

Feb. 27, 1962

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3,022,758

DIE SET FOR DRAWING AND SHAPING SHEET METAL

Filed Dec. 30, 1957

2 Sheets-Sheet 1

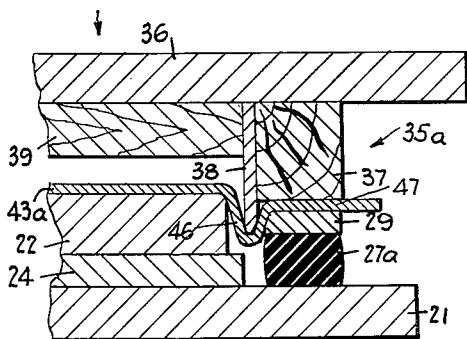
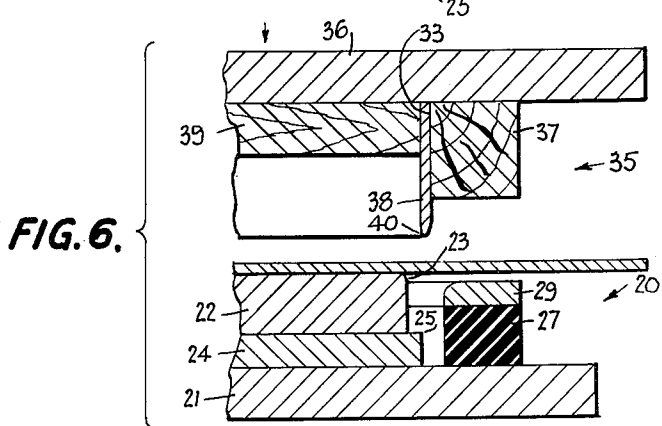
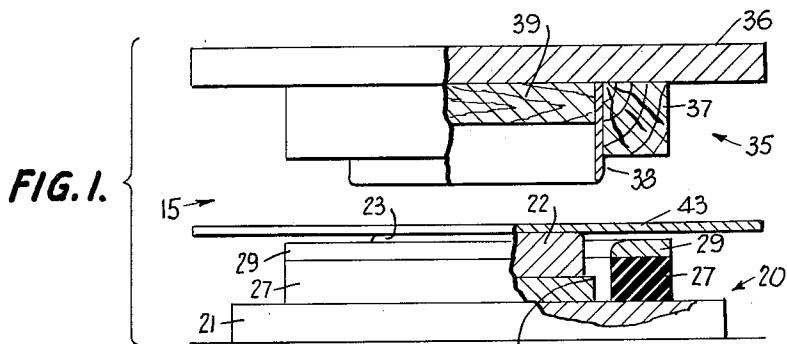


FIG. 7.

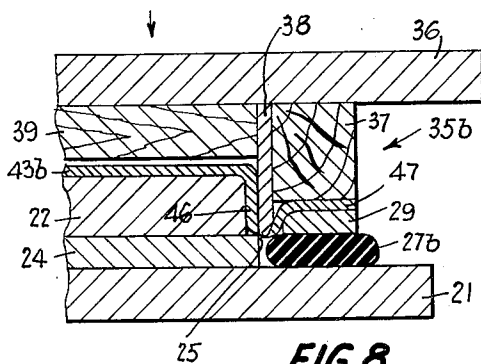


FIG. 8.

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2 Sheets-Sheet 2

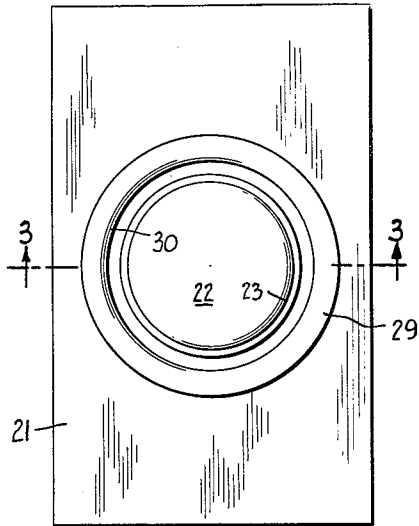


FIG. 2.

