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3,416,474

METHOD AND APPARATUS FOR FORMING A BREAKABLE CONNECTION
BETWEEN TWO PORTIONS OF A CLOSURE CAP

Filed Nov. 15, 1966

4 Sheets-Sheet 1

FIG. 1

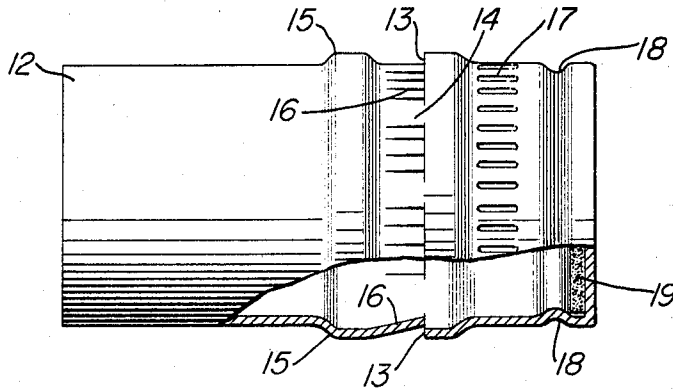
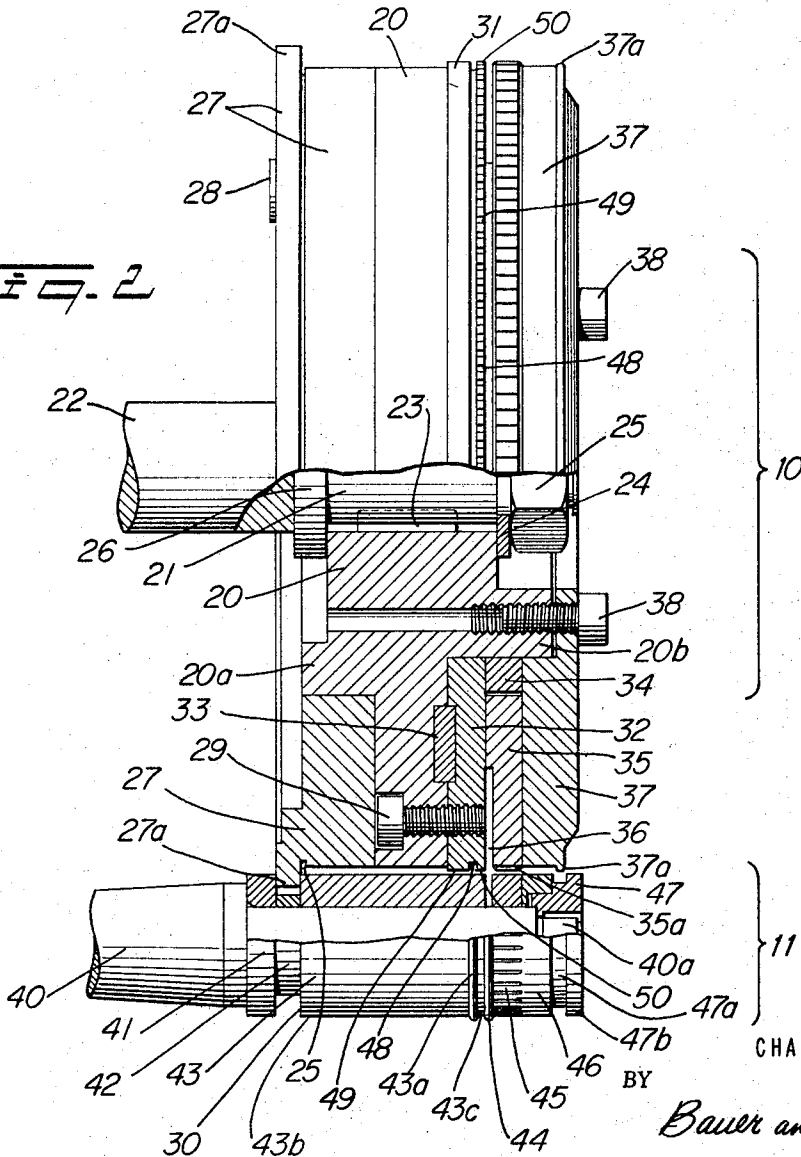


