April 4, 1967 H. G. HENRICKSON ETAL 3,312,098

APPARATUS FOR FORMING CUP-SHAPED MEMBERS

Filed July 1, 1964 4 Sheets-Sheet 1

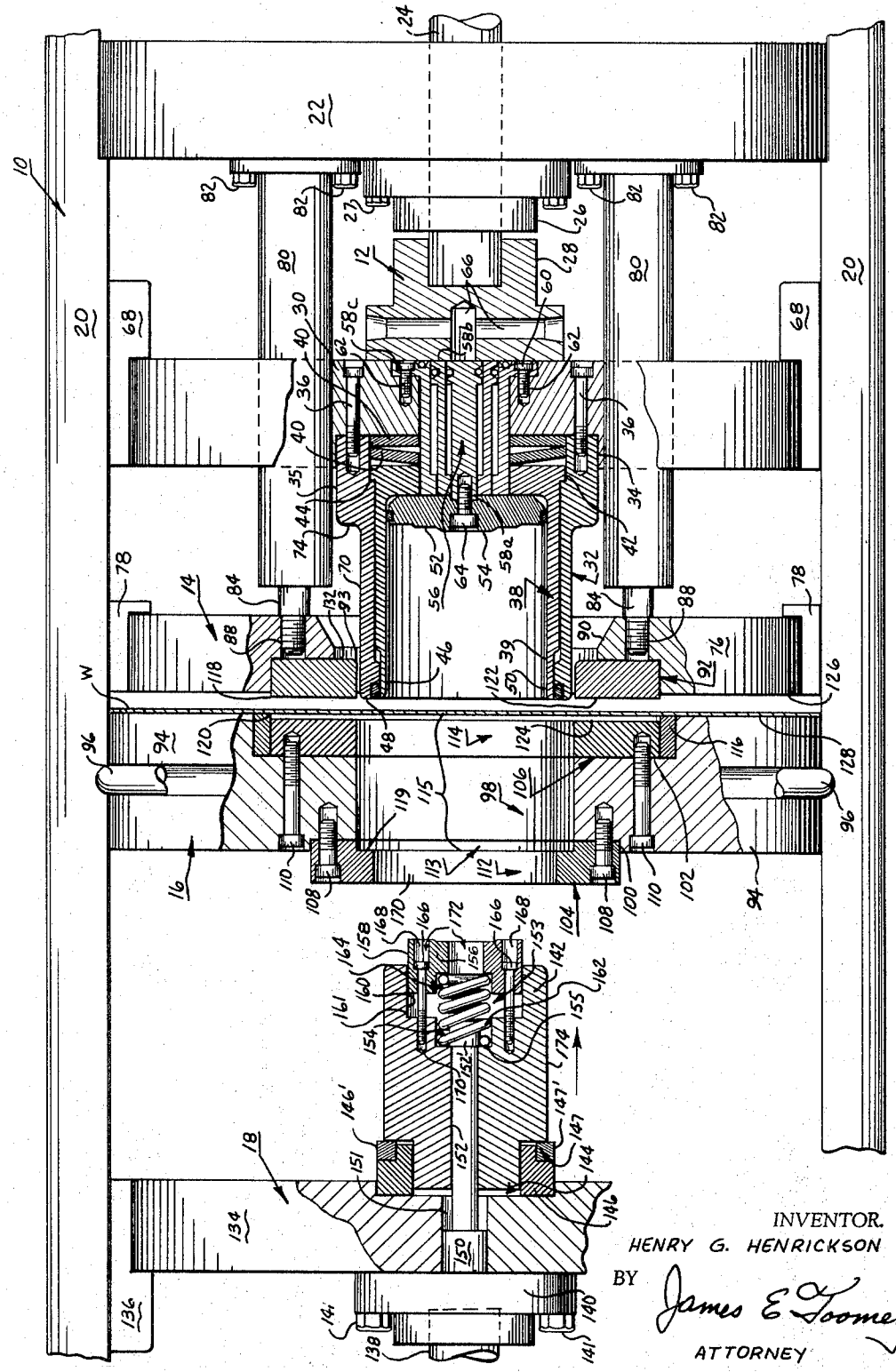


FIG-1

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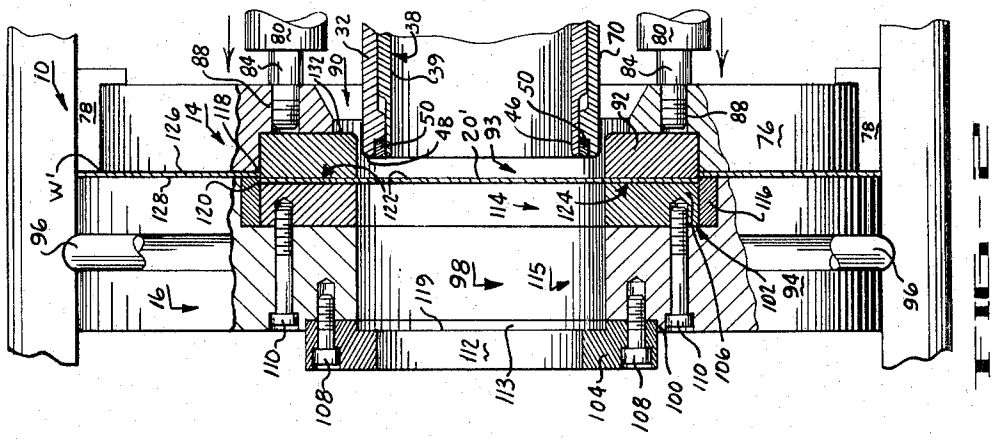


