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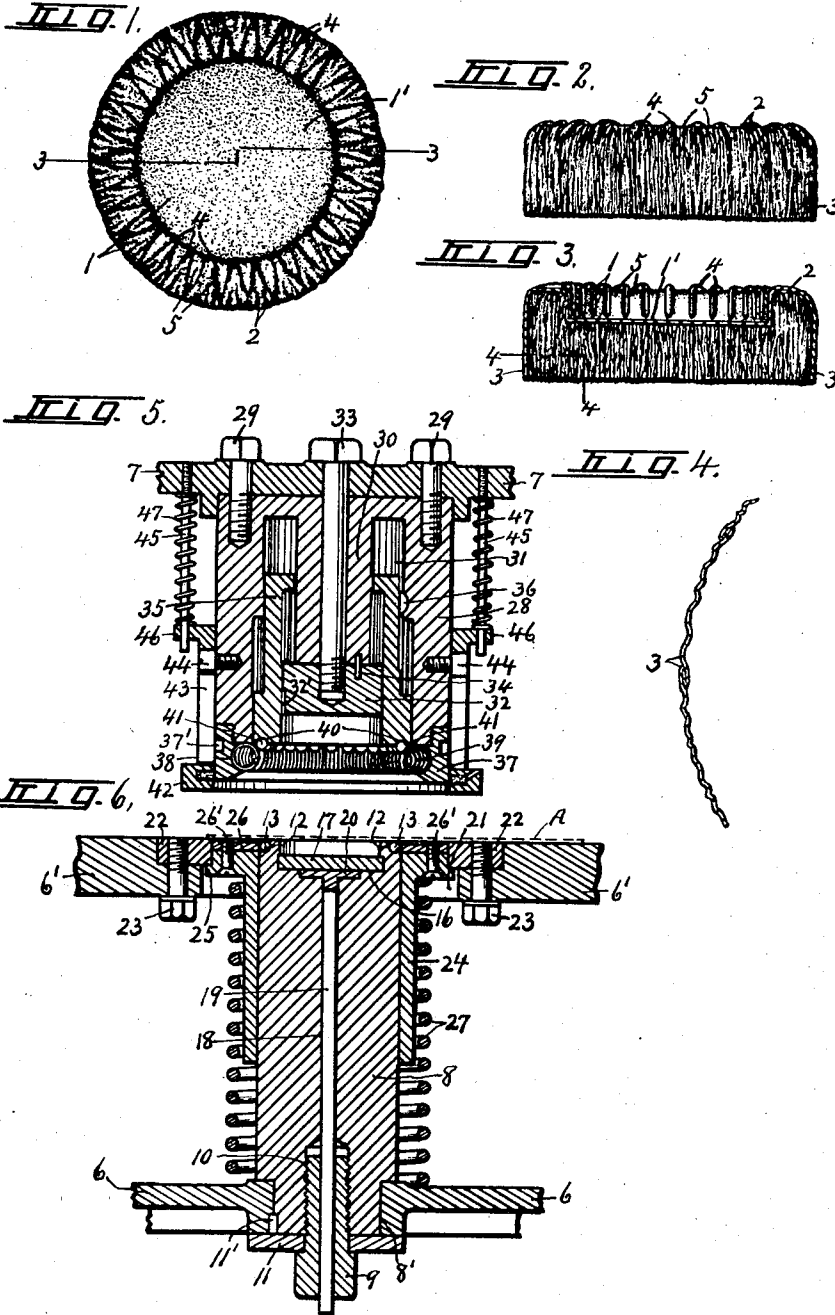
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METHOD OF MAKING OVER-ALL BOTTLE CAPS