FIG. 2



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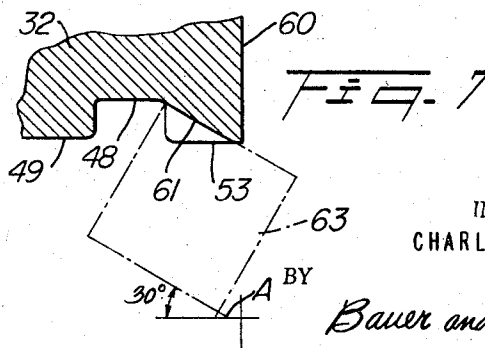
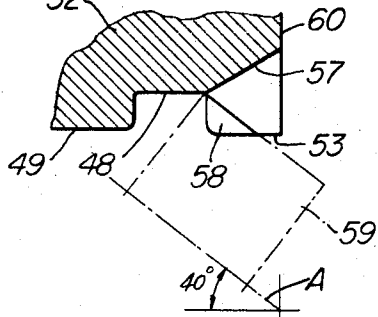
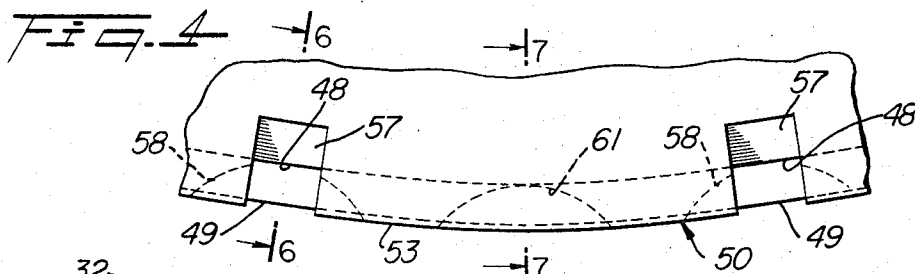
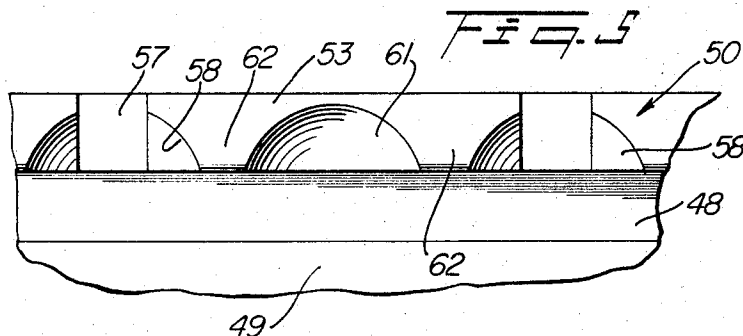
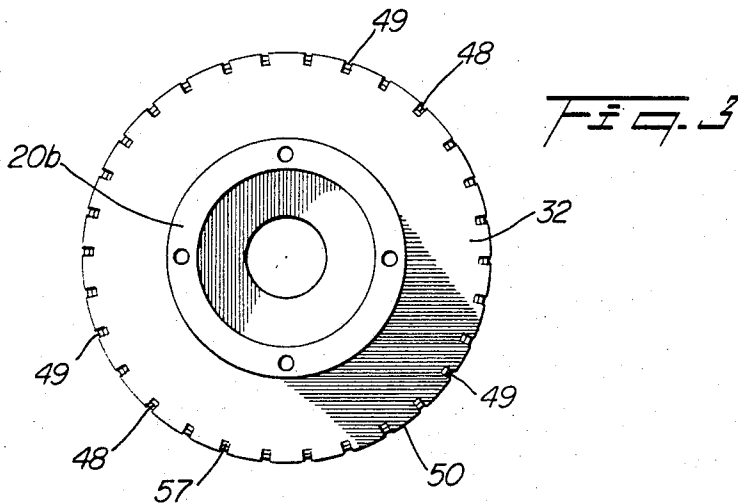
BY
Bauer and Seymour
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FIG. 8

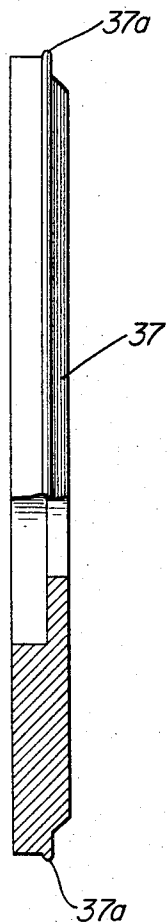


FIG. 9

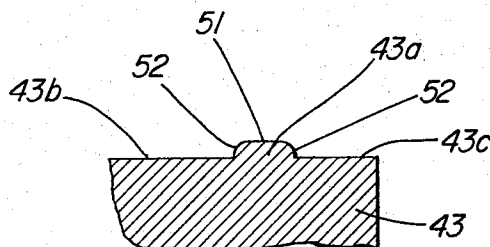
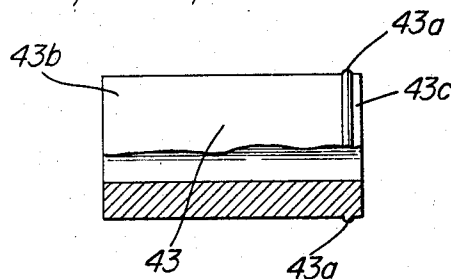