FIG. 2

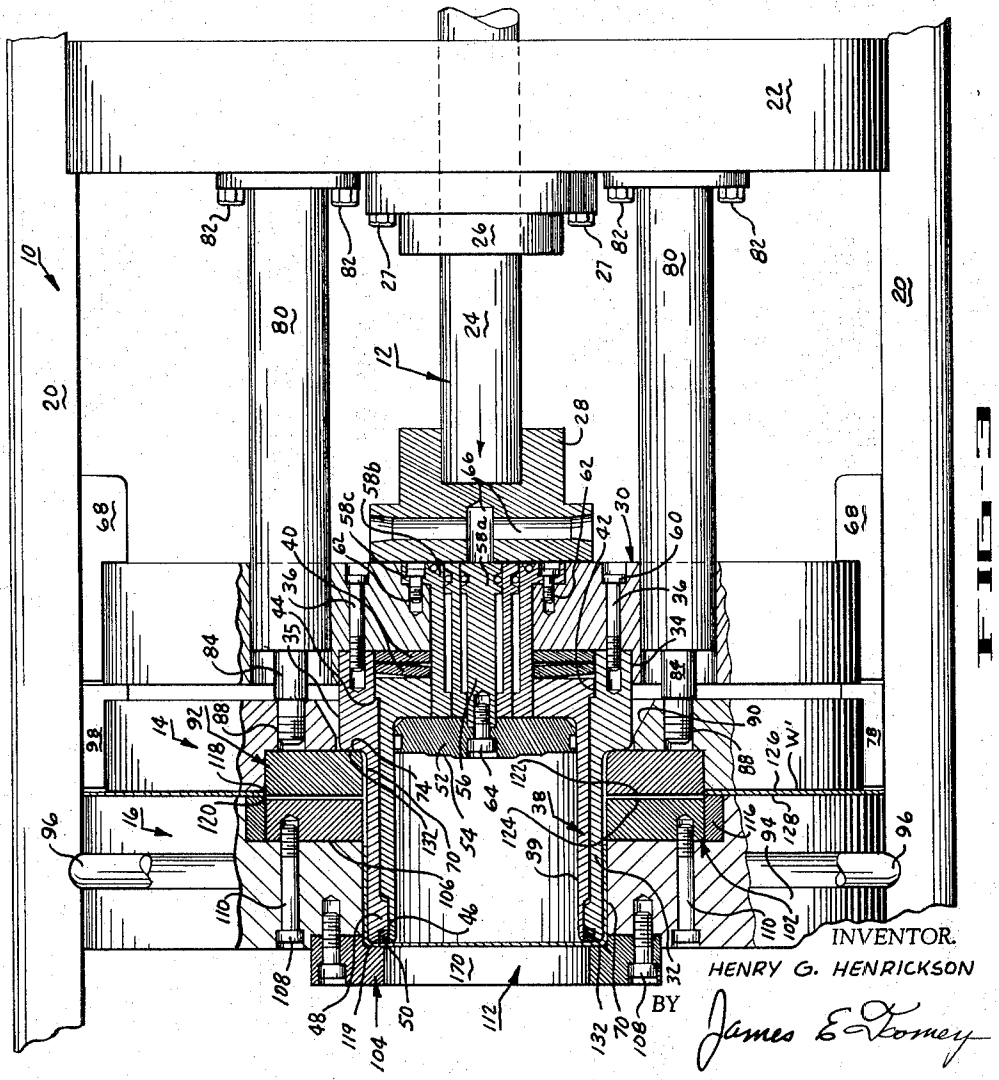


FIG. 3

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Filed July 1, 1964 4 Sheets-Sheet 3

