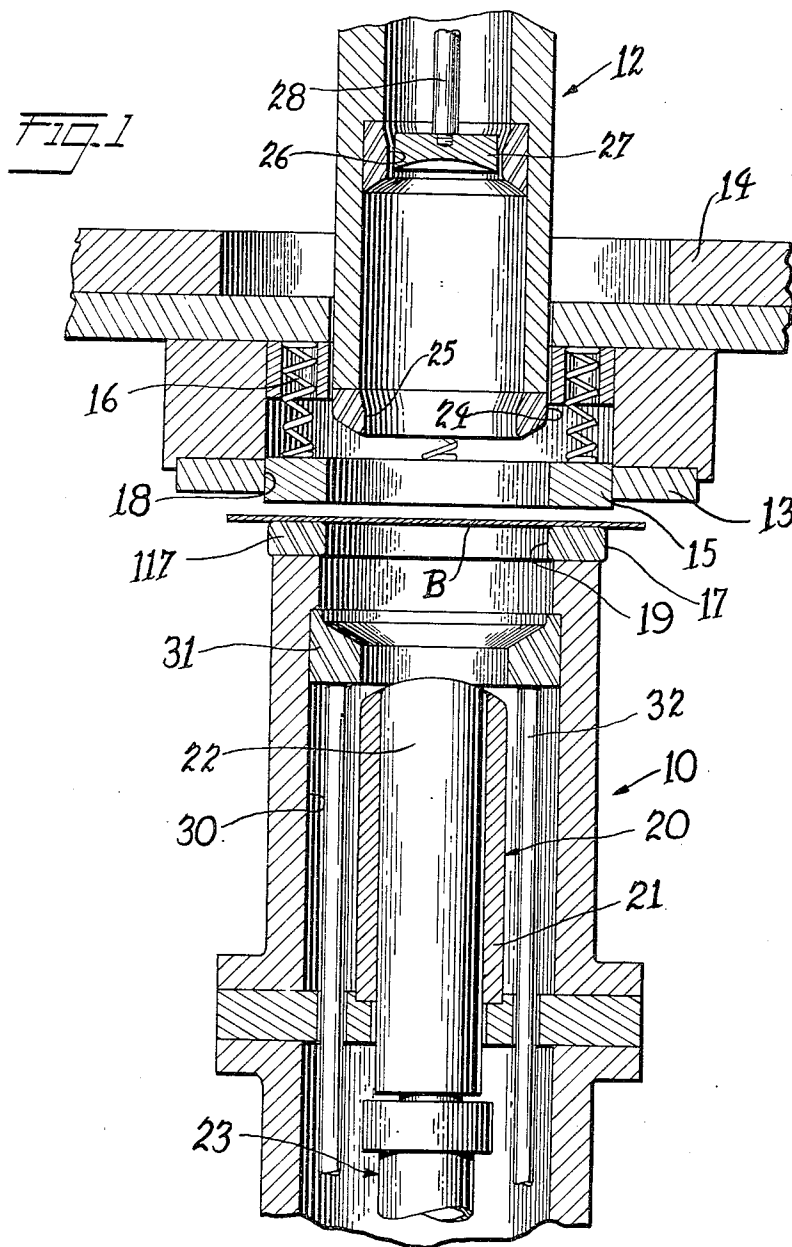


Filed May 25, 1954

DIE FOR DRAWING SHEET MATERIAL

7 Sheets-Sheet 1



BY

BY *Thomas M. Williams*
ATTORNEY

Sept. 4, 1956

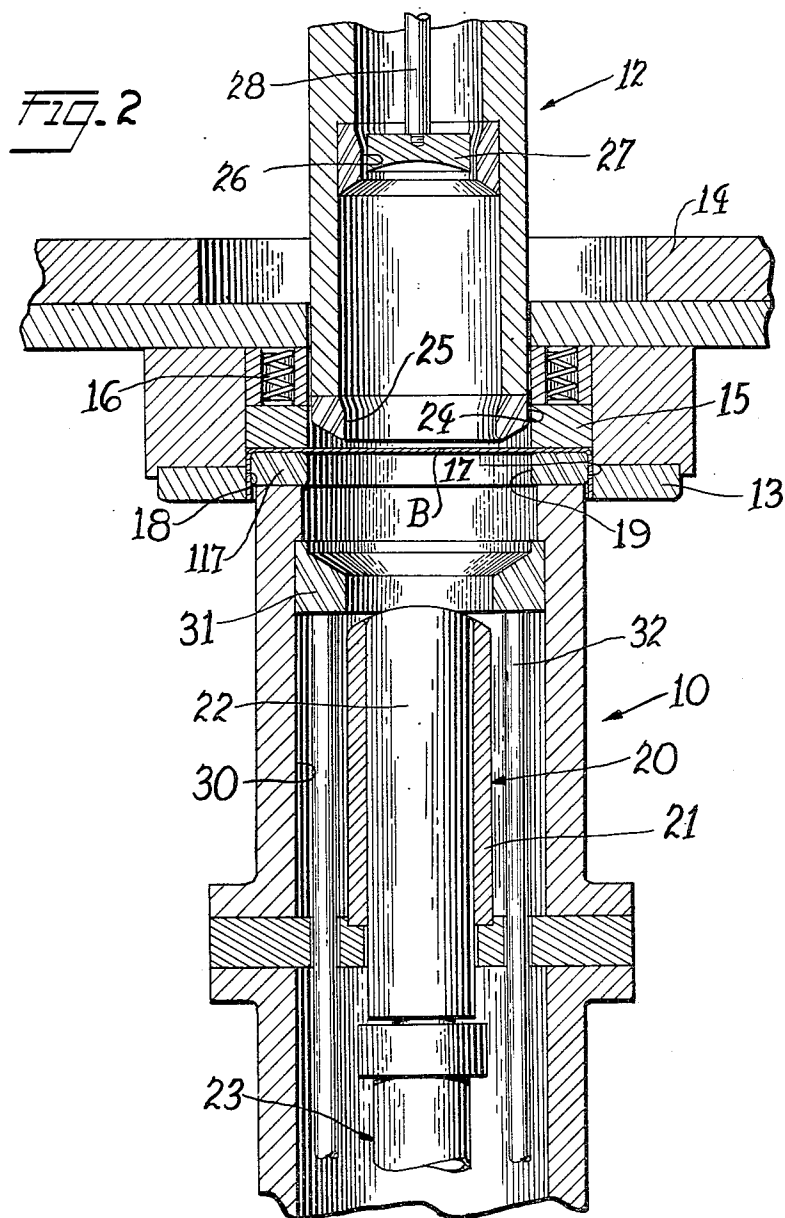
M. S. SCHNELL

2,761,406