FIG. 11

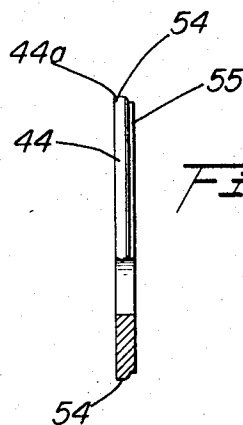


FIG. 12

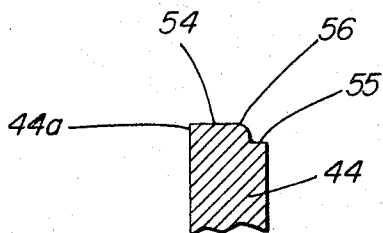


FIG. 12

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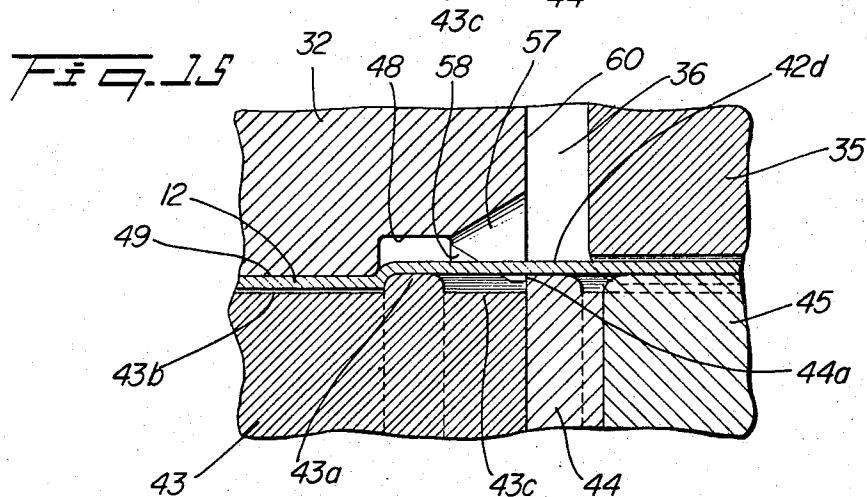
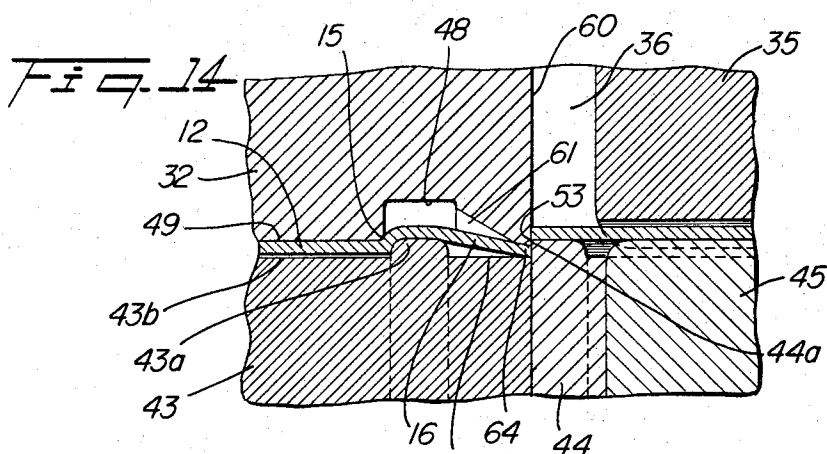
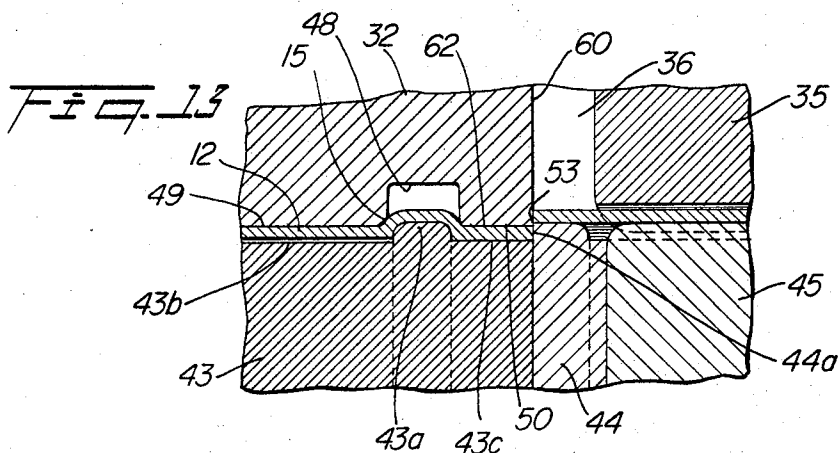
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**METHOD AND APPARATUS FOR FORMING A
BREAKABLE CONNECTION BETWEEN TWO
PORTIONS OF A CLOSURE CAP**

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Claims priority, application France, Dec. 9, 1965,
41,504

10 Claims. (Cl. 113—1)

The present invention is a method and apparatus for making elongated cuts through the tubular deformable metal skirt of a closure cap spaced apart in a line circumferentially around the skirt with intermediate uncut bridge portions to provide a breakable connection between the portions above and below the line.

The method and apparatus of this invention is particularly adapted for partially preforming a closure cap to provide the form of cap disclosed in the copending patent application Ser. No. 518,708 of Charles Musy, filed Jan. 4, 1966, and now Patent No. 3,348,718, issued Oct. 24, 1967. The closure cap disclosed therein is made of deformable material such as aluminum foil and has an elongated tubular skirt adapted to fit down over the neck of a container to be crimped in position thereon with the lower end of the skirt crimped under a shoulder on the neck and the upper end crimped into mating engagement with screw threads around the top of the neck at the open end of the container. A line of cuts and intermediate uncut bridge portions circumferentially around the skirt in the portion above the shoulder portion and below the screw threads provides a breakable connection between the top and bottom portions of the cap which breaks easily when the cap is unscrewed to open the container. Accordingly, the container cannot be opened without breaking the aforesaid connection. The cap therefore deters unauthorized or surreptitious opening of the container and tampering with its contents before its initial opening by a purchaser or other intended person.

The cap disclosed in the above-mentioned application is in condition to be fitted over and crimped on the neck of a container and has the circumferential line of cuts and intermediate bridge portions for the breakable connection already formed in it. The cuts are elongated and the intermediate uncut bridge portions are relatively short so as to connect the portions above and below the line of cuts but to break easily when the cap is unscrewed to open the container. In accordance with the invention disclosed in that application the lips of each cut are in face to face opposed relation an amount equal to at least part of the thickness of the skirt along at least a part of the length of the cut so that the opposed face portions of the cuts are in abutting contact when longitudinal pressure is applied to the cap to fit it down on the neck of a container preparatory to crimping it in position thereon. The opposed abutting face edges of the cuts thus provide additional longitudinal compressive strength to supplement the strength of the bridge portions between the cuts to resist buckling of the cap at the line of cuts and bridge portions when the cap is pushed down onto the container neck. Since this additional compressive strength is provided without having to reduce the length of the cuts or increase the width of the bridge portions between, it strengthens the cap to

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facilitate putting it on the container initially without sacrificing the ease with which turning pressure breaks the connection between the top and bottom portions of the cap when the cap is unscrewed.

