bore for entry therein upon relative reciprocation of the members, a substantially planar wall of the first member being spaced from and opposed to a substantially planar wall of the second member, and one of the planar walls including means cooperative with the other of the planar walls for subjecting a flange of a container body received between the walls to a compressive force upon relative reciprocation of the pair of members to enhance the dimensional stability and the end seaming characteristics of the container body.

Still another object of this invention is to provide a novel apparatus of the type immediately above-described wherein the means for subjecting the flange to a compressive force is an annular shoulder projecting from the wall of the first member toward the wall of the second member to effect a coining operation on the flange.

A further object of this invention is to provide a novel apparatus of the character immediately above-described, and in addition, to provide a shear externally surrounding and slidably contacting an exterior wall of the first member which trims the flange upon reciprocation of the pair of members after the flange has been coined by the annular shoulder.

Another object of this invention is to provide a novel container body of the type including a tubular container wall integrally joined by a radius to a flange and including means adjacent the radius for setting the flange by balancing internal forces thereof.

Still another object of this invention is to provide a novel container body of the character above-described in which the means for balancing the internal stresses of the flange tending to distort the same is a coined groove adjacent the radius of the container body.

With the above, and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims and the several views illustrated in the accompanying drawing.

In the drawing:

FIGURE 1 is a fragmentary sectional view of a die assembly and illustrates a redrawn flanged container body received in a bore of a female die, a male die cooperating with an upwardly directed annular ridge of the female die to coin a flange of the container body adjacent a radius thereof, and the position of a shear prior to a trimming operation to size the flange.

FIGURE 2 is a fragmentary sectional view of the die assembly of FIGURE 1 and illustrates the shear completing the removal of the material of the flange projecting radially outwardly beyond peripheral walls of the male and female dies.

FIGURE 3 is a fragmentary top perspective view of a container body, and illustrates a relatively shallow indentation or groove formed in a flange of the container body.

A novel die assembly constructed in accordance with this invention is best illustrated in FIGURES 1 and 2 of the drawing, and is generally designated by the reference numeral **10**.

The die assembly **10** comprises a male member or die **11** and a female member or die **12**. The male and female dies, **11** and **12** respectively, are arranged in axial alignment and are relatively reciprocally mounted in a conventional press in a manner well known in the prior art and forming no part of this novel invention.

The male die **11** includes a draw punch **13**. The draw punch **13** is secured to the male die **11** by a plurality of bolts (not shown). An upper body portion **14** of the draw punch **13** is substantially circular in transverse section and has an upper exterior peripheral wall **15**. A downwardly facing substantially planar annular wall or shoulder **16** of the upper body portion **14** terminates radially inwardly at a lower external peripheral wall **17** of a substantially cylindrical punch **18**. The lower exterior peripheral wall **17** of the punch **18** blends into a tapered wall **20** terminating at an end wall **21**. The punch **18** establishes the inside diameter of a container body at its mouth, i.e., the "plug diameter," in a manner which will be described more fully hereafter.

The female die **12** has a vertical bore **22** defined by an interior peripheral wall **23**. The bore **22** of the female die **12** is in axial alignment with the punch **18** of the male die **11** and the interior peripheral wall **23** there-

of establishes the exterior diameter of container body in a manner which will be made apparent hereafter.

A substantially planar, annular, upwardly facing wall **24** of the female die **12** opposes the downwardly facing annular wall **16** of the draw punch **13**. An upwardly projecting circumferential shoulder or ridge **25** is located at the juncture of the annular upwardly facing wall **24** and interior peripheral wall **23** of the female die **12**. A pair of upwardly converging circumferential wall portions **26** and **27** of the shoulder or ridge **25** set off a circumferential apex **28** having an included angle of substantially 90 degrees.

An upper exterior peripheral wall **30** of the female die **12** is in coplanar alignment with the upper exterior peripheral wall **15** of the draw punch **13**. The exterior peripheral wall **30** of the female die **12** terminates at a gradually downwardly diverging circumferential wall **31**.

A shear **32** surrounds the female die **12** and is immovably mounted in the die assembly **10** in any conventional manner. The shear **32** has a downwardly diverging lower circumferential wall **33** which normally seats against the downwardly diverging circumferential wall **31** of the female die **12**. An inner circumferential wall **34** of the shear **32** guidably contacts the exterior peripheral wall **30** of the female die **12**. The inner circumferential wall **34** of the shear **32** terminates at a circumferential shearing or trimming edge **35**.

In describing the operation of the die assembly **10**, it is to be understood that the die assembly **10** is first placed into a conventional press (not shown) and thereafter the press is actuated to space the male die **11** a considerable distance above the female die **12**. A conventional air cushion or a plurality of compression springs acting against the underside of the female die **12** forces the female die **12** to rise upwardly, as viewed in FIGURE 1 of the drawings, to bring the downwardly diverging circumferential wall **31** of the female die **12** into abutment with the downwardly diverging circumferential wall **33** of the shear **32**.

At this time, a plastic container body **36** having a cylindrical wall **37** joined to a flange **38** by an integral radius **40** is inserted into the female die **12** of the die assembly **10**. The container body **36** may be constructed from polyethylene, polypropylene or similar plastic materials, and has already been redrawn in the manner heretofore described. The redrawn container body **36** is therefore under large internal stresses, particularly in the area of the flange **38** where an upper surface **41** at the radius **40** is under high internal tensile stresses while an under surface **42** is under internal compressive stresses.