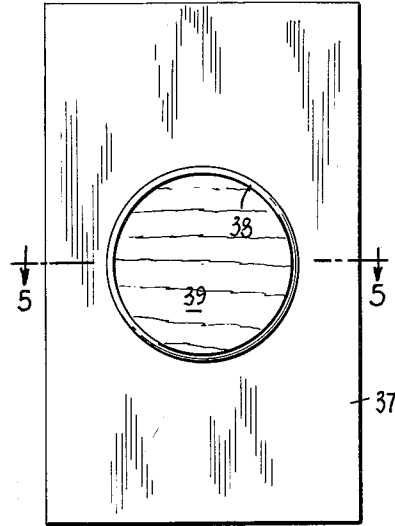


FIG. 4.

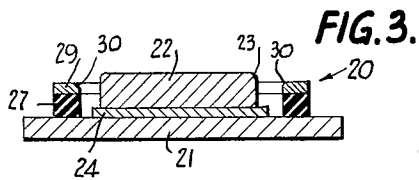


FIG. 3.

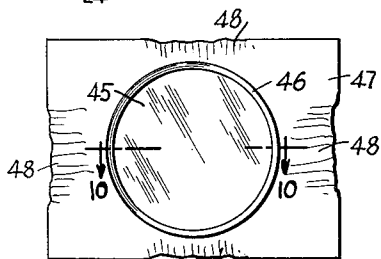


FIG. 9.

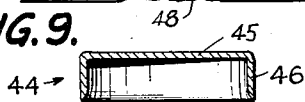


FIG. 10.

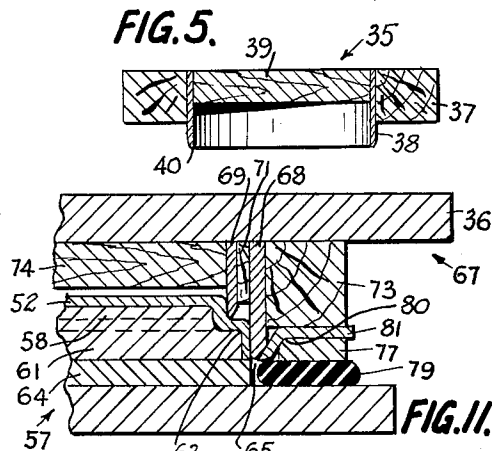


FIG. 5.

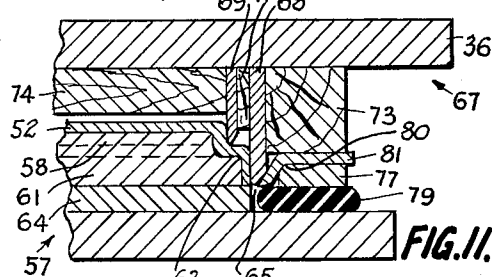


FIG. 11.

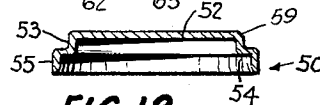


FIG. 12.

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3,022,758 DIE SET FOR DRAWING AND SHAPING SHEET METAL

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9 Claims. (Cl. 113-46)

This invention relates to machine tools and, more particularly to a die set for drawing metal blanks.

Recently developed methods for blanking metal sheet by means of rule die sets, wherein the rule dies have been set in plywood or resinous material, have proven the usefulness, economy, and efficiency of such rule dies for that purpose. It is an object of the present invention to provide a rule die set built along the same principle, but which may also be used for drawing, or drawing and blanking sheet metal with a minimum amount of wrinkles and puckers which are ordinarily encountered during the drawing of metal with any type of die set.

Another object of the present invention is to provide a draw die with steel rules set in plywood or resinous material, and used in connection with a retaining draw ring for drawing or both drawing and blanking sheet metal.