The present invention provides a method and apparatus for shearing the tubular skirt of a closure cap at spaced intervals to form a line of elongated cuts circumferentially around the skirt with relatively short uncut bridge portions between. The material of which such caps are normally made is a metal foil about 0.25 mm. thick, and when such material is sheared in the usual manner, the shearing pushes one lip of the cut relatively across the other so that the opposite face edges of the cut are offset an amount at least equal to the thickness of the material sheared. Then, due to the deformable nature of the material, the faces of the cut remain in this offset relation after the shearing tools are withdrawn.

In accordance with the present invention shearing pressure is applied to the skirt by a tool work surface which has a special configuration to apply pressure to a segment of the skirt over an area along and at spaced intervals, back from a rectangular edge—which cooperates with a rectangular edge of a support at the opposite side of the skirt—to shear the skirt along its rectangular edge and depress adjacent portions of the skirt in a manner such that, when the tool is withdrawn, a portion of the edge of the cut, which was depressed by the shearing, springs out again to a position in which the face edge of the cut at that portion is at least partially aligned in opposed face-to-face relation with the opposite face edge of the cut.

In apparatus in accordance with the invention, the portion of the skirt of a closure cap, which is to be cut, is arranged across a pair of support surfaces spaced apart with an indentation between. One of the support surfaces has a rectangular edge adjacent the indentation and a tool is arranged and operated to depress a segment of the skirt into the indentation so that a rectangular edge of the work surface of the tool cooperates with the rectangular edge of the support surface to shear the skirt along the length of the work surface. In addition to the rectangular edge the work surface of the tool has two spaced apart portions extending from the edge with a concave indentation between. When the work surface is applied to cut the skirt the two spaced portions also press spaced parts of the skirt into the indentation of the support surface so that an edge of the cut formed by the shearing and two spaced parts of the skirt extending from the edge are pressed inward below the surface of the skirt an amount approximately the thickness of the skirt. The part of the skirt intermediate the two spaced depressed parts is only pressed in along a narrow edge portion sufficient to make the cut along that part and when the tool is withdrawn after making the cut the latter edge portion springs outward to an extent which brings its cut face into at least partially opposed face-to-face alignment with the opposite face of the cut at that point along the cut.

In the embodiment of apparatus of this invention described below, the support surfaces are coaxial cylindrical surfaces of a generally cylindrical support element over which the tubular skirt fits. The cylindrical support surfaces are spaced apart with an annular indentation between and the peripheral edge of one of the support sur-

faces adjacent the indentation is rectangular to provide a circumferential edge across which segments of the skirt are sheared. The tool is also generally cylindrical with a plurality of similar work surfaces spaced apart in a circumferential line along a circular section of the tool. The support element and tool are both rotatable and their axes are parallel, the tool being arranged with its line of work surfaces in line with the annular indentation of the support element. The tool is movable toward the support element to a position in which one of its work surfaces engages and presses a segment of a skirt on the support element into the indentation between the support surfaces of the support element so that the rectangular edge of the work surface cooperating with a portion of the rectangular edge on the support element shears the skirt along the edge of the work surface as the work surface presses a segment of the skirt into the indentation in conformity with the configuration of the work surface. The tool and support element are then rotated at the same peripheral speed but in opposite directions so that successive work surfaces of the tool engage, depress and shear successive segments of the skirt in a line circumferentially around the skirt. The length of the sector of the tool on which the work surfaces are formed is at least equal to the circumference of the support element and when a line of cuts has been made completely around the skirt on the support element, the tool is moved away to permit removal of the processed cap and replacement by another to be similarly processed.

In addition to the cooperating work surfaces and indentation for making the line of cuts, the tool and support element also include cooperating knurling tool surfaces and a necking tool and complementary groove so that the cap processed by the apparatus of this invention is provided in one operation with the breakable connection formed by a line of elongated cuts and intermediate uncut bridge portions circumferentially around the skirt, a circumferential knurled portion, and an indented groove or neck which serves to secure a sealing disc of cork on other suitable material within the top end of the cap.

An object of the present invention is to provide a method, and apparatus for its practice, for making an elongated cut in deformable material by shearing in such a manner that a portion of one of the edges of the cut which is displaced relative to the opposite edge by the shearing springs back at least part way so that the opposite faces of the cut at that portion are in opposed face to face relation at least part way through the cut.

Another object is to provide a method and apparatus for making a plurality of such cuts spaced apart in a line circumferentially around the tubular deformable metal skirt of a closure cap leaving relatively short uncut bridge portions between to provide a breakable connection between the parts of the cap above and below the line, whereby the cuts formed in the aforesaid manner increase the resistance of the cap to longitudinal pressure without impairing the ease with which the connection is broken by turning the top of the cap relative to the bottom.

