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Garnett, Jr.

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[54] **APPARATUS FOR AND METHOD OF MAKING A NESTABLE CONTAINER**

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[73] Assignee: **Reynolds Metals Company**, Richmond, Va.

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[52] **U.S. Cl.** **72/348**, 72/351

[51] **Int. Cl.** **B21d 22/24**

[58] **Field of Search** ..... 72/347, 348, 349, 350, 351; 113/120 G

[56] **References Cited**

UNITED STATES PATENTS

3,312,098	4/1967	Henrickson et al.	72/349
3,678,725	7/1972	Langewis	72/344
460,551	10/1891	Bodge	72/349
1,187,461	6/1916	Knox	72/349
3,580,041	5/1971	Tilly et al.	72/336
3,695,084	10/1972	Siemonsen et al.	72/348

FOREIGN PATENTS OR APPLICATIONS

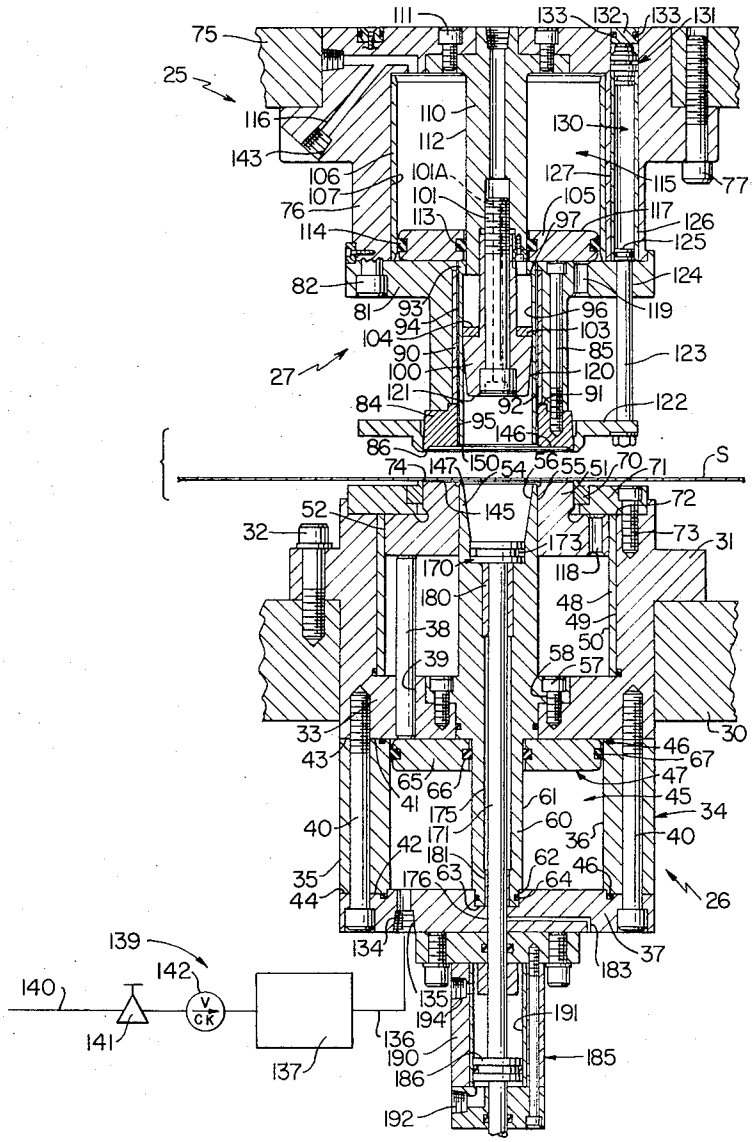
970,080	9/1964	Great Britain	72/347

Primary Examiner—Richard J. Herbst

[57] **ABSTRACT**

An improved apparatus for and method of making a nestable container are provided wherein a flat blank is drawn to define a drawn container which is reverse redrawn to form the nestable container which has a side wall and an annular planar flange extending therefrom with a toroidal bead extending from the flange and having at least a portion thereof arranged within and beneath the peripheral edge of the flange. The apparatus comprises a die set having integral fluid cushion means of simple construction which controls the movements of cooperating dies during both the drawing and reverse redrawing action.