Another object of the present invention is to provide a draw ring for die sets having novel mounting means for effectively distributing the drawing pressure to the blank and for preventing a large proportion of wrinkles and puckers from forming in the blank during such drawing process.

Still another object of the present invention is to provide a combination rule die set which may be used to provide complex drawn shapes and for automatically blanking the drawn shape from the blank after the drawing operation.

Still a further object of the present invention is to provide a combined draw ring and stripper plate for die sets that is responsive to the movement between the male and female die members to first prevent the formation of wrinkles and puckers in the metal blank and to then strip the waste material from the assembly.

Still a further object of the present invention is to provide a die set having a draw ring which is movable with the female die member relative to the punch during the drawing operation for providing effective control of the blank metal flow so as to prevent the formation of wrinkles and puckers in the metal as the male and female die members move relative to each other.

All of the foregoing and still further objects and advantages of this invention will become apparent from a study of the following specification, taken in connection with the accompanying drawing, wherein:

FIG. 1 is a front elevational view, with parts broken away, of a die set made in accordance with the present invention.

FIG. 2 is a plan view of a male die member and draw ring forming a part of the present invention.

FIG. 3 is a transverse cross-sectional view taken along line 3-3 of FIG. 2.

FIG. 4 is a plan view of a female rule die member forming a part of the present invention.

FIG. 5 is a transverse cross-sectional view taken along line 5-5 of FIG. 4.

FIG. 6 is an enlarged fragmentary cross-sectional view of the apparatus shown in FIG. 1, with the parts in an initial operating position.

FIG. 7 is a view similar to FIG. 6, showing the parts in an intermediate position.

FIG. 8 is a view similar to FIG. 7, showing the parts

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in a final operative position prior to the return thereof to the initial position of FIG. 6.

FIG. 9 is a plan view of a metal blank which has been drawn by the apparatus made in accordance with the present invention, prior to removal of the waste material from the peripheral edges thereof.

FIG. 10 is a transverse cross-sectional view taken along line 10-10 of FIG. 9, with the waste material removed.

FIG. 11 is a view similar to FIG. 8 of the drawing, illustrating a modified form of die set that is operative to draw and blank more complicated shapes.

FIG. 12 is a view similar to FIG. 10, showing the shape of a member drawn and blanked by apparatus constructed in accordance with the invention illustrated in FIG. 11.

Referring now to the drawing and more particularly to FIGS. 1 to 10 thereof, a die set 15 made in accordance with one form of the present invention is shown to include a so-called male die unit 20 and a female die unit 35. The male unit 20 includes a lower shoe 21, upon which a blanking plate 24 is secured. This plate 24 has a cutting edge 25 for blanking the metal blank in a manner hereinafter described. A male punch 22 having a beveled upper edge 23 is symmetrically arranged upon the top of the blanking plate 24 and secured thereto.

A retaining draw ring 29, having an inwardly facing upper bevelled or rounded edge 30 of substantially the same shape as that defined by the punch plate 22 but of slightly larger size, is supported upon a resilient or movable stripper pad 27. The retaining draw ring is initially disposed at approximately the same level as the top of the punch 22, as is more clearly shown in FIG. 6 of the drawing.

The female die unit 35 is in the form of a rule die member that is secured to and carried by the upper shoe 36 of the die set. This rule die includes a main mounting board 37 having a central cut-out 33 within which the steel rule 38 is positioned. A filler plug 39 is secured within the steel rule 38 for rigidly supporting the steel rule in a manner well known to those skilled in the art. The steel rule 38, which has a bevelled or rounded inside edge 40 of the same size and shape as the blanking plate edge 25 is of correspondingly larger size than the punch plate 22. Insofar as relative sizes and dimensions are concerned, it is to be noted that the distance between edge of the steel rule and the periphery of the punch 22 is substantially the thickness of the metal blank 43, as is the distance between the outer peripheral edge of the steel rule 38 and the inner peripheral edge of the retaining draw ring 29. In other words, the distance between the punch 22 and draw ring 29 must be substantially as great as the sum of the thickness of the steel rule 38 and of a size to admit twice the thickness of the blank being drawn, whereby as will be apparent the comparatively frail steel rule 38 is supported against lateral deflection on both sides thereof during the drawing operation. Furthermore, the radius of curvature of the bevelled edge 39 of the draw ring 29 is substantially the radius of curvature of the bevelled edge 23 of the punch 22.