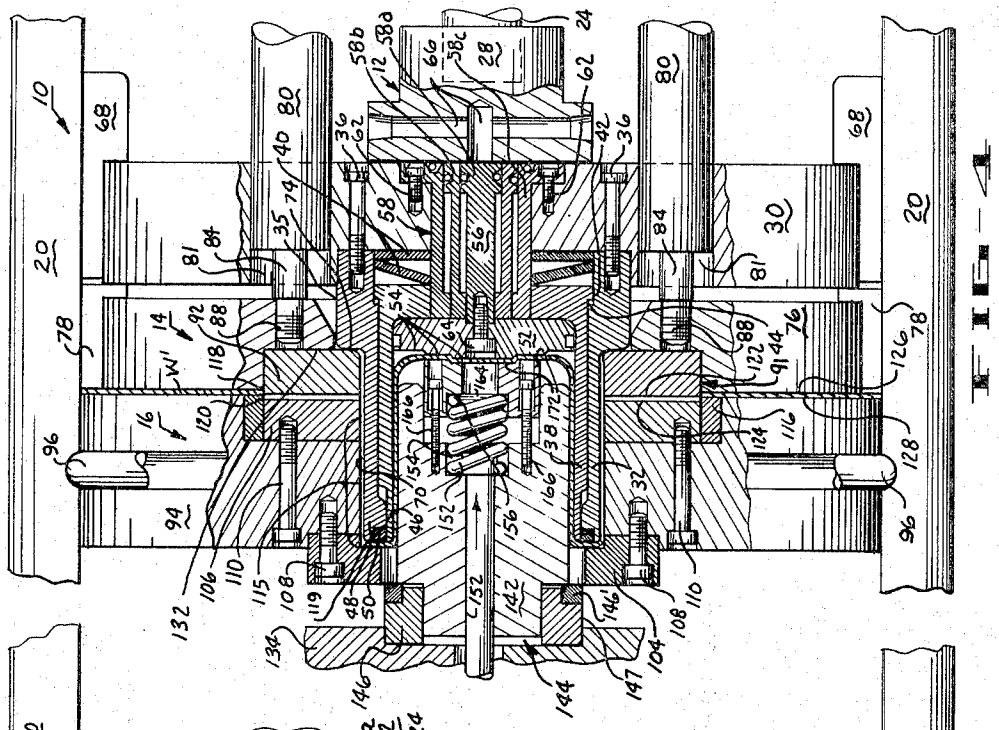


FIG-4

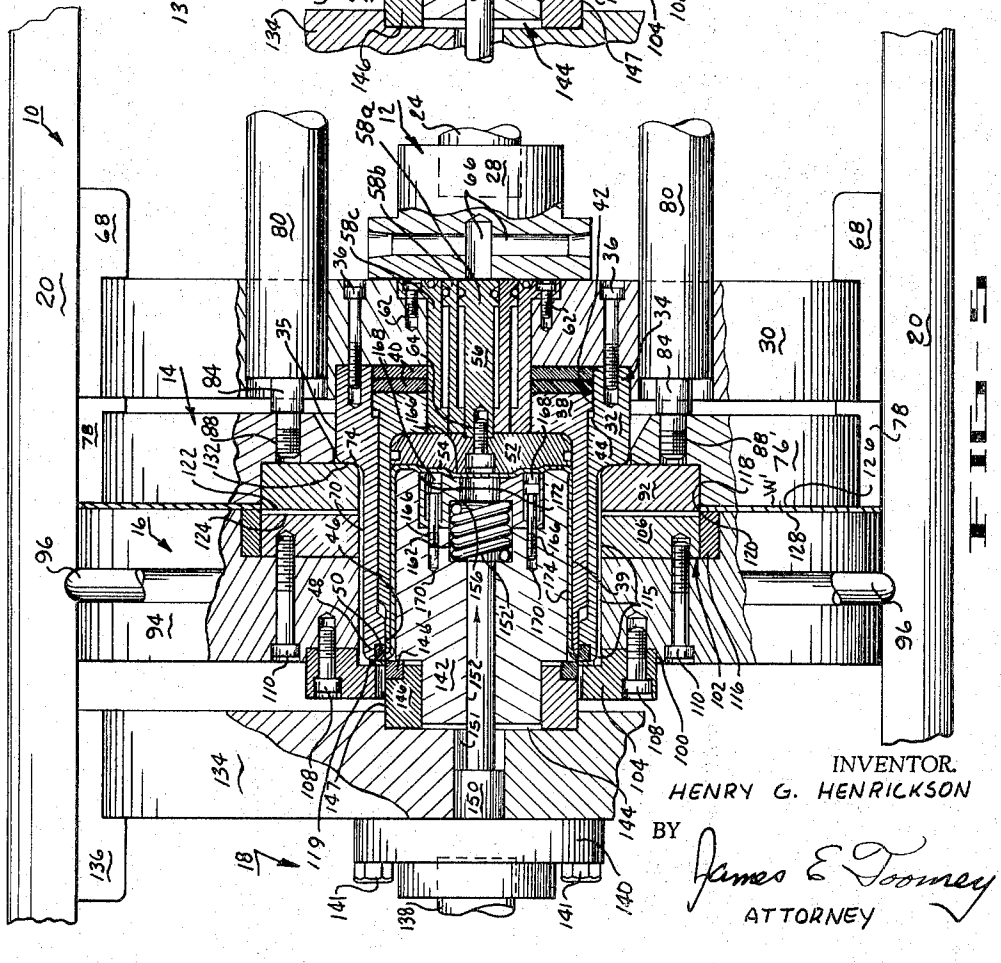


FIG-5

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APPARATUS FOR FORMING CUP-SHAPED MEMBERS

