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(54) Improvements relating to the drawing and ironing of cans

(57) The present method and apparatus for redrawing a cup made from a double cold reduced material having low stretch characteristics converts a cup formed with a peripheral flange (17) into an elongated can shape in which the bottom is formed with a given profile, e.g. a dome. A die (12) is moved relative to a punch (14) and redraw sleeve (16) thereon redrawing the cup material into an elongated shape. The die (12) has an annular flange wiping member (30) mounted on the top thereof which serves to force the peripheral flange (17) parallel to the punch axis during the redrawing operation. In this manner the cup material is eased into the die within the annular flange wiping member and the generation of excessive stress on the can bottom and along its sidewall is avoided during the profiling operation.

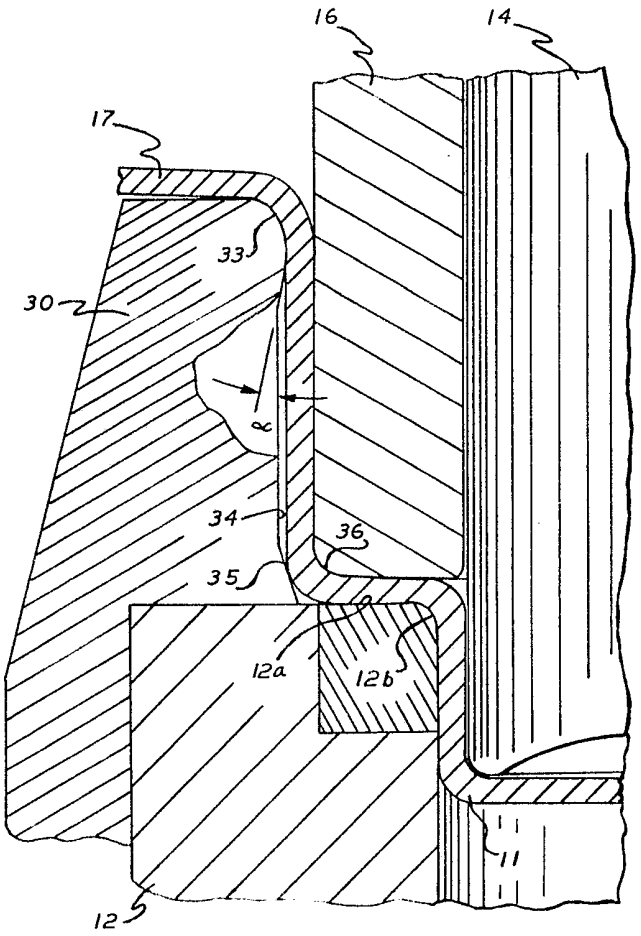

FIG.5

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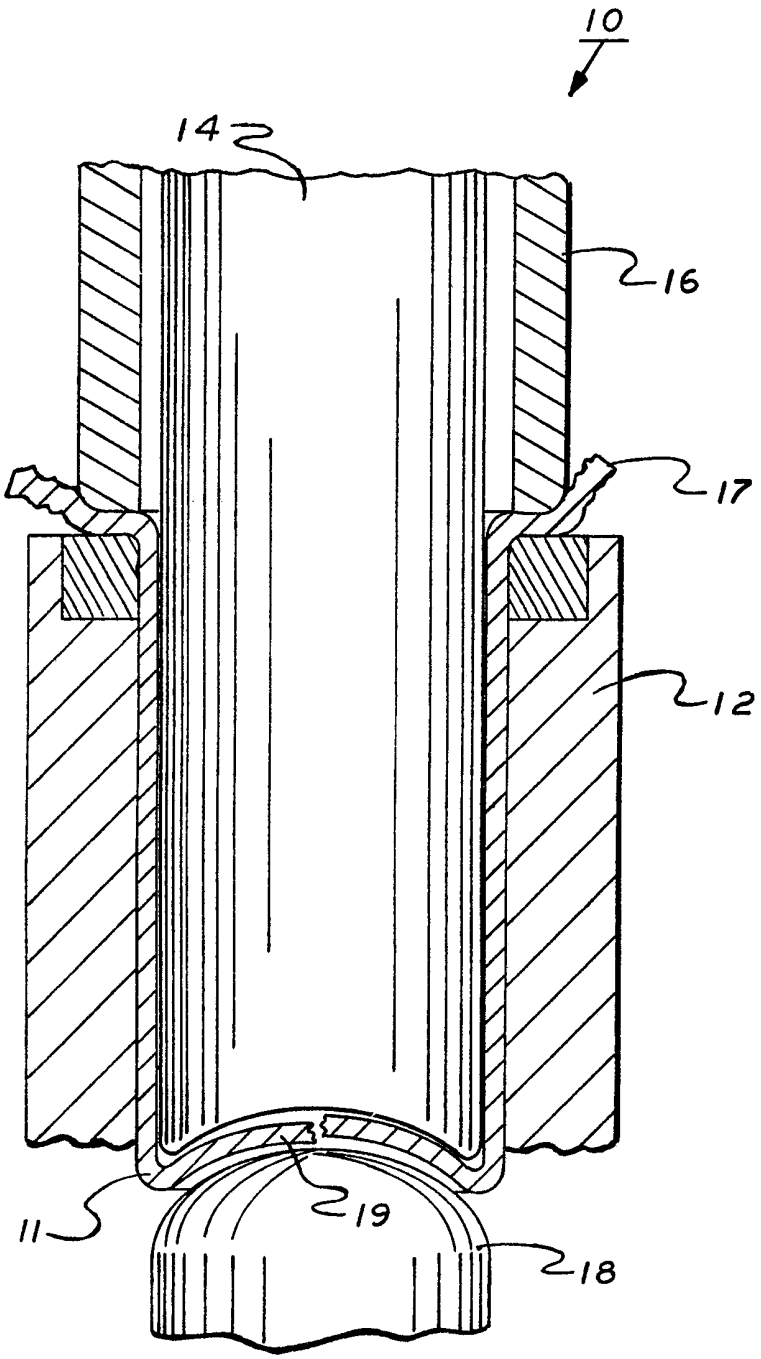

