US 20130098926A1

(19) **United States**

(12) **Patent Application Publication**

Monro

(10) **Pub. No.: US 2013/0098926 A1**

(43) **Pub. Date: Apr. 25, 2013**

(54) **CAN MANUFACTURE**

(75) Inventor: **Stuart Monro**, Brighthampton (GB)

(73) Assignee: **CROWN PACKAGING TECHNOLOGY, INC.**, Alsip, IL (US)

(21) Appl. No.: **13/452,464**

(22) Filed: **Apr. 20, 2012**

Related U.S. Application Data

(63) Continuation of application No. PCT/EP2011/055847, filed on Apr. 13, 2011.

(30) **Foreign Application Priority Data**

Apr. 13, 2010 (EP) 10159826.6

Publication Classification

(51) **Int. Cl.**

B21D 22/24 (2006.01)

B65D 1/16 (2006.01)

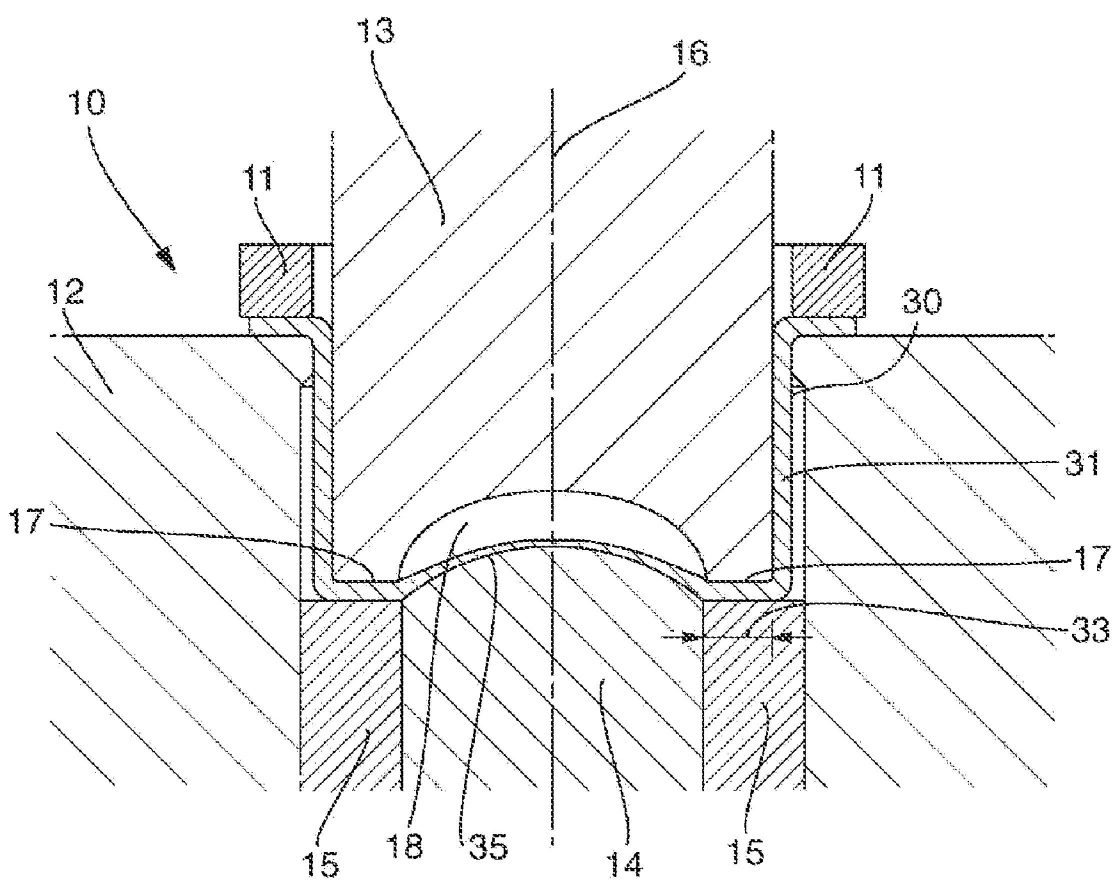
(52) **U.S. Cl.**

CPC ***B21D 22/24*** (2013.01); ***B65D 1/165*** (2013.01)

USPC **220/608**; 72/349; 220/604

(57) **ABSTRACT**

A method and apparatus are disclosed which are suitable for use in the manufacture of two-piece metal containers. In particular, a press is disclosed which makes cup sections from metal sheet using a combination of drawing and stretching operations. The cups resulting from the press have the advantage of having a base thickness that is thinner relative to the ingoing gauge of the metal sheet.