The die set shown in FIGS. 1 to 8 is operative to draw and blank the cup 44 illustrated in FIGS. 9 and 10, which has a base 45 and deep flange 46. With the parts in the initial position shown in FIG. 6 of the drawing, the metal blank 43 overlies the top of the punch 22 and draw ring 29. As the rule die member 35 moves downwardly to an intermediate position 35a, a blankholder pressure is imparted upon the peripheral portions of the blank through the clamping action of the mounting board 37 and the retaining drawing 29 to enable the rule 38 to form the flange 46 of the work piece. The movable stripper pad 27 is accordingly compressed or raised and depressed

or lowered to a lower plane 27a, thus enabling the retaining draw ring 29 to move a substantial distance with the female unit 35 relative to the male unit 20. Upon continued downward movement of the female unit 35a to the extreme position 35b, a steel rule 33 is operative to sever the waste material 47 from the work piece 43b through the cooperation of the blanking edge 25 of the blanking plate 24 to thus complete the drawing and blanking operation. Of course, the movable or resilient stripper pad 27a is further compressed and depressed to the final position 27b which enables the draw ring 29 to follow the final movements of the female die unit 35b. Thus, upon the return movement of the female die unit 35b to the initial position 35, the expansion of the stripper pad 27b to the initial position 27 will also strip the waste metal 47 from the unit. Since the movement of the draw ring 29 within the female die unit relative to the male die unit provides for better control of the blank holder pressure, any wrinkles or puckers 48 are confined to the waste material 47 and do not enter the finished product 44.

By applying the aforementioned principles, still further advanced and more complex shapes may be formed, such as that illustrated in FIGS. 11 and 12. The work piece 50 is formed with a base 52, a first flange 53, an offset 54, and a second larger diameter flange 55. This member is drawn and blanked with the apparatus shown in FIG. 11 in which the male unit 57 includes a main punch 58 having a beveled peripheral edge. The main punch 58 is supported upon or is integral with an auxiliary punch plate 61 of larger dimensions having a similar beveled edge 62. Finally, a blanking plate 64 of still larger dimensions is disposed beneath the drawing punches and has a sharp peripheral edge 65.

The female rule die unit 67 has a mounting board 73 within which the main drawing and blanking rule 63 of the same size and shape as the edge 65 of the blanking plate 64 is supported. An auxiliary forming or drawing rule 69 is substantially the same size and shape as the associated drawing plate 61 is disposed within and spaced from the main rule 63 by means of a filler or spacer member 71 which may be of any desired material, such as a laminated impregnated band. These rules are further secured within the mounting board 73 by a filler plug 74 which provides the necessary clamping action therewith. The retaining draw ring 77 having an inwardly facing beveled or curved edge 80 is carried upon the top of a resilient or movable pad 79 which exerts a sufficient controlling blank holder pressure during the drawing and blanking of the blank, and which strips the waste material 81 from the assembly after each operation. It will thus be recognized that as the male and female die units move toward each other, the main forming rule 63 will first contact the blank, following which the auxiliary rule 69 will contact the initially formed parts of the blank, so as to draw the material into the complex cross-sectional shape illustrated. Finally, as the main forming rule 63 passes the edge 65 of the blanking plate 64, the waste material 81 will be severed from the work piece. In the manner hereinbefore described, the movement of the draw ring 77 with the female die unit 67 relative to the male die unit 57 is operative to control the wrinkles and puckers in the metal blank so as to confine them to the waste material and out of association with the formed work piece.