6 Claims, 9 Drawing Figures



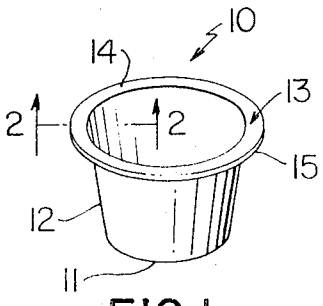


FIG. 1

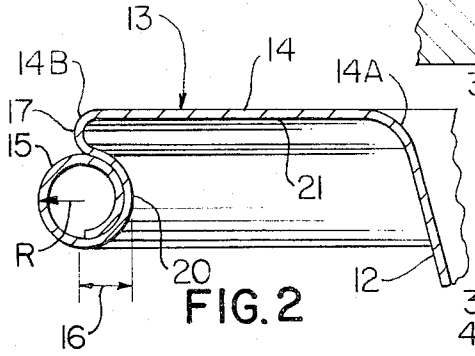


FIG. 2

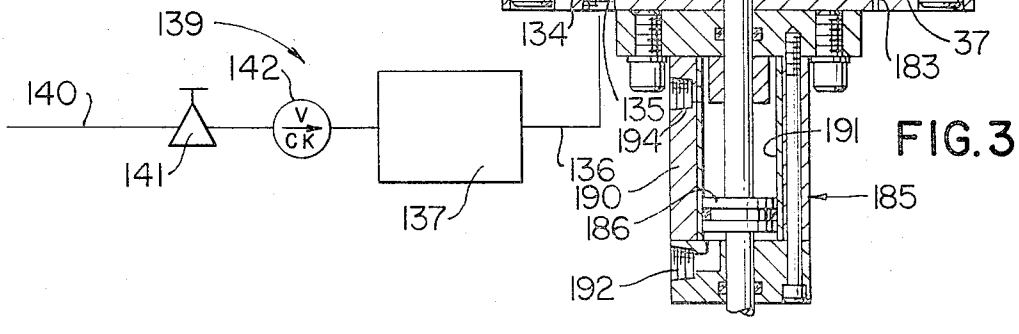


FIG. 3

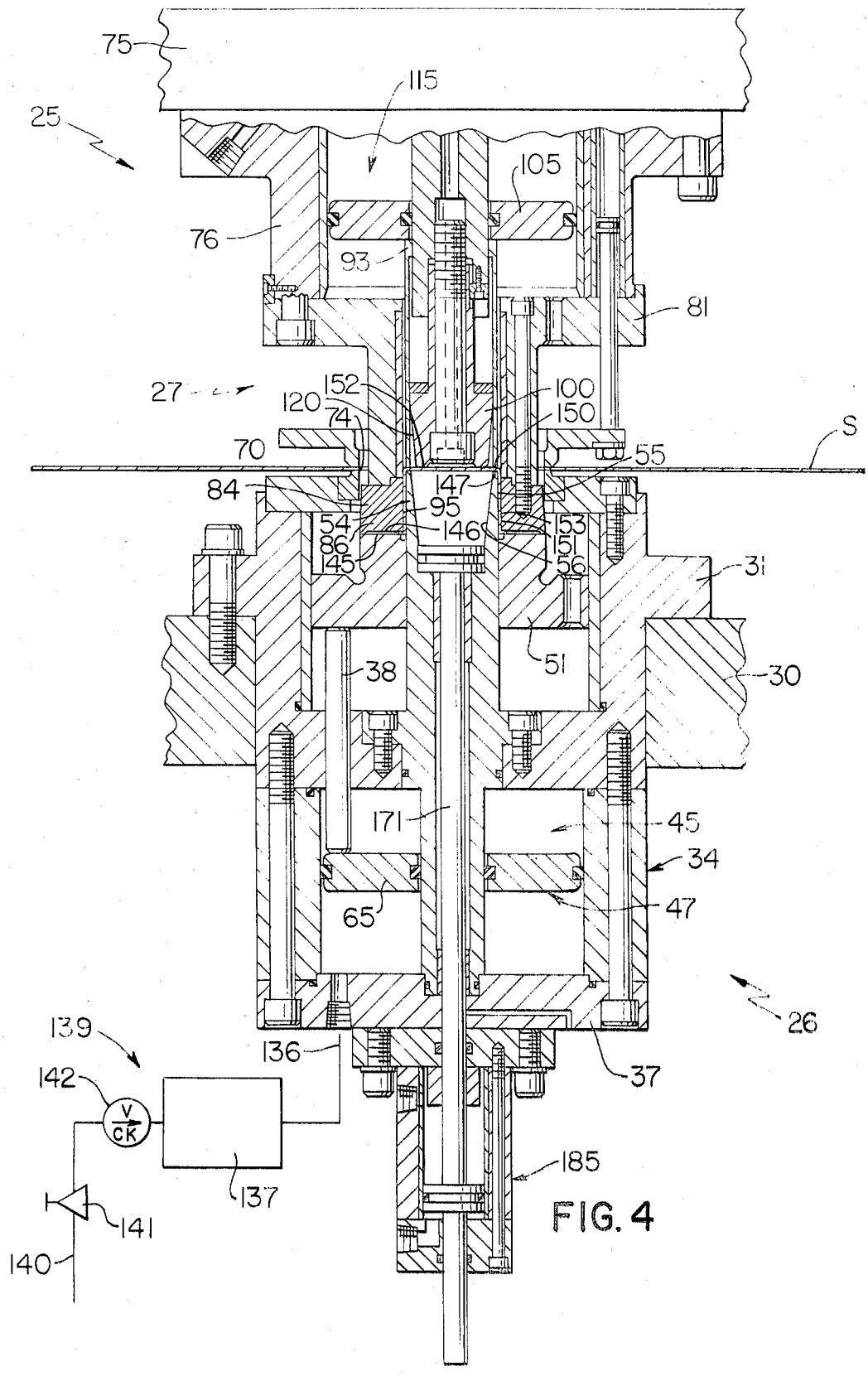

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FIG. 4

