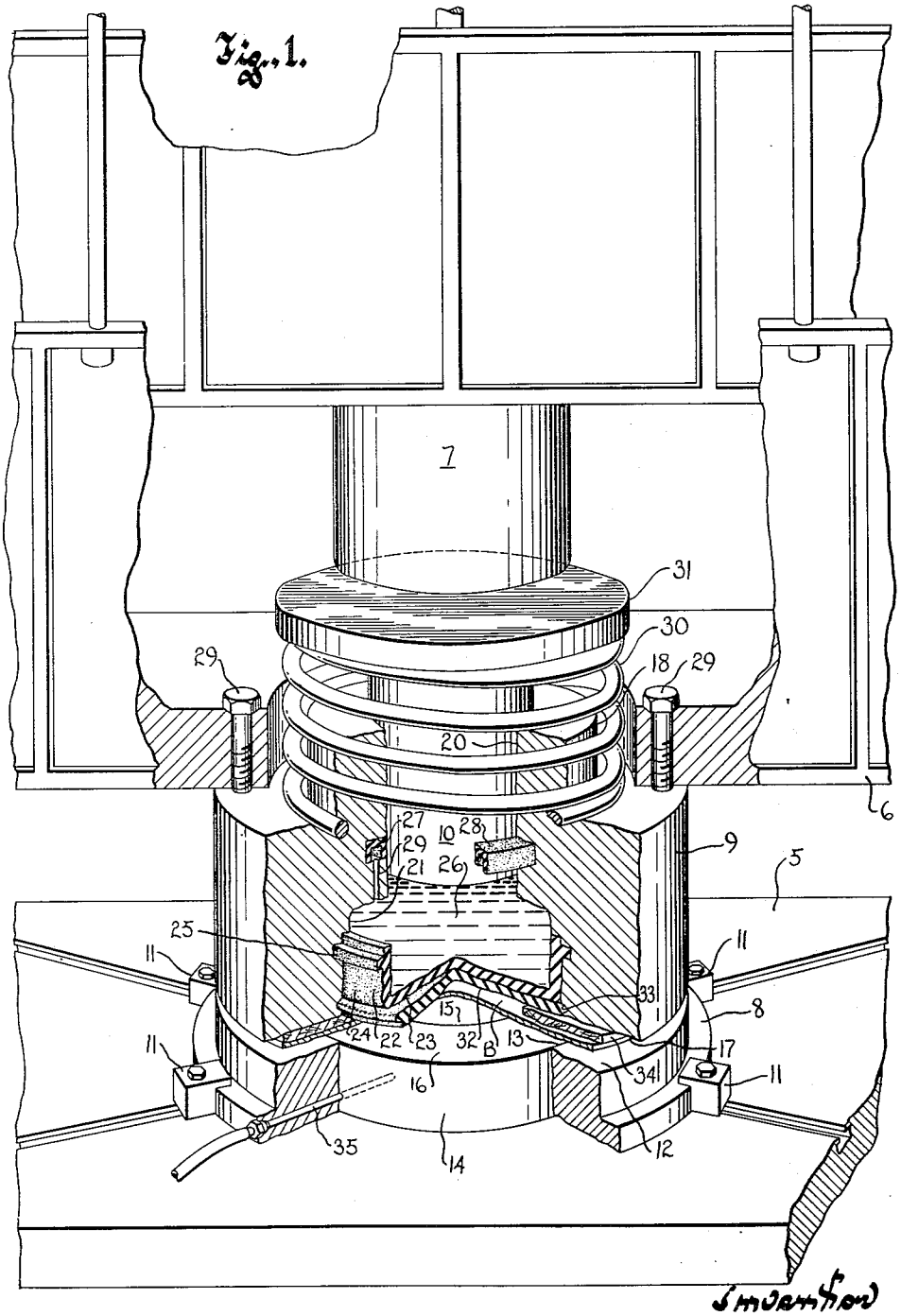
Sept. 4, 1956 H. MÖLLER 2,761,405

HYDRAULIC FORMING ATTACHMENT FOR PRESSES

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Fig. 1.