Filed July 1, 1964 4 Sheets-Sheet 4

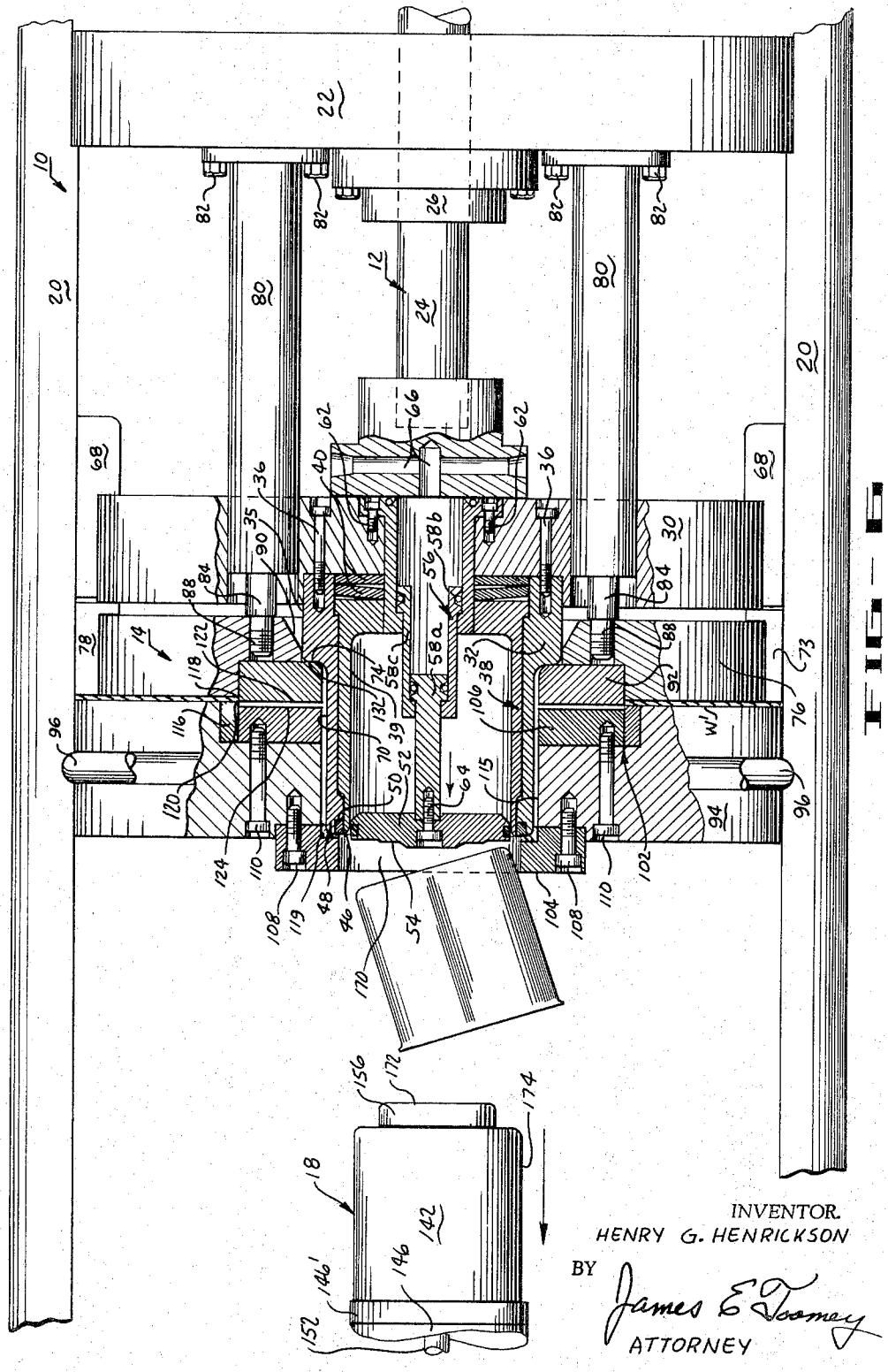


FIG. 5

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3,312,098

APPARATUS FOR FORMING CUP-SHAPED MEMBERS

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This invention relates to the fabrication of cup-shaped articles or containers while using what is known in the art as draw and redraw techniques. More particularly, the invention is concerned with providing a unique compact draw and redraw punch and die apparatus for forming such articles during an operative cycle of the said apparatus and wherein said apparatus is comprised of a movable punch and drawing assembly at one end thereof and a movable redraw mandrel assembly at the other end thereof and wherein all of the movable assemblies are arranged in cooperative coaxial relation with a stationary drawing assembly.

Accordingly, it is the primary purpose of the present invention to provide a unique compact draw and redraw punch and die apparatus wherein novel means are provided to permit sequential singular strokes of a punch and drawing assembly at one end of the apparatus and a redraw mandrel assembly at the other end thereof, and wherein all of the end assemblies are disposed in coaxial relation with a stationary drawing assembly located intermediate the ends of the apparatus to thereby produce a cup-shaped workpiece of predetermined configuration in successive stages by cutting, shaping or drawing and then redrawing the workpiece during one operative cycle of the apparatus.

This and other purposes and advantages of the instant invention will become more apparent from a review of the following detailed description when taken in conjunction with the appended drawings, wherein:

FIGURE 1 is a plan view of the punch and die apparatus of the instant invention with certain parts fragmented and other parts broken away in longitudinal section to illustrate an "at rest" position of the apparatus;

FIGURE 2 is a plan view of a portion of the apparatus of FIG. 1 with certain elements being broken away in longitudinal section to illustrate the clamping engagement of the drawing assemblies during an intermediate stage of operation;

FIGURE 3 is a plan view of another portion of the apparatus of FIG. 1 with various components being broken away in longitudinal section to illustrate the position of these components at the end of the drawing stroke of the punch assembly of the apparatus;

FIGURE 4 is a fragmented plan view similar to FIG. 3 and discloses the position of various components of the apparatus at an intermediate stage of the redraw stroke of the mandrel assembly of the apparatus;

FIGURE 5 is a plan view, similar to FIG. 4, and discloses the position of various components of the apparatus at the end of the redraw stroke of the mandrel assembly; and

FIGURE 6 is a plan view similar to FIG. 1 with parts being fragmented and in longitudinal section and illustrates an operative position of the punch and mandrel assemblies as the finished workpiece is ejected from the apparatus.

With further reference to the drawings and in particular FIG. 1, a preferred form of apparatus that can be used in carrying out the teachings of the instant invention generally comprises a framework **10** made up of plate and rod members preferably welded together in a conventional fashion in the configuration shown. Mounted upon framework **10** adjacent one end thereof is a movable punch assembly **12** and a movable drawing assembly **14**. A stationary drawing assembly **16** is affixed to framework **10** intermediate its ends and a movable redraw mandrel assembly **18** is mounted on framework **10** at the other end. All of these assemblies are hereinafter described in detail. It is to be understood that the framework **10** of the apparatus can be disposed in any suitable position or plane, although the horizontal position is preferred.

The operation of the apparatus can be described generally as follows. A continuous length of sheet-like, web material W such as a web of aluminum of a suitable alloy and gauge is controllably and intermittently fed by means (not shown) between the movable drawing assembly **14** and the stationary drawing assembly **16** of the apparatus in FIG. 1. When the apparatus of the instant invention is actuated by suitable control means (not shown) a circular blank **20'** is first severed from the inserted web W in the fashion indicated in FIGURE 2. This severing is followed by a punch shaping of the blank **20'** into the shallow cup-shape in the manner shown in FIGURE 3. Further actuation of the apparatus after the punch shaping of the workpiece in FIGURE 3, causes the workpiece to be reversely drawn to its final desired size and shape in the fashion indicated in FIGURE 4 prior to having its flanged end trimmed by completion of the stroke of the mandrel assembly **18** which is portrayed in FIGURE 5. Complete withdrawal of the mandrel assembly **18** as noted in FIGURE 6 permits ejection of the finished workpiece by an ejector to be more fully described hereinafter that constitutes a part of the punch assembly **12**.