FIG. 1

PRIOR ART

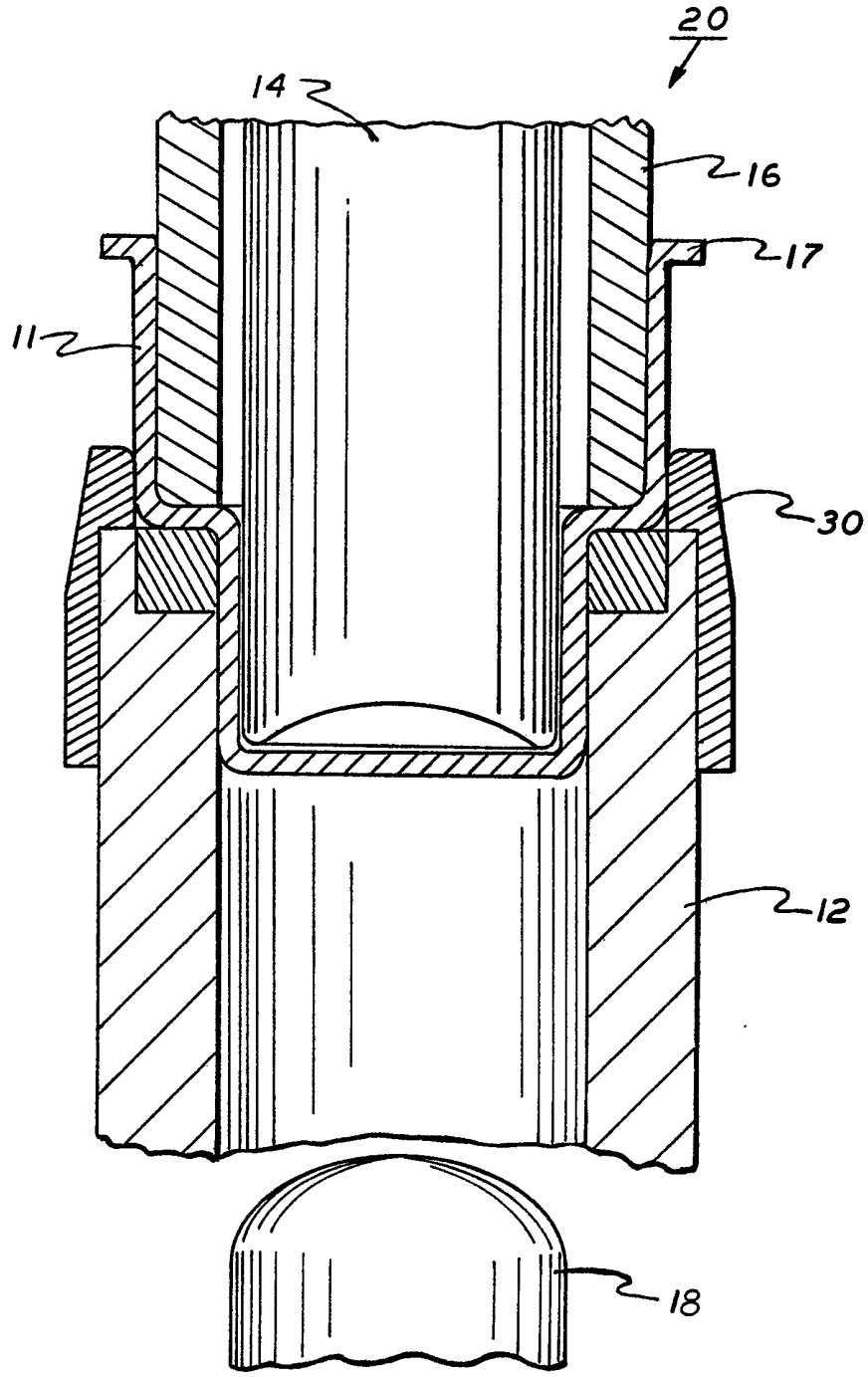

FIG. 2

