

Jan. 20, 1953

O. IMMENROTH

2,625,896

ROTARY PROGRESSIVE DIE FOR PRESSES

Filed March 15, 1948

5 Sheets-Sheet 2

FIG. 4.

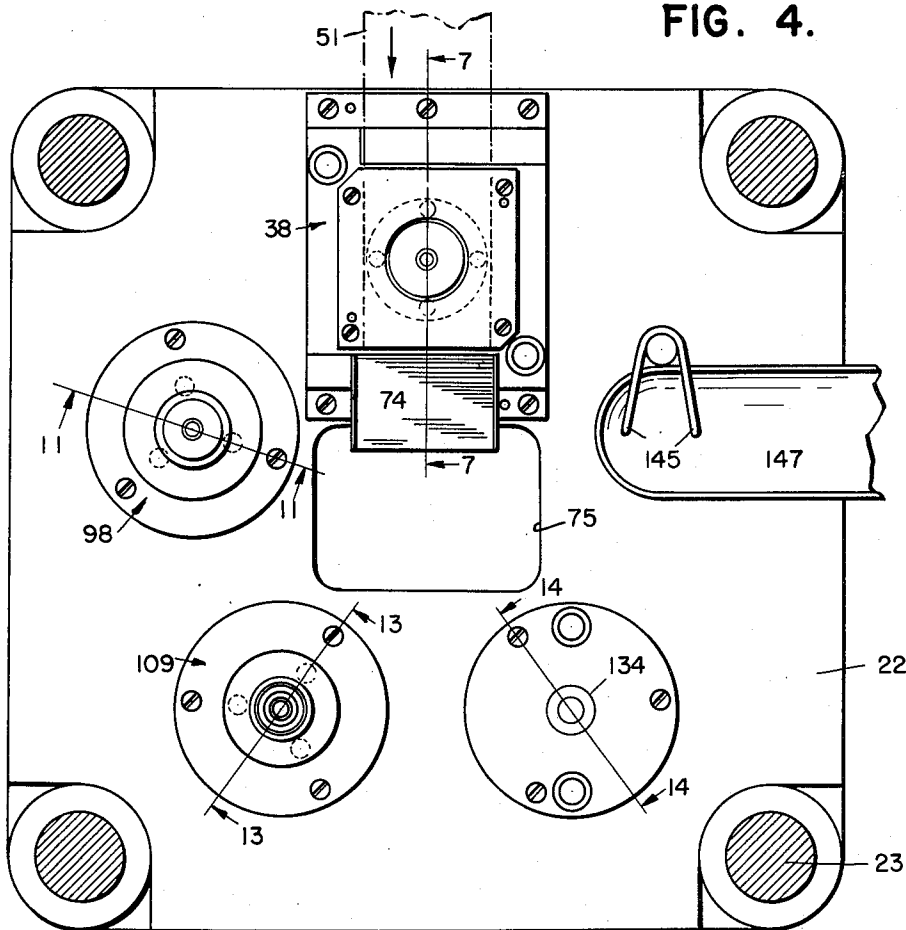


FIG. 5.

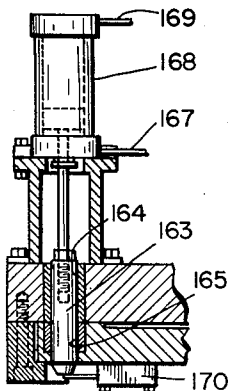
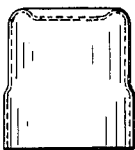


FIG. 6.



INVENTOR
OTTO IMMENROTH
BY *Morrison Graham*
ATTORNEYS

Jan. 20, 1953

O. IMMENROTH

2,625,896

ROTARY PROGRESSIVE DIE FOR PRESSES

Filed March 15, 1948

5 Sheets-Sheet 3

FIG. 7.