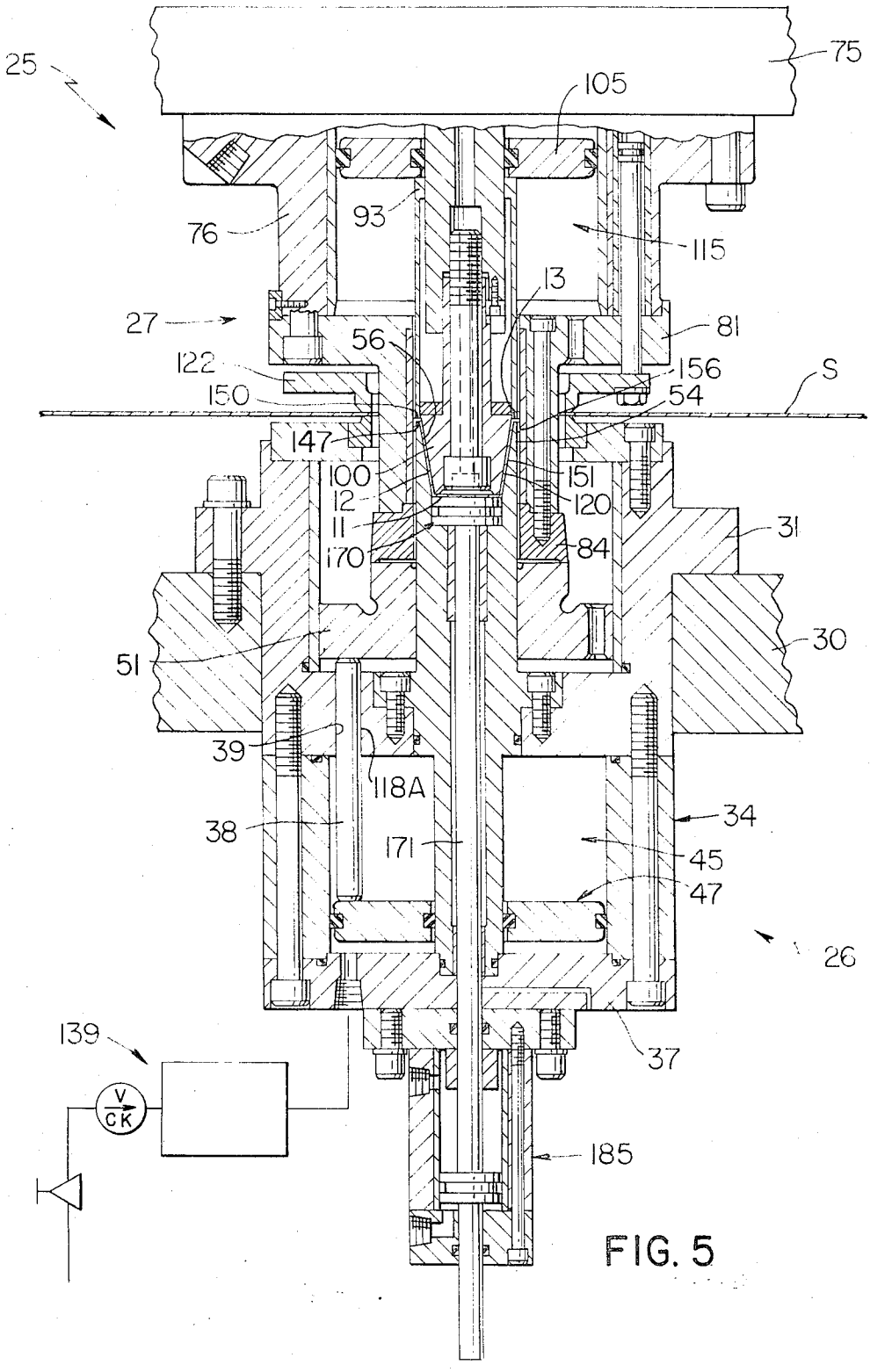

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FIG. 5

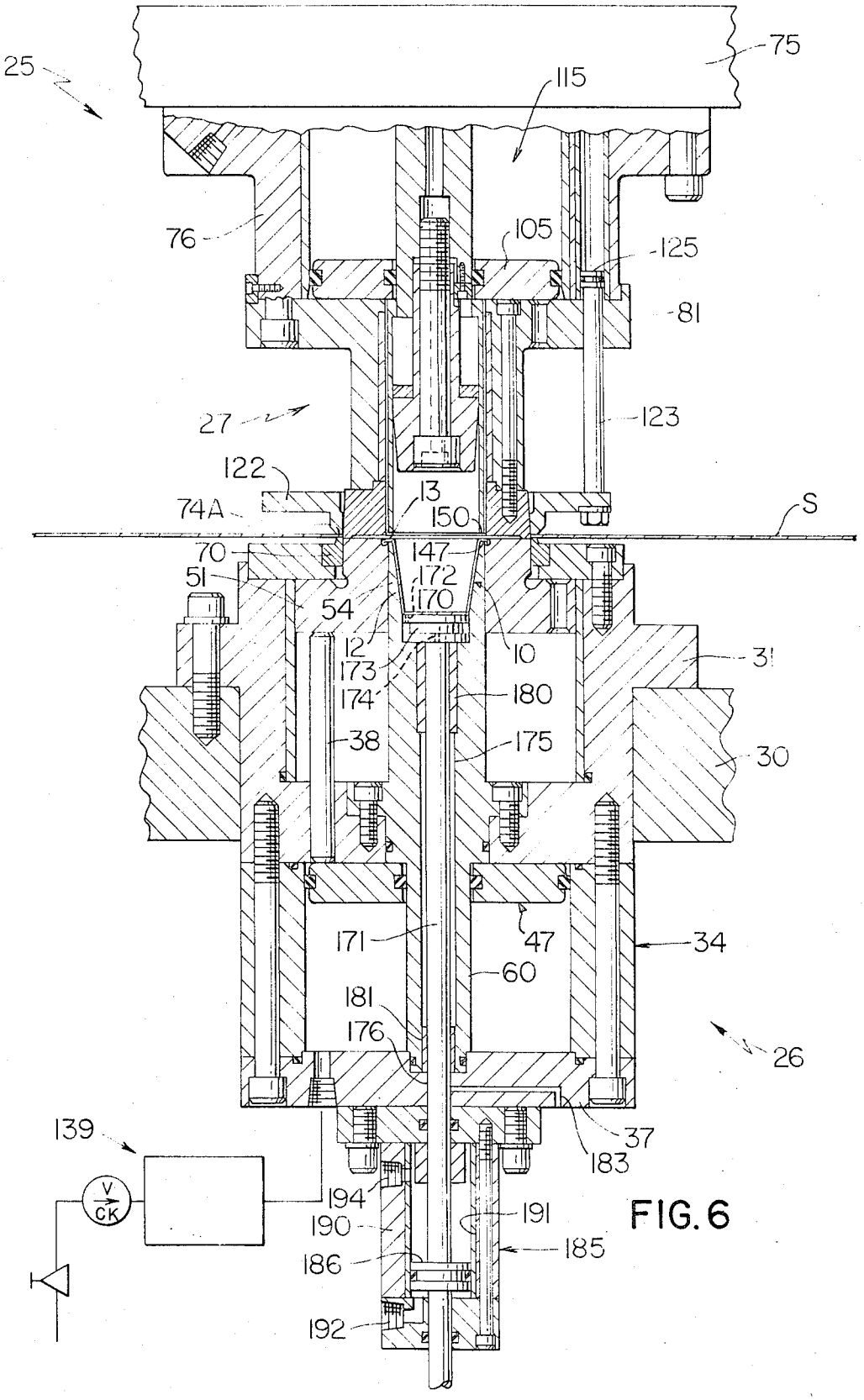

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FIG. 6

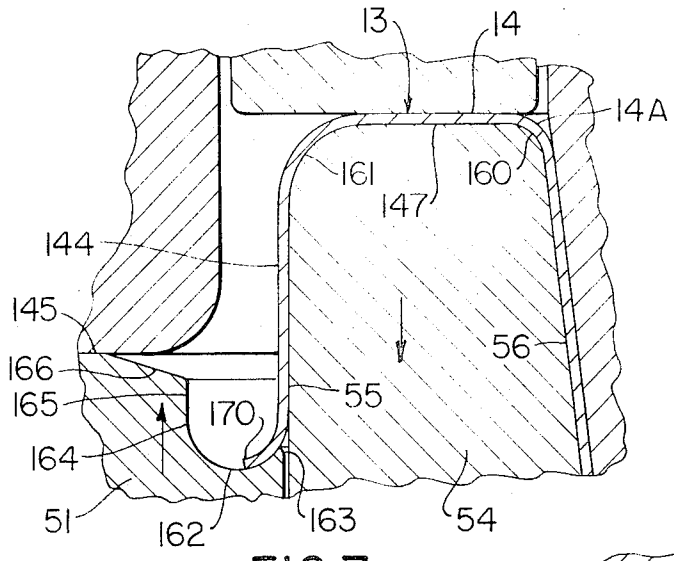
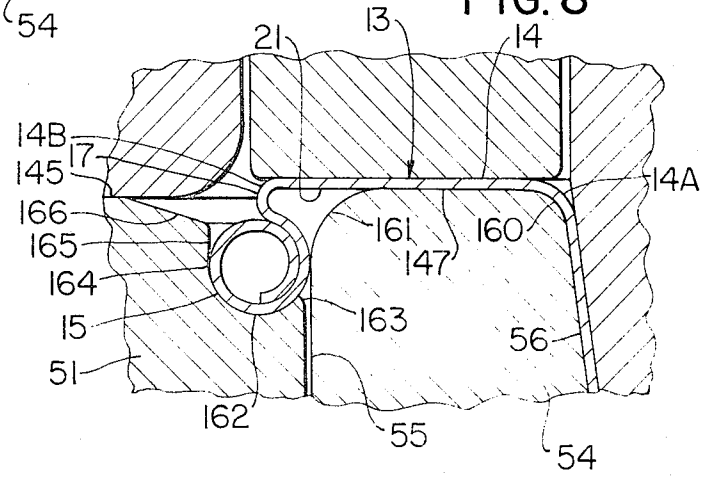