The framework **10** generally comprises a plurality of spaced identical rods **20** interconnecting plate members **22** at either end that act as backing plates for the apparatus. Although only one backing plate **22** at one end of the framework **10** is shown in FIG. 1 or 6 in association with the movable punch and drawing assemblies **12** and **14**, it is to be understood that a similar backing plate **22** at the other end of the framework **10** is associated with the movable mandrel assembly **18**. While there are only two rods **20** shown in the drawings it is to be understood that any suitable number may be provided to properly rigidify the apparatus frame **10** between the backing plates **22** as well as to rigidly support and maintain alignment of the assemblies or platen means **12**, **14**, **16** and **18** as aforementioned during the operation of the device as will become more apparent hereinafter.

The movable punch assembly **12** unique of shape is connected to a conventional actuator (not shown), and preferably hydraulic, by means of the interconnecting shaft **24** which is slidingly supported in a backing plate **22** by the adapter plate **26** which is affixed to the backing plate **22** in a suitable manner by the machine screws **27**. The intermediate spacer block **28** of assembly **12** is affixed at one end to the forward end of the shaft **24** while the other end of block **28** is affixed to an outer spacer block **30** that extends between the rods **20**. These spacer blocks **28** and **30** are anchored to each other in a conventional fashion such as by machine screws.

A female die assembly generally comprised of a punch shaping die **32** and a reverse drawing die **38** is advantageously mounted on the forward end of the punch assembly **12**. The enlarged outer cylindrical surface **35** at the rear end of the punch shaping die **32** is adapted to be inserted in a cylindrical recess **34** at the foward end of the spacer block **30**, so that the shaping die **32** can be securely fastened to the block **30** by a plurality of machine screws **36** in the conventional manner. The punch shaping die **32** advantageously surrounds in circumscribing relation the reverse drawing die **38**. Die **38** is resiliently and slidably disposed within the shaping die **32**. To this end a pair of washer type spring members **40**,

one of which has a frusto-conical shape, is interposed between the enlarged rear portion of the drawing die 38 and the forward end of the spacer block 30. Members 40 are also surrounded by the rear portion of the shaping die 32 mounted within the recess 34. An annular flange 42 on the rear portion of the drawing die 38 cooperates with an annular stop or shoulder 44 on the rear extremity of the shaping die element 32 and the springs 40 urge the annular flange 42 into abutting relation with this annular shoulder 44. By virtue of this abutting relation the forward ends 46 and 48 respectively of the drawing die 38 and the shaping die 32 are maintained in radial alignment as shown in FIGS. 1–4 and 6. The forward ends 46 and 48 are permitted to have the relative longitudinal movement shown in FIG. 5 when the biasing action of the springs 40 is overcome in the manner hereinafter described. The forward end 48 of the shaping die 32 further includes a cylindrical recess or pocket within which an annular cutting ring 50 is inserted as indicated in the drawings.

An ejector or plunger 52 is advantageously mounted within the female die assembly for slidable engagement with the inner cylindrical surface 39 of the drawing die 38. A stepped annular surface 54 of the ejector 52 facing the open end of the female die assembly advantageously contributes to the shaping of the workpiece as will be noted more fully hereinafter. A telescopic tandem piston assembly 56 generally comprised of three interconnected piston sections 58*a*, 58*b* and 58*c* is adapted to be mounted in aligned bores in die 38 and spacer block 30, as well as through the central openings of the washer springs 40. The rear extremity of the largest piston section 58*c* includes an annular flange which is adapted to be mounted within a cylindrical recess 60 at the rear portion of the spacer block 30. Machine screws 62 securely fasten the largest piston section 58*c* and in turn the telescopic piston assembly 56 to the spacer block 30. The forward end of the smallest piston section 58*a* is connected to the ejector 52 in a conventional manner by the machine screw 64 which extends through an axial bore in the ejector 52 to threadably connect with an opening at the forward end of the piston section 58*a*. Actuation of the piston assembly 56 by suitable control means from its fully retracted position indicated in FIGS. 1–5 to its fully extended position produces a correspondingly extension of the ejector 52 from its retracted position and seating against the rear portion of the drawing die 38 to the fully extended position shown in FIG. 6. Interconnecting passageways 66 in spacer block 28 communicate with the interior of piston assembly 56 as well as with a suitably controlled source of fluid such as air in order to effect the alternate extension and collapse or retraction of assembly 56.

Punch assembly or platen means 12 is maintained in coaxial alignment with the aforementioned assemblies 14, 16 and 18 during its movements by means of the spacer plate 30 which is mounted by means of its attached shoe portions 68 for slidable engagement with opposed surface portions of the rods 20 as is evident upon inspection of the drawings. The outer cylindrical surface of the shaping die 32 is advantageously stepped whereby the narrow cylindrical surface 70 at its forward end is interconnected to the enlarged cylindrical surface 35 by an annular shoulder 74. Thus the unique construction and shape of the punch assembly 12 is such that it includes a female die assembly as a part thereof which comprises a shaping die 32 that surrounds a reverse drawing die 38 which in turn surrounds an ejector 52 as aforedescribed.

The movable drawing assembly 14 advantageously cooperates with the stationary drawing assembly 16 in such a manner as to permit insertion of a web of sheet material, such as aluminum, intermediate assemblies 14 and 16 prior to clamping engagement of the movable drawing assembly 14 with the stationary assembly 16. The movable drawing assembly 14 includes a plate member 76 that

extends between the frame rods 20. Mounted upon each transverse end of plate member 76 are shoes 78 which facilitate the slidable movement of the plate member 76 relative to the rods 20. A pair of cylindrical sleeve members 80 for punch assembly 12 are affixed at one end to the backing plate 22 by cap screws 82 and at the other end to plate member 76 by means of piston rod members 84 that telescope within members 80 and threadably engage aligned openings 83 provided in plate member 76. The outer cylindrical surface of each sleeve member 80 passes through an aperture 81 provided in the plate member 30 so as to bearingly engage the plate member 30 upon movement of the punch assembly 12 as aforedescribed. The forward extremity of shaping die 32 is supported by means of the drawing ring die 92 in an aperture 90 that is coaxially aligned with the punch assembly 12. Aperture 90 is advantageously larger than the diametrical extent of the female die assembly and it is beveled on the side facing the punch assembly 12. Drawing ring 92 is disposed on the oposing side of this aperture 90.