A further object is to provide a method and apparatus for forming a line of cuts and intermediate bridge portions, a knurled portion, and a sealing disk retaining groove circumferentially around the tubular skirt of a closure cap in one operation.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

FIG. 1 is a side elevation, partly broken away, of a closure cap having a tubular skirt and showing a circumferential line of cuts and intermediate uncut bridge portions, a knurled portion, and an annular sealing disk retaining groove formed in the skirt by the method and with the apparatus of this invention;

FIG. 2 is a side elevation, partly in section, of the tool and support elements that comprise apparatus in accordance with the invention;

FIG. 3 is a transverse section through the tool element of the apparatus showing in end elevation the cylindrical portion of the tool element which has work surfaces for applying shearing pressure to a tubular skirt on the support element;

FIG. 4 is an enlarged view of a part of the edge of the cylindrical portion of the tool element shown in FIG. 3 and showing a work surface thereon in enlarged end elevation;

FIG. 5 is a side elevation of the part of the edge of the cylindrical portion of the tool element shown on FIG. 3;

FIG. 6 is a section along the line 6—6 of FIG. 4;

FIG. 7 is a section along the line 7—7 of FIG. 4;

FIG. 8 is a side elevation, partly in section of the necking tool portion of the tool element;

FIG. 9 is a side elevation, partly in section, of the second cylindrical support surface of the support element and adjacent cylindrical surfaces which are of smaller radius;

FIG. 10 is an enlarged section in the plane of symmetry through a peripheral portion of the support surface and parts of the adjacent cylindrical surfaces shown in FIG. 9;

FIG. 11 is a side elevation, partly in section, of the first supporting surface of the support element showing its rectangular peripheral edge across which a skirt supported thereon is sheared;

FIG. 12 is an enlarged section in the plane of symmetry through a peripheral portion of the first support surface shown on FIG. 11;

FIG. 13 is an enlarged sectional view in the plane of symmetry through the spaced apart support surfaces of the support element and a cooperating work surface of the tool element showing a section of the work surface pressing a part of a skirt on the support element into the indentation between the support surfaces to shear the skirt along the edge of that part and to press a portion of that part of the skirt laterally into the indentation, at right angles from the sheared edge;

FIG. 14 is a view similar to FIG. 13, but showing another part of the work surface pressing into the indentation only the edge of the part of the skirt to be sheared; and

FIG. 15 is a view similar to FIGS. 13 and 14, but showing a space between adjacent work surfaces in line over the indentation in the support element to provide an uncut bridge portion between cuts formed in the skirt by successive work surfaces.

Referring to FIG. 2 of the drawings the apparatus in accordance with the present invention comprises a generally cylindrical tool element 10 having surface portions cooperating with surfaces of a generally cylindrical support element 11 for incising and shaping the elongated skirt 12 of a closure cap placed on the support element 11. The cap 13 is a cap of the type adapted to be fitted down over and crimped on the neck of a container and is made of deformable metal such as aluminum foil 0.25 mm. thick.

Looking at the cap shown in FIG. 1, the apparatus of FIG. 2 operates to make a plurality of elongated circumferential cuts 13 spaced apart in a line circumferentially around the skirt 12 of the cap with relatively short uncut bridge portions 14 between. As shown, the line of cuts 13 is parallel to an annular bulge 15 formed in the skirt. In

forming each cut 13, specially shaped work surfaces of the tool element—subsequently described in detail—cause a portion of the face edge of the lip of each cut, which is pressed inward during the cutting or shearing operation, to lift partially out again at a rib portion 16 so as to be aligned in opposed face-to-face relation with the face edge of the opposite lip at least part way through the cut at the rib portion 16.

At the same time the apparatus makes the line of cuts 13 in the skirt 12, it also impresses into the skirt a circumferential knurled portion 17 and an annular groove 18 which serves to retain a sealing disk 19 in the top end of the cap. The cap is made of deformable material, such as aluminum foil about 0.25 mm. thick, and before being worked on by the apparatus shown in FIG. 2, the skirt 12 is a smooth cylindrical tube, which slips onto the support element. After being incised and shaped by the apparatus into the form shown in FIG. 1, the cap is pressed down tight over the neck of a container and crimped in position, with the bottom end portion of the cap being crimped in under a shoulder on the neck to secure it on the neck. The circumferential line of cuts 13 and bridge portions 16 then provide a breakable connection between the top and bottom of the cap which breaks when the top of the cap is unscrewed to open the container for the first time so that the broken connection thereafter provides visible evidence that the container has been opened.

As seen in FIG. 2, the body 20 of the tool element 10 is fixed on the spindle portion 21 of a shaft 22 by a key 23 and by a washer 24 and nut 25 on the outer end of the shaft so that the tool element rotates with the shaft. A motor, not shown, is suitably connected to rotate the shaft and tool element. A washer 26 on the inner end of the spindle portion of the shaft positions the tool element along the shaft for aligning the tool element with the support element. The longitudinal alignment of the tool element along the shaft may be altered by substituting another washer 26 of a different thickness.

At the inward (left) end of the tool element 10 a flanged ring 27 carried on a cylindrical boss 20a on the inward end of the body 20 is adjusted in axial position relative to the body by screws 28 and 29 acting on respectively opposite sides of the ring. A peripheral flange 27a of the ring 27 is received in an annular groove 30 in the support element 11 to fix the relative axial positions of the tool and support elements.

A ring 31 (FIG. 3) having a tool sector 32 fitted therein, is carried on a cylindrical boss 20b on the outward end of the body and is centered by a ring 33 fitting in opposed matching grooves in the abutting surfaces of the ring and tool sector 31, 32 and the body. Next to the ring 31 are a small ring 34 carried on the boss 20b and a larger knurling ring 35 concentrically around the small ring 34, with radial play of about 0.2 mm. between the rings. The peripheral surface of the large ring 35 is a knurling surface 35a. The inward side of the knurling ring 35 is undercut as indicated to provide a space 36 between the ring 35 and the ring and tool sector 31, 32. At the outward end of the tool element a disk 37 (FIG. 8), having an annular rib 37a projecting from its peripheral surface, abuts the concentric rings 34 and 35 and is secured over the end of the boss 20b by screws 38.