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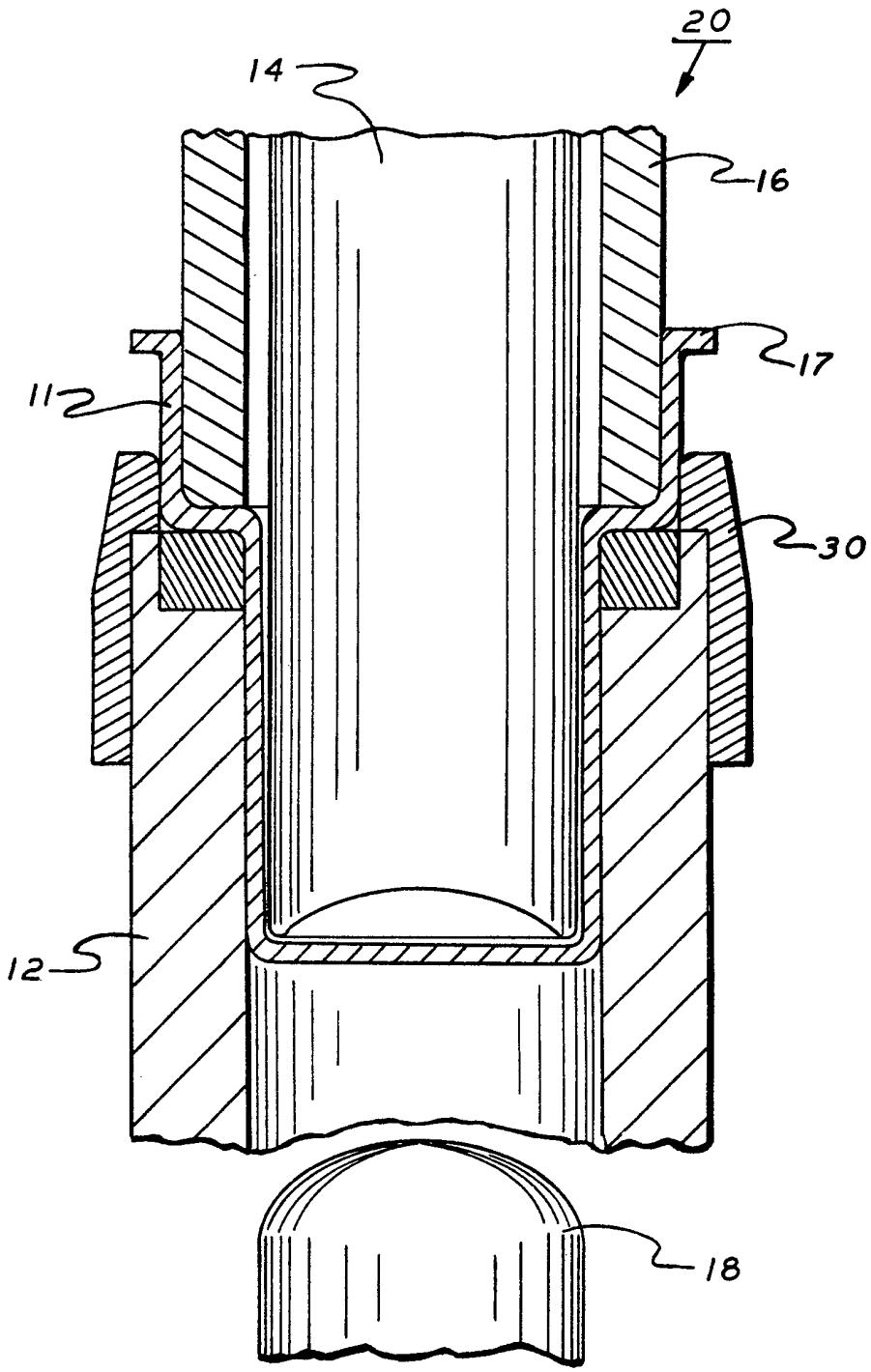