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HYDRAULIC FORMING ATTACHMENT FOR PRESSES

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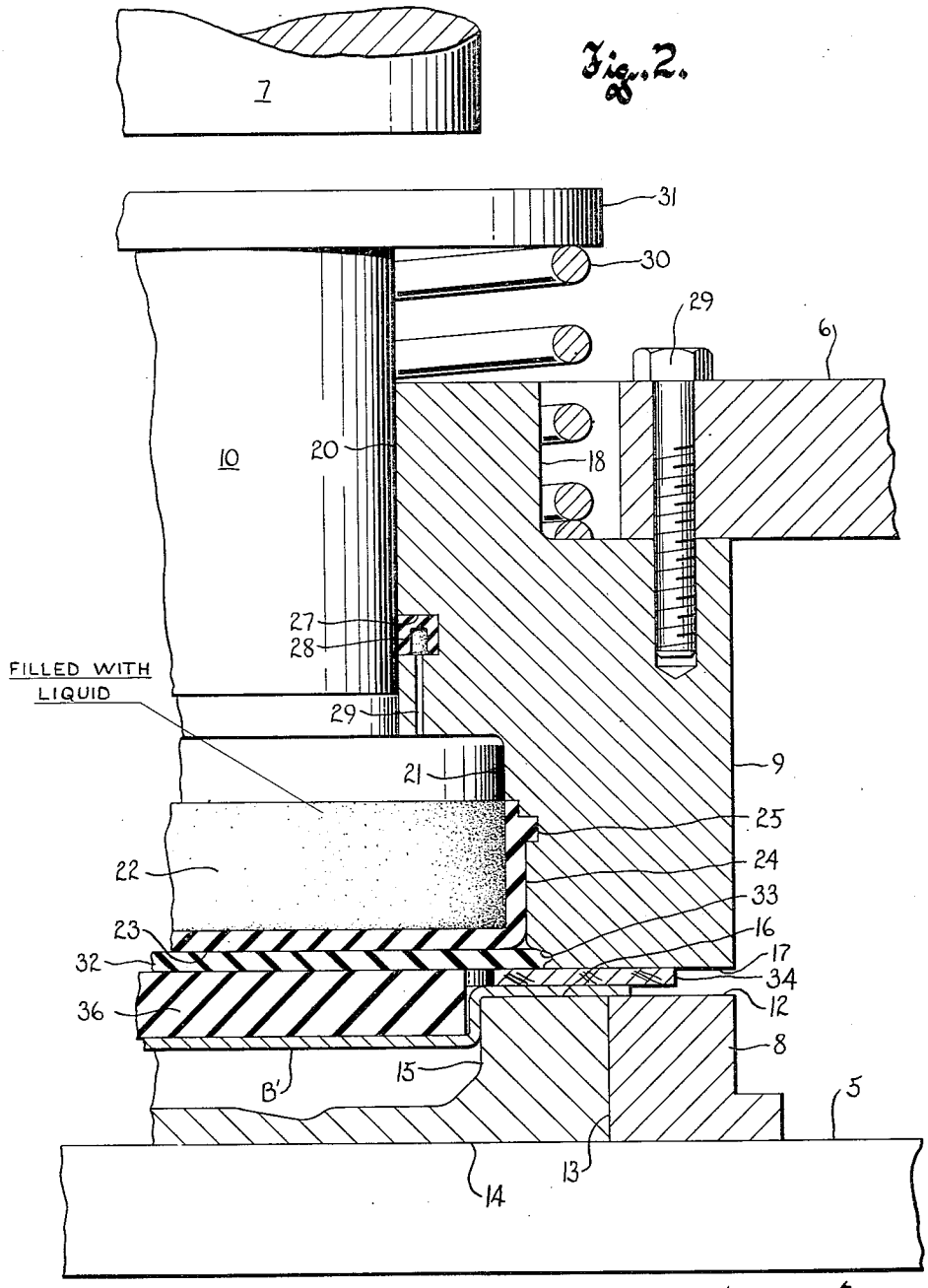


Fig. 2.

