DRAW AND WALL IRON PROCESS FOR METAL CANS

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ABSTRACT

A method for forming a container in a reduced number of steps and a container made therefrom which has a thin upper wall section and a heavier lower wall section and bottom to provide extra resistance to impacts in the more normally vulnerable areas of the container, the method also comprehending forming a container from a wall ironed cup and leaving a flange on the open top of the container thus eliminating a common problem of split flanges and also simplifying the trimming operation by a simple die cut rather than by conventional rotary knife cutting.

3 Claims, 9 Drawing Figures
DRAW AND WALL IRON PROCESS FOR METAL CANS

DISCUSSION OF THE PRIOR ART

In the art of making two-piece cans, a typical method consisted of making a circular blank and then drawing the blank to form a shallow cup, then redrawing the cup to reduce its diameter and deepen the cup and then wall ironing the cup to reduce the wall thickness and further deepen the cup. A relatively heavy bottom was provided which peripherally joined the lower margin of a substantially thin side wall. This type of operation is susceptible to tearing of the metal at the corner juncture between the heavy section of the bottom and the lower margin of the thinned side wall. Poor impact resistance results at such corner defined by a thin side wall joining a thick bottom. The successive draws of prior art processes imposes high stress loading at the juncture of the side wall with the bottom which can cause failures during the formation of the container and reliance must be had upon uniform stretching of the material.

In the prior art operation the cup, after ironing, is cylindrical and has a cylindrical thin upper section. The next operation requires trimming with a rotary cutter which comprises cutting around the circumference of the cup with a rotary cutter which generally does not obtain a continuous straight edge, that is, normally the edge at the end of the cut is stepped with respect to the edge at the beginning of the cut and a notch is formed.

The next step in the conventional method is to spread the metal at the cut edge section to form a flange. This entails stretching the metal from a smaller diameter to a large diameter and in the process stress concentrations develop at the notch which is conductive to forming flange cracks. Also in the prior art process, the grain orientation of the metal is in parallel lines axially of the cup prior to flanging.

In forming the out-turned flange, the metal grain lines are then flared outwardly since the metal is stretched which is a predominant cause of flange cracking. To combat this effect, metal formulations are critical at increased cost and the angle at which the flange can depart from the axis of the container is limited.

SUMMARY OF THE INVENTION

The instant invention is directed to a novel method of forming a container in minimum steps which are arranged to obtain an improved container having different wall sections strategically oriented to facilitate manufacture and improve the product.

The invention comprehends a process of drawing a cup in which the side wall is ironed to form a cup having a thin wall section adjoining a thicker bottom and wherein thereafter, a peripheral portion of the bottom is drawn and the cup is reduced in diameter without reducing the thickness of the peripheral portion or the previously formed thin wall section which results in a container having a thin wall upper section and a thicker wall lower section.

An important feature and object of the invention is to form a flange for the container from a cup while the cup is being reduced in diameter, which is contra to the prior art practice of making the flange by enlarging the diameter, thus eliminating the split flange problem.

The preceding object of the invention provides additional benefits in that a shorter stroke press is used than in the prior art wherein the container preform is made deeper or longer than the final container since the metal to form the flange portion and the scrap are in axial alignment with the side wall of the preform. Thus, the stroke of the press must be long enough to make the preform. The extra length of stroke reduces the speed of operation and also increases the cost of the equipment.

Another important aspect of the invention resides in being able to form a container with a flange in one continuous operation and wherein the flange is formed in the process of reducing the diameter of the container so as to eliminate stretching the metal and thus developing incipient flange cracks.

The invention also comprehends a method of making a container with a peripheral flange by redrawing of a wall ironed cup to leave a flange and then trimming the flange with a simple die cut in lieu of flaring the wall ironed cup to provide a larger diameter flange from a smaller diameter cup as is done in the prior art.

Another object is to provide a novel process of forming a container wherein the depth of the last draw is controlled so that a peripheral portion about the open end of the container remains between the dies which provide a drawing surface transverse to the axis of the container whereby as the cup is being reduced in diameter and the metal compressed circumferentially, an outwardly projecting crack-free peripheral cover-sealing flange is produced.

A still further object is to provide a novel process in which the side wall of the container is ironed to a thin section and then a lower wall portion of the container is drawn from a thicker bottom while reducing the diameter of the container and elongating the wall-forming bottom portion followed by a reduction in diameter and an elongation of the thinner section of the side wall under reduced axial loading which not only facilitates the drawing operation but also minimizes the possibilities of rupturing the container wall.