FIG. 3

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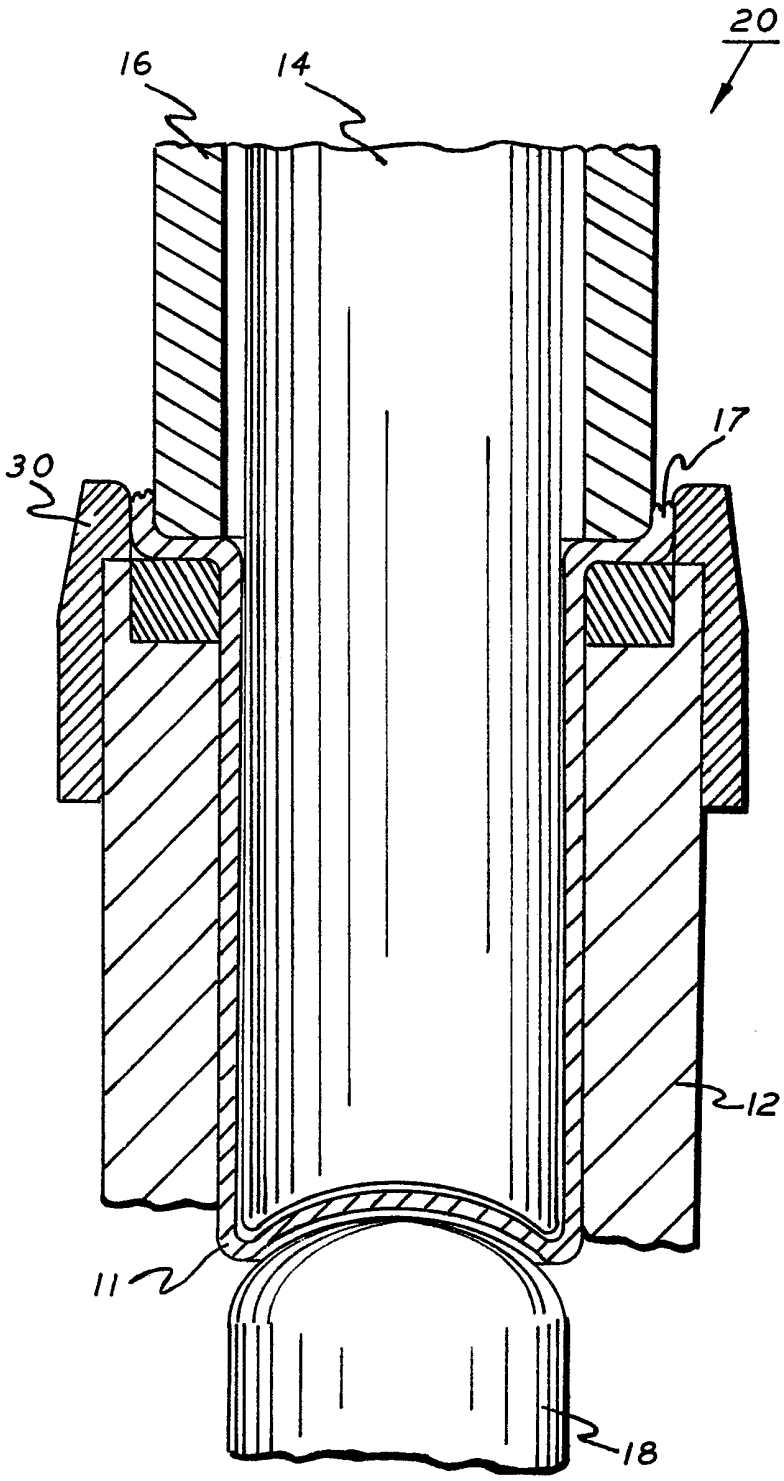