The stationary drawing assembly or platen means 16 includes a plate member 94 that extends between the frame rods 20 and is anchored at its ends to the rods 20 in a suitable fashion such as by the dowel pins 96 indicated in the drawings. The plate member 94 has a cylindrical aperture 98 which is arranged coaxially with the assemblies 12, 14 and 18. The cylindrical recess 100 bounding one side of aperture 98 in opposed relationship to the mandrel assembly 18 is of smaller diameter and shallower than the cylindrical recess 102 bounding the other side of aperture 98. The recesses 100 and 102 advantageously have drawing die elements 104 and 106 mounted therein by means of the machine screws 108 and 110 in the manner shown in the drawings. The dies 104 and 106 respectively include coaxial cylindrical apertures 112 and 114. It is to be observed that the aperture 114 of die 106, the inner most cylindrical recess 113 of the die 104 and the aperture 98 of the plate member 94 advantageously define a common cylindrical surface indicated at 115 of the same diameter the purpose of which will become more apparent hereinafter.

A cutting ring insert 116 is advantageously interposed between the outer peripheral surface of the die element 106 and the cylindrical surface of the recess 102. The exposed peripheral surfaces of the opposed draw ring dies 92 and 106 are of the same diametrical extent such that when the movable drawing assembly 14 is advanced by extension of the rod members 84 relative to sleeve members 80 by means of a conventional hydraulic actuator (not shown) within the sleeves 80 the outer circumferential edge 118 of the die 92 advantageously cooperates with the opposite inner circumferential edge 120 of the cutting ring 116 to sever a circular blank 20′ from the web material W inserted between the opposed surfaces 126 and 128 of the plate members 76 and 94 and between the opposed surfaces 120 and 122 of the dies 92 and 106 in the fashion indicated in FIG. 2. Thus certain parts of members 76 and 94 can be said to constitute workpiece holding elements. The axial extent of the exposed and opposed surfaces 122 and 124 respectively of the dies 92 and 106 is so proportioned in relation to the axial extent of the opposed surfaces 126 and 128 of the plate members 76 and 94 that after cutting the blank 20 from the web material W in the fashion indicated in FIG. 2 the opposed surfaces 126 and 128 cooperate to clamp the remaining portion of the web material W′ therebetween while the opposed surfaces 122 and 124 merely maintain the blank 20′ in holding or non-friction relation. In other words the axial extent of the annular gap between the opposed surfaces 126 and 128 of the plate members 76 and 94 when they are in a closed condition is advantageously slightly less than the annular gap that exists between the opposed surfaces of 122 and 124 when they too are in a closed condition whereby the remaining web W′ is clampingly engaged

between the surfaces 126 and 128 while the severed blank 20' is held flat between and in non-frictional relationship with the die surfaces 122 and 124.

After the blank 20' has been severed from the web W and with the drawing assemblies 14 and 16 in clamping relationship, the punch assembly 12 is advanced to a fully extended position in the manner indicated in FIG 3 for the purpose of shaping the blank 20' into a shallow cup-shape within the stationary drawing assembly 16. More specifically upon actuation of the punch assembly 12 by the control means and shaft 24, the shaping die 32 of the female die assembly will be advanced through the aperture 93 of the die 92 whereby the forward ends 46 and 48 of the drawing and shaping dies 32 and 38 will engage an intermediate annular portion of the blank 20' and cause the metal of the blank 20' to flow past the common surface 115 of the apertures 113, 98 and 114 of the stationary drawing assembly 16 while simultaneously causing the blank to assume the preselected shallow cup-shape as illustrated in FIG. 3. The forward movement of the shaping die 38 is advantageously stopped or limited by the abutment of the shoulder 74 of die 32 with the inner annular surface 132 of the drawing die 92. This abutment is predetermined whereby the axial extent of the annular gap between the forward ends 46 and 48 of the dies 38 and 32 and the annular shoulder 119 that bounds the recess 113 is such as to advantageously hold the bottom wall portion of the shallow cup-shaped workpiece in non-frictional contact with ends 46 and 48 and shoulder 119. Similarly the outer cylindrical surface 70 of the shaping die 32 is proportionally related to the cylindrical surface 115 defined by the surfaces of the apertures 113, 98 and 114 whereby the radial annular gap therebetween is such that the cylindrical portion of the shallow cup-shaped workpiece is held in non-frictional or non-binding contact between surfaces 115 and 70.

The mandrel assembly 18 disposed in coaxial alignment with the other aforedescribed assemblies 12, 14 and 16 is advanced toward these later assemblies by suitable control means (not shown) and in timed relationship with the aforedescribed movements of the punch assembly 12 and the drawing assembly 14.

As best shown in FIG. 1, mandrel assembly 18 is comprised of a plate member 134 that extends between the framework rods 20. The ends of plate member 134 are provided with shoe portions 136, only one of which is shown. These facilitate slidable movement of the plate member 134 relative to the rods 20 in a similar fashion as the aforedescribed plate members 30 and 76. The rear face of the plate member 134 can be connected to a suitable hydraulic actuator by means of a rod 138, partially shown, which is affixed at one end in a suitable manner to the adapter plate 140 which in turn is secured to the plate member 134 by the machine screws 141 in a conventional fashion.