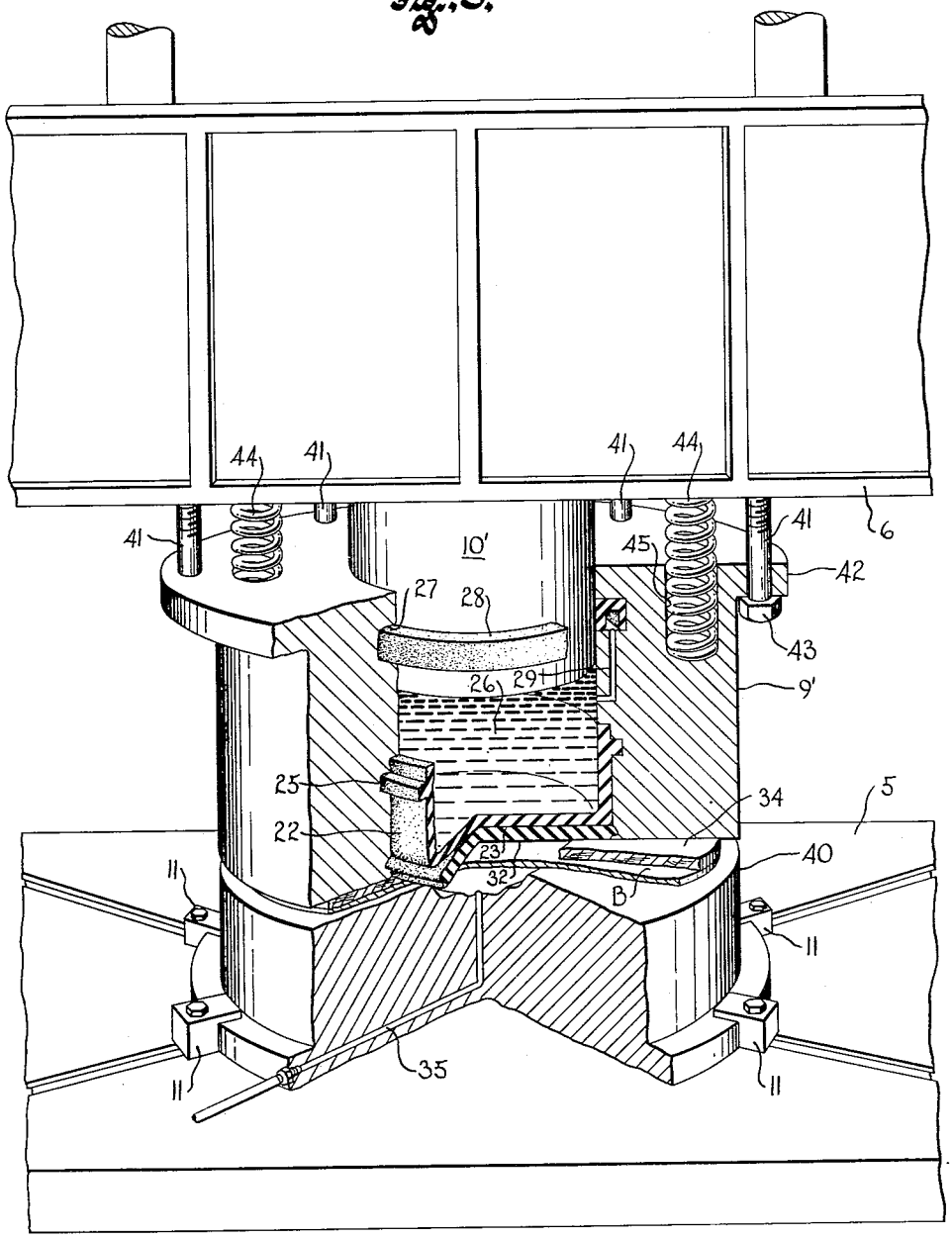
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HYDRAULIC FORMING ATTACHMENT FOR PRESSES

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Fig. 3.