FIG. 7

FIG. 8



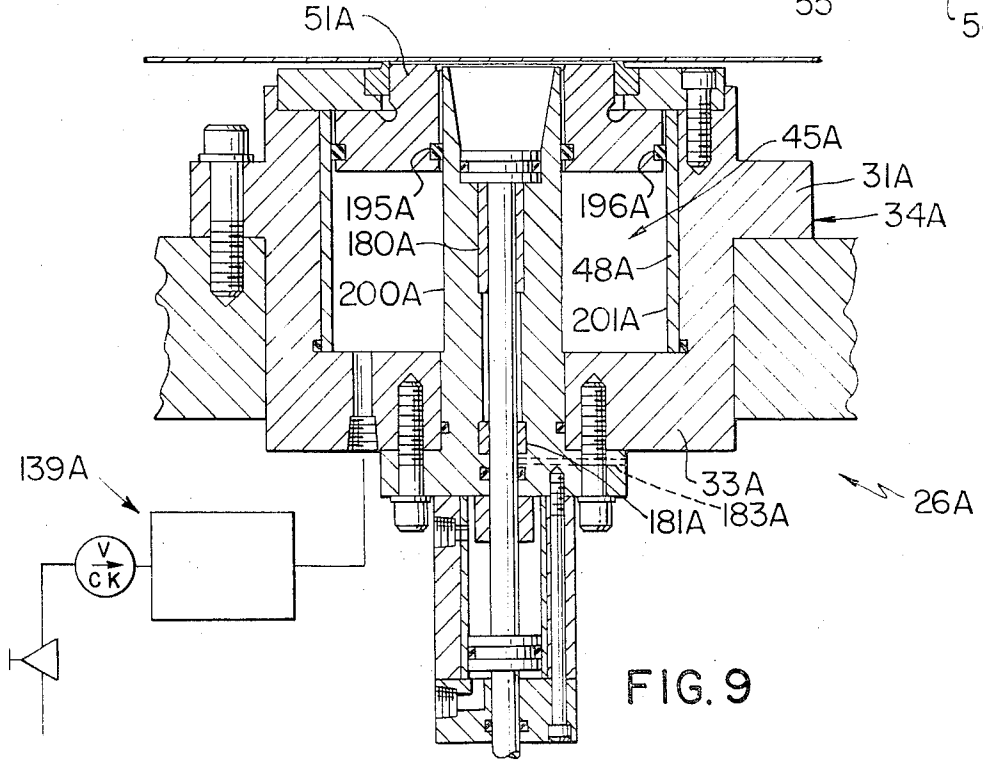


FIG. 9

APPARATUS FOR AND METHOD OF MAKING A NESTABLE CONTAINER

BACKGROUND OF THE INVENTION

Previously proposed apparatus for producing drawn thin gauge containers made using hardened metallic foil stock are generally deficient because they require complex and expensive mechanisms; further, these mechanisms are difficult to maintain in top operating condition. Accordingly, the overall cost for containers of the character mentioned is excessive.

SUMMARY

This invention provides an improved apparatus and method for making comparatively inexpensive containers from blanks of hardened metallic foil wherein each blank is drawn to define a drawn container which is then reverse redrawn to form a nestable container which has a side wall and an annular planar flange extending therefrom with a toroidal bead extending from the flange and having at least a portion of such bead arranged within and beneath the peripheral edge of the flange. The apparatus comprises a die set having integral fluid cushion means of simple construction which controls the movements of cooperating dies during both the drawing and reverse redrawing action.

Other details, uses, and advantages of this invention will become apparent as the following description of the embodiments thereof presented in the accompanying drawings proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show present preferred embodiments of this invention, in which

FIG. 1 is a perspective view of a typical container made using the apparatus and method of this invention.

FIG. 2 is an enlarged fragmentary cross-sectional view taken on the line 2—2 of FIG. 1 particularly illustrating a planar annular flange extending from the side wall of the container and a toroidal bead arranged beneath and partially within the terminal edge of the flange;

FIG. 3 is a fragmentary cross-sectional view illustrating an exemplary embodiment of the apparatus used in making the container of FIG. 1 prior to the beginning of the forming action and illustrating an elongated strip or web of metallic material arranged between cooperating die sets of the forming apparatus;

FIG. 4 is a view similar to FIG. 3 illustrating the die sets partially moved together against a yielding fluid cushion to draw a circular blank, which was sheared upon initially moving the die sets together, and define a drawn container;

FIG. 5 is a view similar to FIG. 4 illustrating the die sets in a further stage whereupon such die sets have moved together sufficiently to define a reverse redrawn container construction having a tubular wall portion extending beneath a planar annular flange thereof;

FIG. 6 illustrates the position of the cooperating die sets after forming the tubular wall portion of FIG. 5 to provide the toroidal bead and define the completed container of FIG. 1;

FIG. 7 is an enlarged fragmentary cross-sectional view of cooperating components of the die sets used to form the tubular wall portion to define the toroidal bead and illustrating the cooperating components at the beginning of the bead-forming action;

FIG. 8 is a fragmentary cross-sectional view similar to FIG. 7 illustrating the positions of the cooperating components once the bead has been formed; and

FIG. 9 is a cross-sectional view similar to the lower portion of FIG. 3 illustrating another exemplary embodiment of the apparatus of this invention.

DESCRIPTION OF ILLUSTRATED EMBODIMENTS

Reference is now made to FIG. 1 of the drawings which illustrates an exemplary nestable container made using the apparatus and method of this invention and such container is designated generally by the reference numeral **10**. The container **10** has a bottom wall **11** and a frustoconical side wall **12** which has an annular flange **13** extending outwardly from the top edge thereof.