Original Filed July 27, 1933

2 Sheets-Sheet 1



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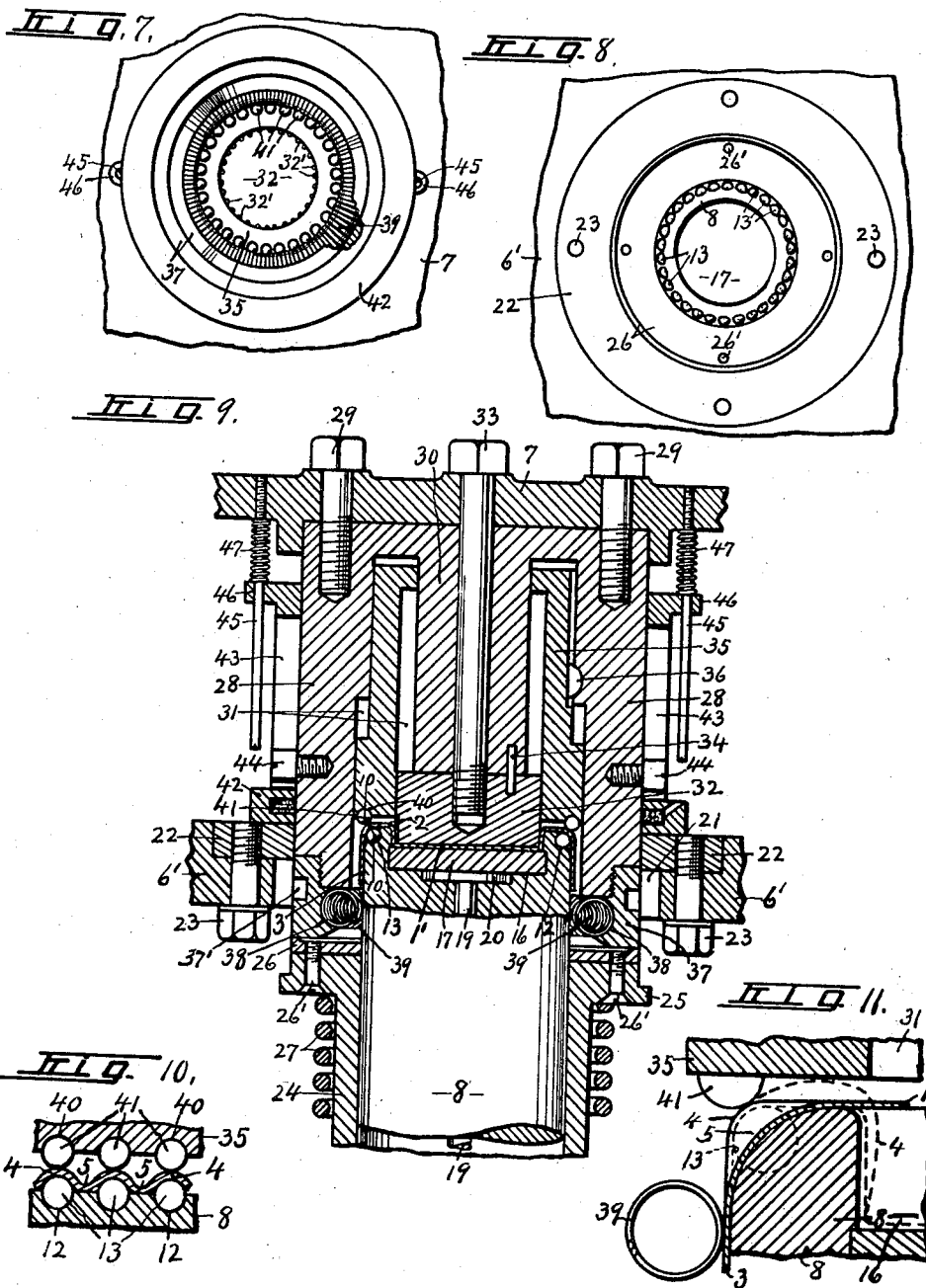
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UNITED STATES PATENT OFFICE

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METHOD OF MAKING OVER-ALL BOTTLE CAPS

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Original application July 27, 1933, Serial No.
682,474. Divided and this application March
15, 1937, Serial No. 131,096

4 Claims. (Cl. 113—121)

This application is a division of application Serial No. 682,474, filed July 27, 1933, now Patent Number 2,076,096, for Apparatus for making bottle caps, and relates more particularly to the method of making over-all bottle caps by which the cap is formed in one piece, preferably from a sheet of light, strong and durable metal having a high degree of ductility, malleability and tenacity, such, for example, as tissue aluminum of about the thickness of "Cellophane" or thin tin-foil capable of being easily molded under pressure to the desired form under atmospheric temperatures and of retaining its form under ordinary usage.