Still referring to FIG. 2, the support element 11 is formed by a number of circular elements mounted coaxially in abutting relation on a spindle portion of a shaft 40 which is rotated by suitable connections to a motor, not shown. From the inward (left) end of the support element 11 its components are: a washer 41; a ring 42; an elongated cylindrical member 43 (FIGS. 9 and 10) having an annular rib 43a located near its outward end and separating a main cylindrical surface 43b between the inward end of the member and the rib from a short cylindrical surface 43c between the rib and the outward end of the member; a shearing disk 44 (FIG. 11) having a rectangular peripheral edge 44a at its inward side; a

ring 45 having a peripheral knurling surface 45a; a ring 46; and a bushing 47 which has an undercut cylindrical portion 47a and a cylindrical end 47b threaded onto a ferrule 40a on the outward end of the spindle portion of the shaft 40 to secure the components on the shaft.

The shafts 22 and 40 and the generally cylindrical tool and support elements mounted thereon are parallel. The profiles of the surfaces of the tool and support elements are complementary and during the operation of the apparatus for incising and shaping the skirt 12 of a cap on the support element 11, the elements are spaced so that the major portions of their complementary surfaces are spaced apart an amount equal to the thickness of the skirt 12.

At the inward end of the support element 11, the ring 42 between the washer 41 and cylindrical member 43 is of a smaller diameter than the adjacent washer and cylindrical member thereby to form the annular groove 30 in which the flange 27a of the ring 27 of the tool element rides as means to hold the elements in adjusted axial relation with the respective complementary surfaces in correct operative alignment. As shown in FIG. 2, the peripheral surfaces of the ring 27 (excluding its flange 27a) and the body 20 of the tool element form a cylindrical surface aligned with the major portion of the cylindrical surface 43b of the cylindrical member 43 of the support element, the opposed cylindrical surfaces being spaced apart the thickness of a skirt 12 when the elements are in operative relation.

The peripheral surface of the tool sector 32 in the ring 31 of the tool element has an annular groove 48 between a cylindrical surface 49 and a circumferential line of work surfaces 50, subsequently described in detail. The groove 48 is aligned to cooperate with the rib 43a of the support element to form the annular bulge 15 in the skirt 12 of a cap. As seen in FIGS. 9 and 10, the rib 43a of the cylindrical member 43 has an outer cylindrical surface 51 and quarter round sides 52 forming curved surfaces extending the outer cylindrical surface 51 of the rib 43a to the respective cylindrical surfaces 43b and 43c of the member 43.

Now referring back to FIG. 2, the cylindrical surface 49, which is at the inward end of the sector 23 adjacent the cylindrical surface of the body 20, is of a slightly larger diameter than the surface of the body 20 so that a skirt 12 is compressed slightly between the surface 49 and the cooperating surface 43b of the cylindrical member 43. The length of the peripheral surface of the tool sector 32 corresponds to the circumference of a skirt 12 of a cap placed on the support element 11 and the outside diameter of the tool sector 32 is about 1.8 mm. larger than the outside diameter of the ring 31 in which the sector is fixed. In addition the outside diameter of the tool sector 32 at the cylindrical surface 49 is about 0.2 mm. less than the outside diameter at the circumferential line of work surfaces 50.

As best seen in FIGS. 13, 14 and 15, each of the work surfaces 50 has a rectangular edge 53 at its outward peripheral edge cooperating with the rectangular edge 44a of the shearing disk 44. The shearing disk 44 which is axially adjacent the outward end of the cylindrical member 43 has a larger diameter than the adjacent cylindrical surface 43c of member 43. Thus, an annular indentation is formed in the support element 11 between peripheral edge 44a of the shearing disk and the rib 43a of the member 43 and the circumferential line of work surfaces 50 of the tool element are in line with the cylindrical surface 43c, which defines the depth and width of the indentation, to press a portion of the skirt 12 on the support element 11 into the aforesaid indentation and to shear the skirt between the rectangular edges 53 and 44a thereof when the tool and support elements are in operative relation.

Looking at FIGS. 11, 12 and 13 the shearing disk 44

has two cylindrical surfaces, 54 and 55, the surface 54 having a larger diameter than other surface 55 with a quarter round portion 56 between. The larger cylindrical surface 54 extends to the inward side of the disk 44, the rectangular edge 44a being at the inward side of surface 54. When a cap is placed on the support element, the skirt 12 of the cap is supported on the cylindrical surface 54 of the disk 44 and on the cylindrical surface 51 of rib 43a across the indentation between. The intermediate cylindrical surface 43c, which forms the bottom of the indentation, is below a line across the cylindrical surfaces 54 and 51 an amount equal to the thickness of the skirt 12 and, with tool and support elements in operative position, the circumferential line around the work surfaces 50 and around their rectangular edges 53 is in axial line with the cylindrical surface 54 of the disk 44. The cylindrical surface 54 of the disk 44 is in line with the space 36 in the tool element, the space 36 being slightly wider than the surface 54, and the sides of the rectangular edges 53 and 44a are closely adjacent a common plane between them at right angles to the axes of the elements. Thus the skirt is sheared across the edge 44a by an edge 53 of one of the work surfaces 50 when the portion of the skirt over the indentation is pressed into it by the work surface.

Referring back to FIG. 2, at the outward side of the disk 44 the ring 45 with a peripheral knurling surface cooperates with the ring 35 of the tool element, which also has a peripheral knurling surface, for impressing a knurled portion 17 in a skirt 12. The depths of the knurls are about 0.2 mm. and the ring 35, which is concentrically around the ring 34 with radial play of about 0.2 mm. between them, is rotated relatively around the ring 34 by the driving connection created between the cooperating knurled surfaces of the rings 45 and 35 by the portion of the skirt 12 being knurled. Thus the ring 35 on the tool element is independent of the rotation of the tool element and is rotated at the speed of rotation of the support element. The depth of the knurls is a function of the diameter of the small ring 34 (being relative to the amount of radial play between the rings 34 and 35) and may be varied by substituting rings 34 of a different diameter.