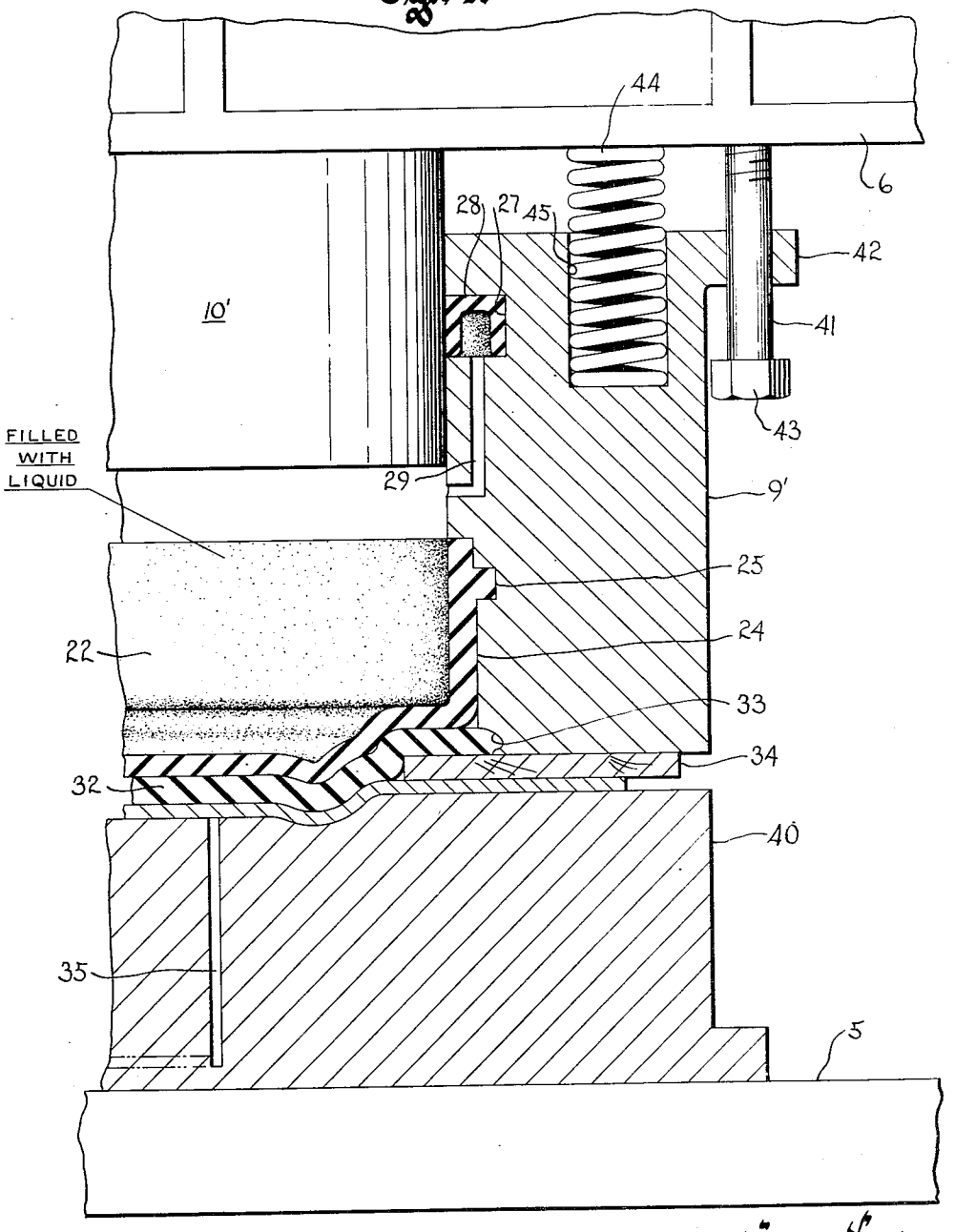
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HYDRAULIC FORMING ATTACHMENT FOR PRESSES

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Fig. 4.



