

Description

This invention relates in general to new and useful improvements in the formation of metal end units for cans, and more particularly to a metal end unit which may be formed utilizing a minimum of metal while having sufficient strength to meet the required container internal pressures. The metal end unit is particularly adapted for use in packaging carbonated beverages and the like.

The present invention provides a method of forming a metal end unit according to claim 1.

The present invention also provides a die assembly for forming a metal end unit according to claim 4.

The end unit which is the subject of this invention is provided with a countersink surrounding the center panel within the chuck wall. An early developed such end unit is disclosed in the patent to Schultz, US-A-4,109,599 granted August 29, 1978. In accordance with the Schultz patent, an aluminum end unit is first formed as a shell in a first set of tooling and is thereafter transferred to a second set of tooling wherein a center panel of such shell is moved axially relative to a peripheral seaming flange with the metal surrounding the center panel buckling to form the desired countersink. However, the tooling of this patent did not prove satisfactory to many for commercial purposes.

Subsequent to the Schultz invention, different tooling was developed by Metal Box of England with the resulting grant to Taube et al of U.S. -A-4,571,978 on February 25, 1986 and US-A-4,606,472 on August 19, 1986.

US-A-4571978 relates to a method of and an apparatus for forming a reinforced pressure resistant can end according to the pre-characterising parts of claims 1 and 4 respectively, by gripping a central panel of a metallic blank between an axially aligned reform pad and an indent ring, the reform pad being in internal concentric relationship to a draw punch and the indent ring being in internal concentric relationship to a lift ring, the draw punch being movable in a first direction to exert first forces against a peripheral edge portion of the blank in a first direction to form the peripheral edge portion out of the plane of the central panel and shape the blank into a generally flanged cup-shaped configuration defined by the central panel, a radius, a frusto-conical wall and an annular flange and while the central panel is still gripped, second forces are exerted beyond the first forces and in a second direction opposite the first direction to form at least a part of the metal of the radius, in the absence of restraint or constraint, out of the plane of the central panel and to a side thereof opposite the flange to form an annular reinforcing countersink radius.

While the tooling of some of these patents did permit a single set of tooling to form the desired end unit, other tooling was developed by Redicon Corporation of Canton, Ohio followed by the grant to Bulso, Jr. et al of U.S. -A- 4,516,420; US-A-4,587,825; US-A-4,587,826 and US-A-4,715,208. In accordance with these patents, the punch core was provided at the bottom thereof with a peripheral projection which in the formation of the shell for the end unit, the desired countersink was initiated. The tooling specifically disclosed in Bulso, Jr., US-A-4,715,208 was purchased and trials run therewith. However, in accordance with this tooling, when the chuck wall of the shell was formed, the chuck wall had a lower cylindrical portion while the upper portion is of a frustoconical configuration. Thus these two portions were in angular relation to one another and intersected along a circular line. In the reformation of such a shell so as to increase the depth of the countersink, the cylindrical portion of the chuck wall was eliminated. However, the chuck wall was still weakened at the previous line of intersection and the desired strength of the end unit was not commercially obtainable with the desired metal thickness.

Another difficulty encountered with the tooling of Bulso, Jr. et al US-A-4,715,208 was that in the formation of the shell the metal was drawn around the annular projection at the bottom face of the punch core with the resultant thinning of the metal in that area.

As is clearly explained in the Schultz patent, the metal end unit must have a certain buckle strength for a specific use. Most specifically, the buckle strength of an aluminum end unit for use in conjunction with a can for the packaging of carbonated beverages and the like is 620 kPa (90 psi). Unfortunately, end units of the selected wall thickness and aluminum stock formed in accordance with Bulso, Jr. et al US-A-4,715,208 was found to have a buckle strength just below 620 kPa (90 psi.)

At this time it is pointed out that the tooling and the method of forming metal end units clearly differs among the Schultz, Taube et al and Bulso, Jr. patents. Further, the utilization of such tooling differs with Schultz utilizing two sets of toolings, Taube et al holding the center panel stationary and utilizing outer tooling to form the shell and thereafter form the countersink while Bulso, Jr. et al specifically utilizes a countersink initiating punch core.

In accordance with this invention, when the shell is being formed utilizing the punch core, the punch core at the end of the shell forming stroke of the punch core, corroborates with a lower die core to clamp the center panel of the shell, after which while the seaming flange of the shell is held sta-

tionary, the punch core and the die core are moved in the reverse direction of the shell forming movement of the punch core while clamping the center panel therebetween so as to effect the buckling of the metal of the shell surrounding the die core to form the required countersink. It has been found that the buckle strength of the resultant end unit is increased by 13.8 to 20.7 kPa (two to three psi) compared to that obtained according to US-A-4 715 208 so as to bring the buckle strength of the end unit up to that required for commercial production.