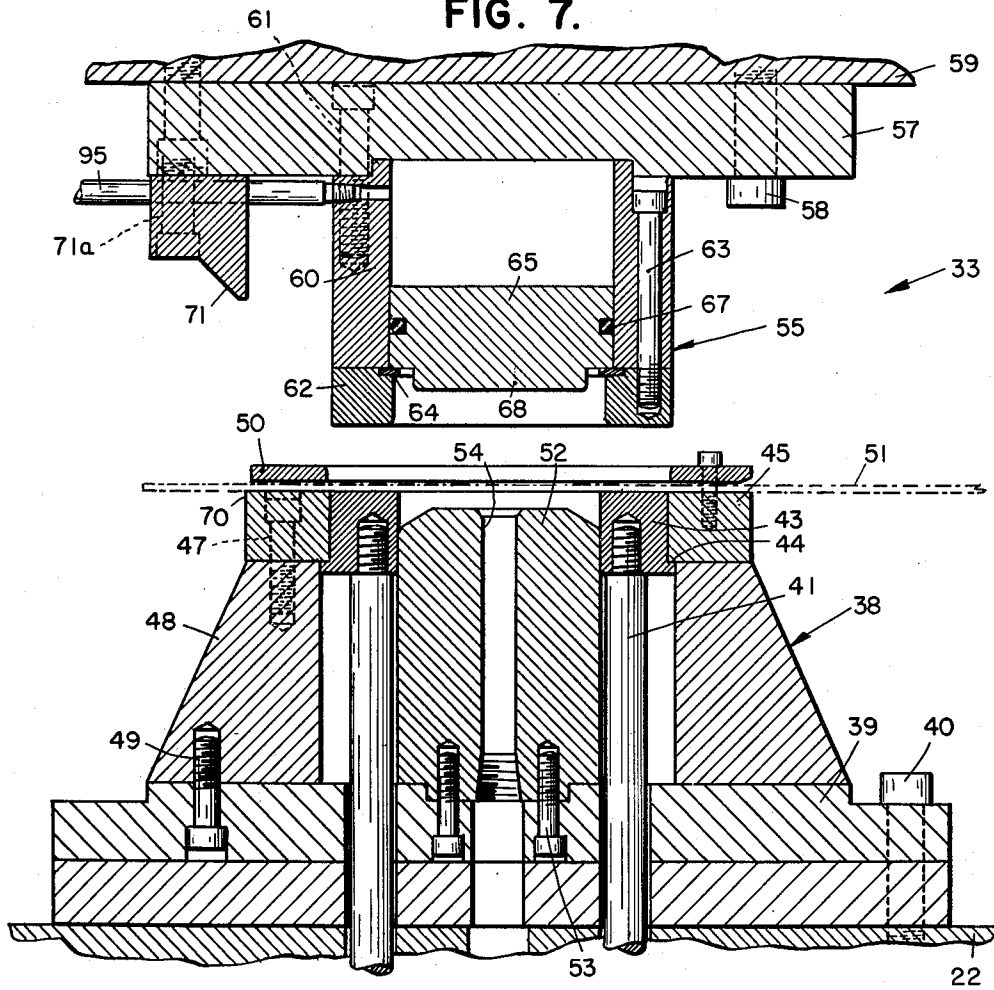
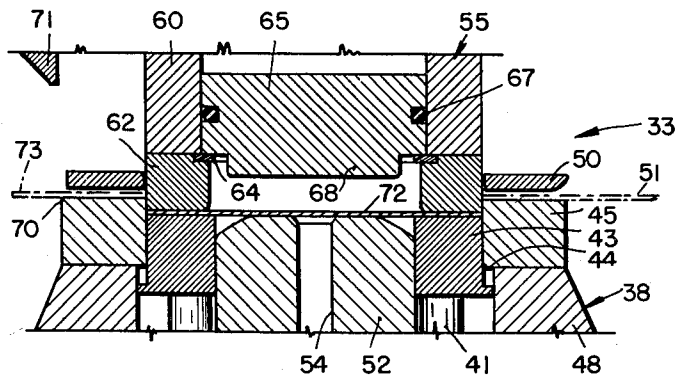


FIG. 8.



INVENTOR
OTTO IMMENROTH

BY *Morrison & Lachman*

ATTORNEYS

Jan. 20, 1953

O. IMMENROTH

2,625,896

ROTARY PROGRESSIVE DIE FOR PRESSES

Filed March 15, 1948

5 Sheets-Sheet 4

FIG. 9.

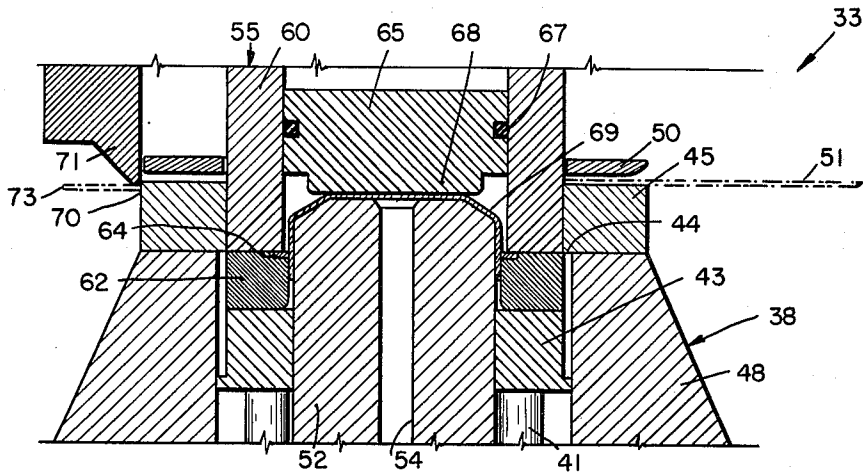


FIG. 10.