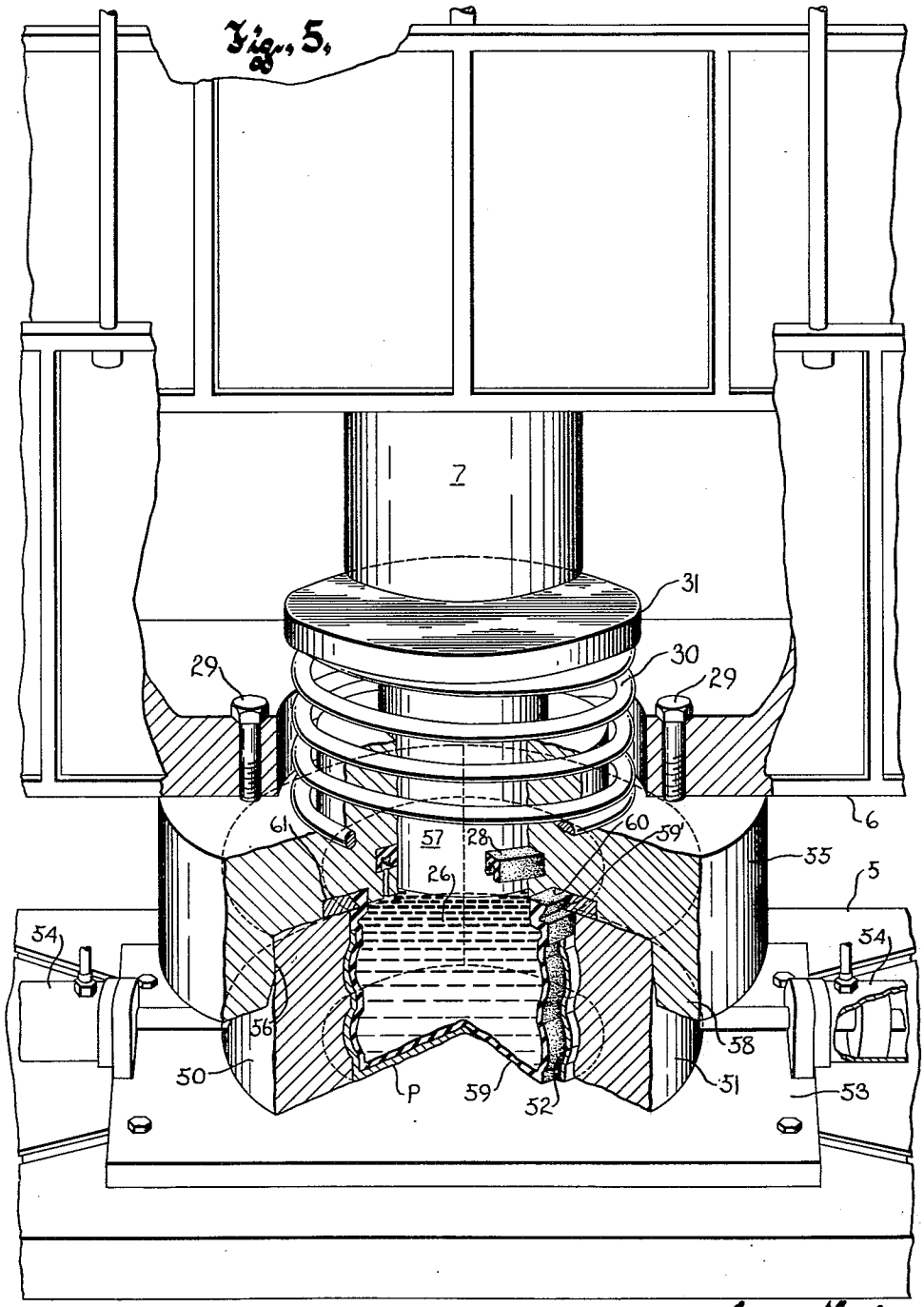
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HYDRAULIC FORMING ATTACHMENT FOR PRESSES

Filed Dec. 8, 1954 5 Sheets-Sheet 5

Fig. 5.