The flange **13** has a planar annular top surface **14** adjoined at opposite ends by an inner arcuate portion **14A** and an outer arcuate portion **14B**, see FIG. **2**. A toroidal bead **15** extends from the flange **13** and has at least a portion **16** arranged within the peripheral outline or peripheral circular edge **17** of the flange **13**, i.e., the portion **16** is within a right circular cylinder having a diameter which coincides with edge **17**. The bead **15** has a double thickness throughout at least a portion of its cross-sectional outline and as indicated at **20**.

The portion **16** of the bead **15** which is arranged within the peripheral outline of the flange **13** is arranged substantially adjoining the bottom surface **21** of the flange **13**. In particular, the top surface of bead **15** is arranged beneath the plane of the bottom surface **21** by a distance which is less than the cross-sectional radius R of the bead **15**. Substantially all of the planar annular top surface **14** is usable to provide a sealing surface area for a lid or closure and such closure may be fastened against surface **14** using techniques known in the art.

In addition to the large seal area provided on the annular flange **13**, the container **10** has great strength in its flange **13** due to the construction and arrangement of the toroidal bead **15**. The toroidal bead **15** also enables a conventional reclosure lid to be easily placed on the container **10** once its closure has been removed and only a portion of the contents of the container used.

The container **10** is preferably made using the apparatus and method of this invention, which is designated generally by the reference numeral **25** in each of FIGS. **3–6** of the drawings. The apparatus **25** comprises a lower die set or structure **26** and a cooperating upper die set or structure **27** and such die sets may be readily used in a die press of standard construction.

The lower die set **26** comprises a fixed support **30**, see FIG. **3**, which has a die holder **31** fixed thereto using bolts **32** and the die holder **31** has a transverse or bottom portion **33**. The die set **26** has integral fluid cushion means designated generally by the reference numeral **34** and such fluid cushion means is particularly adapted to control the forming action of the components comprising the die sets to assure efficient forming of the container **10**.

The fluid cushion means **34** comprises a substantially cylindrical housing **35** having right circular cylindrical

inside surface **36** and a circular bottom cap or plate **37.** The housing **35** is held in position against the bottom portion **33** of the die holder **31** by a plurality of threaded bolts **40** so that the top and bottom annular surfaces **41** and **42** respectively thereof are held in clamping engagement against an annular bottom surface portion **43** of portion **33** and an annular inside surface portion **44** of the plate **37.** The inside cylindrical surface **36** and the inside surface of the plate **37** define a fluid chamber **45** and to assure that the chamber **45** is a fluid tight chamber a pair of sealing rings each designated by the reference numeral **46** are suitably held in associated grooves at the top and bottom of chamber **45.**

The fluid cushion means **34** comprises a piston assembly **47** which is adapted to move axially within the cylindrical chamber **45** and a plurality of cooperating pressure pins **38** each extending through an associated right circular cylindrical bore **39** in the bottom portion **33.** Any number of pins may be provided depending upon the container **10** being formed and a plurality of **3, 4, 5, 6,** and even more have been provided. Further, the function of the pins **38** will be described in detail subsequently.

The die holder **31** of die set **26** has a wear bushing or sleeve **48** suitably fixed to an inside cylindrical surface **49** thereof and the sleeve **48** has a right circular cylindrical inside surface **50.** The die set **26** also has an annular ring which will be referred to as a curling ring **51** supported concentrically within its die holder **31** and the curling ring has an outside surface **52** which is slidably supported for vertical movement along the cylindrical surface **50.** The curling ring **51** also has a portion which is particularly adapted to define the reverse toroidal bead **15** in the container **10** and such portion will be described in detail subsequently.

The die set **26** has a first die member which, in essence, is a dual purpose die member **54** and such die member has an outside forming surface **55** of right circular cylindrical configuration and an inside forming surface **56** of substantially frustoconical configuration.

The die member **54** is fixed to the transverse bottom portion **33** of the die holder **31** by a plurality of threaded bolts **57** which extend through suitable openings in an integral annular flange **58** comprising the die member **54.** The die member **54** has a cylindrical lower extension **60** which extends centrally through the chamber **45** and is provided with an outside cylindrical surface **61.**

The extension **60** serves as a central guide for the piston assembly **47** as it moves axially upwardly and downwardly in the chamber **45.** The extension **60** has a reduced diameter portion **62** which is received in tight fitting relation within a central recess **63** in the plate **37** so that the lower end of the extension **60** is supported firmly in position and a sealing O-ring is provided between the reduced diameter portion **62** and a right circular cylindrical surface **64** comprising recess **63.**

As previously mentioned, the piston assembly **47** is supported for axial movement within the chamber **45** and the assembly **47** comprises an annular disc-like piston **65** having a ring **66** received within an associated groove comprising its inside surface and having another larger diameter ring **67** received within an associated groove in its outside surface. The rings **66** and **67** are adapted to slidably engage surfaces **61** and **36** respectively to maintain a fluid-tight seal between the chamber **45** as the piston assembly **47** is moved axially. Further, as the piston assembly **47** moves within chamber **45** the pressure pins **38,** which are supported on the top surface of the disc-like portion **65,** move in a corresponding manner.

The die set **26** also has a female blanking die **70** which is suitably fixed within a support ring **71** and the ring is in turn supported on a shoulder **72** on the die holder **31** and attached thereto by a plurality of threaded bolts **73.** The blanking die **70** has an inside cutting edge **74** which, in this example of the invention, has a circular outline.

The upper die set **27** comprises a support structure **75** which has a punch holder **76** fixed to structure **75** by a plurality of threaded bolts **77** and a plurality of dowel pins, not shown, are provided to assure that the punch holder **76** is correctly aligned in the structure **75** prior to attachment thereof by the threaded bolts **77.** The die set **27** has a holding ring **81** which is attached to the punch holder **76** by a plurality of threaded bolts **82** and another die member **84** which may be referred to as the second die member of the apparatus **25** is provided and fixed to the holding ring **81** by a plurality of threaded bolts **85.** The die member **84** may be considered a blanking punch inasmuch as it has a cutting edge **86** of circular outline which is adapted to cooperate with the cutting edge **74** of the blanking die **70.**

The upper die set **27** has a wear sleeve **90** which has its lower edge supported on a shoulder **91** of its die member **84** and such sleeve is suitably fixed to prevent axial movement thereof. The sleeve **90** has a cylindrical inside wear surface **92.**

The upper die set **27** also has a blank holder **93** which has an outside cylindrical surface **94** which is slidably supported on the surface **92** of the wear sleeve **90** and on inside forming surface **95** of the die member **84** which is aligned with surface **92** and vertically therebeneath. The blank holder **93** has an inside cylindrical surface **96** and an annular shoulder **97** is provided as an integral part of holder **93** and projects radially inwardly from the top edge of inside surface **96.**

The die set **27** includes a forming punch **100** which is fixed to the punch holder **76** by a threaded bolt **101.** The bolt **101** has a longitudinal passage **101A** extending therethrough to assure that air is not trapped between the forming surfaces of punch **100** and the container being formed. The punch **100** has a stop ring **103** suitably fixed to its top portion and the stop ring **103** has a surface **104** which is adapted to engage shoulder **97** of the blank holder **93** to limit the downward movement of such blank holder. The upward movement of the blank holder **93** within the punch holder body **76** is controlled by an annular piston assembly or piston **105** and in a manner to be described in detail subsequently.