The main object is to produce in one operation a bottle cap of this character with a central cup-shaped portion and a marginal skirt portion in which the cup-shaped portion is of slightly less diameter than the interior diameter of the mouth of the bottle while the skirt portion is of slightly greater diameter than that of the head of the bottle so that the cap may easily drop into place upon the bottle by its own weight ready to be sealed thereon by any suitable capping machine in a manner hereinafter described.

Another object is to render the cap self-retaining upon the bottle when applied thereto without extra retaining means.

A further object is to form the overturned rim of the cup-shaped portion with substantially radial ribs and grooves alternating with each other in regular order for reinforcing and expansion purposes.

One of the specific objects is to rumple the skirt in an axial direction about its circumference during its formation so as to render it more pliable and therefore more easily expanded and contracted over and upon the mouth of the bottle than would otherwise be possible, the term "rumple" being used in its broadest sense to indicate irregular and relatively fine wrinkles.

Other objects relating to the manner of forming the rim corrugations (ribs and grooves) and rumpled skirt will be brought out in the following description.

In the drawings—

Figure 1 is a top plan of my improved bottle cap.

Figure 2 is a side elevation of the same.

Figure 3 is a vertical sectional view taken on line 3—3, Figure 1.

Figure 4 is an enlarged detail horizontal sectional view of a portion of the skirt of the cap taken on line 4—4, Figure 3.

Figures 5 and 6 are vertical sectional views

respectively of the upper and lower sets of dies for forming the cap, a portion of the sheet from which the cap is to be formed being shown by dotted lines as resting upon the upper face of the lower set of dies, the dies of both sets being shown in their normal open positions.

Figure 7 is an inverted end view of the upper set of dies shown in Figure 5.

Figure 8 is a top plan of the lower set of dies shown in Figure 6.

Figure 9 is an enlarged vertical sectional view of both sets of the dies in their closed cap-forming positions, the cap being shown in section.

Figure 10 is an enlarged detail sectional view taken on line 10—10, Figure 9, showing portions of the adjacent ends of the lower and upper corrugating dies, but more particularly the relation of the cooperative sets of balls for forming the ribs and grooves in the rim of the cup-shaped central portion of the cap.

Figure 11 is an enlarged vertical sectional view of one side of the upper end of the lower die-post and lower end of one side of the upper die in position to form the rim corrugations of the bottle cap together with a portion of the spring ring in position for rumpling the skirt of the cap, a portion of which is also shown in section, the dotted lines indicating the position of the ribs when the cap is finished.

As illustrated more clearly in Figures 1 to 3 inclusive and Figures 9 and 10, the bottle cap is made of extremely thin or tissue aluminum or its equivalent having a high degree of ductility, malleability and tenacity, together with inherent lightness and non-corrodibility, and comprises a substantially cylindrical cup-shaped central portion 1 having an outturned rim 2 and a marginal skirt 3, all of which parts are arranged about a common axis representing the axis of the bottle to which the cap is to be applied.

The bottle (not shown) to which the cap is to be applied may be of any well known construction having the usual inner annular ledge, the rounded rim, enlarged head, and reduced neck.

The cup-shaped portion 1 of the cap is of slightly less diameter than that of the interior of the mouth of the bottle to allow it to readily seat itself therein under its own weight preparatory to sealing the same by any suitable capping machine, and is provided with a substantially flat and horizontal bottom portion 1' disposed in a plane at substantially right angles to the axis and adapted, if necessary, to rest upon the inner annular ledge of the mouth of the bottle.

The rim 2 of the cap is concavo-convex in cross-section to conform more or less closely to the rounded contour of the top of the bottle with which it is adapted to engage.

5 The skirt portion 3 is of slightly greater diameter than the external periphery of the head of the bottle to enable it to readily pass over and around the same during the capping operation.

The overturned rim 2 is provided with raised 10 ribs 4 and grooves 5 alternating with each other in regular order throughout the circumference of the rim, thereby establishing regular corrugations for reinforcing purposes and also to permit the inner upright side walls of the rim to be 15 expanded into close engagement with the inner periphery of the mouth of the bottle by suitable capping means, not necessary to herein illustrate or describe, because this expansion of the rim of the cap takes place only during the capping 20 operation.