DIE FOR DRAWING SHEET MATERIAL

Filed May 25, 1954

7 Sheets-Sheet 2



INVENTOR.
MICHAEL S. SCHNELL
BY

Michael Williams
ATTORNEY

Sept. 4, 1956

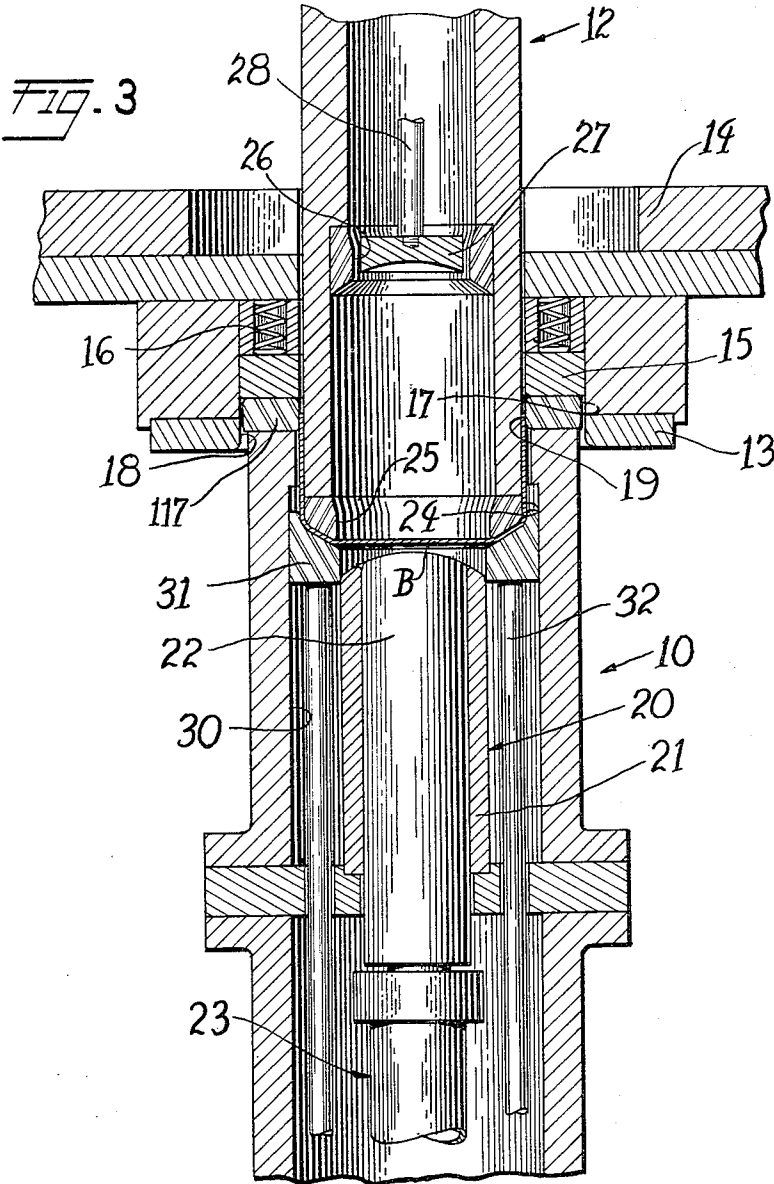
M. S. SCHNELL

2,761,406

DIE FOR DRAWING SHEET MATERIAL

Filed May 25, 1954