The invention contemplates forming the container in a continuous process of drawing a shallow cup from a blank, the cup having a side wall, a bottom and an open top and then ironing the side wall to thin the side wall and deepen the cup, then clamping the bottom between opposing dies which provide drawing surfaces transverse to the axis of the container, then forcing a center portion of the bottom through a reduced diameter draw die while drawing the peripheral portion of the bottom first inwardly from between the opposing dies and axially through said draw die and continuing the drawing to reduce the diameter of the container and elongate the thin section of the wall to deepen the cup.

A still further object is to form the cup during the initial forming operation with a thin wall section and at the latter stages of the forming operation form an additional wall portion of the cup from the thicker bottom portion so that during the last processing the thick end of the cup is drawn through the dies first and is followed by the thinner wall section which is more susceptible to the forming operation without rupturing.

These and other objects and advantages inherent in and encompassed by the invention will become more apparent from the specification and the drawings, wherein:
FIG. 1 is a blank for making the container; FIG. 2 is a cross-section of a shallow cup drawn in the first step from the blank; FIG. 3 is a cross-section of the cup after side wall ironing process deepens the cup and thins the side wall;

FIG. 4 is a cross-section of the container after redrawing and paneling the bottom and flanging and trimming the flange; FIG. 5 is a cross-section of the container after it is beaded; FIG. 6 is a cross-section view of the die assembly in open position for forming the container of FIGS. 1-5;

FIG. 7 is an enlarged cross-sectional view of a portion of the die assembly of FIG. 6; FIG. 8 is a composite view showing the die assembly in several operating positions; and FIG. 9 is an enlarged sectional view of the flange trimming station of the die.

DESCRIPTION OF THE INVENTION

The finished container generally designated 2 is formed from a circular blank 3 which is drawn into a shallow cup 4a having a side wall 5 and a bottom or base 6 and an open top 7. In the drawing process, the thickness of the wall and base remains the same. The shallow cup 4a is then subjected to a wall ironing operation of the side wall 5 into a thinner section and elongating the same to form a deepened cup designated 4c while the initial thickness of the bottom or base 6 is maintained.

In the third step of the process, the cup 4c is redrawn in which the peripheral portion 10 of the bottom is formed to provide the thicker lower section 11 of the side wall of the container. As best seen in FIG. 4, the section 11 is of the same thickness as the bottom 6 and that the outside diameter designated OD in FIG. 4 is the same as the OD of the upper thinner section 14 of the side wall. However, the inner diameter designated ID is less than the ID of the thinner section. Thus the process produces a can from metal such as steel or aluminum which strategically disposes the metal to provide a container having a thick lower section and bottom especially in the vulnerable corner 13 formed at the juncture of the bottom and side wall. The thick section of the corner better resists impacts as when the can is dropped particularly when it is filled and heavy.

Another feature of the invention in thinning the upper section 14 of the wall first is that this reduces the loading on the wall when it is redrawn in that the pressures of the dies are reduced and placement of the thick section 11 of the wall at the base provides the necessary strength to preclude the possibility of fracturing the side wall.

The main feature of the invention is that the wall ironed cup is redrawn and a flange is left on the container. In prior art, a wall ironed cup has never before been redrawn for the purpose of leaving a flange on the open top of the container for later use in a double seam operation. The significant feature of forming the flange for double seaming is this that a serious problem known as split flanges no longer exist. Split flanges will frequently occur when the flange is formed from a cylindrical open top.

This common problem is inherited from the wall ironing process in which the grain direction in the metal become parallel to the center line of the container. A transversal grain direction in a container body is always attained on three piece containers to avoid splitting of the metal when the flange is formed.

A further feature resides in forming the container in the last step by redrawing so that the OD of the thick and thin sections is constant so as not to impose a ridge or uneven external surface which would complicate labeling.

As best seen in FIG. 4, the step of forming the thick wall section is combined with the step of paneling the bottom wall and also in forming of the peripheral outwardly directed flange 15 about the open end of the container followed by a trimming operation to provide a circular edge 16 about the flange and part with the ragged scrap indicated at 17.

Thereafter, the side wall is subjected to a beading operation to form a series of beads 19, 19 in the thin side wall section 14 for strengthening the same. The container is now finished formed for double seaming in usual manner.