It has been found that by eliminating the impression encircling the outer extremity of the countersink radius due the initial formation of the chuck wall in two angularly related portions, the tendency of the end unit to fail by buckling is greatly reduced. Further, because the metal is drawn around a radius at the bottom of the punch core of Bulso, Jr. et al end unit, the possibility of metal thickening in the countersink, as taught by Schultz US-A-4,109,599 has been precluded.

On the other hand, as opposed to by tightly clamping the center panel between the punch core and the die core, and by holding the chuck wall against its forming die and moving in unison the punch core and die core, it has been found that the center panel remains centered and the flow of metal from the center panel to form the countersink uniform as opposed to the non-clamping of the center panel in accordance with Schultz US-A-4,109,599 and the holding of the center panel stationary as taught in the Taube et al patents.

Embodiments of the present invention will now be described hereinbelow, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a fragmentary sectional view showing the tooling at the start of the forming operation with a blank clamped in place.

Figure 2 is a sectional view similar to Figure 1 and shows the tooling advanced to draw in a peripheral portion of the blank.

Figure 3 is another fragmentary sectional view showing the tooling actuated to form the end unit shell.

Figure 4 is another fragmentary vertical sectional view showing movement of the tooling to reform the shell and form the countersink.

Figure 5 is an enlarged fragmentary vertical sectional view taken through a portion only of the tooling and shows the specific configuration of the shell as formed.

Figure 6 is an enlarged fragmentary sectional view similar to Figure 5 and shows the manner in which the shell is reformed by moving the center panel upwardly between the punch core and the die core to form the countersink.

Figure 7 is a fragmentary sectional view similar to Figure 1 showing the manner in which the completed end unit is removed from the tooling.

It is to be understood that the drawings of this application follow closely the drawings of Bulso, Jr. et al US-A-4,715,208 and differ therefrom in the configuration of a punch core and the effect of that change in configuration on the method of forming an end unit. Accordingly, reference may be had to Bulso, Jr. et al US-A-4,715,208 for further structural details of the tooling to which this invention relates. Further, the tooling of this invention may be utilized in a conventional press, such as that disclosed in Ridgway U.S. -A- 3,902,347.

Referring now to the drawings in detail, it will be seen that starting at the top center there is a punch core 10 which will be actuated by an inner ring (not shown) to which the punch core 10 is secured by means of a punch core holder (not shown). The tooling at the top next includes an outermost punch shell 12 that is carried by an outer ring (not shown) by way of a punch shell retainer 14.

Radially inboard from the punch shell 12 is a first pressure sleeve 16 which has one or more pistons (not shown) disposed above it and which act on the pressure sleeve 16 in response to fluid pressure. It is to be understood that the pressure sleeve 16 is relatively movable with respect to both the punch shell 12 and the punch core 10.

The tooling includes a base which carries a cut edge 18. Radially inboard of the cut edge 18 is a second pressure sleeve 20 which is fluidly supported on the tooling base in opposed relationship to the punch shell 12.

Still further radially inwardly is a die core ring 22 which is fixedly supported on the base. Yet further inboard is a knock-out piston 24 which is fluidly supported on the base for separate movement.

The die core ring 22 is disposed opposite the first pressure sleeve 16 while the knock-out piston 24 is disposed opposite the periphery of the punch core 10.

A die core 26 completes the tooling area of the base with the die core 26 being movable relative to the base 60 by a piston (not shown).

Referring now to Figure 5, it will be seen that the die core ring 22 has a specific geometry with the upper end having a radiused nose 28 which leads to a downwardly and inwardly tapering wall 30 which may terminate in a lower straight wall 32.

It will also be seen that the pressure sleeve 16 has a contoured lower face including a recessed portion 34 which is generally complimentary to the radiused nose 28.

It will also be seen that the punch core 10 has a tapered lower body portion providing a tapered

side wall 36 which opposes and is parallel to the tapering wall 30 of the die core ring 22. The side wall 36 extends substantially to a bottom face 38 of the punch core 10 and is connected to the face 38 by a radius 40.

Finally, the die core 26 is provided with an upper face 42 which opposes the face 38 of the punch core 10. The die core 26 is provided with a cylindrical side wall 44 which opposes the knock-out piston 24. The cylindrical side wall 44 is joined to the face 42 by way of a radius 46.