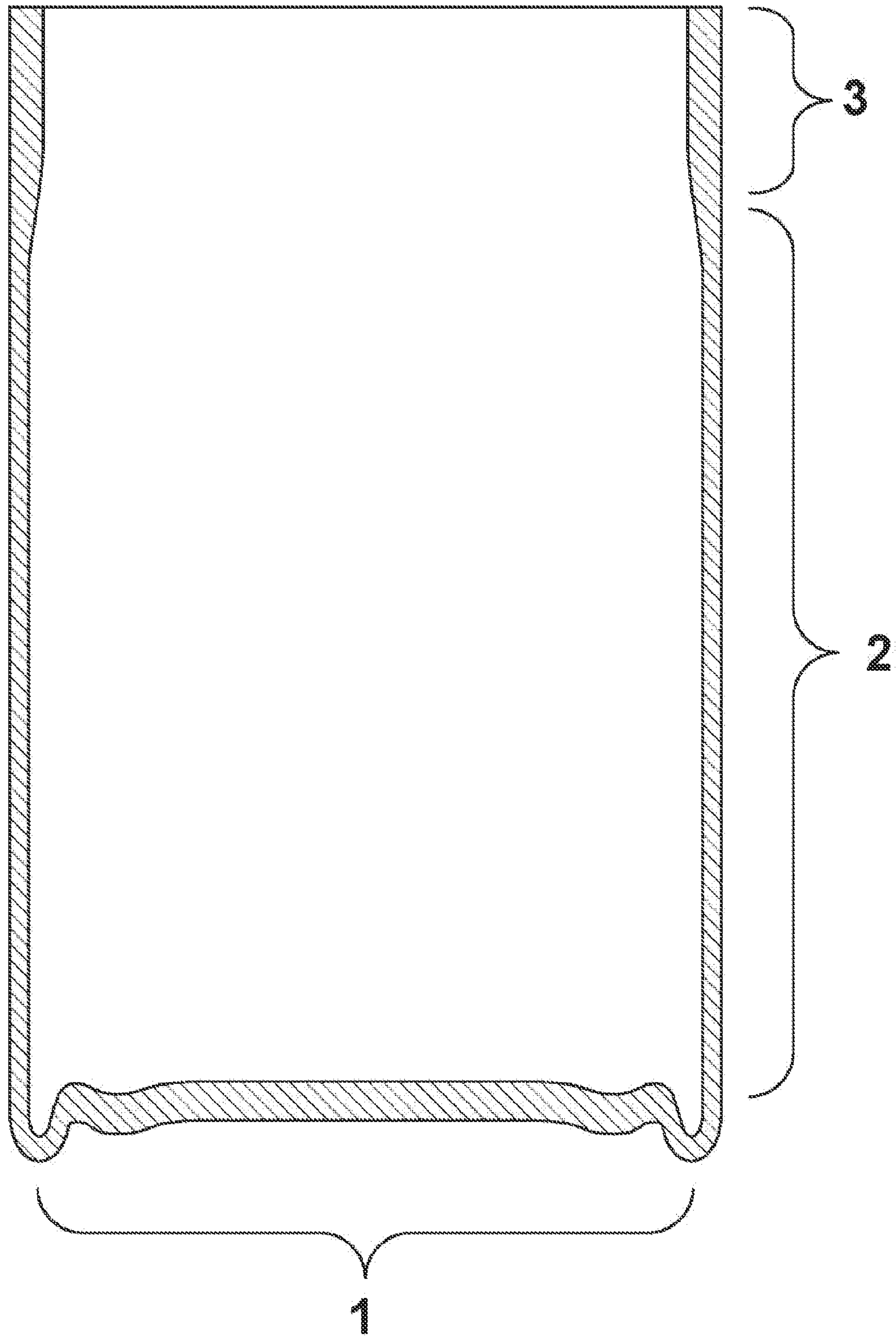


Figure 1