FIGS. 6 and 8 illustrate a triple press with sequentially operated rams and includes a triple action die and punch assembly generally designated 30 for performing the aforementioned process. The assembly 30 is disposed in a press generally designated 21 which comprises a stationary press bed 22 and an opposing movable ram platen 23 to which is suitably secured as by bolts 24, 24 a center punch 25 of a telescoping multi-connection punch assembly broadly designated 26.

Considering FIG. 6, wherein the die shown in open position, the punch assembly 25 is retracted from the die assembly 27 to provide a passageway therebetween.

A strip 29 of can forming stock material, preferably of steel or aluminum, is fed through the passageway 28 over a stripper plate 30 and a draw ring 31 shown in FIG. 7. The plate 30 and draw ring 31, in the extended position of the stripper plate 30, (as best seen in FIG. 7) provide coplanar guide surfaces 32, 33 respectively against or over which the bottom surface 34 of the stock strip 29 is fed or advanced to cover a die opening 35 in the draw ring 31.

Thereafter, a shearing punch 36 is advanced toward the cutting edge 32 by a ram 34 on which it is mounted, the shearing punch having a hollow cylindrical body 38 with a chamfered lower edge 39 which converges with the internal side 40 of the body 38 and forms a knife edge 41. The knife edge 41 cuts the material against an external cutting edge 42 of the draw ring 31 and telescopes thereover as best seen in FIG. 8 and receives the draw ring within a bore 42′ of the shearing punch body 38. Simultaneously, the remaining stock is moved past the cutting edge 42 and is depressed inwardly of the outer face 32 coincidently with the stripper plate compressing springs 43 and moving the retainer bolts 44 to which the stripper is fastened inwardly, the bolts (at least three in number) having their shank portion 45 slidable through aligned apertures 46 in a spacer plate 47 of a mounting block assembly 48, the bolts being headed at 49 and abuttable with the plate 47 at 50 to limit outward movement of the stripper from that shown in FIG. 8 to that in FIG. 7.

The circularly cut blank 3 is slip-held between the outer surface 33 of the draw ring and a flat opposing surface 51 of a clamp ring 52 which is slidable within the bore 42′ of the cutting tool 36. The clamp ring 52
is actuated to clamping position by pressurized air which is held under constant pressure into the air chamber 53 which is formed in an enlarged portion 54 of bore 42' between an enlarged piston head 54' of the clamp ring 52 and an end closure surface 55 of the ram 37 to which the tool 36 is secured by bolts 57 passing through an outward flange 58 of the tool or shear punch 36. Air is admitted under suitable pressure through a port 59 in ram 37 and a passage 60 therein. Suitable sealing rings 61, 62 between the clamp and tool 36 are provided to retain the air.

O-ring seals 63, 63 are fitted into grooves 64, 64 in a bore 65 of the clamp ring 52 and are sleeved over a cylindrical outer punch element 67 which passes through bore 65 and is adapted to engage the center portion of the blank and force it through an opening 68 in the draw ring 31 attendant to the introduction of air under pressure to a chamber 69 formed in a sleeve element 70 which is fitted into and suitably secured to ram 71. The sleeve element 70 is sealed against an annular ram surface 72 by a flexible elastomeric O-ring 73. The ram 71 is provided with an air passage 74 which communicates with cushion chamber 69 to provide an air cushion against the piston head 74' of the outer punch, the head end 74' being sealed against an internal bore surface 75 of the sleeve element 70 and limited in its outward movement through shoulder engagement with the turned shoulder 75' of the sleeve element 70, element 70 being suitably secured to ram 71.

The ram 71 compresses the air cushion in chamber 69 and moves the punch 67 which initially forces the center can-bottom-forming section 76 of the blank through the opening or aperture 68 in the draw ring 31 whereupon the peripheral portion of the blank is drawn to from the cylindrical wall segment 5 of the container 4. It will be noted that the wall segment 5 and bottom wall section 76 are not thinned but retain the original thickness of the blank at this stage of forming.

The shallow cup 4 fits about the cylindrical periphery 77 of the outer punch 67 and is carried thereby, as it is further extended, through an aperture 78 defined by a narrow external wall forming extensions 79 of an ironing ring 80 suitable mounted on the mounting block assembly in axial alignment with ring 31.