Referring now to Figure 1, it will be seen that a prescribed blank B of sheet metal (preferably aluminum) has been inserted into the press, either in sheet form or from a coil of material and is clamped between the upper and lower halves of the tooling. Most specifically, the blank B is clamped between the punch shell 12 and the pressure sleeve 20 on the one hand and the pressure sleeve 16 and the die core ring 22 on the other hand with the punch shell 12 and the pressure sleeve 16 having moved downwardly as indicated by the arrows.

Further advancement of the tooling will lead to the blanking of the blank B against the cut edge 18 followed by piping of the peripheral edge of the cut blank about the periphery of the top of the die core ring 22 so as to form what might be called an inverted or reverse cup as is illustrated in Figure 2. The wiped peripheral edge of the cut blank is identified by the numeral 50.

It will be noted also here that the punch core 10 has advanced so that it has just come into contact with the top surface of the center part of this reverse cup. It will be further noted that the punch shell 12 has overcome the fluid pressure supporting the second pressure sleeve 20, but that the die core ring 22 is fixed and remains in place.

The result of further advancement of the tooling can be seen in Figure 3 wherein the punch core 10 has continued its downward advance in the direction of the arrows and it has forced the die core 26 down. At this point, the center panel CP of the end unit has been preliminarily formed as is best shown in the enlarged view of Figure 5.

From Figure 5 it can be seen that the tapered wall 36 of the punch core 10 has formed the chuck wall CW in cooperation with the tapered wall 30 of the fixed die core ring 22. It is also to be noted, at this point, that the first pressure sleeve 16 is holding, and has held, the blank material against the top of the die core ring 22, so as to control the metal during the forming operation which results in a precisely dimensioned wall without wrinkles. It also should be noted, at this point, that the upper part wall CW is essentially in its final configuration at this stage and will not change and will not be affected by subsequent operations.

It is to be particularly noted that the bottom face 38 of the punch core 10 is of a larger diameter than the top face 42 of the die core 26. Thus the center panel CP as now formed is of a larger diameter than its ultimate diameter.

Referring now to Figure 6, it will be seen that after the tooling has reached the position of Figure 5, the ring coupled to the punch core 10 begins to pull away from the press base taking with it the punch core 10. It will be followed in its upward direction by the die core 26 as is clearly shown by the arrow in Figure 6.

As the punch core 10 and the die core 26 move upwardly in unison, the panel center PC also moves upwardly and begins to reform around the top of the die core 26. Further, the radius 52 previously formed around the radius 40 of the punch core 10 begins to reform and to reduce in diameter.

As the panel center PC is continued to be moved upwardly by the joint action of the punch core 10 and the die core 26, a radius 54 is formed around the radius 56 with the radius 54 defining the periphery of the panel center PC. The net result is that there is formed a countersink, generally identified by the numeral 56 which depends downwardly in surrounding relation around the top part of the die core 26. At the same time, the length of the chuck wall CW is reduced. The resultant countersink 56 includes a lower bight portion 58 which is directly connected to the radius 54 on the inner side thereof and to the lower edge of the chuck wall CW on the outer side thereof.

During the various forming operations, the upper part of the piston 24 engages the countersink 56 as it is being formed.

The resultant end unit, which is generally identified by the numeral 60, includes an outer seaming flange 62 which is carried by the chuck wall CW and with the chuck wall CW being joined to the reduced diameter panel center PC by the countersink 56.

The tooling now continues to move up until the various components of the lower half of the tooling reaches its original position as is shown in Figure 7. The end unit 60 is now supported at the top of the bottom part of the tooling by the piston 24.

The top tooling then continues to move upwardly further until there is sufficient room to remove the completed end unit 60 and to apply a new blank B.

Tests have been conducted with respect to the end units formed with the tooling above described and it has been found that the end units consistently have the required buckle strength, the change in the method of forming the end units and the resultant structure of such end units providing for the 13.8 to 20.7 kPa (2-3 psi) buckle strength

additionally required.