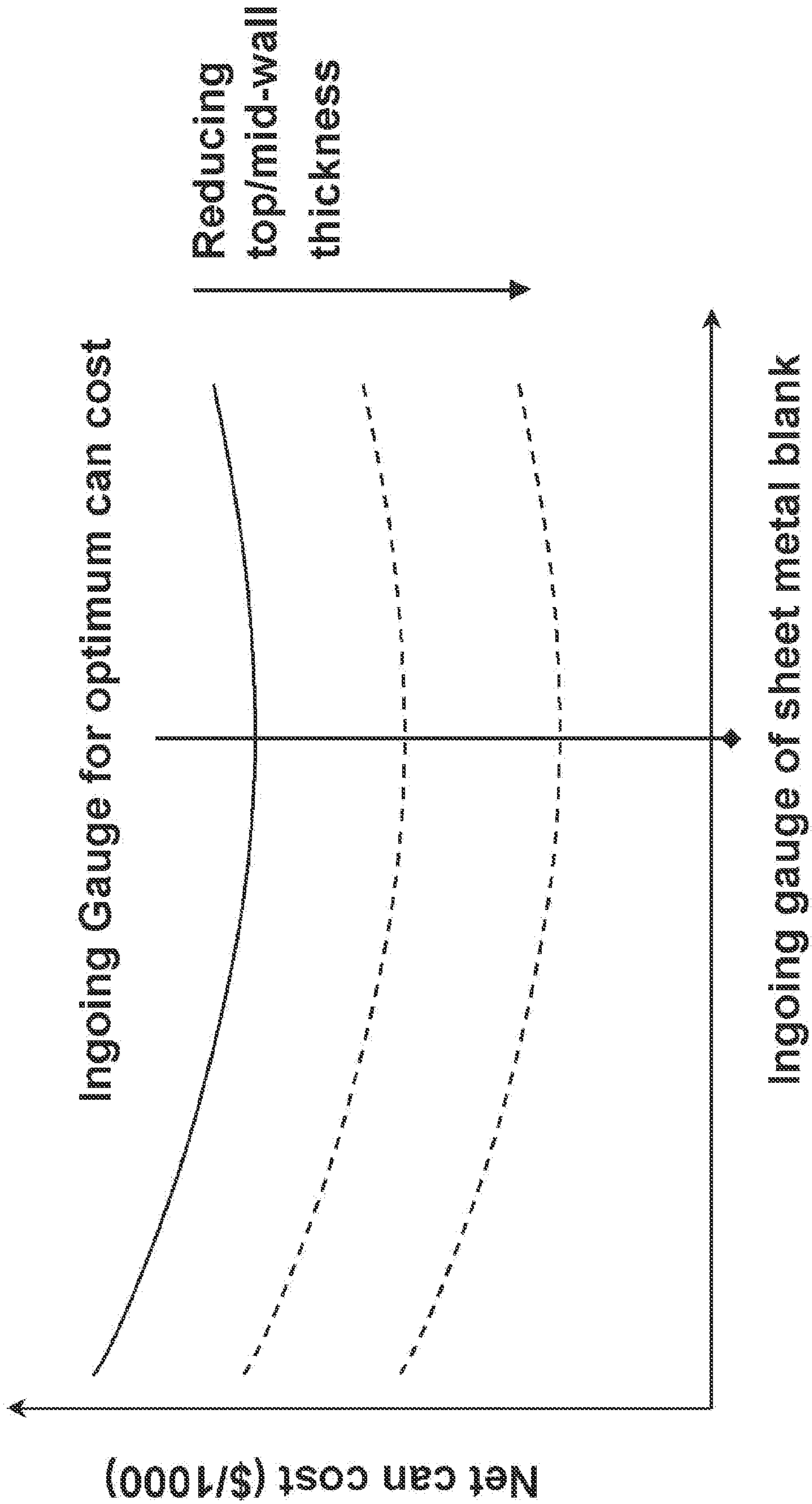
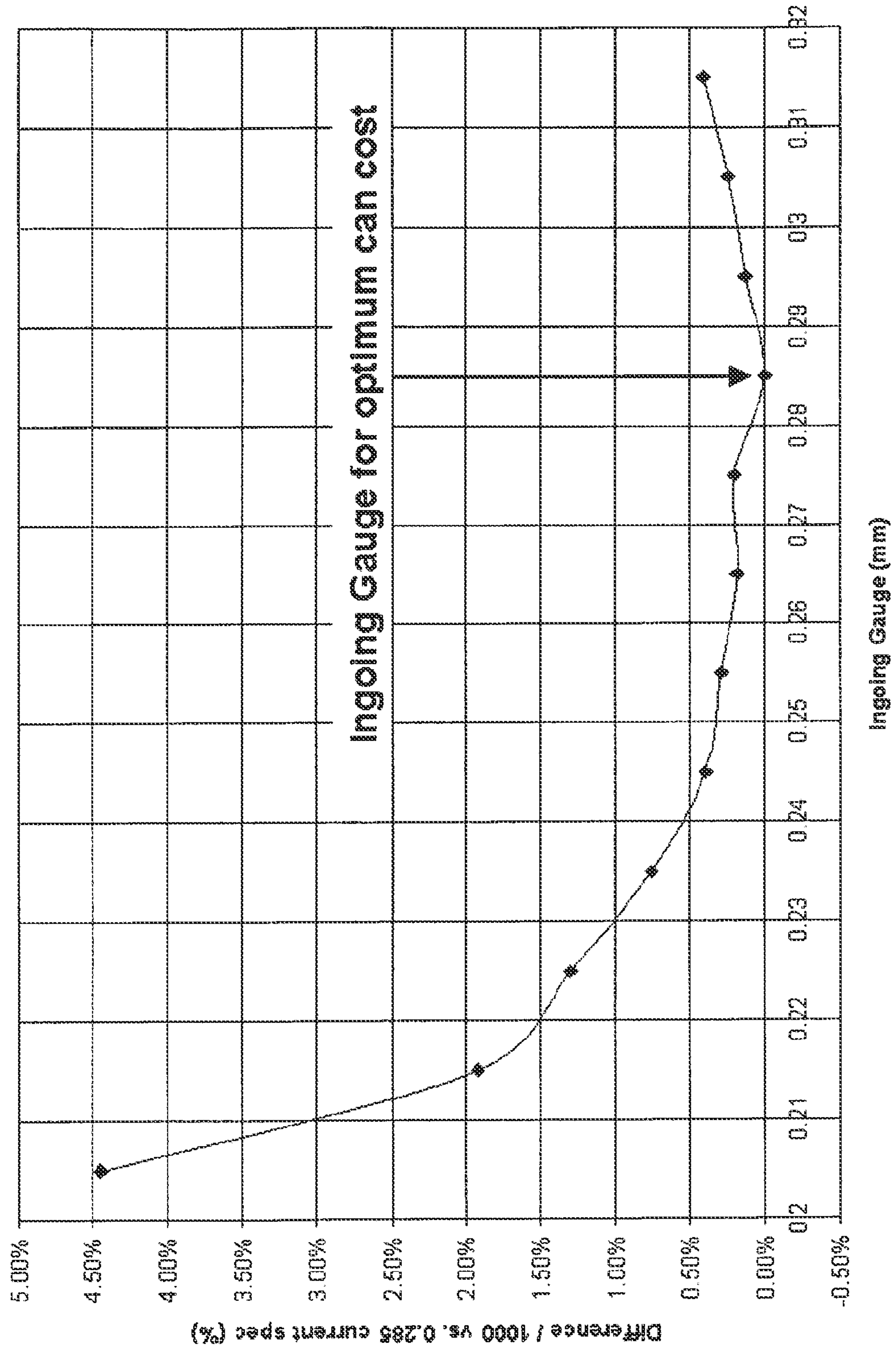