7 Sheets-Sheet 3



INVENTOR.
MICHAEL S. SCHNELL
BY
Michael S. Schnell
ATTORNEY

Sept. 4, 1956

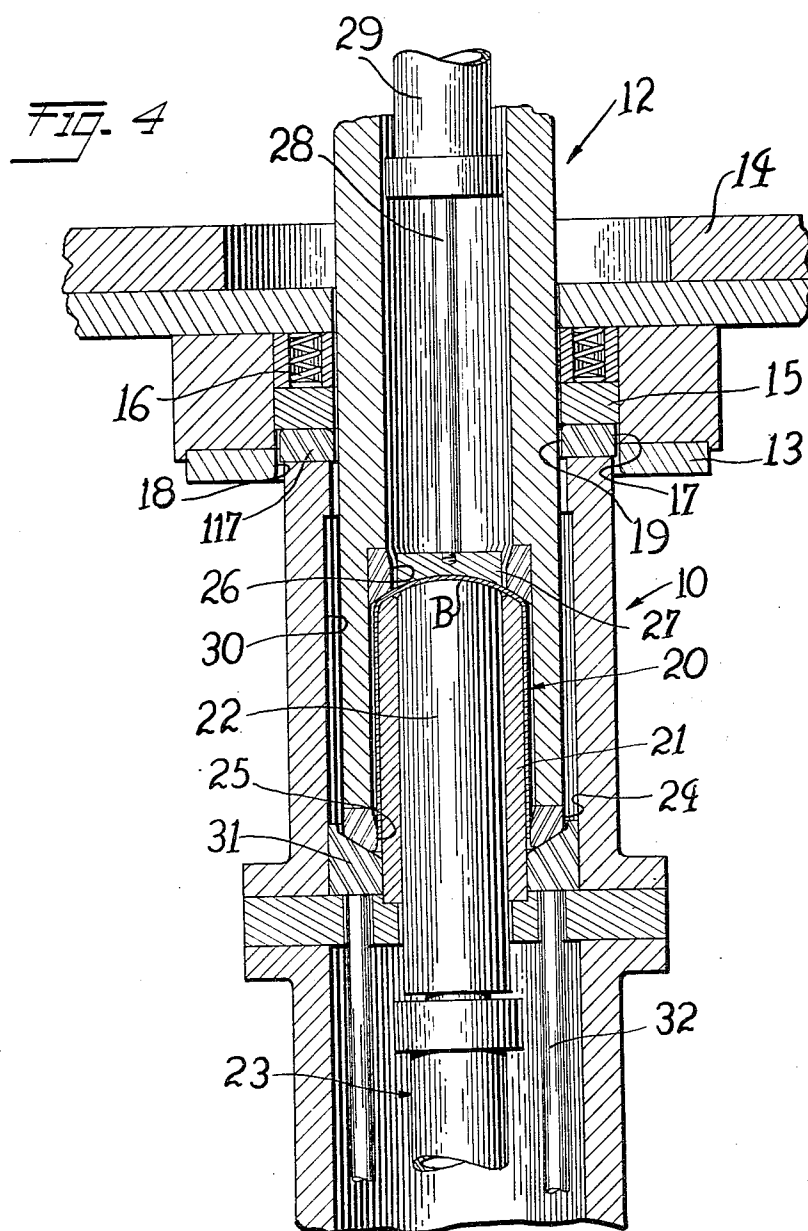
M. S. SCHNELL

2,761,406

DIE FOR DRAWING SHEET MATERIAL

Filed May 25, 1954

7 Sheets-Sheet 4



INVENTOR.