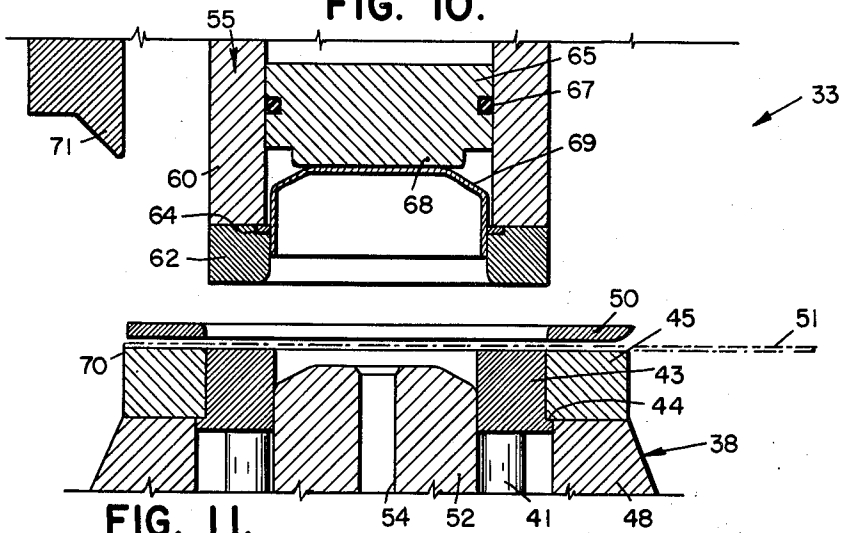
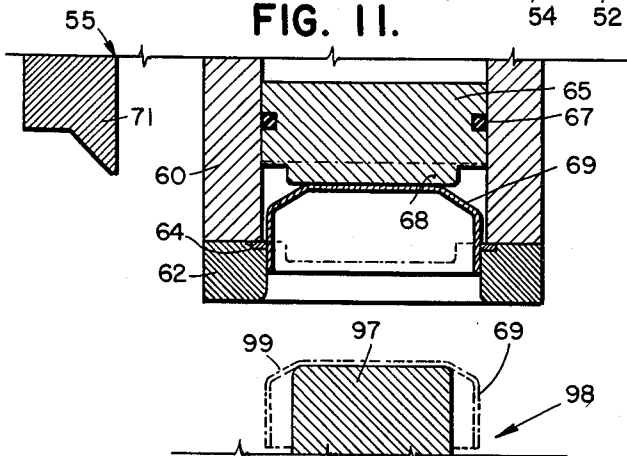


FIG. 11.



INVENTOR
OTTO IMMENROTH

BY *Mary Shahan*
ATTORNEYS

Jan. 20, 1953

O. IMMENROTH

2,625,896

ROTARY PROGRESSIVE DIE FOR PRESSES

Filed March 15, 1948

5 Sheets-Sheet 5

FIG. 12.

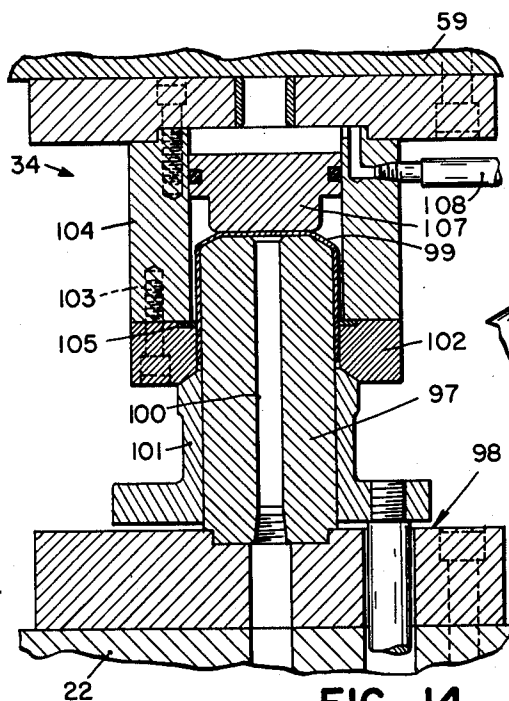


FIG. 13.