While this invention has been described with particular reference to the construction shown in the drawing, it is to be understood that such is not to be construed as imparting limitations upon the invention, which is best defined by the claims appended hereto.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. A draw die set for working on sheet stock, said set comprising:

a male die member;

a female die member;

means supporting said members for relative movement toward and away from a mutually telescoped position;

said male die member comprising a rigid punch;

said female die member comprising a rule die with an

operative edge defining a hollow closed shape;

said female die further comprising a support for said rule die including a first portion circumferentially surrounding and abutting the outer face of said rule die, and a second portion within the rule die and abutting the inner face of said rule die, said first portion projecting downwardly below the bottom face of said second portion;

the shape of said rule die being similar to the shape of said rigid punch and of a uniformly larger size to define a space therebetween when said male and female die members are in mutually telescoped position;

a retaining draw ring encircling said rigid punch and having a central opening of a shape similar to and uniformly larger than said rule die;

said rigid punch and retaining draw ring defining therebetween a space for receiving the full thickness of said rule die when said male and female die members are in mutually telescoped position;

the space between said rule die and said rigid punch being at least about equal to the thickness of the sheet stock when said male and female die members are in mutually telescoped position;

the space between said rule die and said retaining draw ring likewise being at least about equal to the thickness of the sheet stock when said male and female die members are in mutually telescoped position;

and means supporting said retaining draw ring for yieldable movement relative to said punch in response to engagement by the circumferential portion of the female die member therewith during relative movement of said male and female die members toward mutually telescoped position.

2. A draw die set as set forth in claim 1 wherein the draw ring supporting means is resilient.

3. A draw die set as set forth in claim 2 wherein the space between the rigid punch and the draw ring is equal to at least the sum of the thickness of said rule and twice the thickness of the blank to be drawn.

4. A draw die set as set forth in claim 3 wherein the working edge of the rigid punch is tapered or radiused.

5. A draw die set as set forth in claim 4 wherein the working edge of the rule die is tapered on the side facing the draw ring.

6. A draw die set as set forth in claim 2 wherein the male die member comprises a multiple edge punch for forming a plurality of flanges in said blank, said punch having axially aligned working edges increasing in size in a direction away from said female die member, and said female die member includes a similarly shaped forming rule for each of said flange forming edges.

7. A draw die set as set forth in claim 1 wherein there further is provided a blanking plate beneath the rigid punch for shearing cooperation with the rule die.

8. A draw die set for working on sheet stock, said set comprising:

a male die member;

a female die member;

means supporting said members for relative movement toward and away from a mutually telescoped position;

said male die member comprising a rigid punch;

said female die member comprising a rule die with an

operative edge defining a hollow closed shape;

said female die further comprising a support for said rule die including a first portion circumferentially surrounding and abutting the outer face of said rule die, and a second portion within the rule die and abutting the inner face of said rule die, said first por-

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tion projecting downwardly below the bottom face of said second projection;

the shape of said rule die being similar to the shape of said rigid punch and larger at at least one portion to define a space therebetween when said male and female die members are in mutually telescoped position;

a retaining draw ring encircling said rigid punch and having a central opening of a shape similar to and uniformly larger than said rule die;

said rigid punch and retaining draw ring defining therebetween a space for receiving the full thickness of said rule die when said male and female die members are in mutually telescoped position;

the space between said rule die and said rigid punch at said one portion being at least about equal to the thickness of the sheet stock when said male and female die members are in mutually telescoped position;

the space between said rule die and said retaining draw ring being at least about equal to the thickness of the sheet stock when said male and female die members are in mutually telescoped position;

and means supporting said retaining draw ring for yieldable movement relative to said punch in response to engagement by the circumferential portion of the

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female die member therewith during relative movement of said male and female die members toward mutually telescoped position.

9. A draw die set as set forth in claim 8 wherein said male die member comprises a multiple edge forming punch for forming a plurality of flanges of said blank, said punch having axially aligned working edges increasing in size in a direction away from said female die member, and said female die member including a similarly shaped forming rule for each of said flange forming edges.

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