MICHAEL S. SCHNELL

BY

Michael S. Schnell

ATTORNEY

Sept. 4, 1956

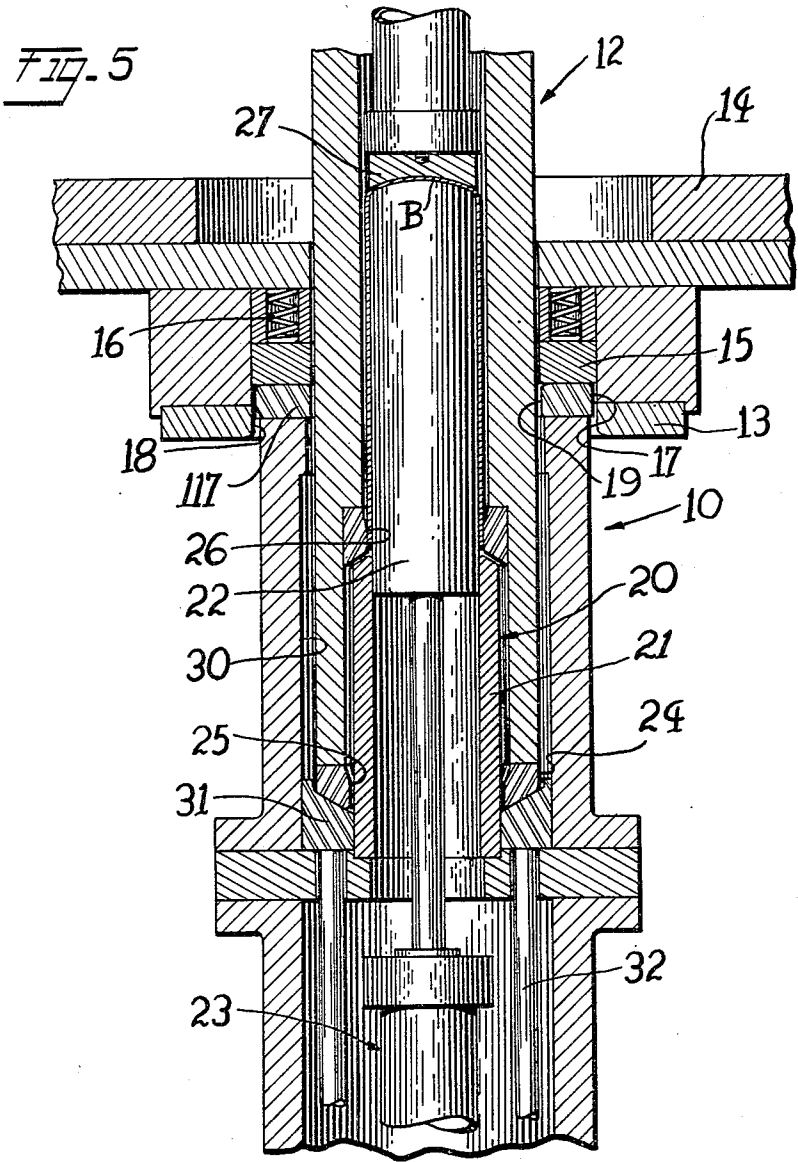
M. S. SCHNELL

2,761,406

DIE FOR DRAWING SHEET MATERIAL

Filed May 25, 1954

7 Sheets-Sheet 5



INVENTOR.
MICHAEL S. SCHNELL
BY *Michael S. Schnell*
ATTORNEY

Sept. 4, 1956

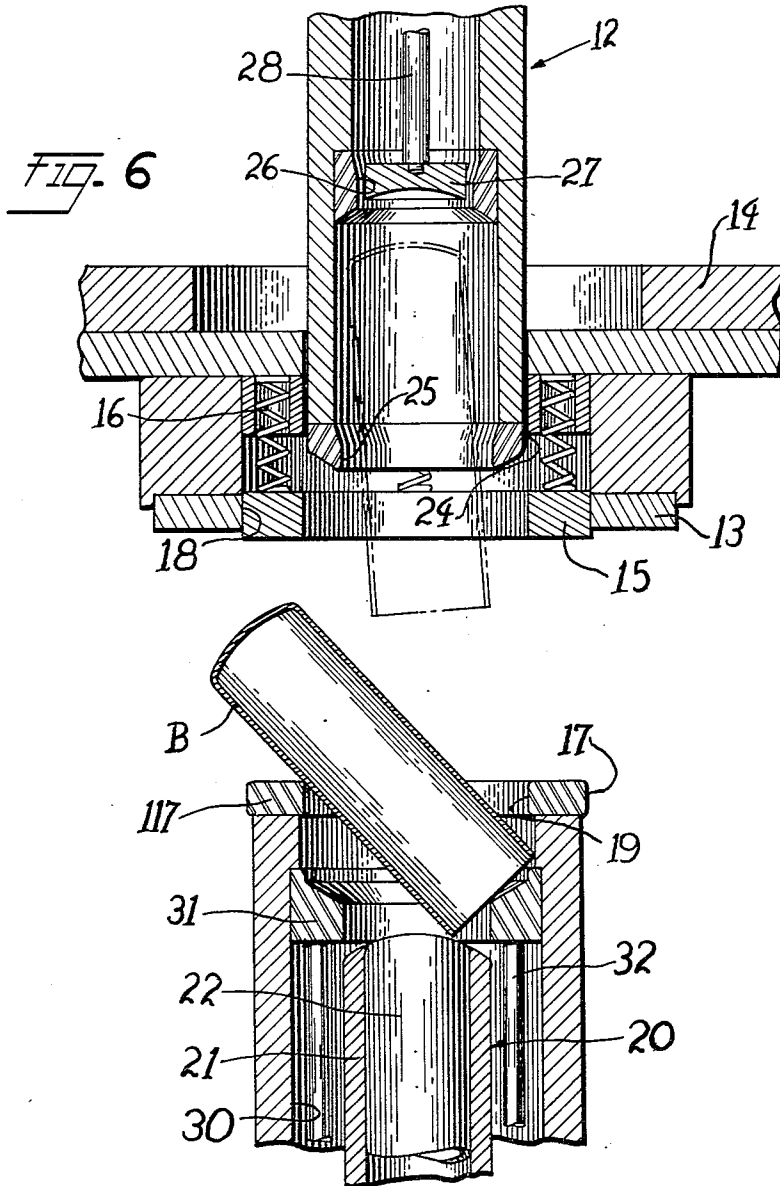
M. S. SCHNELL

2,761,406

DIE FOR DRAWING SHEET MATERIAL

Filed May 25, 1954

7 Sheets-Sheet 6



INVENTOR.
MICHAEL S. SCHNELL
BY
Archibald McIlwain
ATTORNEY

Sept. 4, 1956

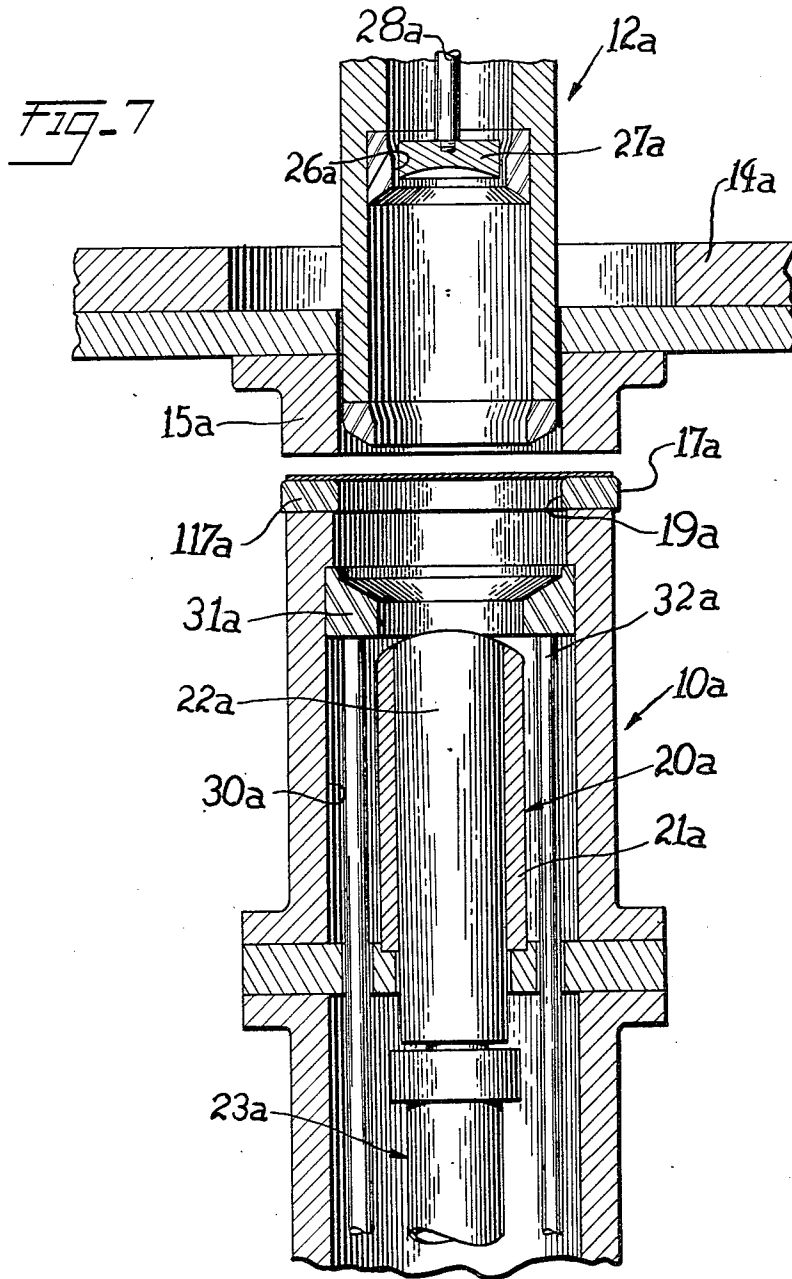
M. S. SCHNELL

2,761,406

DIE FOR DRAWING SHEET MATERIAL

Filed May 25, 1954

7 Sheets-Sheet 7



INVENTOR.
MICHAEL S. SCHNELL

BY

Michael S. Schnell
ATTORNEY

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2,761,406

DIE FOR DRAWING SHEET MATERIAL

Michael S. Schnell, Salem, Ohio

Application May 25, 1954, Serial No. 432,207

2 Claims. (Cl. 113—46)

The present invention relates to dies for drawing sheet material, more particularly to multiple stage dies wherein the sheet material is subjected to a plurality of drawing operations within a single die, and the principal object of my invention is to provide new and improved dies of the character described.

In the sheet metal drawing art it is well-known that the amount of draw to which sheet metal may safely be subjected in a single operation is quite limited. The limitations, of course, depend upon the characteristics of the particular metal being drawn, the thickness of the metal, the shape of the drawn article and many other factors. Because of these limitations, it has been customary to perform a series of drawing operations in order to achieve the desired final form.