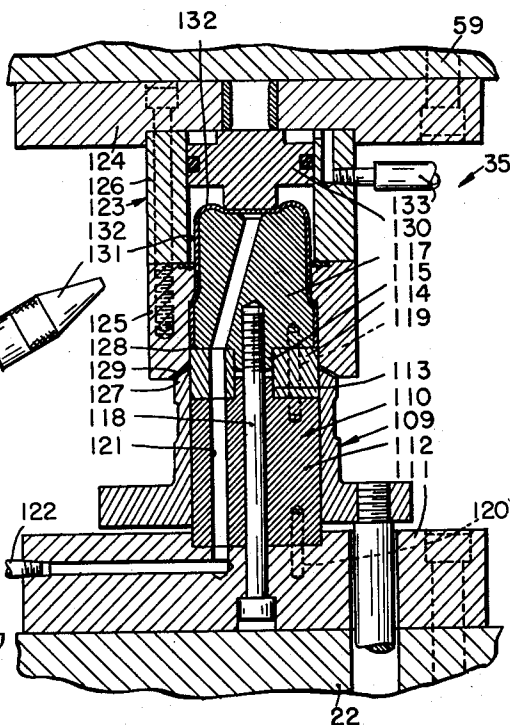
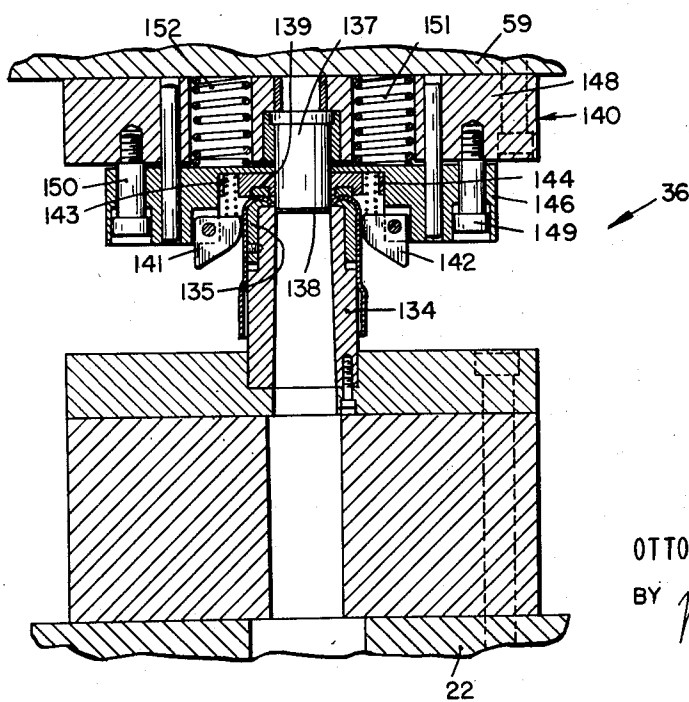


FIG. 14.



INVENTOR
OTTO IMMENROTH

BY *Mary Graham*

ATTORNEYS

UNITED STATES PATENT OFFICE

2,625,896

ROTARY PROGRESSIVE DIE FOR PRESSES

Otto Immenroth, Alhambra, Calif.

Application March 15, 1948, Serial No. 14,863

2 Claims. (Cl. 113—43)

1

The present invention relates to metal forming, and more particularly to the forming of drawn cup-shaped metal pieces by an automatic advance multi-stage die apparatus with controls, grippers, and strippers arranged for automatic operation.

In the draw-forming of deep sheet metal items such as cups, ordnance shells and numerous other items, it is not possible to draw the items to their full depth in a single operation. In such cases the metal is first usually blanked to a form approximating the size and shape required, and then is drawn into a cup shape shallower and wider than its finished form. This cup-shaped member then is re-drawn one or more additional times as required until the finished form is achieved, at which time any excess metal is trimmed off from its rim, and any required additional finishing operations are performed.

I am aware that it is old, for example, in the art of making sewing thimbles, to use a progressive aligned die machine which automatically advances a blank one die at a time, performing successive operations thereon at each working stroke of the machine until the thimble is completed and discharged.

Such a machine, while practical for an operation of this nature, is not adapted for general press shop operations and with a fair-sized blank requiring a fairly heavy draw, it would be difficult to balance off in an ordinary punch or drawing press. Further, it would require a long narrow set up which would not lend itself to the general line of crank type and hydraulic punch or drawing presses found in the average press job shop. The use of such equipment is limited, therefore, to the manufacture of items which are to be produced in such large volume as to warrant building an entire special machine for their production alone.

An object of the present invention is to make an improved and simplified rotary multi-stage drawing die arrangement.

Another object is to make a rotary automatic advance multi-stage die apparatus.

Another object is to make a rotary, automatic advance, multi-stage die apparatus for use on standard punch presses.

Another object is to make a multi-stage drawing arrangement having a plurality of arcuately disposed drawing die members secured to a press bed or bolster, and having a plurality of similarly spaced and disposed cooperating die members mounted on a rotatably movable platen, with coordinated handling and control mechanisms

2

to transpose work piece blanks through successive stages of fabrication upon rotative movement of the platen, and from the final stage thereof to discharge the finished work piece.

Another object is to make an improved multi-stage drawing die apparatus wherein a blank feeding mechanism is coordinated with a rotative die mechanism mounted on a press for relative movement into and out of operative engagement with a cooperating die mechanism, thereby successively to form and advance work piece blanks through successive stages of fabrication at each working stroke of the apparatus.

Another object is to coordinate the movements of a multi-stage die apparatus wherein a plurality of die elements adapted to form successive stages of a progressive die forming operation are located at equal arcuate distances about the axis of a rotatable die assembly, mounted on a drawing press, whereby, between successive operative strokes of the press, work pieces in each stage of fabrication will be advanced one stage, and discharged into starting position for a next successive die operation, a finished work piece being discharged at each stroke of the apparatus.