Reducing
top/mid-wall
thickness
Ingoing Gauge for optimum can cost
Ingoing gauge of sheet metal blank
Net can cost ($/1000)

Figure 2



Ingoing Gauge for optimum can cost
5.00%
4.50%
4.00%
3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
Difference / 1000 vs. 0.285 current spec (%)
0.2
0.21
0.22
0.23
0.24
0.25
0.26
0.27
0.28
0.29
0.3
0.31
0.32
Ingoing Gauge (mm)

Figure 3

Fig.4.

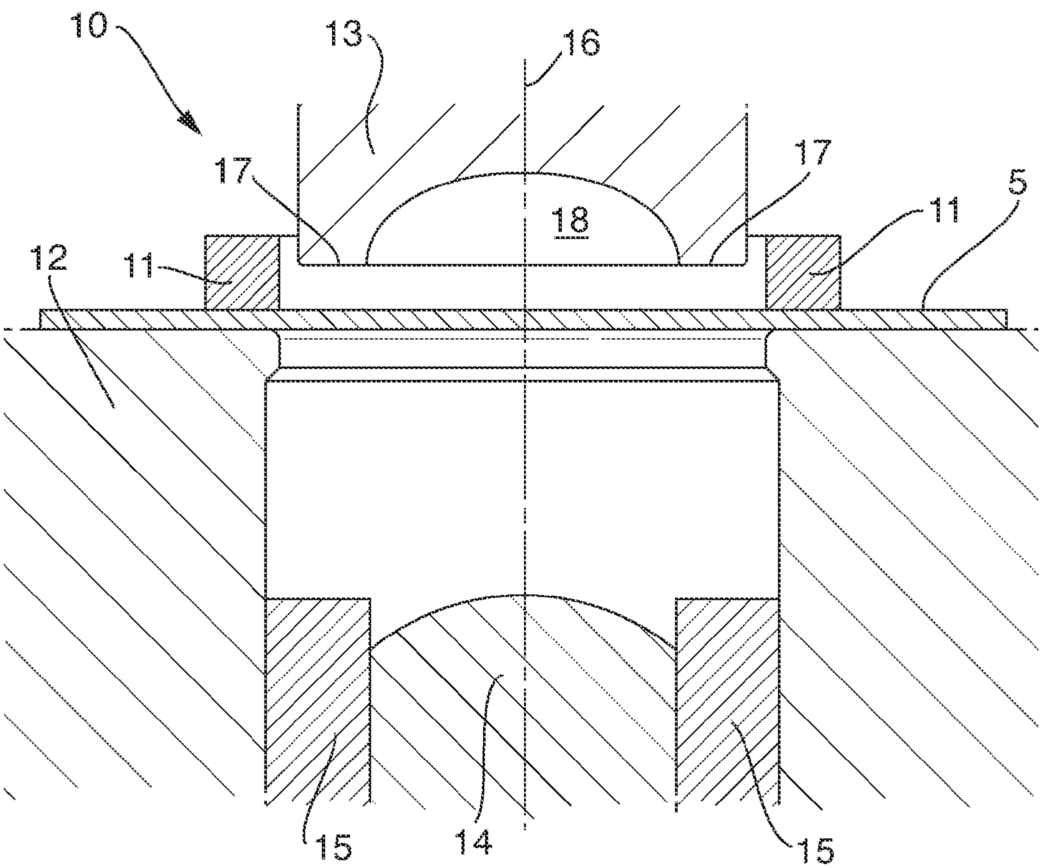


Fig.5.