Claims

1. A method of forming a metal end unit (60) of the type including a radially outer seaming flange (62), a downwardly and continuously radially inwardly sloping chuck wall, a center panel, and an axially downwardly countersink (56) joining said chuck wall to said center panel, said method comprising the steps of forming a shell including said seaming flange (62), said chuck wall and said center panel with said center panel being lowermost and joined to said chuck wall by a radius (52), supporting said flange (62) and said chuck wall by an outer die core ring (22), and clamping said center panel between the opposed flat faces (38, 42) of a punch core (10) and a die core (26) which is of smaller diameter than said punch core, characterized in that while clamping said center panel between said die core (26) and said punch core (10) relatively axially moving said outer die core ring (22) on the one hand and said die core (26) and said punch core (10) to relatively axially move said center panel and said seaming flange (62) to shorten said chuck wall and thereby form a reversely turned countersink (56) between said center panel and chuck wall depending below and generally surrounding said center panel, the shape and size of which thereby shifts from that of said punch core face (38) to that of said die core face (42).
2. A method according to claim 1, wherein said countersink (56) has a U-shaped cross section including a lower bight portion (58) joined directly to said chuck wall as a continuation of said chuck wall and to said center panel by a radius (54).
3. A method according to claim 2, wherein said countersink radius (54) is defined by a die core radius (46).
4. A die assembly for forming a metal end unit for carrying out the method of claim 1, said die assembly comprising outer tooling for shaping a flat metal blank (B) to form an outer seaming flange (62), a central punch core (10) movable axially relative to said outer tooling and in cooperation with said outer tooling to first form a shell including a seaming flange (62), a chuck wall and a center panel with the center panel being axially offset and recessed relative to the seaming flange (62), and a die core (26) being cooperable with said punch core (10)

and having a first face (42) which is opposed to and of smaller diameter than a second face (38) of said punch core 10 to clamp the center panel against said punch core (10), characterized by the punch core having a frustoconical body wall (36) joined directly to said punch core flat face (38) by a radius (40), and said die core having a cylindrical body wall (44) joined directly to said die core flat face (42) by a radius (46), and by means for moving said punch core (10) and said die core (26) in unison in a direction the reverse of the prior movement of said punch core (10) while clamping the center panel to reversely fold a lower portion of the chuck wall to form a countersink surrounding said die core (26).

Patentansprüche

1. Verfahren zum Formen einer metallenen End-einheit (60) von der Art mit einem radial äusseren Bördelflansch (62), einer nach unten und kontinuierlich radial innen geneigten Keilwand, einer mittleren Platte und einer sich axial nach unten erstreckenden Aussenkantung (56), welche die Keilwand mit der mittleren Platte verbindet, genanntes Verfahren enthaltend die Schritte eines Formens einer Schale mit dem Bördelflansch (62), der Keilwand und der mittleren Platte, wobei die mittlere Platte zuunterst liegt und mit der Keilwand über eine Rundung (52) verbunden ist, eines Tragens des genannten Flansches (62) und der Keilwand auf einem äusseren Gesenkkernring (22) und eines Festklemmens der mittleren Platte zwischen den einander zugekehrten flachen Seiten (38, 42) eines Stempelkerns (10) und eines Gesenkkerns (26), der einen kleineren Durchmesser hat als der Stempelkern, dadurch gekennzeichnet, dass, während die mittlere Platte zwischen dem Gesenkkern (26) und dem Stempelkern (10) festgeklemmt ist, der äussere Gesenkkernring (22) einerseits und der Gesenkkern (26) und der Stempelkern (10) anderseits relativ zueinander axial bewegt werden, um die mittlere Platte und den Bördelflansch (62) relativ zueinander axial zu bewegen und damit die Keilwand zu verkürzen und zwischen der mittleren Platte und der Keilwand eine umgekehrte Aussenkantung (56) zu bilden, welche die mittlere Platte im wesentlichen umgibt und sich von dieser nach unten erstreckt, wobei die Form und die Grösse der mittleren Platte von der Anpassung an die genannte Seite (38) des Stempelkerns zu einer Anpassung an die genannte Seite (42) des Gesenkkerns übergeht.



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2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, dass die Aussenkennung (56) einen U-förmigen Querschnitt aufweist mit einem unteren gekrümmten Abschnitt (58), der direkt verbunden ist mit der Keilwand als Fortsetzung derselben und mit der mittleren Platte über eine Rundung (54).

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, dass die Aussenkennungs-Rundung (54) von einer Rundung (46) des Gesenkkerns gebildet wird.