FIG. 4

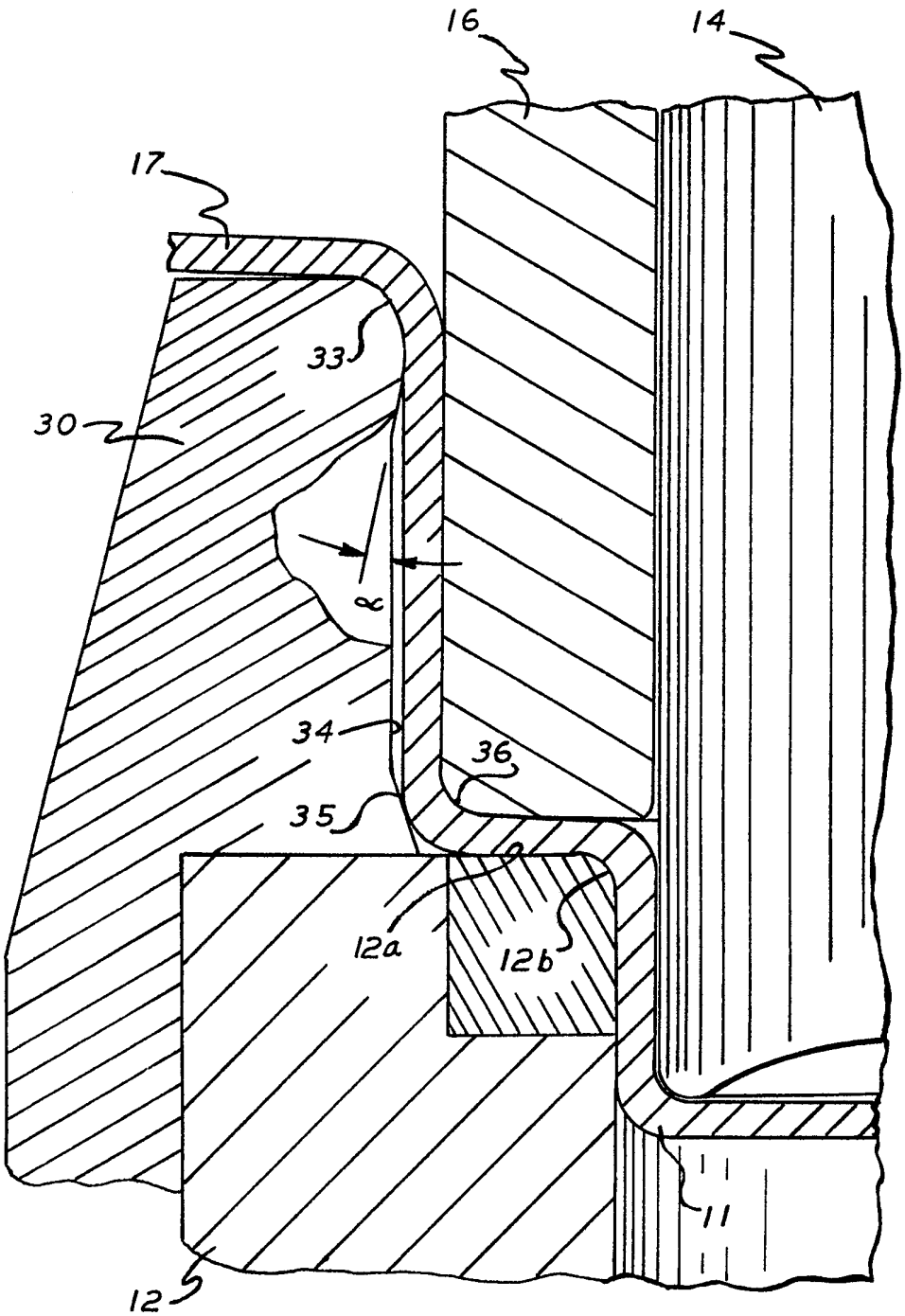

FIG. 5

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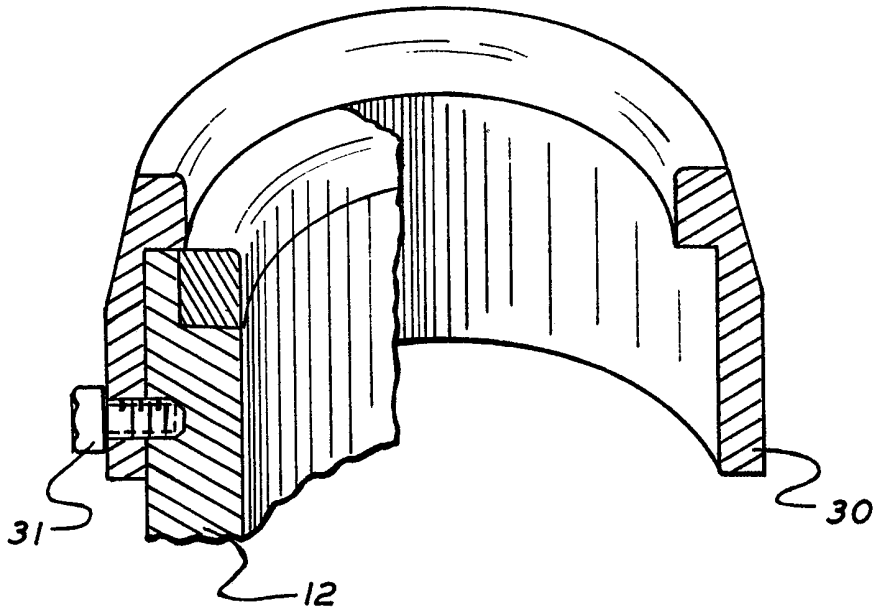

FIG. 6

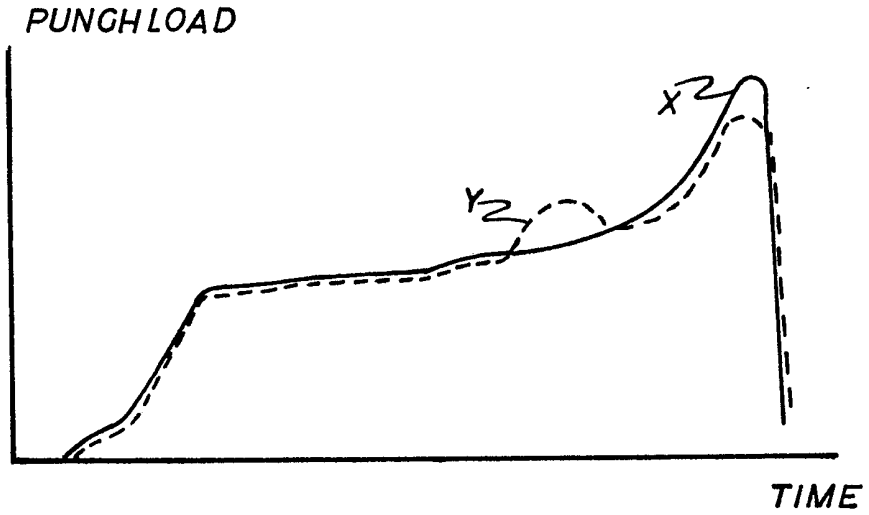

FIG. 7

SPECIFICATION

Improvements relating to the drawing and ironing of cans

The present invention relates to improvements relating to the drawing and ironing of cans.