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2,761,405

HYDRAULIC FORMING ATTACHMENT FOR PRESSES

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Application December 8, 1954, Serial No. 473,926

Claims priority, application Sweden December 14, 1953

11 Claims. (Cl. 113—44)

This invention relates to the art of forming sheet metal blanks into dished or cupped objects by means of hydraulic pressure applied to the blank through an elastic wall. Presses especially designed to utilize this method of shaping and forming sheet metal blanks are not new to the art, but a press specifically designed for this purpose is expensive and limited in its use. It is therefore, the primary object of this invention to provide a device which may be readily installed in a conventional press, and when so installed, converts the press to the forming of sheet metal blanks by hydraulic pressure applied to the blank through an elastic or conformable wall.

Another object of this invention is to provide means for adapting or converting a conventional press to use the described technique which involves but a relatively small expenditure, and which may be quickly and easily installed or removed from the press.

Another object of this invention is to provide a device of the character described which not only enables the forming of relatively simple shapes, but also may be used to form more or less complicated shapes and even shapes having reentrant cavities.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel method and construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate several complete examples of the physical embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a perspective view, partly in section, illustrating one embodiment of this invention mounted in a conventional double acting press;

Figure 2 is a longitudinal sectional view through the device of Figure 1, illustrating how it is used to form relatively deep draws;

Figure 3 is a perspective view, partly in section, of a single acting press equipped with a slightly modified form of this invention, said view illustrating the parts at the instant the press has been closed to the extent of just beginning to grip the blank;

Figure 4 is a longitudinal sectional view of the unit shown in Figure 3, but illustrating the parts in their relative positions at the completion of the forming operation; and

Figure 5 is a perspective view partly in section illustrating a double acting press equipped with still another embodiment of this invention, especially adapted for the formation of shapes having a reentrant undercut cavity.

Referring to the accompanying drawings, in which like numerals indicate like parts, the numeral 5 designates the table of a conventional double acting press equipped

with two press heads 6 and 7, both of which are adapted to be moved downwardly toward the table 5, either in unison or not. The means for raising and lowering the press heads 6 and 7 has not been illustrated since it forms no part of this invention. The adaptor device of this invention roughly comprises three main cooperating elements, namely, a die holder 8, a body member 9, and a plunger 10.

The die holder 8 is adapted to be anchored to the press table 5 in any suitable manner as by means of dogs 11; and in the embodiment of the invention illustrated in Figure 1, comprises a ring or annulus having a flat top surface 12 and a cylindrical bore 13 into which a die 14 may be fitted. The cavity 15 of the die opens upwardly through its top wall 16 which is preferably flat and flush with the top wall 12 of the die holder.

The body member 9 comprises a cylindrical block of suitable metal having a flat bottom face 17 of a size to overlie the top surface 12 of the die holder, and also extend inwardly over the top face 16 of the die. A neck 18 of reduced diameter projects upwardly from the main portion of the body member and a bore 20 extends axially through the neck and the upper portion of the body member. Beneath the bore 20 the body member has a counterbore 21, and mounted in and closing the bottom of this counterbore, is a cup-shaped member 22 of elastic material, preferably rubber, though it is to be understood that any other material having the characteristics of rubber may be employed. The bottom wall 23 of this cup-shaped member 22 is normally flat, and its side wall 24 is cylindrical with an inside diameter equal to that of the counterbore 21.

As clearly shown, the side wall 24 of the cup-shaped member is nested into the side of the counterbore 21 and has a collar 25 which is received in an annular groove in the body member. Accordingly, when the cup-shaped member is snapped into position it is secured against axial displacement from the body member. Not only does this arrangement secure the cup-shaped member against displacement, but it also assures a fluid tight connection between these parts.

The plunger 10 has a close sliding fit in the bore 20 so that its underside coacts with the walls of the counterbore and the cup-shaped member 22 to form a closed chamber. This chamber is filled with a suitable liquid 26. It follows therefore, that downward pressure exerted upon the plunger 10 tending to force the plunger down into the liquid chamber, results in downward displacement of the elastic bottom wall 23 of the cup-shaped member. The pressure engendered upon the liquid 26 also serves to force the side walls 24 of the cup-shaped member against the sides of the counterbore and the body member, to thereby assure against any possibility of leakage of the liquid from the chamber.