4. Gesenkaggregat zum Formen einer metallenen Endeinheit, zur Durchführung des Verfahrens nach Anspruch 1, mit äusseren Werkzeugen zum Verformen eines flachen Metallrohlings (B), um einen äusseren Bördelflansch (62) zu bilden, mit einem zentralen Stempelkern (10), der bezüglich der äusseren Werkzeuge axial bewegbar ist, um in Zusammenarbeit mit den äusseren Werkzeugen zuerst eine Schale zu formen, die einen Bördelflansch (62), eine Keilwand und eine mittlere Platte besitzt, wobei die mittlere Platte bezüglich des Bördelflansches (62) axial versetzt und vertieft ist, und mit einem Gesenkkern (26) zum Zusammenwirken mit dem Stempelkern (10), welcher Gesenkkern eine erste Fläche (42) aufweist, die einer zweiten Fläche (38) am Stempelkern (10) gegenüberliegt und einen kleineren Durchmesser als diese zweite Fläche hat, zum Festklemmen der mittleren Platte gegen den Stempelkern (10), dadurch gekennzeichnet, dass der Stempelkern eine kegelstumpfförmige Körperwand (36) aufweist, die sich über eine Rundung (40) direkt an die genannte flache Seite (38) des Stempelkerns anschliesst, dass der Gesenkkern eine zylindrische Körperwand (44) besitzt, die sich über eine Rundung (46) direkt an die genannte flache Seite (42) des Gesenkkerns anschliesst, und dass Mittel vorhanden sind, um den Stempelkern (10) und den Gesenkkern (26) in einer Richtung zu bewegen, die entgegengesetzt ist zur vorherigen Bewegungsrichtung des Stempelkerns (10), wobei die mittlere Platte festgeklemmt ist, um einen unteren Abschnitt der Keilwand entgegengesetzt zu falten und damit eine den Gesenkkern (26) umgebende Aussenkennung zu bilden.

Revendications

1. Procédé de réalisation d'un élément d'extrémité métallique (60) du type comprenant un rebord de soudage (62) situé à l'extérieur radialement, une paroi de serrage inclinée vers le bas et d'une manière continue vers l'intérieur

radialement, un panneau central, et une partie (56) contrecoudée vers le bas axialement qui relie ladite paroi de serrage audit panneau central, ledit procédé comprenant les étapes qui consistent à former une coque comprenant ledit rebord de soudage (62), ladite paroi de serrage et ledit panneau central, panneau central qui est situé le plus bas et relié à ladite paroi de serrage par un rayon (52), à supporter ledit rebord (62) et ladite paroi de serrage au moyen d'un élément annulaire de matrice extérieur (22), et à serrer ledit panneau central entre les faces planes opposées (38, 42) d'un poinçon (10) et d'une matrice (26) qui a un diamètre inférieur à celui dudit poinçon, caractérisé par l'étape qui consiste, tout en serrant ledit panneau central entre ladite matrice (26) et ledit poinçon (10), à déplacer axialement les uns par rapport aux autres ledit élément annulaire de matrice extérieur (22), d'une part, et ladite matrice (26) et ledit poinçon (10), d'autre part, pour déplacer axialement l'un par rapport à l'autre ledit panneau central et ledit rebord de soudage (62) afin de raccourcir ladite paroi de serrage et de former ainsi une partie contrecoudée (56) tournée en sens inverse entre ledit panneau central et ladite paroi de serrage, partie contrecoudée qui pend vers le bas et, d'une manière générale, entoure ledit panneau central, et dont la forme et la taille passent ainsi de celles de la face (38) dudit poinçon à celles de la face (42) de ladite matrice.

2. Procédé selon la revendication 1, suivant lequel ladite partie contrecoudée (56) possède une section transversale en forme de U comprenant une partie inférieure en anse (58) reliée directement à ladite paroi de serrage dans le prolongement de celle-ci et audit panneau central par un rayon (54).

3. Procédé selon la revendication 2, suivant lequel ledit rayon (54) de la partie contrecoudée est défini par un rayon (46) de la matrice.

4. Ensemble de matriçage pour réaliser un élément d'extrémité métallique en vue de mettre en oeuvre le procédé de la revendication 1, ledit ensemble de matriçage comprenant un outillage extérieur destiné à conformer un flan en métal plat B pour former un rebord de soudage extérieur (62), un poinçon central (10) mobile axialement par rapport audit outillage extérieur et en conjonction avec celui-ci pour former d'abord une coque comprenant un rebord de soudage (62), une paroi de serrage et un panneau central, panneau central qui est



décalé axialement et en creux par rapport au rebord de soudage (62), et une matrice (26) apte à coopérer avec ledit poinçon (10) et comportant une première face (42) en vis-à-vis avec une seconde face (38) dudit poinçon (10) et de diamètre inférieur à celle-ci pour serrer le panneau central contre ledit poinçon (10), caractérisé en ce que le poinçon possède une paroi de corps tronconique (36) reliée directement à sa face plane (38) par un rayon (40), tandis que ladite matrice possède une paroi de corps cylindrique (44) reliée directement à sa face plane (42) par un rayon (46), et en ce qu'il est prévu des moyens destinés à déplacer ensemble ledit poinçon (10) et ladite matrice (26) dans un sens inverse de celui du mouvement précédent dudit poinçon (10) tout en serrant le panneau central pour plier en sens inverse une partie inférieure de la paroi de serrage afin de former une partie contrecoudée qui entoure ladite matrice (26).

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