More particularly, this invention concerns an improvement for the redrawing of a cup shape having a peripheral flange into an elongated can and more especially concerns the use of an annular wiping member which controls the flange during the redrawing operation and enables flow of the stock material into the die areas to avoid undue stresses on the can bottom during a profile forming operation. Similarly, thanks to ironing during redrawing, the can is not fractured at the area where the ironing is completed. Finally, punch nose failures tangential to the punch nose radius are eliminated so larger redraw reduction ratios are possible without breaking the can.

Various types of presses have been used to produce thin metal containers such as those of cylindrical drawn metal sheet usually having greater longitudinal dimensions than lateral dimensions. Existing press apparatus, which can easily produce cans at the rate of 100 to 125 per minute, employ a number of work stations. Typically, there is a station where blanking and cupping occur, another station for redrawing, another station for redrawing and/or bottom profiling and a fourth station for trimming the flange to a predetermined diameter as described, for example, in U.S. Patent No. 4,262,510. A container produced by such means is disclosed in U.K. Patent Application No. 8136914.

The known type of apparatus is not entirely satisfactory for producing cans from single reduced plate or the lower cost stock material which is double cold reduced plate having a relatively low biaxial stretch characteristic of approximately 14% or less. Since double reduced material is relatively inexpensive, it is for this reason desirable to make cans of this material. Unfortunately, there is a tendency for the bottom of the can to rupture during the bottom profile forming operation. This is attributed to the uncontrolled wrinkling of the peripheral flange left on the cup from the previous operation. It is known that the uncontrolled wrinkling of the peripheral flange inhibits flow of the stock material into the die by locking again at the redraw pressure sleeve. As a result there is an excessive stress imparted to the sidewall and/or bottom of the cup during the bottom profile forming operation which may cause the bottom to rupture. With thicker and more expensive materials which exhibit higher stretch characteristics under the same loading conditions, stresses on the can bottom during the bottom profile forming operation are partially compensated for by the stretchability of the material.

In the past, efforts at eliminating flange wrinkling have used a nested die configuration. The nested die configuration was made from machine tool hardened steel or tools with carbide inserts. However, this design requires special tools and expert labor to make and maintain and is, therefore, prohibitive in initial costs and maintenance expenses.

Nested dies are made having a portion which is upstanding adjacent the outside radius of the redraw sleeve. That portion is used to control wrinkling as the material flows past the outside radius and into the space between the redraw sleeve and the die face. Such nested dies are primarily for control of metal flow at the redraw sleeve, but they are not normally designed to remove flange wrinkling prior to the outer radius of the redraw sleeve. In a process where wrinkling due to straightening of the flange must be treated, it is important to ensure that the load imposed is not concurrent with other forming operations, to avoid excessive peak loadings. Before the present invention, no significant success has been attained at minimizing peak loadings and avoiding excessive stresses.

An object of the present invention is to improve the redrawing of thin metallic double reduced material having relatively low stretch characteristics. The present invention to be described in detail provides redrawing apparatus for controlling a peripheral flange on the thin metallic cup, thereby allowing the metal to flow along the cup bottom and sidewall, so that subsequently a profiled bottom shape can be created without recurring damage to the cup bottom or sidewall.

According to the present invention, there is provided apparatus for drawing or redrawing a peripherally-flanged cup, made from thin metallic stock material having low stretch characteristics, into an elongated container by moving a die and punch relative to one another and to a redraw clamping and centering sleeve coaxial therewith, the apparatus including means for thereafter applying a bottom forming member axially relative to the die against the punch to profile the cup bottom, the apparatus further comprising an annular flange wiping member atop the die and coaxial therewith for sliding movement relative to the said redraw sleeve and spaced therefrom by a predetermined distance to effect wiping of the peripheral flange of the cup and to assist flow of the stock material into the die around said annular flange member along the cup sidewall and bottom, the arrangement serving to eliminate undue stress on the cup bottom during the subsequent bottom profiling operation and to avoid overloading the sidewall during ironing.

The annular flange wiping member coaxial with the die member, which moves therewith relative to a punch and redraw sleeve, controls the peripheral flange of the cup during the operation and allows the stock to flow smoothly into the die around the annular flange wiping member. This avoids excessive stressing of the sidewall or bottom of the cup which can lead to metal fracture especially when the bottom profile is being formed.

The invention also provides a method of

drawing or redrawing a cup into an elongated container, wherein the cup is peripherally-flanged and is made from thin metallic stock material having low stretch characteristics, the method comprising the steps of pressing the cup stock material using a die, on which there is mounted an annular flange wiping member, which die is moved relative to a punch and an associated redraw sleeve to wipe the peripheral flange of the cup due to a predetermined clearance between the redraw sleeve and the annular wiping member, and thereby produce flow of the stock material between the die and punch, whereby undue stress on the cup bottom and sidewall is eliminated, and subsequently forming a domed profile in the bottom of the cup.