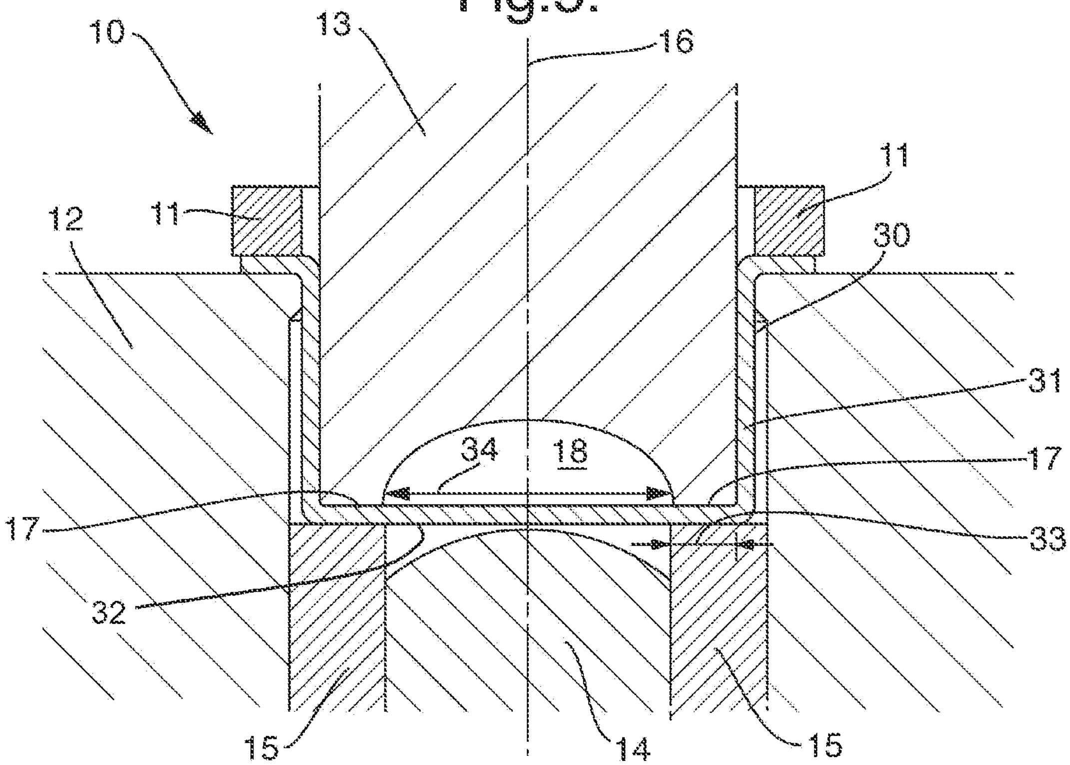
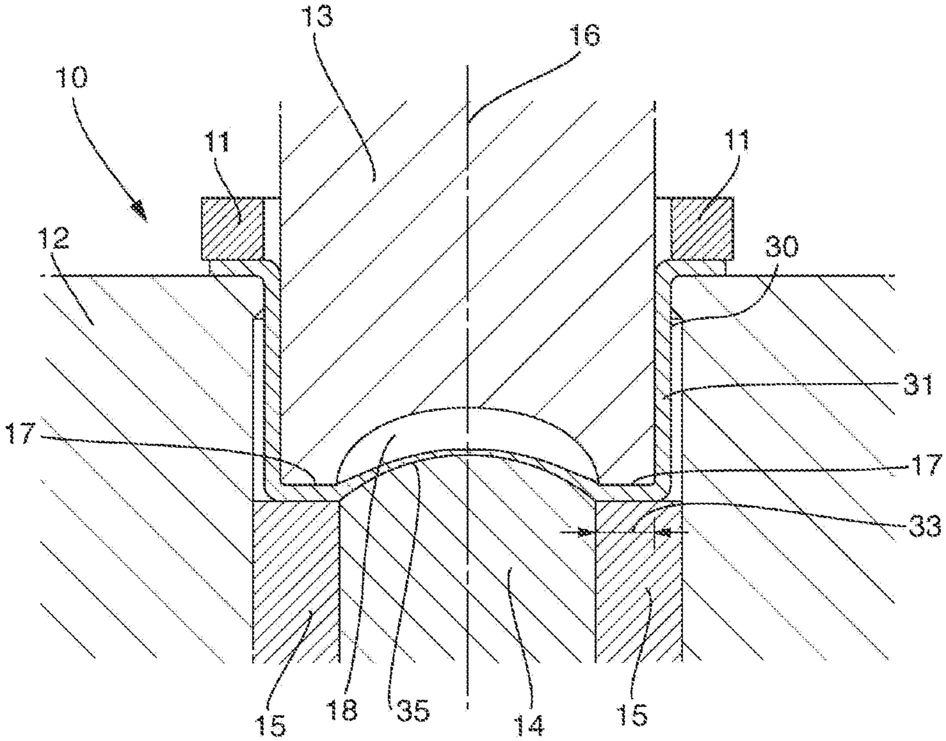


Fig.6.



CAN MANUFACTURE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation of International Application No. PCT/EP2011/055847, filed Apr. 13, 2011, which claims priority to European Application No. 10159826.6, filed Apr. 13, 2010, the contents of each of which are incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] This invention relates to the production of metal cups and in particular (but without limitation) to metal cups suitable for the production of "two-piece" metal containers.

BACKGROUND

[0003] U.S. Pat. No. 4,095,544 (NATIONAL STEEL CORPORATION) Jun. 20, 1978 details conventional Draw & Wall Ironing (DWI) and Draw & Re-Draw (DRD) processes for manufacturing cup-sections for use in making two-piece metal containers. [Note that in the United States of America, DWI is instead commonly referred to as D&I.] The term "two-piece" refers to i) the cup-section and ii) the closure that would be subsequently fastened to the open end of the cup-section to form the container.

[0004] In a DWI (D&I) process (as illustrated in FIGS. 6 to 10 of U.S. Pat. No. 4,095,544), a flat (typically) circular blank stamped out from a roll of metal sheet is drawn though a drawing die, under the action of a punch, to form a shallow first stage cup. This initial drawing stage does not result in any intentional thinning of the blank. Thereafter, the cup, which is typically mounted on the end face of a close fitting punch or ram, is pushed through one or more annular wall-ironing dies for the purpose of effecting a reduction in thickness of the sidewall of the cup, thereby resulting in an elongation in the sidewall of the cup. By itself, the ironing process will not result in any change in the nominal diameter of the first stage cup.

[0005] FIG. **1** shows the distribution of metal in a container body resulting from a conventional DWI (D&I) process. FIG. **1** is illustrative only, and is not intended to be precisely to scale. Three regions are indicated in FIG. **1**:

[0006] Region **1** represents the un-ironed material of the base. This remains approximately the same thickness as the ingoing gauge of the blank, i.e. it is not affected by the separate manufacturing operations of a conventional DWI process.