In the past, a series of drawing operations necessitated a series of dies through which the sheet metal was successively passed. Accordingly, each die required a separate press, an operator for each press, and the added operation and expense of transferring the pieces from one die to the next. Furthermore, because of work hardening, it was usually necessary to anneal the pieces between the various drawing operations.

In Letters Patent No. 2,602,411, issued to me July 8, 1952, I disclose a die which performs two drawing operations at a single stroke of the press. The use of this die eliminates certain disadvantages of prior art drawing dies; however, since this die performs but two drawing operations, other dies may still be required if the piece to be made requires more than two draws.

The present invention discloses a die which performs more than two successive drawing operations in producing a deep cup from a flat, sheet metal blank. Since these operations are performed on a single press, great savings are achieved because only one operator is required, only a single press and die are employed, and because annealing between draws is eliminated. These and other advantages will become apparent from a study of the following description and from the drawings appended hereto.

In the drawings accompanying this specification and forming a part of this application there are shown for purposes of illustration, two embodiments which my invention may assume, and in these drawings:

Figure 1 is a fragmentary sectional view of a four stage die showing the position of parts just prior to the first draw operation,

Figure 2 illustrates the position of parts at the completion of the first draw,

Figure 3 illustrates the position of parts at the completion of the second draw,

Figure 4 illustrates the position of parts at the completion of the third draw,

Figure 5 illustrates the position of parts at the completion of the fourth or final draw,

Figure 6 illustrates the position of parts during ejection and removal of the drawn piece from the die, and

Figure 7 is a fragmentary sectional view of a three

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stage die showing the position of parts just prior to the first draw operation.

Referring to Figures 1 through 6 and with particular reference to Figure 1, it will be seen that my novel die comprises a die body 10 having a die cavity 11 adapted to be secured to the bolster of the press (not shown). A sleeve-like punch 12 is adapted to be secured to the ram of the press (not shown) and a drawing ring 13 is adapted to be secured to a blank holder plate 14.

As will be understood, plate 14 may be actuated by an auxiliary slide if the press employed is of the double-acting type. However, if a single-acting press is employed, the plate 14 may be actuated by the ram of the press, any suitable well-known mechanism being interposed between the plate and the ram to provide for the necessary over-travel of the ram. A blank holder 15 is also adapted to be carried by the plate 14, springs 16 being interposed between the blank holder 15 and the plate 14 for a purpose to be disclosed.