The punch holder **76** has a wear sleeve **106** suitably fixed in position against an inside cylindrical surface **107** thereof. The punch holder **76** has a stem-like central portion **110** which is fixed to the main body of such punch holder by threaded bolts **111** and portion **110** has a hardened cylindrical wear surface **112.**

The piston **105** has a seal construction **113** carried within an associated groove defining its inside surface and the seal **113** supports the inside portion of the an-

nular piston **105** for sliding movement along the cylindrical surface **112.** The member **105** also has another seal construction or annular seal **114** which is suitably supported in a groove provided in the outside periphery of the member **105** and the seal **114** slidably supports the outside portion of member **105** along the inside surface of the wear sleeve **106.**

During operation of the apparatus **25** with its cooperating die sets **26** and **27,** a fluid (air in this example) under pressure is supplied and maintained in an annular chamber **115** defined between surface **112** and sleeve **106.** The air in chamber **115** is provided in a controlled manner through one or more passages **116** in the punch holder **76** and as determined by the operating cycle for the press in which the apparatus **25** is used to maintain pressure on the top surface **117** of the member **105** and thereby maintain a pressure on the blank holder **93** to resist vertical axial movement thereof within the annular chamber **115.**

To assure proper operation of the apparatus **25** a plurality of vent passages **118** are provided through member or ring **51.** The passages **118** communicate with passages **118A** (FIG. **5**) between pins **38** and their cylindrical bores **39** to effectively vent the space above the piston assembly **47.** A plurality of vent passages **119** are also provided in the horizontally extending flange-like portion of member **81** and the passages **119** vent the space between members **105** and **81.**

The punch **100** has a convex substantially frustoconical forming surface **120** adjoined at its outer edge by an annular forming surface **121.** The surfaces **120** and **56** of members **100** and **54** respectively cooperate to define the frustoconical wall **12** of container **10.**

The upper die set **27** also has a stripper **122** which is supported concentrically around the outside surface of the die member **84** and the outside surface of the lower portion of the holding ring **81.** The stripper **122** has a plurality of rods **123** suitably fixed thereto and each of such rods is supported for vertical sliding movement in a cylindrical bore **124** provided in a horizontally extending flange portion of member **81.**

The upper end of each rod **123** has a piston **125** which is slidably received within the inside cylindrical surface of a wear sleeve **126** which is fixed in position within an associated bore **127** in the punch holder **76.** Air under regulated pressure is supplied within a chamber **130** defined by the inside surface of the wear sleeve **126** and such air acts against the top surface of each piston **125** to control the position of its associated rod **123** and, hence, the vertical position of the stripper **122.** The air under pressure is supplied into each piston chamber **130** through an associated assembly **131** and a ring cap **132** is provided at the top of the punch holder **76** and has seals **133** on opposite sides thereof to prevent air leakage from the cylinders **130.**

The integral fluid cushion means **34** comprising the lower die set **26** is provided with air through a passage **134** in the bottom plate **37** and the passage **134** has a threaded connection **135** which threadedly receives a supply conduit **136** from a conventional air pressure accumulator **137.** Air under regulated pressure is supplied to the accumulator through a conduit **140** from any suitable pressure source, such as an air compressor (not shown) or the like; and an adjustable air pressure regulator **141** is provided in the conduit **140** upstream of the accumulator **137,** with a one-way check valve **142** being installed in the conduit **140** between the regulator **141** and the accumulator **137.**

As previously mentioned, a chamber **115** is provided in the upper die set **27** and is supplied with a fluid such as air under regulated pressure through a passage **116.** The passage **116** may have a threaded connection **143** at its outer end and may be supplied with air under regulated pressure through a conduit similar to conduit **136** and utilizing an accumulator, check valve, adjustable pressure regulator, etc., as required to provide the desired pressure in the chamber **115** and as required by the apparatus **25** to assure proper forming of the container **10.**

The apparatus **25** has been described as utilizing air under regulated pressure in its chamber **115** and in chamber **45** of its integral fluid cushion means **34;** however, it will be appreciated that any suitable fluid may be used such as an incompressible hydraulic fluid and in this latter instance suitable ports, conduits, flow control valves, etc., would be provided in association with each chamber **115** and **45** to assure that the proper pressure is always maintained on the piston assemblies **47** and **105** to assure proper forming of the substantially frustoconical container **10.**

Having described the detailed construction and arrangement of the various cooperating component parts comprising the apparatus **25,** the detailed description will now proceed with a description of the manner in which apparatus **25** is used to carry out the improved method of this invention to define the exemplary container **10.**

In particular, a suitable web or strip of sheet stock S such as a strip of 3003-H19 aluminum foil alloy having a thickness in the range of 0.0035 inch is provided between the die sets **26** and **27** and such die sets in this example will be described as comprising components of a standard forming press. The support **30** and die holder **31** are fixed to and comprise the fixed bed of the forming press while the structure **75** and punch holder **76** comprise the moving press ram whereby it will be appreciated that with this construction the forming members **54** and **84** are, in essence, relatively movable toward and away from each other.

With the stock S interposed between the die sets **26** and **27,** the die set **27** is moved toward the die set **26** causing the die member **84** to be used as a blanking punch whereupon its cutting edge **86** cooperates with cutting edge **74** of the female blanking die **70** to shear a flat blank which, in this example of the invention, has a circular peripheral outline. Simultaneously with this shearing or cutting action to define the circular blank a peripheral portion of such blank is clamped initially between an annular clamping surface **145** on the curling ring **51** and a cooperating annular clamping surface **146** on the die member **84.**

Continued movement of the die sets **27** and **26** toward each other causes an annular clamping surface **147** defining the outer or top edge of the die member **54** to clamp an inner annular portion of the blank against a cooperating annular holding surface **150** on the blank holder **93.** As the die sets are moved further together an intermediate product or drawn container is defined which is designated by the reference numeral **151** in FIG. **4** and it will be seen that such container has not been completely formed.