In order to attain these objects there is provided in accordance with one feature of the invention a plurality of drawing die assembly units mounted in equally spaced arcuate positions about the center of a press bed or bolster plate, the bed of the press having openings therein as required for connecting spring or air cushions to the die units. The platen of the press has a rotary assembly thereon with die elements arranged to cooperate respectively with each of the die base elements mounted on the press bed. The rotary platen assembly is provided with actuating means alternately to rotate and return the platen through an oscillative cycle at the completion of each stroke cycle of the press, gripping, stripping safety and work piece release mechanisms being provided to control the advance of the blanks from one stage of fabrication to the next.

These and other features of the invention will be set forth in detail in the following description and the accompanying drawings, comprising five sheets. In the drawings:

Fig. 1 is a side elevational view of an ordinary hydraulic press, portions of a lower die assembly, a press platen and upper die assemblies, and the press hydraulic operating mechanism being broken away to disclose the structures thereof;

Fig. 2 is a transverse sectional view taken on the plane of the line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken on the plane of the line 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional view taken on the plane of the line 4—4 of Fig. 1;

Fig. 5 is an enlarged fragmentary sectional view taken on the plane of the line 5—5 of Fig. 3;

Fig. 6 is a view in side elevation of a completed work piece made with the set of dies illustrated;

Fig. 7 is an enlarged fragmentary vertical sectional view taken on the plane of the line 7—7 of Fig. 4, showing the first stage dies as they would appear with the platen raised;

Fig. 8 is a similar sectional view of the mechanism of Fig. 7, showing the parts as they appear with the platen partly lowered, and is shown after completion of the blanking operation and at the beginning of the drawing operation;

Fig. 9 is a similar sectional view of the mechanism of Fig. 7, showing the parts as they appear upon completion of the down stroke of the press and showing a scrap cutting operation;

Fig. 10 is a similar sectional view of the mechanism of Fig. 7, showing the parts as they appear with the upper die element raised on a return stroke of the press, and with the completed first stage cup blank retained in the upper die;

Fig. 11 is a sectional view taken on the plane of the line 11—11 of Fig. 4, showing the parts as they would appear with the first stage upper die assembly swung by a rotative movement of a rotary platen to a position over the second stage base die assembly, a cup blank formed in the first stage press operation being shown in retained position in the upper first stage die element in solid lines, and discharged onto the second stage lower die element by a downward stroke of an ejecting piston in dot-dash lines;

Fig. 12 is a fragmentary sectional view also taken on the line 11—11 of Fig. 4, but showing the parts as they appear when the rotary platen is in the position it occupies during a downward or working stroke of the press;

Fig. 13 is a fragmentary sectional view taken on the plane of the line 13—13 of Fig. 4 and showing a third stage die assembly at the completion of a downward stroke of the press; and

Fig. 14 is a similar sectional view taken on the line 14—14 of Fig. 4 and showing a fourth stage die assembly at the completion of a downward stroke of the press.

Referring to the drawings in detail, a plurality of multi-stage drawing dies are shown in Figs. 1, 2 and 4 as mounted on a hydraulic press of a usual type, although the apparatus is of course capable of being mounted on a crank press, as will be apparent to those familiar with the art.

In a press 20 illustrated in Fig. 1, a base 21 has a usual bed or bolster plate 22 with tie columns 23 and head plate 24. A press platen 25 is mounted for slidable movement on the columns 23 and is connected through a usual platen height adjusting screw arrangement 27 to an operating piston 28. The piston is mounted in a usual cylinder 29 and is connected to hydraulic lines 30 and 31 for raising and lowering the platen. A larger hydraulic line 32 opens into the head of the cylinder 29 and is connected to a usual quick release valve and to a low pressure large volume supply of hydraulic fluid for rapidly traversing the piston throughout the portions of the press cycle when no heavy work stresses are encountered. Since such arrangements, and the con-

trols therefor, are well known, it will be unnecessary to explain them in further detail.

The bolster plate 22, as shown in Fig. 4, has the lower die assemblies of four die sets 33, 34, 35 and 36 mounted thereon. These lower dies are mounted with their centers equally spaced on a circular arc, the center of said arc being preferably at the center of the bolster.

The blanking, scrap-cutting, and first stage forming die 33 is mounted at the first stage of the cycle. This first stage die is shown at various points of its operating cycle in Figs. 7—11 inclusive.

A bottom die assembly 38 of the first stage die 33 is mounted on a base shoe 39 which is secured to the bolster 22 by screws 40 (see Fig. 7). Draw cushion push rods 41 are normally held in their upward position by usual springs or an air cushion 42 (see Fig. 1). The threaded upper ends of these rods are screwed into a draw ring 43 which normally is held upwardly against an offset stop 44 formed by the lower inner edge of a blanking die 45. The blanking die is secured, as by screws 47 (see Fig. 7), to an annular support 48 which is secured as by screws 49 to the base shoe 39.

A stock metal guide and stripper plate 50 overlies the upper face of the blanking die 45, and is spaced therefrom a sufficient distance to permit a strip 51 of metal blanking stock to pass between it and the upper face of the blanking die. An inner forming die or mandrel 52 is mounted in a recess on the base shoe 39 by screws 53. The mandrel has a central opening 54 to break the suction under the cup which otherwise would resist stripping of the cup from the mandrel by the draw ring or pressure pad 43 on its upward or return stroke.