Pressure thus applied to the liquid 26 is also utilized to assure a fluid tight seal between the side of the plunger 10 and the bore in which it operates. To this end the bore 20 has a groove 27 in which is located an elastic packing ring 28 U-shaped in cross section, with the interior of the U facing downwardly and communicated through one or more ports 29 with the liquid chamber. Liquid is thus forced upwardly into the interior of the U-shaped ring to expand the same and cause it to securely grip the side of the plunger.

The body member 9 is readily removably secured to the underside of the outer press head 6 by bolts 29, and it is to be understood that the body member must be aligned with the die holder 8 and the inner press head or ram 7.

A spring 30 encircling the neck 18 of the body member and interposed between the top of the body member and a head 31 on the upper end of the plunger 10 levitates the plunger and normally holds it in a position at which the

liquid 26 is not under pressure so that the elastic bottom wall 23 of the cup-shaped member is flat. In this position of the parts, the inner press head or ram 7 is spaced from the top of the plunger.

Attention is directed to the fact that the bottom wall 23 of the elastic cup-shaped member is spaced upwardly from the bottom face 17 of the body member 9. This space accommodates a wear disc 32 formed of rubber or other similar elastic material, and of a size to overlie the entire underside of the bottom wall 23. The disc 32 is removably secured in position by having its peripheral edge snapped into an annular groove 33 at the mouth of the counterbore 21.

In the operation or use of the device, assuming that the parts have been set up in the manner described and that the press is open; the body member 9 is thus raised a substantial distance above the top of the die holder and die. A sheet metal blank B to be formed is now positioned on top of the die and die holder in flat juxaposition to the top surface thereof. Next, an annular pressure plate or washer 34 is laid on top of the blank. This plate or washer may be formed of hardwood or any other suitable material, and its aperture should be of the same configuration and slightly larger than the mouth in the cavity 15 in the die.

The blank and pressure plate 34 having been thus positioned, the outer press head 6 is lowered to bring the underside 17 of the body member down onto the pressure plate to clamp the blank between it and the top of the die and die holder, with a force sufficient to guard against wrinkling of the blank as it is drawn inward during the forming operation. With the blank gripped in this manner, the inner press head or ram 7 is lowered to force the plunger 10 down onto the liquid 26 and this, as will be readily apparent, acts hydraulically on and through the elastic bottom wall 23 and the wear disc 32 underlying it to exert downward pressure on the blank to force it into the die cavity.

After the forming operation and opening of the press, the formed part may be quickly dislodged from the die by air pressure blown into the die cavity through a suitable duct 35.

In the event the part to be formed requires a relatively deep draw, it is preferable to form the same in two operations or stages, the first of which is performed in the manner described to produce the partially formed unit B' of Figure 2. To complete the forming operation, a disc 36 is inserted into the hollow of the partially formed part B' and then the operation is repeated in the manner previously described. The insert disc 36 preferably is formed of rubber or other suitably elastic material, but of course, it is to be understood that it must have sufficient body to substantially maintain its mass during the second forming operation.

The use of an insert in this manner has the advantage of enabling the completion of a relatively deep draw without entailing readjustment of the press heads, and of course, it protects the elastic bottom wall 23, since it obviates undue stretching thereof.

It is to be noted that because of the difference in diameter of the counterbore 21 and the plunger 10, the force exerted upon the liquid 26 has an upward component as well as a downward component, the former however, being much smaller than the latter. Because of the presence of this upward force component, it follows that means must be provided to hold the body member 9 down. This is the function of the outer press head 6, and as will readily appear, by proper balancing of the pressure holding the head 6 down and the pressure exerted through the head 7 on the plunger 10, the right degree of grip can be readily maintained on the blank to assure that it will flow smoothly toward the die cavity during the forming operation.

In presses of the single acting type where only a single press head is available, the embodiment of the invention illustrated in Figures 3 and 4, has been found desirable.