The die body 10 has an external drawing surface 17 adjacent the mouth of the die and this drawing surface is proportioned for cooperation with an internal drawing surface 18 of the drawing ring 13. It should be pointed out that where cooperating drawing surfaces are herein mentioned, it is to be understood that such surfaces will be spaced apart a distance consistent with the thickness of the metal being drawn. The die body 10 also has a drawing surface 19 adjacent its mouth which is cooperable with the exterior of the sleeve 12 to draw the sheet metal therebetween and in the embodiment disclosed, the drawing surfaces 17 and 19 are formed at external and internal surfaces of a ring 117 which is suitably secured to form the upper part of the die body 10.

A die post 20 having a rounded-end portion which corresponds to the desired shape of the end-wall of the piece to be drawn is positioned within the cavity 11 of the die body 10 and comprises an outer portion 21 in fixed relation with the die body and an inner portion or ram 22 which is slidable within the portion 21. As will later be described, the inner ram portion 22 of the die post 20 is shiftable upwardly (in the position of parts illustrated) preferably by means of a fluid cylinder 23 which is secured to the bolster of the press.

In the relation of parts herein illustrated, the lower end of the sleeve 12 is provided with an external drawing surface 24 which is cooperable with the aforementioned drawing surface 19 of the die body and the lower end of the sleeve is also provided with an internal drawing surface 25 which is proportioned for cooperation with the exterior of the outer portion 21 of the die post 20. The interior of the sleeve 12 is also provided with an internal drawing surface 26 which is spaced from the end of the sleeve and which is cooperable with the exterior of the portion 22 of the die post 20.

A member 27, which has a lower face contoured to fit with the end-wall of the piece to be formed, is normally positioned within the sleeve 12 adjacent the drawing surface 24. Member 27 is secured to a piston rod 28 of a fluid cylinder 29 (see Figures 4 and 5) which is fixedly carried by the sleeve 12 and the member 27 functions more or less as an article holder during the final draw operation and also functions as a knock-out to eject the finished piece from the die.

The cavity 11 of the die body 10 is enlarged at 30 to slideably receive a pressure ring 31 which is contoured to fit with the lower end of the sleeve 12. The ring 31 is slideable on guide pins 32, and resilient means, such as springs or the like (not shown), yieldably urge the ring 31 to its upper position shown in Figure 1, such position being defined by abutment of the ring 31 with a shoulder formed in the cavity 11.

Operation of the die herein disclosed is as follows:

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With the die parts separated as shown in Figure 1, a blank B may be positioned on the die body 10, and the press (not shown) operated to lower the sleeve 12, the blank holder plate 14, and the associated parts carried thereby. Suitable well-known means, not herein shown, may be used to properly gauge the position of the blank B relative to the drawing surfaces of the die body 10. As the aforementioned parts move downwardly, the blank holder 15 will engage the stock to firmly hold it in position. Continued movement of the press will compress the springs 16 and cause the drawing ring 13 to move into engagement with the blank and thus draw the outer portion thereof between the drawing surfaces 17, 18.

At the completion of the first draw and with the parts in the position shown in Figure 2, movement of the blank holder plate 14 and its associated parts will be arrested while downward movement of the sleeve 12 will continue. (It will be understood that this movement will be provided for by any suitable, well-known press construction which need not be described in detail.) The cup shaped piece formed during the first draw will thereupon be drawn between the drawing surfaces 19, 24 to invert the cup and form it to a smaller size positioned about the exterior of the lower portion of the sleeve 12 (see Figure 3). It will be noted that at the completion of the second draw and as shown in Figure 3, the sleeve 12 has carried the piece into engagement with the pressure ring 31.

Continued downward movement of the sleeve 12 from the position shown in Figure 3 will position the sleeve about the die post 20 and will thus once again invert the piece since it will be drawn between the drawing surface 25 and the exterior surface of the outer portion 21 of the die post to the position shown in Figure 4. During the operation of inverting the piece over the outer portion of the die post, the pressure exerted by the ring 31 will prevent wrinkles from forming in the piece.

At the completion of the third draw and as shown in Figure 4, the end wall of the piece will be positioned between the die post 20 and the member 27. Movement of the portion 22 of the die post in an upward direction against the now stationary sleeve 12 by means of the fluid cylinder 23 will draw the piece between the drawing surface 26 and the exterior of the inner portion 22 of the die post. During this operation the cylinder 29 will exert sufficient pressure against the end-wall of the piece to prevent stretching and thinning of such wall.