The invention will now be described in more detail, and by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows the prior art cup drawing apparatus,

Figures 2, 3 and 4 provide side sectional views in sequence of operation of the redraw apparatus according to the present invention,

Figure 5 is an enlarged partial sectional view illustrating details of an annular flange wiping member according to the present invention,

Figure 6 is a partially sectioned perspective view of the annular flange wiping member, and

Figure 7 is a graph comparing the load characteristics of the prior art device with the present invention.

In Figure 1, there is shown the cup redraw apparatus 10 according to the prior art. The cup is made of stock material 11 which is preferably double cold reduced metal sheet and has a biaxial stretch characteristic of about 14% or less. The redraw operation is done in the press of United States Patent No. 4,262,510, by moving a die 12 relative to a punch 14 and a redraw sleeve 16. The redraw sleeve is provided for centering and applying pressure to the stock 11 during the redraw. It will be noted that the peripheral flange 17 on the cup is wrinkled due to flange metal carried over from the previous draw or redraw operation. It has been found that this wrinkling of the flange inhibits the metal from flowing into the area between the redraw sleeve 16 and the die 12 during the redrawing operation. As a result the cup can be overstressed so that when a profile forming member 18 is moved against the bottom of the cup to form the bottom profile shape a rupture 19 may occur in the bottom of the cup.

Referring now to Figures 2, 3 and 4, there is shown sequentially the operation of redraw apparatus 20 according to the present invention wherein like numerals represent like elements. It will be observed that an annular flange wiping member 30 is mounted on the top of the die 12 for movement therewith. Flange wiping member 30 is secured to die 12 in any suitable manner as by a plurality of retaining bolts 31 (Fig. 6). It will be appreciated that as the annular flange wiping member 30 moves upwardly relative to the punch 14 and redraw sleeve 16, the peripheral flange of the cup is wiped upwardly and controlled by member 30 and sleeve 16. The wiping inhibits wrinkling of flange 17 and enables it to move freely into the area between redraw sleeve 16 and die 12. At the same time the stock 11 is allowed to flow into the die. In the result, the bottom of the cup strengthened and undue stresses in the ironed sidewall or during the bottom profiling operation are thereby avoided. Accordingly, there is substantially no tendency for the sidewall to tear or the bottom of the cup to rupture.

Turning now to Figure 5, there is shown an enlarged cross sectional view of another embodiment of apparatus according to the present invention, to better illustrate the operation therein. Parts in this Figure have identical reference numbers to similar parts of Figures 2 to 4, and equivalent parts would have identical dimensions, as in Figures 2 to 4.

The preferred material thickness is about 0.007" (0.18 mm) of metal with organic coatings of about 0.0005" (0.013 mm) total of both sides, therefore, total thickness is about 0.0075" (0.19 mm) before drawing. In the flange area, however, the thickness overall is about 0.010" (0.25 mm) due to thickening due to forming. The material is first drawn over the punch 14 as the die 13 carries the material upwardly, drawing the material about the fixed punch 14. The material 11 is in the form of a part of a cup which first passed over a die radius 12b. The peripheral flange 17 moves toward the annular flange wiping member 30 by the action of punch 14 and die 12 subsequent to which peripheral flange 17 makes contact with annular flange wiping member 30 and radius 33 causing peripheral flange 17 to be wiped parallel such that it is coaxial with clamping sleeve 16. Radius 33 in the alternate embodiment is about 0.093" (2.36 mm). At that point where the radius 33 becomes tangential with the vertical, the flange wiping member is spaced at least about 0.012" (0.30 mm) from the sleeve 16, and becomes inwardly tapered with an angle α of about 3°, and forms an arcuate nose directed inwardly towards the sleeve 16, as shown in Fig. 5. This taper extends to a relief clearance groove 34 which is approximately 0.005" (0.13 mm) deep. Relief 34 extends from the bottom taper of angle α all the way down the sidewall of the flange wiping member to a fillet or chamfer 35 located at the foot of the flange wiping member 30 adjacent the die 12. The fillet 35 is provided for applying further support to the material 11 as the latter passes about the outside radius 36 of the redraw sleeve 16. This support aids in controlling the movement of the material between the sleeve 16 and the die face 12a. The outside radius 36 of the draw sleeve 16 is 0.080" (2.03 mm) and the chamfer or fillet 35 is typically at 45° to the vertical and is located such that the clearance between the radius 36 and the chamfer 35 at the point of maximum material bending between the vertical and horizontal tangent points of the radius 36 is at least about 0.12" (0.30 mm).