[0007] Region **2** represents the ironed mid-section of the sidewall. Its thickness (and thereby the amount of ironing required) is determined by the performance required for the container body.

[0008] Region **3** represents the ironed top-section of the sidewall. Typically in can making, this ironed top-section is around 50-75% of the thickness of the ingoing gauge.

[0009] In a DRD process (as illustrated in FIGS. 1 to 5 of U.S. Pat. No. 4,095,544), the same drawing technique is used to form the first stage cup. However, rather than employing an ironing process, the first stage cup is then subjected to one or more re-drawing operations which act to progressively reduce the diameter of the cup and thereby elongate the sidewall of the cup. By themselves, most conventional re-drawing operations are not intended to result in any change in thickness of the cup material. However, taking the example of container bodies manufactured from a typical DRD process, in practice there is typically some thickening at the top of the finished container body (of the order of 10% or more). This thickening is a natural effect of the re-drawing process and is explained by the compressive effect on the material when re-drawing from a cup of large diameter to one of smaller diameter.

[0010] Note that there are alternative known DRD processes which achieve a thickness reduction in the sidewall of the cup through use of small or compound radii draw dies to thin the sidewall by stretching in the draw and re-draw stages.

[0011] Alternatively, a combination of ironing and re-drawing may be used on the first stage cup, which thereby reduces both the cup's diameter and sidewall thickness. For example, in the field of the manufacture of two-piece metal containers (cans), the container body is typically made by drawing a blank into a first stage cup and subjecting the cup to a number of re-drawing operations until arriving at a container body of the desired nominal diameter, then followed by ironing the sidewall to provide the desired sidewall thickness and height.

[0012] However, DWI (D&I) and DRD processes employed on a large commercial scale have a serious limitation in that they do not act to reduce the thickness (and therefore weight) of material in the base of the cup. In particular, drawing does not result in reduction in thickness of the object being drawn, and ironing only acts on the sidewalls of the cup. Essentially, for known DWI (D&I) and DRD processes for the manufacture of cups for two-piece containers, the thickness of the base remains broadly unchanged from that of the ingoing gauge of the blank. This can result in the base being far thicker than required for performance purposes.

[0013] The metal packaging industry is fiercely competitive, with weight reduction being a primary objective because it reduces transportation and raw material costs. By way of example, around 65% of the costs of manufacturing a typical two-piece metal food container derive from raw material costs.

[0014] There is therefore a need for improved light-weighting of metal cup-sections in a cost-effective manner. Note that in this document, the terms "cup-section" and "cup" are used interchangeably.

SUMMARY

[0015] Accordingly, in a first aspect of the invention (defined in claim **1**) there is provided a method for manufacture of a metal cup from a metal sheet, the method comprising the following operations:

[0016] i. a drawing operation comprising drawing the metal sheet into a cup having a sidewall and an integral base;

[0017] ii. a stretching operation performed on the cup, the operation comprising clamping an annular region on the base of the cup to define an enclosed portion, and deforming and stretching at least part of the base that lies within the enclosed portion to thereby increase the surface area and reduce the thickness of the base, the annular clamping adapted to restrict or prevent metal flow from the clamped region into the enclosed portion during this stretching operation;

[0018] the drawing and stretching operations performed in a common press.

[0019] In a second aspect of the invention (defined in claim 5) there is provided a press for manufacture of a metal cup from a metal sheet, the press comprising:

[0020] i. means for drawing the metal sheet into a cup having a sidewall and an integral base;

[0021] ii. a clamping element for clamping the drawn cup during a stretching operation, the clamping element adapted to clamp an annular region on the base of the drawn cup to define an enclosed portion;

[0022] iii. a stretch tool adapted to deform and stretch at least part of the base that lies within the enclosed portion in the stretching operation to thereby increase the surface area and reduce the thickness of the base, the clamping element further adapted to restrict or prevent metal flow from the clamped region into the enclosed portion during the stretching operation.

[0023] The method and apparatus of the different aspects of the invention have the advantage (over known processes/apparatus) of achieving manufacture of a cup having a base which is thinner than the ingoing gauge of the metal sheet, without requiring loss or waste of metal. This is achieved by use of a single press, thereby simplifying the manufacturing process. When applied to the manufacture of two-piece containers, the invention enables cost savings to be made of the order of several dollars per 1,000 containers relative to existing manufacturing techniques.

[0024] To ensure that the enclosed portion (and therefore the cup's base) is stretched and thinned during the stretching operation, the base of the drawn cup is clamped sufficiently to restrict or prevent metal flow from the clamped region into the enclosed portion during the stretching operation. If the clamping loads are insufficient, material from the clamped region (or from outside of the clamped region) would merely be drawn into the enclosed portion, rather than the enclosed portion (and the cup's base) undergoing any thinning It has been found that stretching and thinning can still occur when permitting a limited amount of flow of material from the clamped region (or from outside of the clamped region) into the enclosed portion, i.e. when metal flow is restricted rather than completely prevented.