The ribs 4 are relatively narrow as compared with the width of the grooves 5 but are arranged in uniformly spaced relation circumferentially and are of uniform height to stiffen the rim and 25 thereby to hold the bottom portion 1' and skirt portion 3 in more or less fixed concentric relation.

The skirt 3 is ruffled or irregularly crinkled axially to enable it to be easily placed over and upon the head of the bottle without material friction therewith and at the same time permitting 30 the lower edges thereof to be easily contracted around the outer periphery of the head and neck of the bottle under comparatively light inward radial pressure on all parts thereof during the 35 capping operation.

The ribs 4 extend substantially radially across the top of the rim 2 and also extend downwardly therefrom along the inner upright side of the rim to points close to but slightly separated from 40 the bottom 1' so that when the cap is applied to the head of the bottle, the upright inner walls of the cup-shaped portion 1 may be expanded by a suitable capping die or plunger tightly against the inner periphery of the mouth of the 45 bottle to effectively prevent the leakage of the contents of the bottle through the joint, leaving the radial portions of the ribs and bottom walls of the grooves 5 in substantially their original positions after having been previously formed.

50 Specific mechanism is provided for forming the cap as described so that all portions of the cap may be formed in practically one and the same operation.

As illustrated, this cap forming means comprises 55 a lower set of dies mounted in and upon vertically spaced and relatively stationary supporting members 6 and 6', and an upper set of dies mounted in and upon a vertically movable plunger plate 7 adapted to be reciprocated vertically toward and from the upper frame member 60 6' by any suitable means, not necessary to herein illustrate or describe.

Lower set of dies

65 The lower set of dies preferably comprises a relatively stationary upright post 8 rigidly mounted upon the lower frame member 6 to extend upwardly therefrom, and for this purpose has its lower end reduced in diameter and tightly secured in an opening 2' in said frame member 70 with its lower end substantially coincident with the lower face thereof.

A clamping screw 9 is screwed from the underside upwardly into a central threaded socket 10 75 in the lower end of the post 9 and is provided

with a washer 11 engaged with the head of the bolt and with the underside of the frame member 6 to firmly clamp the post to said member against relative axial or angular movement and, 5 if necessary, the post may be locked to the frame member 6 by means of a key 11', as shown in Figure 6.

The portion of the post 8 above the frame member 6 is preferably cylindrical and of a diameter corresponding to the internal diameter of the 10 skirt 3 of the cap to be formed on the upper end thereof but somewhat greater than the external diameter of the head of the bottle for a purpose presently described.

The upper end face of the post 8 and upper 15 face of the upper frame member 6' are disposed in substantially the same horizontal plane for receiving and supporting the sheet material as A shown by dotted lines in Figure 6, and from which the cap is to be formed, it being understood that the sheet material may be intermittently fed in 20 any suitable manner from a reel or other source of supply across and upon the upper face of the upper frame member 6'.

The upper outer annular corner of the post 8 25 is provided with a multiplicity of relatively small substantially hemispherical sockets 12 arranged in relatively close but uniformly spaced relation circumferentially entirely around the periphery of the post for receiving and supporting a corresponding number of relatively small hardened 30 metal balls or bearing members 13 of the same radius as their respective sockets 12.

The diagonally opposite walls of the open sides 35 of the sockets 12 are preferably crimped or swaged against the adjacent portions of their respective balls to firmly hold the latter in operative position against displacement and preferably against relative rotation so that the outer lateral 40 faces of the balls will be substantially coincident with the adjacent portions of the periphery of the post 8, thus providing the upper outer corner of the post with a corresponding number of rounded or spherical bearings around which the 45 skirt 3 of the cap may be bent, in a manner hereinafter more fully explained.

The top of the post 8 is provided with a circular recess 16 of somewhat less diameter than the 50 interior diameter of the mouth of the bottle, the lower end of which is slightly enlarged to receive and retain a resilient cushion plate 17 of rubber or equivalent material adapted to rest upon the flat bottom of the recess and against the peripheral walls thereof, as shown in Figures 6 and 9.