Coaxially outward from the knurling ring 45 are the ring 46 and bushing 47, the circumferential surfaces of the ring 46 and the outward cylindrical end 47b being about the same outside diameter as the cylindrical surfaces 43b and 43c of the cylindrical member 43. The reduced cylindrical portion 47a of the bushing provides a groove between the ring 46 and the cylindrical end 47b which is cooperatively in line with the annular rib 37a of the disk 37 on the outward end of the tool element to form the groove 18 in the upper end of the skirt of a cap on the support element. As shown in FIG. 8 the rib 37a has a half-round configuration in profile.

In operation, the shafts 22 and 40 on which the tool and support elements are mounted are rotated in opposite directions and at speeds such that the complementary surfaces of the elements move relatively in the same direction and at the same surface speed to engage successive portions of the skirt 12 of a cap on the support element and incise and shape it without slipping. The shafts 22 and 40 and the tool and support elements mounted thereon are arranged by suitable means (not shown) to be moved relatively toward each other an amount to bring them into the operative relationship, described above, for incising and shaping the skirt 12 and to be moved relatively apart to permit a cap which has been processed by the apparatus to be removed from the support element and replaced by a new cap to be processed. A cap to be processed is placed over the support element with the closed end of the cap against the end of the bushing 47. When the cap has been processed the groove 18 formed in the cap is in the indentation inward from the cylindrical end of the bushing 47 to some extent, but not sufficiently to prevent the completed cap from being pulled off over the end of the support element.

When a cap is placed on the support element 11, the tool and support elements are moved together into operative relation and are rotated so that the support element makes one complete revolution in contact with the work surfaces 50 along the sector 32 of the tool element. As successive work surfaces 50 thus move into engagement with successive circumferential segments of the skirt 12 on the support they shear the skirt along the segments and impress a particular configuration which causes a part of the offset lip of each cut to move into at least partial face-to-face alignment with the opposite lip.

Referring to FIGS. 3-7 the work surfaces 50 are spaced along the sector 32 of the tool element in a circumferential line with indentations 57 between. In the operation of the apparatus, the indentations 57 form the uncut bridge portions 14 between the cuts 13 which are made by the shearing action of the peripheral edges 53 of the work surfaces cooperating with the edge 44a on the support element. As seen in FIGS. 5 and 6, the indentations 57 open into the circumferential groove 48 and the corners of the work surfaces 50 at the groove 48 are cut off and made concave at 58 by grinding with a cylindrical grinding surface—indicated in dash lines at 59—applied to grind the corners of two adjacent work surfaces 50. The grinding surface has a diameter about 4 times the width of the indentations 57 and its axis A is inclined about 40° into the work surface toward the plane of the outward side 60 of the sector 32.

The central portion of each work surface is undercut by a concave cavity 61 which extends from a point close to the outward edge 53 back to the circumferential groove 48. The cavity 61 opens into the groove 48. Thus, as seen in FIG. 5, each work surface has two spaced portions 62 of its planar surface extending back from its outward rectangular edge 53 to the groove 48 at either side of the cavity 61. Referring to FIG. 7, the cavities 61 are formed in the work surface 50 by a cylindrical grinding surface, indicated in dash lines at 63. The diameter of the grinding surface is about 5 times the width of the indentations 57, and its axis A' is inclined about 30° into the face of the work surface toward the plane of the outward side 60 of the sector 32.

In operation, a cap having an elongated tubular skirt 12 is placed on the support element 11 with the portion, in which the line of cuts 13 is to be made, supported across the outer cylindrical surface 54 of the disk 44, the outer cylindrical surface 51 of rib 43a and the indentation between. The tool element 10 is moved toward the support element to engage the cap on the support element. Then the two elements are rotated in opposite directions at the same peripheral speed so that the profiles of the tool element and support element cooperate to incise, knurl and impress the bulge 15 and groove 18 in the skirt 12 progressively around the circumference of the skirt.

As the elements rotate, successive portions of the peripheral surface of the sector 32 cooperate with complementary surfaces of the support element in the manner illustrated in FIGS. 13 to 15. The annular bulge 15 is formed in the skirt as the circumference of the skirt is progressively pressed down over the rib 43a of the support element by the cylindrical surface 49 and the work surfaces 50 of the tool element; the groove 48 which is between the surface 49 and work surfaces 50 being in cooperative alignment with the rib 43a. The work surfaces 50 press circumferential segments of the skirt into the indentation between the rectangular edge 44a of the disk 44 and the rib 43a of the support element so that the rectangular edge 53 of each successive work surface 50 shears a portion of the skirt in across the rectangular edge 44a to make a cut 13. As seen in FIG. 13, the widest parts of each work surface 50, which are the spaced portions 62, press a portion of the skirt into the full width of the indentation between the rib 43a and edge 44a,

but, as seen in FIG. 14, the narrow central portion of the work surface only presses a narrow portion 64 in at the cooperating shearing edges 53 and 44a. The adjacent portion of the skirt slopes outward, as permitted by the concave cavity 61, to form that portion of the skirt into convex rib 16 extending from the bulge 15 and to the narrow portion 64 at the cut. The bridge portions 14 between the cuts 13 are formed by the indentations 57 between the work surfaces as indicated in FIG. 15. The concave corners 58 at each indentation provide a curved part between the edges of the bridge portions 14 and the adjacent portions which are pressed in by the widest portions 62 of the work surfaces.