[0025] The method and apparatus of the invention is particularly suitable for use in the manufacture of metal containers, with the final resulting cup being used for the container body. The final resulting cup may be formed into a closed container by the fastening of a closure to the open end of the cup. For example, a metal can end may be seamed to the open end of the final resulting cup. However, typically the cup resulting from the method of the invention would be subjected to either or a combination of a re-drawing operation and an ironing operation. The re-drawing operation may comprise one or more stages, each stage having the effect of inducing a staged reduction in cup diameter. The ironing operation would have the benefit of increasing the height of the sidewall of the cup produced by the method and apparatus of the invention. Preferably, the stretching operation comprises deforming and stretching at least part of the base that lies within the enclosed portion into a domed profile. In the field of metal containers for carbonated beverages, it is common for the base of the container body to be inwardly-domed to resist pressure generated by the product. The "dome" provided by the method and apparatus of the invention may serve as the inwardly-domed region of a beverage container body. However, it is likely that the cup would undergo a later reforming operation to provide the domed base of the cup with a desired final profile necessary to resist in-can pressure.

[0026] The method of the invention is suitable for use on cups that are both round and non-round in plan. However, it works best on round cups.

[0027] One other way of minimising the amount of material in the base of cup-sections produced using conventional DWI and DRD processes would be to use thinner gauge starting stock. However, tinplate cost per tonne increases as the gauge decreases. This increase is explained by additional costs of rolling, cleaning and tinning the thinner steel. When also taking account of material usage during manufacture of a two-piece container, the variation in net overall cost to manufacture the container versus ingoing gauge of material looks like the graph shown in FIG. 2. This graph demonstrates that from a cost perspective, going for the thinnest gauge material does not necessarily reduce costs. In essence, there is a cheapest gauge of material for any container of a given sidewall thickness. The graph also shows the effect of reducing the thickness of the top and mid-wall sections of the container in driving down the cost curve. FIG. 3 shows the same graph based upon actual data for UK-supplied tinplate of the type commonly used in can-making. For the material illustrated in FIG. 3, 0.285 mm represents the optimum thickness on cost grounds, with the use of thinner gauge material increasing net overall costs for can production. The graph of FIG. 3 shows the percentage increase in overall cost per 1,000 cans when deviating from the 0.285 mm optimum ingoing gauge thickness.

[0028] The final resulting cup of the invention has the benefits of a thinner (and therefore lighter) base.

[0029] The "metal sheet" can include a blank cut from a larger expanse of metal sheet.

[0030] By "annular clamping" or clamping an "annular region" is meant that the base of the drawn cup is clamped either continuously or at spaced intervals in an annular manner.

[0031] The clamping element may be in the form of a continuous annular sleeve; alternatively, it may be a collection of discrete clamping elements distributed in an annular manner to act against the metal sheet.

[0032] The method and apparatus of the invention are not limited to a particular metal. They are particularly suitable for use with any metals commonly used in DWI (D&I) and DRD processes. Also, there is no limitation on the end use of the cup that results from the method and apparatus of the invention. Without limitation, the cups may be used in the manufacture of any type of container, whether for food, beverage or anything else.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] FIG. 1 is a side elevation view of a container body of the background art resulting from a conventional DWI process. It shows the distribution of material in the base and sidewall regions of the container body.

[0034] FIG. 2 is a graph showing in general terms how the net overall cost of manufacturing a typical two-piece metal container varies with the ingoing gauge of the sheet metal. The graph shows how reducing the thickness of the sidewall region (e.g. by ironing) has the effect of driving down the net overall cost.

[0035] FIG. 3 is a graph corresponding to FIG. 2, but based on actual price data for UK-supplied tinplate.

[0036] Embodiments of the invention are illustrated in the following drawings, with reference to the accompanying description:

[0037] FIG. **4** is a cross-section through a press of the invention showing a blank of metal sheet prior to the drawing and stretching operations.

[0038] FIG. **5** is a cross-section through the press of FIG. **4**, but after the drawing operation to draw the blank of metal sheet into a cup having a sidewall and integral base.

[0039] FIG. **6** is a cross-section through the press of FIGS. **4** and **5**, but after the stretching operation to deform and stretch the base of the drawn cup.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Mode(s) for Carrying Out the Invention

Drawing Operation

[0040] FIG. **4** shows a combined drawing and stretching press **10**. A blank of metal sheet **5** is "slidably clamped" in position between the opposing surfaces of a draw pad **11** and an end face of a draw die **12**. A draw punch **13** is located above the upper surface of the blank of metal sheet **5** Within the bore defined by the draw die **12** is a stretch punch **14** which is radially-inwards of and surrounded by annular clamping element **15**.

[0041] Once the blank **5** is "slidably clamped" between the draw pad **11** and the draw die **12**, the draw punch **13** is moved axially downwards (along axis **16**) until the peripheral annular region **17** of the end face of the punch contacts a corresponding region on the blank **5** (see FIG. **5**). The draw punch **13** is urged downwards through the bore of the draw die **12** to progressively draw the initially planar blank **5** into a cup **30** having a sidewall **31** and integral base **32**.

[0042] By "slidably clamping" is meant that the clamping load during drawing is selected so as to permit the metal sheet **5** to slide, relative to whatever clamping means is used (in this case a "draw pad **11**"), in response to the deforming action of the draw punch **13**/draw die **12** on the metal sheet. An intention of this slidable clamping is to prevent or restrict wrinkling of the material during drawing.