This recess extends upwardly above the upper 55 face of the cushion 17 a distance substantially equal to the axial depth of the cup-shaped portions of the cap 1 and its internal diameter is substantially equal to the external diameter of said cup-shaped portion so that when the latter 60 is pressed into the upper end of the recess and against the upper face of the cushion 17 in a manner presently described, it will form the central cup of the cap of somewhat less external diameter than the internal diameter of the 65 mouth of the bottle, as shown in Figure 3.

The object of the resilient cushion 17 is to facilitate the embossing of the bottom of the cup by embossing characters on the lower face 70 of the upper cap-forming die, hereinafter explained.

Provision is made for replacing these cushions from time to time as they become worn, and for 75 this purpose the post 8 is provided with a central lengthwise guide opening 18 extending there-

through and through the clamping screw 9 for receiving an ejector rod 19 which extends downwardly through the guide opening 18 and below the lower end of the clamping screw 9, the upper end of said ejector rod being enlarged at 20 to normally rest in a reduced extension of the circular recess 16 and against the lower face of the cushion 17 so that when the cushion becomes worn or otherwise impaired it may be expelled from the recess 16 by upward movement of the ejector rod 19.

A new cushion may then be inserted from the top downward into and against the bottom of the recess 16 to rest against the upper enlarged end 20 of the ejector stem.

The upper frame member 6' if provided with a circular opening 21 concentric with the axis of the post 8 and of somewhat greater diameter than that of the circular blank from which the cap 1 is to be formed, the upper end of said opening being enlarged for receiving a hardened metal shearing ring 22 which is secured in place by clamping bolts 23 with its upper face in the same plane as that of the frame member 6' as shown in Figures 6 and 9.

The inner diameter of the shearing ring 22 is slightly less than that of the underlying portion of the opening 21 and is of the same diameter at the top as that of the flat blank from which the cap is to be formed.

A tubular clamping member 24 is telescopically mounted upon the periphery of the upper end of the post 8 for relative vertical movement and has its upper end enlarged to the interior diameter of the shearing ring 22 to closely fit therein when in its up position, as shown in Figure 6, said enlargement having its lower end provided with an annular shoulder 25 adapted to engage the underside of the adjacent portion of the ring 22 to limit the upward movement of the tubular clamping member 24.

The vertical depth of the annular enlargement on the upper end of the tubular clamping member 24 is somewhat less than that of the ring 22 but is supplemented by an additional hardened metal ring 26 of the same external diameter as the internal diameter of the ring 22 and is secured to the upper face of the tubular clamping member 24 by screws or bolts 26', it being understood that the inner diameter of the ring 26 is equal to the external diameter of the post 8, as shown in Figure 6.

A spring 27 is interposed between the enlarged upper end of the clamping member 24 and upper face of the lower frame member 6 around the post 8 for yieldingly holding the clamping member 24 in its uppermost position with its shoulders 25 engaging the underside of the ring 22, as shown in Figure 6.

Upper set of dies

The upper set of cap forming dies are mounted upon the plunger member 7 and comprises an inverted cylindrical cup-shaped member 28 having its upper end secured by bolts 29 to the underside of the plunger plate 7 to extend downwardly therefrom in coaxial relation to the post 8, the interior diameter of the lower half of the member 28 being somewhat greater than the external diameter of the skirt 3 of the cap 1 and, therefore, of still greater diameter than the external diameter of the upper end of the post 8 so that when the plunger plate 7 is moved downwardly to its pressing position in the act of forming the skirt 3, the lower end of the mem-

ber 28 will extend around the upper end of the post in spaced relation thereto, as shown in Figure 9.

The top wall of the member 28 is provided with a central pendant boss 30 extending downwardly therefrom coaxial with the post 8 and of considerably less external diameter than the internal diameter of the outer portions of the member 28 to form an intervening annular chamber 31, the upper half of which is of less diameter than that of the lower half previously mentioned for a purpose presently described.

A cup-forming die 32 is secured to the lower end of the boss 30 by means of a clamping bolt 33 extending centrally through said boss and having its lower end threaded and engaged in a threaded aperture in the die 32 which is held against rotation relatively to said boss by a key or pin 34, as shown in Figures 5 and 9.