The mandrel assembly 18 includes a redraw shaping element 142 of composite construction which includes a cutting ring 146' suitably affixed to platen 134 by means of a backing plate 146 and a male die 156. The cutting ring 146' is mounted in a cylindrical recess 147 in plate 146. The male die 156 is advantageously resiliently mounted within a cylindrical opening 153 in element 142. The redraw element 142 is mounted upon the forward surface of the plate member 134 after attachment of plate 146 and cutting ring 146' and location of plate 146 in the cylindrical recess 144 of the plate member 134. The redraw element 142 is securely anchored to plate 134 by means of a bolt 150 that extends through the axial bore 152 of element 142 and bore 151 in plate 134. The enlarged portion of bolt 150 threadably engages the axial bore 151 within the plate member 134. The forward head end 152' of the bolt is adapted to abut the annular shoulder 155 of the inner cylindrical recess 154 that extends between the axial bore 152 for the shank of bolt 150 to the outer and larger recess 153.

The outer cylindrical surface 158 of the male die 156 is adapted to slidably contact the cylindrical surface 160 of the recess 153. A coiled spring 162 is adapted to be mounted at one end of the cylindrical recess 164 in the inner end of the male die 156. The other end the coiled spring 162 is adapted to be mounted in the inner recess 154 and to freely surround the head end 152' of the bolt. To limit the extension of the coiled spring 162, machine screws 166 extend through parallel longitudinal stepped bores 168 in the male die 156 and their threaded ends engage the aligned parallel threaded openings 170 projecting inwardly from the annular shoulder 161 of the recess 153. Upon inspection of FIGS. 1 and 4–5 it is evident that adjustment of the machine screws 170 limits the action of the coiled spring 162 in resiliently biasing male die 156 in the recess 153. The stepped annular surface 172 of the male die 156, the outer cylindrical surface 174 of the redraw element 142 and the outer cylindrical surface 147' of the cutting ring 146' upon advancement of the mandrel assembly 18 by the control means cooperate with the surface 39 of the drawing die 38 and the stepped surface 54 of the ejector 52 in the manner indicated in FIGS. 4–6 to reversely draw the shallow cup-shaped workpiece to its final desired size. It is to be noted here that the outer cylindrical surface 147' of the cutting ring 146' is substantially the same diameter as the cylindrical surface of the aperture 112 in the bottoming die 104 as well as the outer cylindrical surface of the die 38 at its forward end 46. Although not heretofore mentioned, the forward ends 46 and 48 of the dies 38 and 32 are advantageously beveled as indicated in the drawings to define lip and flange forming means when the workpiece is reversely drawn in the fashion shown in FIG. 4. Moreover, the stepped surfaces 54 and 172 with the workpiece bottom wall therebetween cooperate to partially form the annular reinforcing ribs shown in FIG. 4.

Complete advancement or bottoming of the mandrel assembly 18 in the manner indicated in FIG. 5 overcomes the biasing action of the coiled spring 162 and effects retraction of the male die cylindrical surface 158 into the cylindrical recess 153 while the cutting ring 146' abuts the forward end 46 of the die 38 to overcome the biasing action of the springs 40. Such advancement completes the formation of the annular ribs in the bottom wall of the workpiece in FIG. 5 while the outer peripheral cutting edge of the cutting ring insert 146' cooperates with the internal peripheral cutting edge of the cutting ring insert 50 on the shaping die 32 to trim the formed flanged end of the reversely drawn workpiece. It will be observed here with particular reference to FIGS. 4 and 5 that the forward extent of the biased male die 156 is so related to the position of the cutting ring 146' whereby the workpiece is completely reversely drawn between the cooperative surfaces 54 and 172 of the ejector 52 and male die 156 as well as the cooperative surfaces 39 and 174 of the die 38 and redraw element 142 prior to the cutting action of the ring 146' and ring insert 50.

After retraction of the mandrel assembly 18 is indicated in FIG. 6 the ejector or plunger 52 can be advantageously actuated to an extended position to thereby eject the finished workpiece from the apparatus upon actuation of the telescopic piston assembly 56 by suitable pneumatic control means as aforescribed. Upon withdrawal of the punch assembly 12 by its hydraulic actuator means from assemblies 14 and 16 and after or prior to separation from assemblies 14 and 16 the trimmed metal waste between the annular shoulder 119 of the recess 113 and the forward end 48 of the shaping die 32 can be allowed to fall under the action of gravity or by suction means through a slotted opening (not shown) provided in the cylindrical surface of the recess 113.

In summary, the instant invention provides a compact

but unique apparatus for blanking out a workpiece from a web of material, and for thereafter drawing and then reversely redrawing the workpiece into a preselected cup-shaped article and finally flanging and trimming the workpiece in one complete cycle of operation of the apparatus.

An advantageous embodiment of the invention has been shown and described. It will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the spirit and scope thereof as set forth in the appended claims, wherein.

What is claimed is:

1. An apparatus for forming a cup-shaped workpiece comprising the combination of a movable punch and hollow drawing die assembly, a forming die means, a movable mandrel means disposed in cooperative coaxial relationship both with said punch and hollow drawing die assembly and the forming die means, a pair of opposed workpiece holding elements arranged in movable opening and closing relationship with respect to each other and associated with said forming die means and said movable punch and hollow drawing die assembly, said workpiece holding elements having opposed surfaces and cutting means which cooperate upon the initial and continued advancement of the movable punch and hollow drawing die assembly relative to said forming die means for effecting a cutting of a flat workpiece from a web of material inserted between said opposed surfaces, means limiting the advance of one workpiece holding element relative to the other workpiece holding element whereby the cut workpiece will be disposed in nonfrictional relationship with respect to the holding elements as well as the movable punch and hollow drawing die assembly and said forming die means as the punch of the movable punch and hollow drawing die assembly advances the workpiece through the forming die means and forces the workpiece to assume a cup-shaped configuration, means limiting the advance of said movable punch and hollow drawing die assembly relative to and through said forming die means whereby the workpiece will be disposed between and held in nonfrictional relationship with respect both to said movable punch and hollow drawing die assembly and said forming die means prior to and during advancement of the movable mandrel means against the bottom of the workpiece and into the hollow drawing die of said movable punch and hollow drawing die assembly so as to reversely redraw the workpiece and means for advancing said movable mandrel means along with the workpiece into the hollow drawing die of said movable punch and hollow drawing die assembly.