The press is then closed in a conventional manner forcing the punch **18** of the male die **11** into an open mouth **43** of the container body **36** defined by an uppermost portion of the cylindrical container wall **37**. As the draw punch **13** carried by the male die **11** descends, the flange **38** of the container body **36** is forceably clamped between the opposed walls **16** and **24** of the respective male and female dies **11** and **12**. This clamping pressure forces the upwardly projecting circumferential ridge **25** of the female die **12** into the underside **42** of the flange **38** adjacent the radius **40**, which causes an indentation **44** to be coined into the under surface **42** of the flange **38** completely around the circumferenece of the container body **36**, as is best illustrated in FIGURE 3 of the drawing. Since the open mouth **43** of the container body **36** is clamped between the punch wall **17** and the wall **23** of the bore **22**, the coining action simultaneously "sets" the open mouth **43** to the desired tolerance. In particular, the inside diameter of the container body, i.e., the "plug diameter" is established and the tendency of the open mouth **43** to creep open causing an undesirable increase in the "plug dameter" is precluded. This coining by the upwardly projecting circumferential ridge **25** compresses the material of the flange **38** and reduces the thickness thereof approximately ten to twenty percent. During the coining of the container body **36** there is no drawing per se; rather, the plastic material of the container body is forced to flow only by the application of pressure between the draw punch **13** and the female die **12**.

As the draw punch **13** and the female die **12** are further depressed against the air cushion or compression springs acting against the underside of the female die, the female die **12** continually moves downwardly as viewed in FIGURE 1 against the force of the conventional air cushion or compression springs. The descent of the female die **12** under the influence of the male die **11** draws the flange **38** downwardly to the position illustrated in FIGURE 1 of the drawing. At this point the cutting edge **35** of the shear **32** underlies the under surface **42** of the flange **36**. Continued downward movement of the dies **11** and **12** urges the flange **38** of the container body **36** beyond the shearing edge **35** of the shear **32** to the position illustrated in FIGURE 2 of the drawing, thereby shearing or trimming the flange **32** in a manner clearly illustrated in FIGURE 2. During this shearing operation, it will be particularly noted that exterior peripheral walls **30** and **15** of the respective dies **12** and **11** cooperate with the inner cylindrical surface **34** of the shear **32** to evenly trim the flange **38**.

It should be particularly noted that the flange **38** of the container body **36** is trimmed after the same has been set by the coined indentation **44**. This permits very little variation in the contour of successive flanges produced by the die assembly **10** as compared with flanges which might have been trimmed to final dimension before they had been set to the desired final shape.

After the flange **38** of the container body **36** has been trimmed, the press is opened in a conventional manner, the container body **36** is removed from the female die **12** and the process may again be repeated in the manner described.

A metallic end or closure (not shown) may now be secured to the flange **38** of the container body **36** by a conventional double-seaming operation. As heretofore noted, because the coined plastic flange increases the rigidity of the flange **38** the plastic material of the flange is not pushed out of position by the metallic closure during the course of the seaming operation. The "plug diameter" remains substantially constant and because undesired "creep" of the plastic material is avoided, the flange **38** thereby virtually eliminating poor seams or no seams at all.

While an example of a preferred form of the die apparatus is disclosed herein, as well as a preferred method and a novel article produced thereby, it is to be understood that variations in the die assembly, the method and the article may be made without departing from the spirit and scope of this invention. For example, while the die assembly is constructed to produce a generally cylindrical article or container, this disclosed die assembly is merely exemplary and a die assembly capable of forming non-cylindrical, containers, i.e., oblong, pear-shaped, etc., is within the purview of this application. The novel non-cylindrical containers formed by such a die, as well as the method of so forming such containers, is also deemed part of this invention. Therefore, any generally tubular container, either cylindrical or non-cylindrical, forms a part of this invention and the invention is limited only insofar as defined in the appended claims.

I claim:

1. A drawn plastic article of the type including a tubular wall integrally joined by an arcuate portion of small radius to a flange, the flange having a first surface, a second opposite surface and a predetermined thickness, the improvement comprising coined groove means generally at the juncture of the arcuate portion and the flange forming an integral part of at least one of said surfaces of said flange, and said coined groove means

establishing compressive forces in said at least one surface of said flange which balance tensile forces in the other of said surfaces of said flange thereby neutralizing the flange to prevent distortion thereof.

2. In a drawn plastic container body of the type including a tubular body wall integrally joined by an arcuate portion of small radius to a flange, the flange having an upper surface, a lower surface and a predetermined thickness, the improvement comprising coined groove means generally at the juncture of the arcuate portion and the flange forming an integral part of said flange, and said coined groove means establishing compressive forces in the lower surface of said flange which balance tensile forces in the upper surface of said flange thereby neutralizing the flange to prevent distortion thereof.

3. A drawn container body of the type defined in claim 2 wherein said coined groove means is a continuous circumferential coined indentation.

References Cited by the Examiner

UNITED STATES PATENTS

2,422,952	6/1947	Da Kin	29—535
2,595,132	4/1952	Foskett	220—74
2,887,244	5/1959	Betner	220—54
2,936,493	5/1960	Scherer	264—138
2,979,771	4/1961	Taber	18—19
2,989,019	6/1961	Van Sciver	113—51
3,005,572	10/1961	Gustafson et al.	220—72
3,022,758	2/1962	Rheingold et al.	113—46
3,026,573	3/1962	Ciaio	248—138
3,043,354	7/1962	Fitzgerald	220—31
3,054,144	9/1962	Goodwin et al.	18—19
3,104,776	9/1963	Bestrom	220—72
3,110,086	11/1963	Phillips	29—545
3,114,455	12/1963	Claisse et al.	206—56

FOREIGN PATENTS

129,460	10/1948	Australia.
698,124	10/1953	Great Britain.

LOUIS G. MANCENE, *Primary Examiner.*

THERON E. CONDON, GEORGE E. LOWRANCE, *Examiners.*