The planar surface of each work surface 50 presses the skirt into the indentation between the rib 43a and rectangular edge 44a an amount approximating the thickness of the skirt. The above described configuration impressed into the skirt by each of the work surfaces is such that when a work surface presses a portion of the skirt into the latter indentation and withdraws as the elements rotate, the narrow portion 64 at the center of the impressed configuration moves outward again so that the opposing lips of the cut along the narrow portion 64 are at least partially in face-to-face alignment through the thickness of the skirt. Thus, the portions of the lips of each cut adjacent the rib portions 16 are in partial face-to-face relation and provide longitudinal support for the skirt at the circumferential line of cuts 13 when the cap is pressed onto a container.

The knurled portion 17 and annular groove 18 are formed in the skirt of the cap at the same time the line of cuts 13 are formed. Thus, the skirt is shaped in condition to be fitted and crimped on the neck of a container in one continuous operation by apparatus of this invention.

The cooperating tool portions of the apparatus of this invention are made of high chrome steel tempered to give it a resistance to drawing in the order of 220 kg. per square millimeter. The disk 44 could also be made of steel with tungsten carbide at its working surfaces to increase their service life.

As many apparently widely different embodiments of the present invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments.

What is claimed is:

1. A method of making a cut through a part of the wall of the tubular deformable metal skirt of a closure cap comprising supporting the skirt across a pair of coaxial cylindrical surfaces, said surfaces being spaced apart with a space between and one of said surfaces having a rectangular edge adjacent said space, applying pressure to a part of the wall of the skirt over said space in a configuration to press said part into the space lengthwise along a portion of said rectangular edge to shear the length of the part across said edge and to press said part laterally into the space at two spaced-apart portions thereof extending across the space at right angles from said edge whereby the cut edge of the sheared portion of the skirt between said two spaced apart portions lifts at least part way out of said space when the pressure is removed.
2. The method of claim 1 including making additional cuts in the same manner in a line circumferentially around the skirt and spaced apart to leave relatively short uncut portions between.
3. The method of claim 1 in which said pressure is applied to press said part of the wall of the skirt into said space an amount equal to the thickness of the wall of the skirt.
4. The method of claim 1 in which said pressure is applied progressively in a circumferential direction.
5. Apparatus for making cuts through the tubular deformable metal skirt of a closure cap comprising support means having first and second support surfaces spaced

apart with an indentation between for supporting the interior of a skirt of a closure cap thereacross, said first support surface having a rectangular peripheral edge adjacent said indentation, tool means movable toward said support means, a work surface on said tool means adapted when the tool means is moved toward the support means to engage a portion of a skirt on the support means and press said portion into said indentation, said work surface having a configuration comprising a rectangular edge across one side and two spaced apart surfaces extending generally at right angles therefrom with a concave indentation between extending almost to the rectangular edge, said work surface being aligned so that when the tool means is moved toward the support means to engage and press a portion of a skirt supported on the support means into said indentation, the rectangular edge of the work surface cooperates with said rectangular edge of the first support means to shear said skirt across the latter edge and said two spaced apart surfaces and rectangular edge of the work surface press a corresponding configuration of the skirt into said indentation, and means to move the tool means toward the support means a sufficient distance for said work surface to press a portion of a skirt on the support means into said indentation and shear the skirt.

6. The apparatus of claim 5 in which said support means comprises a generally cylindrical body portion adapted to extend into the interior of the tubular skirt of a closure cap, said support surfaces and said indentation being coaxial cylindrical surfaces of said body portion and said indentation being a cylindrical surface indented from a line across the support surface an amount approximating the thickness of the wall of a skirt to be supported thereacross, and in which said tool means has a plurality of similar work surfaces spaced apart in a line, and including means to move said tool means so that said work surfaces are moved in succession relatively around the circumference of a skirt over the support means to engage and press successive spaced portions of said skirt into said indentation thereby to make a plurality of cuts through the skirt spaced apart in a circumferential line therearound.

7. The apparatus of claim 6 in which said tool means comprises a generally cylindrical body having said work surfaces projecting therefrom in a line circumferentially around said body, said tool means and support means being mounted for rotation about parallel axes respectively, and including means for rotating said support means, and means for rotating the tool means in the opposite direction from the direction of rotation of the support means and at the same peripheral speed when said tool means has been moved toward said support means as aforesaid.

8. The apparatus of claim 7 in which the cylindrical body portion of said support means includes a cylindrical surface adjacent said second support surface coaxially at the side thereof opposite said indentation and having a radius less than the radius of the second support surface by an amount approximating the thickness of the wall of a skirt to be supported across said support surfaces, said second support surface having curved peripheral edges, said tool means having a cylindrical surface complementary to the said cylindrical surface of the support means which is adjacent said second support surface thereof and an annular groove between said cylindrical surface and the said circumferential line of work surfaces of the tool means complementary to said second support surfaces of the support means to press said skirt against the said cylindrical surface of the support means and bulge the skirt over said second support surface when the tool means is moved toward the support means to cause one of said work surfaces to depress a portion of said skirt into said indentation and shear the skirt.

9. The apparatus of claim 8 in which at least the portion of said cylindrical surface of the tool means adja-

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cent said annular groove has a slightly smaller radius than said line of work surfaces.

10. The apparatus of claim 8 which includes complementary knurling tool surfaces respectively on the tool means and support means for impressing a knurled portion in a skirt on the support means when the tool means is moved toward the support means for cutting a skirt on the support means, the knurling surface on the support means being adjacent the first support surface thereof at the side opposite from said indentation and the knurling surface of the tool means being aligned to cooperate therewith.

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