In operation, the material 11 is controlled when

it is bent between (1) the radius 33 of the flange wiping member 30 and the side of the draw sleeve 16 and (2) the chamfer 35 at the foot of the flange wiping member 30 by a similar clearance of 0.012" (0.30 mm). The relief 34 provides for a reduction of tension as the material 11 passes between the flange wiping member 30 and the sleeve 16, thus minimizing the loading on the material when loading is unnecessary. The additional control provided by the chamfer 35 at the foot of the flange wiping member 30 increases the amount of control of the metal and prevents wrinkling at radius 36 because the metal bending at that point is under the pressure of the reduced clearance between the chamfer 35 and the sleeve 16. While it would be desirable for the curvature of the radius 36 to be reproduced at the chamfer 35, it is impracticable because of the weakness of a feathered edge which would result where the flange wiping member meets draw die clamp surface 12a. Therefore, the chamfer 35 was selected, but a radiussed fillet without a feathered edge would work as well.

Figure 7 illustrates a graph of the loading characteristics of the punch versus time during the redrawing and bottom profiling of the cup. In solid line labeled X, there is shown the load characteristic of a device without the annular flange wiping member. In dashed lines labeled Y, there is shown the load characteristic versus time of the punch using the annular flange wiping member of the invention. It will be observed that in the case of this invention that the maximum punch load is reduced as compared to the punch loading without flange wiping. The maximum load occurs in the latter part of the bottom profiling operation. It is known that this improved behaviour is due to the control over the peripheral flange 17 during the wiping action by the annular flange wiping member 30. Since this wiping occurs prior to bottom profiling the flow of material from the sidewall and into the bottom reduces the stresses during bottom profiling. As a result the peak loading on the material is lessened during bottom profiling.

By the above described invention it is possible successfully to draw and iron a cup made from material which is double cold reduced and which has relatively low stretch characteristics. The cup is convertible into a container which has a domed bottom without excessive stresses being generated along the sidewall and in the bottom thereof. It will be appreciated that the method and apparatus according to the invention enable the forming operation to be accomplished with a minimum of cost and without the need to design complicated equipment costly in terms of tooling and servicing labor.

The present disclosure has related specifically to use the third working operation of a particular press. Those skilled in the art will appreciate that the invention could be used during a previous redraw operation or with a different press.

CLAIMS

1. Apparatus for drawing or redrawing a peripherally-flanged cup, made from thin metallic stock material having low stretch characteristics into an elongated container by moving a die and punch relative to one another and to a redraw clamping and centering sleeve coaxial therewith, the apparatus including means for thereafter applying a bottom forming member axially relative to the die against the punch to profile the cup bottom, the apparatus further comprising an annular flange wiping member atop the die and coaxial therewith for sliding movement relative to the said redraw sleeve and spaced therefrom by a predetermined distance to effect wiping of the peripheral flange of the cup and to assist flow of the stock material into the die around said annular flange member along the cup sidewall and bottom, the arrangement serving to eliminate undue stress on the cup bottom during the subsequent bottom profiling operation and to avoid overloading the sidewall during ironing.

2. Apparatus according to claim 1, including retaining means releasably securing the annular flange wiping member to the top face of said die.

3. Apparatus according to claim 1 or claim 2, wherein a clearance is provided between the annular flange wiping member and the redraw sleeve, the clearance being at least 0.012" (0.30 mm).

4. Apparatus according to claim 3, wherein the annular flange wiping member is further formed with a relief zone centrally disposed adjacent to the redraw sleeve and providing an additional clearance of about 0.005" (0.13 mm) therebetween.

5. Apparatus according to claim 4, wherein a first portion of the annular flange wiping member contacting the cup stock material is formed with an arcuate shape and has a clearance of about 0.012" (0.30 mm) relative to the redraw sleeve.

6. Apparatus according to claim 5, wherein a second portion of the flange wiping member contacting the stock material is formed with a chamfer having a clearance of about 0.012" (0.30 mm) with respect to the redraw sleeve.

7. A method drawing or redrawing a cup into an elongated container, wherein the cup is peripherally-flanged and is made from thin metallic stock material having low stretch characteristics, the method comprising the steps of pressing the cup stock material using a die, on which there is mounted an annular flange wiping member, which die is moved relative to a punch and an associated redraw sleeve to wipe the peripheral flange of the cup due to a predetermined clearance between the redraw sleeve and the annular wiping member, and thereby produce flow of the stock material between the die and punch, whereby undue stress on the cup bottom and sidewall is eliminated, and subsequently forming a domed profile in the bottom of the cup.

8. A method according to claim 7, wherein the stock material is reduced and has a thickness of about 0.010" (0.25 mm) and a stretch characteristic less than about 14%.

9. A method according to claim 7 or 8, wherein the said annular flange wiping member is made from hardened steel material.

10. A method according to claim 7, 8 or 9, wherein peak loading on the punch is reduced during the dome forming operation.

11. Apparatus for drawing or redrawing a metallic cup in the manufacture of a container, substantially as herein described with reference to Figures 2 to 4 or 5 of the accompanying drawings.

12. A method of drawing or redrawing a metallic cup in the manufacture of a container substantially as herein described with reference to Figures 2 to 4 or 5 of the accompanying drawings.

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