The external diameter of the die 32 is equal to the interior diameter of the cup-shaped portion of the cap 1 formed thereby but is of somewhat less diameter than that of the interior of the mouth of the bottle.

A sleeve 35 is reciprocally movable within the chamber 31 around the post 30 and die 32, the upper end of the sleeve being reduced to about the same diameter as that of the boss while the lower end is enlarged to about the same diameter as that of the interior of the lower half of the member 28.

The interior diameter of the remaining portions of the sleeve are substantially the same as the external diameter of the die 32 so that the dies and boss and also the interior walls of the lower half of the chamber 31 serve to guide the sleeve in its vertical movement, said sleeve being held against angular movement relatively to the member 28 by means of a key 38, Figure 9.

The member 28 extends downwardly from its supporting plate 7 some distance below the lower face of the cupping die 32 and has its lower end reduced and threaded externally and engaged by an internally threaded shearing member 37 of the same external diameter as that of the member 28 and also of about the same external diameter as the internal diameter of the lower shearing ring 22 with which it is adapted to cooperate for cutting a circular blank from the sheet material A preparatory to forming the cap, shown in Figures 1, 2 and 3.

The upper shearing ring 37 is also preferably made of hardened steel and is provided with peripheral recesses 37' for receiving a spanner wrench or equivalent by which it may be tightened and loosened when assembling or disassembling the parts of the upper cap-forming dies.

The portion of the shearing ring 37 below the lower end of the member 28 is provided with a concave annular groove 38 in which is seated the outer periphery of a circular coil spring 39, the inner periphery of which extends slightly beyond the inner face of the adjacent end of the member 28 and is of about the same or slightly less diameter than the external diameter of the post 8.

That is, the coil spring 39 is loosely seated in the annular groove 38 so that it may turn more or less freely therein and is held against displacement therefrom under its own tension, it being understood that the helixes of the spring will be arranged in close proximity to each other, particularly at the inner side of the coil for rumpling the skirt of the bottle cap during the cap-forming operation.

It will be noted upon reference to Figure 5 that

the lower end face of the ring 37 is beveled upwardly and inwardly and that the coil spring 39 projects inwardly beyond the lower wall of the groove 38 while the upper edge of the spring 5 abuts against the lower end face of the member 28 to cooperate with the lower wall of the groove 38 in holding the spring against vertical displacement.

The inwardly protruding portions of the coil 10 spring 39 serve as a stop for engaging the lower end of the sleeve 35 and thereby limiting the downward movement of said sleeve when the upper set of dies is raised to its normal position so that the lower end face of the sleeve 35 will normally be displaced in about the same horizontal 15 plane as the lower end face of the member 28 and upper face of the coil spring 39, as shown in Figure 5.

The lower end face of the sleeve 35 is provided 20 with a multiplicity of relatively small substantially hemispherical recesses 40 for receiving a corresponding number of hardened metal balls or bearing members 41, the recesses and balls being arranged in uniformly spaced relation circumferentially a slightly greater distance from the axis 25 of the sleeve 35 than the balls 13, but in relatively close proximity to each other at the lower outer corner of the sleeve.

The number of balls 41 and recesses 40 corresponds to the number of balls 13 in the upper end 30 of the post 8, but are arranged in opposed but slightly offset radial relation to those of the other set as shown in Figure 9, to facilitate the corrugation of the rim 2 of the cap 1 and thereby to 35 form the ribs 4 and groove 5 in a manner hereinafter described.

The length of the area of each of the sockets 40 is slightly greater than half the circumference 40 of each of the balls so that after the balls have been placed in operative position in said sockets the inner walls thereof may be crimped or swaged inwardly to hold the balls in their operative positions with their lower portions projecting slightly beyond the lower end face of 45 the sleeve 35.

A collar 42 is slidably mounted upon the periphery of the lower portion of the cup-shaped member 28 for relative vertical movement thereof and is provided with vertically elongated slots 43 50 for receiving radial guide pins 44 which are screwed into the adjacent sides of the member 28 for holding the collar against angular movement relatively to the member 28 while permitting its free vertical movement.