The drawn container **151** has a bottom wall **152** and a side wall **153** and is defined by the outside forming

surface 55 of the die member 54 cooperating with the inside forming surface 95 of the die member 84. During the drawing of container 151 the outer portion of the circular blank is clamped between the annular clamping surfaces 145 and 146 while the surfaces 147 and 150 define the bottom wall 152 and serve to draw that portion of the blank arranged outwardly of the surfaces 147 and 150 through surfaces 145 and 146 to define the side wall 153.

The drawing action is achieved using the unique fluid cushion means 34. In particular, as the die set 27 is moved downwardly by the press ram the downward movement of piston assembly 47 and hence forming die 84 downwardly into the chamber 45 is cushioned and controlled by compressing the air in such chamber. This compressing is achieved by the piston assembly 47 which is urged downwardly by the ring 51 acting against the pressure pins 38 which in turn engage the annular piston 65 of the assembly 47. As the forming die 84 moves downwardly its forming surface 95 cooperates with forming surface 55 of die member 54 to define the drawn container 151. The amount of resistance offered to downward movement of the forming die 84 is controlled merely by controlling the pressure in the chamber 45 and this is achieved comparatively simply through the use of an air pressure control system which will be designated by the reference numeral 139 and such air pressure control system is comprised of accumulator 137, check valve 142, adjustable air pressure regulator 141 and associated conduits and components.

At the point in the forming of the drawn container 151 where the major part of its side wall 153 has been defined, i.e., the position shown in FIG. 4, the construction and arrangement of the components of the die sets 26 and 27 is such that the punch 100 engages the bottom wall 152 of the drawn container 151 to start forming the reverse redrawn container 10. As previously mentioned, the reverse redrawing is achieved by the convex frustoconical surface 120 of the punch 100 cooperating with the concave frustoconical surface 56 of the die 54 and during this reverse redrawing action the clamping surface 147 and the holding surface 150 on the members 54 and 93 respectively define what may be considered as an annular forming passage through which that portion of the drawn container 151 initially arranged outwardly of the peripheral edges of the surfaces 147 and 150 is drawn to define the redrawn container and essentially in the manner illustrated in FIG. 5 of the drawings.

During the redrawing action the cooperating surfaces 56 and 120 defining the side wall 12 of the container 10 and the surfaces 147 and 150 cooperate to define the planar annular flange 13 of such container. The redrawing is achieved also using the fluid cushion means 34 whereby during such redrawing the ram and upper die set 27 is continued to be moved downwardly from the position of FIG. 4 to the position of FIG. 5. This causes piston assembly 47 to be urged further downwardly into the chamber 45 through the action of pins 38, ring 51, and die 84 and the movement of these components is cushioned by further compressing the air in chamber 45. During this increment of movement the pressure in fluid chamber 115 of the upper die set 27 is such that constant pressure is maintained on the member 93.

The bottom wall 11 and side wall 12 of the redrawn container 10 are completed with the cooperating components of the die sets 26 and 27 in the positions illustrated in FIG. 5 and it will be noticed that the annular flange 13 defined between the surfaces 147 and 150 has a tubular wall portion 156 extending to one side of the plane of the annular flange 13. In this example, the tubular wall portion 156 extends beneath the horizontal plane of flange 13.

At the completion of the reverse redrawing action (which is the position of the cooperating die sets illustrated in FIG. 5 of the drawings), the die set 27 is returned to its original position by moving the ram of the forming press upwardly. During this upward movement a portion of the curling ring 51 engages the lower edge of the tubular wall 156 to form the reverse toroidal bead 15 and complete the container 10. The curling ring 51 is moved by the pressure pins 38 which are in turn urged upwardly substantially automatically by the piston assembly 47 once the ram and hence die set 27 is moved upwardly, see FIG. 6.

Reference is now made to FIGS. 7 and 8 of the drawings which illustrate in enlarged view parts of the curling ring 51 and associated die members which enable the forming of the flange 13 and toroidal bead 15. In particular, it will be seen that the die member 54 has an arcuate portion 160 as viewed in cross section extending between its concave frustoconical forming surface 56 and its clamping surface 147 and the arcuate surface portion 160 defines the inner arcuate portion 14A of the flange 13. The member 54 also has an arcuate portion 161 extending between its outer forming surface 55 and clamping surface 147 and portion 161 is defined by an arc having a larger radius than the portion 160 and such larger radius assures the formation of the arcuate portion 14B in the flange 13 without obstruction once the cooperating components of the die sets are moved together in the manner mentioned above.

The curling ring 51 has a concave curling surface 162 (as viewed in cross section) one end of which terminates in a slightly rounded wedge-like edge 163. The opposite end 164 adjoins a substantially vertically extending cylindrical surface portion 165 of controlled length. The surface 165 adjoins an inclined surface 166 which is inclined at an angle which may be generally of the order of 10° to 20° from a horizontal plane defined by the horizontal plane of the clamping surface 145.

Once the cooperating die sets 27 and 26 have formed the bottom wall 11 and side wall 12 of the container 10 with the wall portion 156 being arranged essentially in the position illustrated in FIG. 5, the press is returned to its initial position whereupon pins 38 restore the curling ring 151 to its original position causing edge 163 to engage a lower edge 170 of the wall portion 144 as illustrated in FIG. 7 of the drawings and commence curling of the wall portion 156 in what may be considered a reverse manner until the curled bead 15 illustrated in FIG. 8 has been formed. During the last increment of travel of the curling ring 51 the flange 13 is maintained in a clamped manner between clamping surfaces 147 and 150 to thereby assure that the annular surface 14 remains planar and has a maximum surface area. At the completion of the forming of the bead 15 the outer arcuate portion 14B is formed in the flange 13 by compressing the formed bead 15 up-

wardly toward the bottom surface 21 of the flange 13. Thus, the bead 15 is arranged substantially adjoining bottom surface 21 and the cooperating arrangement of the components of the die sets is such that the toroidal bead is arranged substantially adjoining the bottom surface 21 by a distance which is less than the cross-sectional radius R of the bead 15.

With the container 10 completely formed, see FIG. 6, the stripper 122 is constantly yieldingly urged downwardly by its rods 123 which are urged by air under pressure supplied to the top surface of associated pistons 125 whereby the web or sheet S of material is held firmly against the surface 74A of the female blanking die 70 until after die set 27 disengages die set 26. The sheet S is then free of the die sets and may be suitably advanced a predetermined increment and the forming operation repeated to define a circular blank, intermediate drawn container 151, and reverse redrawn container 10 essentially as described above.