2. An apparatus as set forth in claim 1 wherein the means for limiting the advancement of said movable punch and hollow die assembly relative to and through said forming die means comprise surfaces on said movable punch and hollow drawing die assembly and one of said opposed workpiece holding elements which are adapted to abut one another.

3. An apparatus for forming a cup-shaped workpiece comprising the combination of a movable hollow punch means and a movable mandrel means, a stationary platen means provided with a forming die and disposed intermediate said punch and mandrel means, said punch means including a reverse drawing die surrounded by a shaping die member, biasing means connected to the reverse drawing die for normally effecting alignment of the forward free ends of the drawing die and shaping die member, workpiece holding elements movable toward and away from each other and associated with said drawing die and shaping die member and the forming die of said stationary platen means, said elements having opposed surfaces including cutting surfaces which cooperate upon the initial and continued advancement of the movable punch means relative to the forming die of said stationary platen means to effect the cutting of a flat workpiece from a web of material inserted between said opposed surfaces and then to hold the workpiece in non-frictional relationship with respect to the shaping die member and forming die of said stationary platen means as the said shaping die member advances the workpiece through said forming die and forces the workpiece to assume a cup-shaped configuration, and means for actuating said movable mandrel means whereby said mandrel means can reversely draw said cup-shaped workpiece by drawing said cup-shaped workpiece in said reverse drawing die of said punch means and said mandrel means being provided with a cutting ring means which cooperates with certain portions of said stationary platen means and punch means to trim the peripheral edge of the redrawn cup-shaped workpiece upon the bottoming of said mandrel means in said reverse drawing die of said punch means.

4. An apparatus as set forth in claim 3 wherein said mandrel means includes a male die means which cooperates with an ejector on the punch means in forming a plurality of reinforcing ribs on the bottom of the cup-shaped workpiece.

5. An apparatus as set forth in claim 3 wherein telescopic means are provided for actuating the ejector during ejection of the reversely drawn workpiece.

6. An apparatus as set forth in claim 3 wherein said punch of said movable punch and drawing die assembly includes an ejector for ejecting the workpiece from the apparatus upon completion of the redrawing thereof.

7. An apparatus as set forth in claim 4 including means for resiliently biasing said male die means on said mandrel means.

8. A reverse drawing apparatus for forming a cup-shaped workpiece comprising the combination of a movable hollow punch means and a movable mandrel means, a fixed platen means provided with a forming die and disposed intermediate said punch and mandrel means, said punch means including a hollow reverse drawing die surrounded by a shaping die member and a workpiece ejector disposed within the hollow interior of said reverse drawing die, workpiece holding elements movable toward and away from each other and associated with said shaping die member and reverse drawing die for loosely holding the workpiece relative to said forming die and shaping die member as the shaping die member advances the workpiece through the forming die and forces the workpiece to assume a cup-shaped configuration, means for advancing the mandrel means relative to said reverse drawing die upon the formation of said cup-shaped workpiece whereby said mandrel means can reversely draw said cup-shaped workpiece, a cutting ring affixed to said mandrel means, said ring cooperating with certain portions of said fixed platen means and movable punch means to trim the peripheral edge of the workpiece upon the bottoming of said mandrel means in said reverse drawing die, and means for actuating said workpiece ejector upon the redrawing of the workpiece.

9. An apparatus as set forth in claim 8 including means for resiliently biasing said reverse drawing die relative to said shaping die member whereby the free ends of said shaping die member and reverse drawing die of said punch means can cooperate with the cutting ring of the mandrel means to trim the peripheral edge of the workpiece.

10. An apparatus as set forth in claim 8 wherein the means for actuating the ejector includes a plurality of telescopingly arranged tandem-connected pistons.

11. An apparatus as set forth in claim 8 wherein said mandrel means includes a resiliently biased male die means which cooperates with the ejector upon advancement of the mandrel means into the reverse drawing die to form reinforcing ribs on the bottom portion of the workpiece.

12. An apparatus for forming a cup-shaped workpiece comprising the combination of axially aligned movable hollow punch means and movable mandrel means, a stationary platen means and movable platen means dis-

posed intermediate said punch and mandrel means and axially aligned therewith, said punch means including a reverse drawing die and a shaping die element surrounding said reverse drawing die, means biasing said reverse drawing die relative to said shaping die elements so as to permit relative movement therebetween, lip and flange forming means on the forward ends of the reverse drawing die and said shaping die element, means provided on the opposed surfaces of said movable and stationary platen means for holding a workpiece therebetween upon advancement of the movable platen means toward the stationary platen means, said stationary platen means further including a drawing die which cooperates with said shaping die element upon advancement of the punch means to effect a forming of the workpiece into a cup-shape, means for advancing the mandrel means towards and into said reverse drawing die upon the formation of the cup-shaped workpiece whereby the mandrel means can reversely draw the cup-shaped workpiece, and a cutting ring on said mandrel means which cooperates with the lip and flange forming means on said reverse drawing die and shaping die element to flange and trim the peripheral edge of the reversely drawn workpiece during bottoming of the mandrel means in the reverse drawing die.

13. An apparatus as set forth in claim 12 wherein said punch means includes means for limiting the advancement of said punch means toward the stationary platen means.

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