An upper first stage die assembly 55 comprises a shoe 57 secured as by screws 58 to a rotatable platen 59 (see Figs. 1, 2 and 7). A cylinder 60 is secured to the shoe by screws 61, and a blanking punch and forming ring 62 is secured to the lower face of the cylinder 60 by screws 63. An annular piston stop ring 64, which preferably is of hard fiber, is mounted in a groove in the inner upper face of the blanking punch and forming ring 62 to limit the downward movement of a work piece ejecting piston 65 which is mounted for movement axially of the cylinder 60. A piston sealing ring 67 is mounted in an annular groove around the piston. The piston has a downwardly projecting central portion 68 to insure ejecting a formed cup-shaped blank 69 when the piston is driven down under pneumatic pressure, after completion of each working stroke of the press and the succeeding advancing rotative movement of the rotary platen 59, as will be brought out later herein.

The side of the first stage lower blanking die 45 toward the center of the press has a straight sharpened edge 70 thereon, which cooperates with a shearing blade 71 mounted on the upper die shoe 57 as by screws 71a (see Fig. 7) to shear off the scrap resulting from each previous blanking operation from the metal of the strip stock 51.

The first stage die set, in moving from its initial open position illustrated in Fig. 7, to that shown in Fig. 8, punches out a disc blank 72 from the metal of the stock strip 51 and grips the marginal edge portion of this disc blank between the draw ring 43 and the blanking punch and forming ring 62. Further continued downward movement of the first stage upper die assembly draws the blank downwardly over the forming mandrel 52. The forming ring 62 is spaced from the mandrel 52 a distance equal approximately to

5

the thickness of the metal being drawn. This forms the metal of the blank closely over the mandrel in the usual manner. The lower edge portion of the blank, being gripped between the pressure pad and the lower face of the forming die, assists in this draw-forming operation.

The first stage dies are shown in their fully closed position in Fig. 9, at which point the shearing blade 71 severs a previously punched portion of scrap 73 from the stock strip. This severed scrap drops into a scrap chute 74 (see Fig. 4) and passes downwardly through a central opening 75 provided therefor in the bolster plate. From here the scrap may be caught in a tote box or be carried by suitable conveyor means in a usual manner to a disposal area.

Upon completion of the downward stroke of the press, the direction of press movement is reversed in the usual manner, as by a switch mounted to be actuated by the press at its limit of downward movement and reverse the flow of hydraulic liquid into the press cylinder on opposite sides of the piston. Such valve control switches are customarily employed for performing various functions on presses, and it is believed unnecessary to illustrate this and similar switches and their associated air and hydraulic valves employed in the present apparatus, in detail.

After each working stroke of the press, the first stage formed cup blank 69 will be forced upwardly by the pressure pad 43, stripping the cup from the mandrel and holding it in the upper die, where it is retained by friction against the inner side of the forming ring 62 and the fiber piston stop ring 64.

As the press platen reaches its upper limit of movement, it operates a hydraulic valve control switch 78 in a usual manner to admit hydraulic fluid under pressure to the outer ends of two hydraulic cylinders 79 and 80 (see Figs. 1 and 3). These hydraulic cylinders are of a usual two-way type, and are pivotally mounted on pivot pins 81 and 82 respectively. Plungers 83 and 84 of these two hydraulic cylinders have their outer ends pivotally connected to a rotary platen oscillating plate 89 which is secured to the rotary platen 59 (see Figs. 1 and 2) through a central bearing 90, which mounts the rotary platen for rotative movement closely beneath the press platen.

The normal position of the rotary platen during a working stroke of the press is shown in Fig. 2, with the upper die assembly of each die stage located directly over its associated lower die assembly. As illustrated in Figs. 2 and 4, the centers of the die assemblies of the different stages around both the platen and the bolster plate may be separated from each other by angular distances of approximately 72°. The admission of hydraulic fluid under pressure to the outer ends of the hydraulic cylinders 79 and 80 through hydraulic lines 91 and 92 (see Fig. 3) extends the plungers of these cylinders and advances the rotary platen 59 through this angular distance. The return stroke of the hydraulic cylinders upon the admission of hydraulic fluid under pressure through lines 93 and 94 returns the platen to its normal position. Further details of the structure of the rotary platen and the manner of its support and limitation of its rotatable movement will be set forth in detail later herein.

The advance rotation of the rotary platen through the angular distance which separates the different die sets on the bolster moves the upper die assemblies of each of the first three stages

6

of dies into vertical register with the lower die assembly of the next successive stage on the bolster and moves the upper fourth stage die assembly over a discharge chute 147. Thus, at the completion of each advance rotative movement of the rotary platen the upper die assembly of the first die set will be in vertical alignment with the lower die assembly of the second die set, as shown in Fig. 11, and the cup-shaped first stage blank 69 will be held in the upper die assembly as shown in solid lines in Fig. 11.