Upon completion of the final draw and with the parts in the position shown in Figure 5, the fluid pressure in the cylinder 29 will be released, cylinder 23 will be actuated to return portion 22 to its lowermost position as shown in Figures 1, 2, 3, 4 and 6, and sleeve 12 together with blank holder plate 14 will be raised to the position shown in Figure 6. It will be noted that as portion 22 is retracted, the piece will be stripped from this portion by engagement with portion 21 and the piece will be carried up with the sleeve 12 since the piece will tightly engage the drawing surface 26.

Cylinder 29 will now be actuated to urge member 27 downwardly to the position shown in Figures 1, 2, 3, 4 and 6 and this will eject the piece from the sleeve whereby it will fall into the cavity of the die body 10 as illustrated in full lines in Figure 6. The completed piece may now be removed, another blank placed in position upon the die body, and the foregoing operations repeated to draw another piece from the flat blank.

Figure 7 illustrates a three stage die which is similar to the die disclosed in Figures 1 through 6 and in which corresponding parts have been indicated by similar reference numerals followed by the letter *a*. The die is shown in the open position immediately prior to the start of the drawing operation and it will be noted that in this die the first forming operation hereinbefore described has been eliminated. Since there is no necessity for the drawing ring 13, this part has been eliminated and the blank

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holder 15a is secured directly to the blank holder plate 14a as shown.

It is believed that since the die shown in Figure 7 is similar to the one hereinbefore described in detail, operation of this die will readily be apparent.

In view of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my invention and it will also be apparent to those skilled in the art that the embodiments herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described, hence it will be appreciated that the herein disclosed embodiments are illustrative only, and that my invention is not limited thereto.

I claim:

1. A drawing die for effecting multiple stage draw reductions on sheet material by a single die stroke, comprising a fixed die member having a vertical die cavity and provided with an internal drawing surface, a hollow upright die post fixed within said cavity and having an exterior drawing surface disposed co-axially therewith, a movable sleeve disposed co-axially with said die cavity, said sleeve having an external drawing surface at its lower end cooperable with the internal drawing surface of said fixed die member, said sleeve also having vertically spaced interior drawing surfaces, said sleeve being movable into said die cavity for cooperation of its exterior drawing surface with the internal drawing surface of said fixed die member to engage and deform sheet material positioned therebetween into a cup-shaped shell having a closed end surrounding the lower end of the sleeve, further movement of said sleeve into said die cavity telescoping the sleeve over said post so that the closed shell end is pushed into the moving sleeve by the upper post end, the lower interior die surface on said sleeve cooperating with the exterior die surface on said post to turn said shell inside out into a similar shell of reduced width and increased length surrounding said upper post end, a ram mounted for vertical movement within said hollow post, and means for moving said ram outwardly from said post to press against the closed inner end surface of the reduced shell to further reduce the width and increase the length of the latter by pushing it through the upper of said interior drawing surfaces of said sleeve.

2. A drawing die for effecting multiple stage draw reductions on sheet metal by a single die stroke, comprising a fixed die member having a vertical die cavity and provided with internal and external drawing surfaces, a hollow upright die post fixed within said cavity and having an exterior drawing surface disposed co-axially therewith, a movable sleeve disposed co-axially with said die cavity and a movable draw ring disposed co-axially with and surrounding said sleeve, said draw ring having an internal drawing surface cooperating with the exterior drawing surface of said fixed die member upon movement of said draw ring over and about the upper end of said die member to engage and deform a blank of sheet material positioned therebetween into a cup-shaped shell surrounding said upper end of said die member, said sleeve having an external drawing surface at its lower end cooperable with the internal drawing surface of said fixed die member, said sleeve also having vertically spaced interior drawing surfaces, said sleeve being movable into said die cavity for cooperation of its exterior drawing surface with the internal drawing surface of said fixed die member to engage the closed end of said shell and turn said shell inside out into a cup-shaped shell of reduced width and increased length surrounding the lower end of said sleeve, further movement of said sleeve into said die cavity telescoping the sleeve over said post so that the closed end of the reduced shell is pushed into the moving sleeve by the upper post end, the lower interior die surface on said sleeve cooperating with the

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exterior die surface on said post to turn said latter shell inside out into a similar shell of further reduced width and increased length surrounding said upper post end, a ram mounted for vertical movement within said hollow post, and means for moving said ram outwardly from said post to press against the closed inner end surface of the last mentioned shell to still further reduce its width and increase its length by pushing it through the upper of said interior drawing surfaces of said sleeve.

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