The die sets 26 and 27 are then returned to their initial positions so they are vertically spaced apart a distance greater than the amount illustrated in FIG. 3 and such distance is greater than the height of the completed container 10 to enable removal of the completed container.

The die member 54 has a bottom-wall forming portion 170 which is fixed to a vertically movable shaft 171, see FIG. 6. The portion 170 has a plurality of vertical openings 172 which extend through an upper flange portion thereof and communicate with a peripheral groove 173. A plurality of openings 174 are also provided and extend through a lower flange portion. The shaft 171 extends vertically through aligned openings 175 and 176 in the central portion 60 of forming die 54 and the plate 37 respectively. A pair of sleeve bearings or sleeves 180 and 181 are provided at opposite ends of the vertically extending bore 175, and the shaft 171 is slidably received therethrough. A sufficient clearance is provided between the inside cylindrical surfaces of the sleeves 180 and 181 so that any air trapped between the container 10 and the forming portion 170 during forming thereof will flow through openings 172, groove 173, passages 174, and vertically downwardly along the outside surface of the shaft 171 to ambient through suitable passages 183 in the bottom plate 37.

The lower die set 26 also has an actuating assembly or actuator 185 for the vertical shaft 171. The actuator 185 comprises a piston 186 fixed to the lower portion of the shaft 171 and a cylinder assembly 190 provided with a cylindrical bore 191 and supporting the piston 186 for reciprocating sliding movements. The shaft 171 and portion 170 serve as a knockout for a completed container 10 whereby once a container has been completed air under regulated pressure is supplied through a port 192 in the cylinder assembly 190 and acts against the bottom surface of the piston 186 thereby raising the shaft 171 and the container 10 above the die set 26. Once the container has been removed, using any suitable means, air under pressure is supplied through a port 194 in assembly 190 and such air acts against the top surface of the piston 186 to thereby retract the shaft 171 to its original position.

Any suitable valve means and associated controls may be used to provide air to either port 192 or 194, as desired, and from any suitable air pressure source. Further, instead of using air to operate the assembly 185 any suitable gas or liquid may be used.

Another exemplary embodiment of an integral fluid cushion means of this invention is illustrated in FIG. 9 of the drawings and is used in a die set which is very similar to the die set 26; therefore, such die set will be designated generally by the reference numeral 26A and representative parts of die set 26A which are very similar to corresponding parts of die set 26 will also be followed by the letter designation A and not described again. Only those component parts which are substantially different from corresponding parts in die set 26 will be designated by a new reference numeral also followed by the letter designation A and described in detail.

The main difference between the die set 26A and the die set 26 is that the die set 26A does not have a fluid chamber and associated structural components beneath the transverse bottom portion 33A of its die holder 31A.

The fluid cushion means 34A in die set 26A comprises a chamber which for easy correlation with the similar-operating chamber of die set 26 will be designated by the reference numeral 45A. The chamber 45A is defined by the inside surface of wear sleeve 48A, the annular curling ring 51A, and the inside surface of bottom portion 33A. The annular ring 51A has an O-ring 195A received within an associated groove extending inwardly from its inside surface and another larger diameter O-ring 196A extending inwardly from its outside surface. The ring 195A slidably engages a suitably finished cylindrical wear surface 200A of die member 54A while ring 196A slidably engages wear surface 201A of the wear sleeve 48A.

The chamber 45A is supplied with air by pressure control system 139A and the operation of the fluid cushion means 34A is substantially identical to the operation of the fluid cushion means 34 whereby the description of such operation will not be repeated. Accordingly, it will be appreciated that the die set 26A may be used interchangeably with the die set 26 in the apparatus 25.

While present preferred embodiments of this invention, and methods of practicing the same, have been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. An apparatus for making a nestable container from a flat blank comprising; a first die set comprising, a first die member supported at a fixed position and having an inside and an outside forming surface, an annular ring supported concentrically around said first die member, and fluid cushion means provided as an integral part of said first die set; a second die set comprising a second die member and a punch; said die sets and members being supported for relative movement toward and away from each other; said second die member cooperating with said outside forming surface upon movement of said second die member in one direction to form a drawn container from said blank with the movement of said second member being controlled by said annular ring and said integral fluid cushion means; said punch cooperating with said inside forming surface upon moving said punch in said one direction to form a reverse redrawn container by redrawing said drawn container while keeping a tubular wall por-

tion of the drawn container outwardly of said outside forming surface; said punch being controlled during said reverse redrawing by said annular ring and said integral fluid cushion means; said annular ring having an inside portion which is adapted to be urged against said tubular wall portion by said integral fluid cushion means to define a reverse bead on said container having a toroidal configuration; said first die set comprising a die holder having a cylindrical inside surface and a transverse bottom portion; said first die member being fixed to said die holder concentrically within said cylindrical inside surface with said annular ring being supported concentrically between said first die member and said cylindrical inside surface; said integral fluid cushion means comprising a cylindrical housing portion having a bottom plate, said cylindrical housing portion and plate being fixed against said transverse bottom portion and defining a fluid chamber, and a fluid piston assembly supported for axial sliding movement within said fluid chamber, said piston assembly operatively associating with said annular ring to control its axial movement; said transverse bottom portion having a plurality of openings extending therethrough parallel to the central axis for said first die set and further comprising a plurality of pressure pins corresponding in number to said openings and extending therethrough, each of said pins having one end engaging said annular ring and an opposite end engaging said piston assembly to thereby transmit movement of said annular ring to said piston assembly.

2. An apparatus as set forth in claim **1** in which said fluid cushion means comprises air cushion means and further comprising an air pressure control system for controlling air pressure in said chamber.

3. An apparatus as set forth in claim **1** in which said first die member has a cylindrical lower extension which extends beneath said transverse bottom portion of said die holder and axially through said fluid chamber, said cylindrical extension serving as a central guide for said piston assembly.

4. An apparatus as set forth in claim **3** in which said first die set further comprises a knockout device for removing the completed container therefrom.

5. An apparatus as set forth in claim **3** in which said first die member also has a portion supported beneath and within its inside forming surface for forming the bottom wall of said container and said first die set further comprising a rod fixed to the bottom-wall forming portion, said rod extending through an axial bore in said first die member and through said bottom plate, and an actuator for actuating said rod upon completing said container, said rod and bottom-wall forming portion comprising a knockout device for removing each completed container from within said first die set.

6. An apparatus as set forth in claim **5** in which said rod has a piston fixed to its lower end and further comprising a pneumatic cylinder adapted to receive said piston therein, said piston and cylinder comprising said knockout device.

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