Upon completion of the advance rotative movement of the rotary platen, a control of a usual type is operated to open a valve controlling the admission of compressed air through a line 95 (see Fig. 7). This admits compressed air into the cylinder 60 over the piston 65, driving the piston 65 downwardly to the dotted line position shown in Fig. 11, and ejecting the cup-shaped first stage work piece 69 which drops vertically onto a forming mandrel 97 of a second stage lower die assembly 98. The cup-shaped first stage work piece has its closed end upset as at 99, so that it will tend to center the cup blank from the first stage die set as it drops onto the forming mandrel 97 of the lower second stage die assembly.

It is common practice to introduce air into the area directly above a formed work piece, but such a manner of ejection has two objectionable features. One, if the work piece is split in forming so that the split portion is exposed to the compressed air, the air will escape through the split and the piece will fail to eject. The other objectionable feature lies in the fact that if the work piece should stick in the die, a considerable pressure may be built up behind it so that when it is ejected it travels with considerable velocity and may be damaged by impact. Since the propulsive action of the piston stops shortly after the work piece is released from the die, no great velocity can be developed in the work piece, and the piston ejects split work pieces as effectively as it does sound ones.

The second stage die set 34, as shown in Fig. 12, includes the central forming mandrel 97 and has an axial suction breaking air opening 100 therethrough in the same manner as the first stage mandrel. A pressure pad 101 is mounted slidably over the mandrel 97, the upper edge of this draw ring being sloped to engage a similarly sloped lower face of an upper annular drawing die 102. This drawing die 102 is secured, as by screws 103, to a cylinder 104.

A fiber piston impact ring 105 is mounted similarly to that of the first stage die assembly to receive the impact of an ejecting piston 107 at the limit of its downward movement. A compressed air line 108 is connected to open into the space above the piston 107 to drive it downwardly to eject the second stage blank at the completion of each advancing movement of the rotary platen. This second stage die assembly is shown at the downward limit of press movement in Fig. 12, as is also a third stage drawing and trimming die set which is shown in Fig. 13.

This third stage die set comprises a lower die assembly 109, a forming mandrel assembly 110 of which is mounted on a base shoe 111. The forming mandrel assembly comprises a lower portion 112 with a reduced neck portion 113 extending upwardly centrally thereof. A squeeze ring or trimming die 114 is mounted over this neck, and receives a downwardly extending neck

portion 115 of an upper forming die or mandrel portion 117.

The mandrel parts are secured against rotation and to the base shoe 111 as by a central bolt 118 and positioning pins 119 and 120. An offset passage 121 for compressed air for stripping is provided through the mandrel, and is connected to a compressed air line 122. Compressed air is admitted through the line 122 at the beginning of each return stroke of the press by usual type controls to strip the formed work piece from the mandrel.

An upper third stage die assembly 123 has a cylinder 126 mounted on a shoe 124 secured to the rotary platen. An annular forming and trimming die 125 mounted on the lower end of the cylinder has the lower edge thereof sloped to conform with the slope of the upper face of a draw ring 127. This third stage die set has a double drawing and forming action in that the upper portion of the die at 125 is offset inwardly to iron the metal of the blank inwardly over the reduced upper end of the mandrel 110. As the upper die assembly approaches its lower limit of movement, the inner lower edge of the forming and trimming die passes over the upper shearing edge 128 of the ring 114, thereby shearing or squeezing and severing any metal projecting below this point. This severed metal 129, shown gripped between the draw ring 127 and the lower sloping face of the drawing and trimming die 125, is carried downward as illustrated in Fig. 13 to the full downward movement of the upper die assembly. The lower end of an ejecting piston 130 is formed to enter a recess in the top of the mandrel 110 to form a depression in the upper end of the cup-shaped blank at the bottom of the press stroke. On return of the upper die to its raised position, the draw ring 127 carries the severed trim piece 129 upwardly to a point laterally adjacent a nozzle 131 which is connected to a source of compressed air through a valve, not shown, which opens momentarily as the platen approaches the upper end of its stroke to blow the trim piece 129 off the mandrel and into the scrap opening in the bolster.

During the upward movement of the platen, compressed air is admitted through the passage 121 in the mandrel, thereby forcing the cup-shaped third stage work piece 132 upwardly and retaining it in the upper die assembly. When the rotary platen is advanced as the press reaches its upper limit of movement, compressed air is admitted through a line 133 to the interior of the cylinder 126 above the upper face of the ejecting piston 130 which operates in the manner previously described to eject the blank 132 and drop it downwardly into position over a fourth stage die mandrel 134.