As the container 4 is forced through the wall ironing ring 80, the side wall which in the instant example initially was 0.0093 inches thick is reduced to a thickness of 0.0062 inches and the depth of the cup 4a side wall is increased from 1.975 inches to 2.896 inches.

The outer punch continues to extend to its full length as seen in FIG. 8. At this point, a peripheral edge portion 10 of bottom side 82 of the bottom wall forming section 76 of the container 4a (see 2nd stage FIG. 8) engages a top surface 83 (3rd stage) of a redrawing ring 84, the ring 84 being held in press bed 22 with block 48. In this position, the portion of the can bottom alignment with the outer punch is slip-held between the surface 83 and of the redrawing die and the end face 85 of the outer punch (FIG. 9).

Thereafter, the inner or center punch 25 is extended through the hollow outer punch 67 by press rams 23 moving toward base 22.

The center or inner punch 25 has an end face providing a paneling profile including an annular peripheral rim or bead 87 which circumscribes a cavity or pocket 88. The cavity 88 and rim 87 are complemental to an opposing profile 89 on a head 90 of a knock-out punch 91 which engages the center portion of the can bottom forming section 76, said center portion eventually becoming the bottom 6 of the can. As the center punch 25 is advanced, it not only panels the bottom 6 against the profile 89 but also forces the bottom through a center aperture 93 of the redrawing ring 84 whilst the knock-out punch 91 retracts through the cavity 92 in the die block in timed sequence with the advance of the inner punch. As the container is being drawn through the second drawing ring 84 the thick bottom edge portion 10 is displaced inwardly first transversely from between the opposing transversely extending surfaces 83 and 85 of the outer punch and redrawing ring and then turned axially and reformed into a thickened lower wall section 11 of the container. Since the upper portion 14 of the side wall of the container in this stage is thinner than the lower portion 11, the metal forms relatively easy and the force required to pull it through the space 93 defined between the clamping surfaces 83 and 85 is minimized. The drawing process at this stage effects a hoop loading on the metal drawing it together. The drawing is continued until only a marginal portion of the container wall about the open end remains and this portion, designated 15, forms the outwardly projecting flange 15. The inner plunger or punch 25 has an annular cutter ring or die cutter 96 secured thereto intermediate its ends which is positioned with further advance to punch 25 to trim the flange 15 by shearing off the scrap portion 17 of the flange against an external cutting edge element 97 mounted on the drawing ring 84. As now will be appreciated, this displacement of the metal is not conducive to developing flange cracks.

Thereafter the punches 67, 25 are retracted and simultaneously the knock-out punch 91 is advanced by a suitable timed cam mechanism 99 (schematically shown) of any well known design to push the container out of the cavity and into the can discharge opening 98 whereby the container drops out into a collection or transfer device (not shown).

The cycle is then repeated for the next container. It will be understood that only a preferred embodiment of the invention has been disclosed which is not intended by way of limitation since other embodiments will now become apparent to those skilled in the art.

The scope of the invention is to be determined as set forth in the appended claims.

I claim:

1. In a method of forming a metal container wherein a metal blank is drawn into a shallow cup having a side wall, base at one end and an opening at the other end and wherein the base and side wall are of the same thickness, comprising:

first ironing the side wall to elongate and thin the same and deepen the cup;
then redrawing the cup to a smaller diameter by pulling the metal transaxially inwardly and then axially to cause the metal to flow circumferentially in a hoop compressive direction and axially in a tensile direction; and
then terminating the redrawing and leaving an edge portion of the side wall about said open end as an outwardly projecting flange and then trimming said flange by cutting the same with a circular die.

2. A method of making a container comprising:

cutting a blank from a sheet of metal, then drawing the blank into a cup having a bottom and a side
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7 wall, then wall ironing the cup to thin the side wall and elongate the same axially, then redrawing the cup to reduce its diameter and elongate it axially and to form a side wall having a thick lower portion and thin upper portion by drawing the bottom of the cup between a pair of opposed dies providing limited drawing surfaces transverse to the axis of the container and continuing the redrawing by passing the cup immediately thereafter through an axial drawing surface in one of the dies extending concentric with the axis of the container, terminating the redrawing operation just prior to the exit of the marginal edge portion of the side wall from between said transaxial surfaces to leave an outwardly flared cover-attachment flange about the open end of the container.

8. The method according to claim 2 and then trimming the flange by cutting the same with an annular cutter while the flange is held between said transaxial surfaces.

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