Stretching Operation

[0043] Once the draw punch **13** reaches the end of its stroke, annular clamping element **15** is moved axially upwards until an annular region **33** on the base **32** of the drawn cup is clamped between the annular clamping element and the peripheral annular region **17** of the end face of the draw punch **13** (see FIG. **5**). The material of the cup's base enclosed by this annular clamping is referred to as the "enclosed portion" **34**.

[0044] Stretch punch **14** is then moved axially upwards (along axis **16**) to contact the enclosed portion **34** (see FIG. **6**). The stretch punch **14** is urged upwards into the recess **18** defined within the end face of the draw punch **13** to progressively deform and stretch the material of the enclosed portion **34** of the cup **30** into a domed profile **35** (see FIG. **6**). The clamping load applied between the annular clamping element **15** and the peripheral annular region **17** of the end face of the draw punch **13** is sufficient to restrict or prevent metal flow from the clamped annular region **33** into the enclosed portion **34** during this stretching operation. To enhance the gripping effect, the end face of the annular clamping element **15** may be textured (not shown in the figures) to thereby allow use of a reduced clamping load compared to use of an annular clamping element having a smooth polished end face.

[0045] As shown in FIG. **6**, the cup that results from the stretching operation performed in press **10** has a reduced thickness in its base relative to the ingoing gauge of the blank of metal sheet **5**. As indicated above in the general description of the invention, this cup may be used as a container body, but would generally be subjected to either or a combination of redrawing and ironing operations to optimise the cup diameter and sidewall thickness. As also indicated in the general description of the invention, the domed region **35** may be particularly beneficial for containers intended for pressurised products, such as carbonated beverages.

What is claimed:

1. A method for manufacture of a metal cup from a metal sheet, the method comprising the following operations:

i. a drawing operation comprising drawing the metal sheet into a cup having a sidewall and an integral base;

ii. a stretching operation performed on the cup, the operation comprising clamping an annular region on the base of the cup to define an enclosed portion, and deforming and stretching at least part of the base that lies within the enclosed portion to thereby increase the surface area and reduce the thickness of the base, the annular clamping adapted to restrict or prevent metal flow from the clamped region into the enclosed portion during this stretching operation;

the drawing and stretching operations performed in a common press.

2. The method as claimed in claim **1**, wherein the drawing operation comprises locating the metal sheet between a draw punch and a draw die, and moving either or both of the draw punch and draw die towards each other such that the draw punch extends through the draw die to thereby draw the metal sheet into the cup, the annular clamping during the stretching operation comprising clamping the annular region on the base of the cup between the draw punch and a clamping element disposed on the opposite side of the cup to the draw punch.

3. The method as claimed in claim **2**, wherein the stretching operation comprises using a stretch punch disposed on the opposite side of the cup to the draw punch and moving either or both of the stretch punch and clamped cup towards each other to deform and stretch at least part of the base that lies within the enclosed portion.

4. The method as claimed in claim **1**, wherein the stretching operation comprises deforming and stretching at least part of the base that lies within the enclosed portion into a domed profile.

5. A press for manufacture of a metal cup from a metal sheet, the press comprising:

i. means for drawing the metal sheet into a cup having a sidewall and an integral base;

ii. a clamping element for clamping the drawn cup during a stretching operation, the clamping element adapted to clamp an annular region on the base of the drawn cup to define an enclosed portion;

iii. a stretch tool adapted to deform and stretch at least part of the base that lies within the enclosed portion in the stretching operation to thereby increase the surface area and reduce the thickness of the base, the clamping element further adapted to restrict or prevent metal flow from the clamped region into the enclosed portion during the stretching operation.

6. The press as claimed in claim **5**, wherein the means for drawing the metal sheet comprises a draw punch and a draw die, either or both of the draw punch and draw die being moveable towards each other such that the draw punch may extend through the draw die to draw the metal sheet into the cup, the clamping element disposed on the opposite side of the cup to the draw punch such that in use during the stretching operation the clamping element clamps the annular region of the base between the clamping element and the draw punch.

7. The press as claimed in claim **6**, wherein the stretch tool comprises a stretch punch disposed on the opposite side of the cup to the draw punch, either or both the stretch punch and combination of draw punch and clamping element being moveable towards each other such that in use the stretch punch deforms and stretches at least part of the base that lies within the enclosed portion.

8. The press as claimed in either of claim **6**, wherein the draw punch is provided with a recess or bore to enable the stretch tool to extend all or partly within the recess or bore during the stretching operation.

9. A container comprising:

a circumferential sidewall defining an end; and

a bottom portion enclosing the end of the circumferential sidewall, wherein a material of the bottom portion is stretched relative to the circumferential sidewall to form a thinner preselected profile.

10. The container of claim **9**, wherein the thinned preselected profile is a dome.

11. The container of claim **10**, wherein the material of the container at or about the dome has a substantially uniform thickness.

12. The container of claim **10**, wherein the container is formed from a blank of material; wherein the blank of material has a base gauge prior to being formed; wherein, after being formed, the material of the container at or about the dome has a thickness; and wherein the thickness of the material at or about the dome is less than the base gauge.

13. The container of claim **12**, wherein the thickness of the material at or about the dome is about 0.0003 inch to about 0.003 inch thinner than the base gauge.

14. The container of claim **9**, wherein the container is formed from a blank of material; and wherein the blank of material has a preformed dome portion.

15. The container of claim **9**, wherein the container is a can body.

16. The container of claim **9**, wherein the container is a cup.

* * * * *