A lower die assembly of the fourth stage die set has a punching die 135 mounted on the mandrel 134. A punch 137 is mounted in the upper die assembly to punch a central blank 138 out of the cup. A lettering die 139 is mounted in a recess in an upper die assembly 140 to imprint suitable lettering into the curved upper rim of the cup. Since the punching of the central opening in the end of the cup prevents the use of air stripping means, a pair of cam gripping fingers 141 and 142 are pivoted in the upper die assembly to grip the completed work piece and raise it upwardly on each return stroke of the press. Each of these cam gripping fingers is resiliently urged downwardly about its pivot by light coil springs 143 and 144. At the limit of

advance rotary movement of the platen, these cams are arranged to pass between a pair of inwardly sloping cam release arms 145 which swing the lower ends of the cams inwardly, separating their cup gripping faces, and thereby release the completed work piece, permitting it to drop into the discharge chute 74 (see Fig. 4).

An upper die shoe 148 of this fourth stage die set has a block 146 mounted for limited vertical slidable movement thereon on supporting pins 149 and 150. The block 146 is spring pressed by strong springs 151 and 152 to permit flexing under the impact of the lettering die and thus prevent damage to the lettering die.

The rotary platen 59 shown in Figs. 1 and 2 comprises a heavy steel disc which is mounted in the bearing 90 to bear against the lower face of the press platen and to rotate with the central bearing 90 and hydraulic cylinder actuated oscillating plate 89, as previously described. The rotary platen 59 is supported marginally by the three support plates 153, 154 and 155 which are secured, as by bolts 157, to the platen 25 of the press. Each of these support plates 153, 154 and 155 is spaced from the platen of the press as by spacer blocks 158 (see Fig. 1) of sufficient thickness to provide a working clearance to permit oscillation of the rotary platen. The inner faces of these spacers are arcuately formed to register with the periphery of the rotary platen.

A pair of stop plates 160 and 161 are mounted on the rotary platen to engage opposite ends of one of the platen support plates to limit the rotative movement of the rotary platen under the impulses of the hydraulic cylinders 79 and 80. A spacer 162 of suitable width may be inserted adjacent the stop plate 160 to provide accurate adjustment of the limit of movement of the rotary platen.

A safety locking lug 163 is mounted slidably in an opening 164 in the press platen 25. A hole 165 in the rotary platen 59 is located to register with the opening 164 when the rotary platen is returned to proper position for a working stroke of the press. At the upper limit of press movement the locking lug 163 is raised upwardly by the admission of hydraulic fluid through a lower hydraulic line 167 into a hydraulic cylinder 168 controlling the movements of the locking lug 163. When thus raised, the lower end of the lug clears the rotary platen and permits it to rotate under the impulse of the hydraulic cylinders 79 and 80. Prior to the initiation of a downward or working stroke of the press platen, however, hydraulic fluid is introduced into the cylinder 168, through an upper hydraulic line 169, forcing the locking lug 163 downwardly. If the rotary platen is in proper position for initiation of a working stroke of the press, the locking lug will be free to move downwardly into platen locking position. In this position the lower end of the locking pin projects slightly below the rotary platen and actuates a microswitch 170 which controls admission of hydraulic fluid to the press cylinder. Thus, an actual working stroke of the press cannot be initiated unless the rotary platen is in proper position for the initiation of such stroke.

There is thus provided a simple, easily arranged multiple stage die stamping and forming apparatus which can be incorporated in a usual type of press so as to provide a low cost, high production output of even relatively large stampings without the necessity for special and expensive machines. The apparatus is capable of various modifications which will readily occur to the

skilled die designer and die maker, the particular set of dies illustrated being merely for the purpose of clearly illustrating one embodiment of the invention. It is desired, therefore, not to limit the invention except as set forth in the following claims.

I claim:

1. A rotary multiple stage drawing die mechanism for presses, comprising, in combination with a press having a press bolster and a press platen movable toward and away from each other, a rotary platen mounted closely adjacent said press platen, a plurality of forming die elements mounted in a circular arc on said press bolster, a plurality of similarly spaced cooperating die elements mounted similarly on said rotary platen, said rotary platen having a normal position and a rotatably advanced position, said die elements on the rotary platen each comprising a cylinder, a work piece ejecting piston in the cylinder, a forming ring on the end of the cylinder, a work retaining ring projecting inwardly of the cylinder wall and forming ring wall and positioned between the cylinder and forming ring, said work retaining ring being adapted to retain a formed work piece and act as a stop for said piston, and means for introducing a supply of compressed air to each of said ejecting pistons at the advanced position of said rotary platen.

2. In a press having a bolster plate, a head plate and a movable platen, a rotary platen mounted on the movable platen facing said bolster plate, a rotary platen oscillating plate on the side of the movable platen opposite said rotary platen, bearing means rigidly connecting the rotary platen and oscillating plate, and a fluid operated piston and cylinder means pivotally mounted at one end on said movable platen and at the other on said oscillating plate at a point thereon outwardly of the center thereof.

OTTO IMMENROTH.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
311,034	Ring	Jan. 20, 1885
778,210	Anderson	Dec. 27, 1904
2,173,358	Ernst	Sept. 19, 1939
2,190,821	Broomham	Feb. 20, 1940
2,301,682	Candee	Nov. 10, 1942
2,341,667	Stacy	Feb. 15, 1944
2,377,097	Norris	May 29, 1945
2,382,041	Ernst	Aug. 14, 1945