This collar normally extends downwardly a short distance below the lower end face of the shearing ring 37 and is adapted to cooperate with the upper face of the shearing ring 22 for holding the sheet material in fixed position during the 60 shearing cooperation of the ring 37 with the shearing ring 22.

The upper ends of the slots 43 are closed to cooperate with the pins 44 for limiting the downward movement of the collar 42.

Suitable guide rods 45 are secured to the plate 7 65 to extend downwardly therefrom at opposite sides of the member 28, the lower ends of said rods being extended through registering apertures 46 in the upper end of the collar to assist in guiding the latter in its vertical movement.

Suitable coil springs 47 are interposed between the upper end of the collar 42 and lower face 70 of the plate 7 around the rods 45 for yieldingly holding the collar in its extreme downward position, as shown in Figure 5.

The lower end of the cupping die 32 is provided with a multiplicity of vertically elongated peripheral slots 32', Figures 5 and 7, arranged in uniformly spaced circumferential relation corresponding to the spacing of the balls 41 for receiving the inner ends of the ribs 4 of the bottle cap 1 as the central portion thereof is depressed by the die 42 into the upper end of the opening 16 in the top of the lower die post 8, as will be hereinafter more fully described. 10

Operation

Assuming that the plunger plate 7 and dies carried thereby are in their normal positions with relation to the lower die-supporting frame, 15 as shown in Figures 5 and 6, and that the sheet metal from which the caps, shown in Figures 1, 2 and 3, are to be formed is fed across and upon the upper face of the upper frame member 6' to the position shown by dotted lines in Figure 6. 20

The plunger plate 7 and parts carried thereby are then moved downwardly until the lower end of the collar 42 engages the upper face of the sheet A to clamp and to temporarily hold the sheet in position to be cut upon the upper face 25 of the ring 22.

Immediately following this engagement of the lower end of the yielding collar 42 with the sheet material, the continued downward movement of the plunger plate 7 will bring the cutter ring 37 30 into shearing engagement with the lower shearing ring 22 for cutting a circular disk from the sheet material of the same diameter as the interior diameter of the shearing ring 22.

Simultaneously with this cutting operation, the pressure of the downwardly moving shearing ring 37 and coil spring 39 upon the marginal edge of the disk will bend said marginal edge downwardly around the outer faces of the balls 13, at the same time depressing the sleeve 24 against the action of its retracting spring 27. 40

Then, as the downward movement of the upper set of dies continues, the collar 42 will be yieldingly held in its clamping position by means of the springs 47 against the upper face of the 45 lower cutter ring 22 so that after the cutting operation just described, the downward bending of the marginal edge of the previously cut disk will continue through the engagement of the inner face of the coil spring 39 therewith and before the lower end of the die 32 has been brought into engagement with the previously cut disk, thus leaving the remaining portions of the disk in a flat horizontal plane, Figure 11.

As previously stated, the annular coil spring 55 39 is free to roll in its annular bearing 38 with more or less irregularity throughout its length, the effect of which is to rumple the downwardly turned skirt portion of the disk around the upper end of the post 8 in that the wrinkles or crinkles will be formed by the inner sides of the numerous helices of the coil spring which presses the skirt against the periphery of the post, it being understood that the inner sides of the coil spring will be more or less compressed by reason of their engagement with said skirt during the descent of 65 the plunger plate 7 and parts carried thereby.

The normal distance between the lower face of the upper die member 32 and horizontal center of the spring 39 is greater than the depth of 70 the skirt 3 of the finished bottle cap so that as the plunger plate 7 with the dies thereon continue their downward movement, or at about the same time that the spring 39 passes beyond the lower edge of the previously down-turned 75

skirt portions 3, the die member 32 will engage and depress the central portion of the disk into the upper end of the opening 16 and against the upper face of the cushion 17, thereby drawing the skirt upwardly and inwardly between the opposed sets of balls 13 and 41 to form the ribs 4 and grooves 5 which ribs will then extend across the rim 2 and downwardly along the inner sides thereof to points near the bottom 1' of the cup-shaped portion of the disk, as shown more clearly in Figure 3, thus completing the formation of the bottle cap as shown in Figures 1, 2 and 3.

Previously to engagement of the die 32 with the central portion of the disc, the die sleeve 35 which carries the balls 40 at its lower end will engage the intermediate portion of the disc so as to impose the weight of the sleeve 35 upon the disc as the plunger plate 7 and dies carried thereby are lowered, thereby yieldingly holding the intermediate portion of the disc between the balls 40 and 13 so as to permit the upward and inward movement of the skirt as the central portion of the disc is depressed by the die 32 near the end of the downward stroke of the plunger plate 7.

After the bottle cap has been formed in the manner described, the plunger plate 7 with the dies thereon will be elevated to their normal up positions, as shown in Figure 5, thus permitting the sleeve 24 to be returned upwardly to its starting position by its springs 27 for stripping or ejecting the finished bottle cap from the top of the post 8 during which operation the collar 42 will be returned downwardly to its lowermost starting position by the springs 47 while the upper die sleeve 35 will be returned to its normal down position by its own weight or by other means, if required, the apparatus being then in position for a repetition of the operation described for forming other similar caps.

The lower end of the skirt of the cap will then be in the opening in the sheet material from which the bottle cap disk was previously cut and, as the sheet is again moved to register another portion thereof with and between the opposed sets of dies, the finished cap will be carried forwardly therewith to one side of the dies where it is free to drop through the opening onto the head of the bottle to be capped or may be removed by hand or otherwise for subsequent placement upon the head of the bottle preparatory to sealing the same thereon by a suitable capping machine, not shown.

When the finished bottle cap has been placed upon the head of the bottle in any manner with its cup-shaped portion in the mouth thereof and its skirt portion surrounding the head and adjacent portion of the neck of said bottle, the peripheral walls of the cup-shaped portion will be expanded against the walls of said mouth while the skirt portion will be compressed against the outer periphery of the head and neck to firmly hold the cap in place against accidental displacement and at the same time to form a liquid-tight and air-tight joint with the bottle, it being understood that the bottom of the skirt will then be compressed around the neck of the bottle just below the head or roll on the head thereof.

Any suitable capping machine or other means

may be employed for applying the finished cap to and sealing it upon the head of the bottle in the manner described, and it is to be understood that the present invention relates to the construction of the cap and the method of and apparatus for making the same including any equivalents thereof irrespective of the means for applying the finished cap to the bottle except insofar as disclosed.

It will be noted upon reference to Figures 9 and 11, that the balls 41 project slightly below the lower end face of the die sleeve 35 to form an annular space so that when the dies are closed upon the cap in the act of forming the ribs 4 and grooves 5, the upwardly projecting radial ribs may be readily drawn into and through said space while the lower faces of the grooved portions are free to move across and upon the upper end face of the lower die 8.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is—

1. The herein described method of making bottle caps from sheet material consisting in cutting a disc from the sheet, bending the marginal portions of the disc axially in one direction to form a cap skirt, depressing the central portion of the disc into cup-shaped form, and corrugating the rim of the cap simultaneously with the depression of the central portion.

2. The method of making bottle caps from a flat sheet of foil consisting in cutting from the sheet a disc of sufficient area to cover the mouth and surround the head and a portion of the neck of the bottle, yieldingly holding the intermediate portion of the disc, bending the marginal portions of the disc in one direction to form a skirt, cupping the central portion of the disc in the same direction and thereby pulling the skirt in the opposite direction, and corrugating the rim of the cupped portion during the cupping operation.

3. The method of making a bottle cap from a disc of sheet foil consisting in yieldingly holding the intermediate portion of the disc between opposed elements, cupping the central portion of the disc while yieldingly holding the intermediate portion thereof between said elements to pull the marginal portions of the disc inwardly, and corrugating the rim of the cup during said inward pulling operation.

4. The herein described method of making articles from a disc of sheet material, which comprises yieldingly holding the intermediate portion of the disc between opposed dies having peripherally spaced and correspondingly opposed spherical bearing surfaces disposed adjacent to the margins of said dies, pressing the marginal portions of the disc in one direction around the periphery of one of the dies, and then depressing the central portion of the disc into an opening in one of the dies whereby to pull the marginal portions of the disc in the opposite direction and between the spherical surfaces aforesaid while yieldingly held between the dies so as to corrugate a portion of the disc during its formation by the dies into the finished article.

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