This embodiment of the invention differs from that described principally in that the cross sectional area of the liquid chamber is the same as that of the plunger. Accordingly, there is no upward component of force during the application of pressure upon the liquid. Also, in the modification shown in Figures 3 and 4, there is, strictly speaking, no die holder. Instead, the die 40 iself, is secured to the press table 5.

The body member 9' is suspended from the press head 6 by a plurality of bolts 41 which pass freely through holes in a flange 42 on the body member, with their heads 43 engageable by the underside of the flange. A number of compression springs 44 reacting between the press head 6 and the body member 9' and preferably seated in pockets 45 in the body member yieldingly urge the body member downwardly and tend to maintain its flange engaged with the heads 43 of the suspension bolts.

The plunger 10' is secured directly to the press head 6. Accordingly, as the press is closed, the plunger and the body member move in unison until the parts reach the positions shown in Figure 3 at which instant the underside of the body member comes in contact with the pressure plate or washer 34 and clamping pressure upon the blank B begins to be exerted. As the press head 6 continues its descent, the springs 44 are compressed and the clamping pressure upon the blank is increased. Simultaneously with this increase in clamping pressure, the plunger 10' exerts pressure upon the liquid 26 to deform the elastic bottom wall of the cup-shaped member and thereby force the blank down into the cavity of the die as shown in Figure 4.

The embodiments of the invention thus far described are intended for the formation of relatively simple shapes and are not useful where the part to be produced has a reentrantly shaped configuration. Where such work is to be produced, the construction shown in Figure 5 may be employed. Here again a double acting press such as that illustrated in Figures 1 and 2, is used, but the body member and die construction, are somewhat different. Because of the need for accommodating reentrant or undercut shapes, the die, of necessity, must be formed of separable sections or segments. Two or more such segments may be used, and in the present instance, the die comprises two similar half sections 50 and 51. When these sections or segments are engaged with one another, they form a complete annulus, the inner wall 52 of which defines the shape of the die cavity.

The two sections or segments 50 and 51 are slideably mounted upon a plate 53, which in turn is secured to the press table 5, and are constrained to translatory movement toward and from one another, such movement being imparted to sections or segments by air cylinders 54 or the like.

The body member 55 has a bore 56 in which the plunger 57 operates, and a skirt 58 extends down from the peripheral portion of the body member to embrace the die segments when the latter are engaged with one another. In this relationship of the parts, the skirt 58 holds the die segments against separation.

The liquid chamber in this embodiment of the invention is formed largely by the elastic cup-shaped member 59, the height of which is such that its side wall overlies the entire inner surface 52 of the die segments when the parts are in their operative relationship.

The means for securing the elastic cup-shaped member to the body member comprises a rim 59' on the edge of the cup-shaped member received in a groove 60 in the underside of the body member along with a locking ring 61 which embraces the rim. The contiguous surfaces of rim and locking ring are conical as shown so that the rim has a roughly dovetail shaped cross section. Thus, upon assembly of the parts, the cup-shaped member is fastened to the body member.

In the operation of this form of the invention and assuming that the press is open, the die sections or segments

are first brought together and then the part P to be formed, which has previously been drawn into a cupped formation having a straight side wall, is dropped down into the die cavity. The outer press head 6 is then lowered to bring the elastic cup-shaped member down into the part P and engage the skirt 58 of the body member over and around the closed die.

With the parts thus engaged and disposed, the inner press head 7 is lowered, whereupon pressure is applied to the plunger 57, which acting through the liquid and the elastic walls of the cup-shaped member, expands the part P snugly against the walls of the die cavity. After the press is reopened, it follows of course, that the sections or segments of the die must be separated by means of the air cylinders 54 whereupon the finished part may be removed.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in this art that this invention provides a simple, highly effective device for quickly and easily adapting any ordinary press to the formation of sheet metal blanks by means of hydraulic pressure acting through an elastic or conformable wall.

What I claim as my invention is:

1. A device for use with a conventional press having press head means movable toward a die supporting table upon closure of the press, for adapting the press to the forming of work by hydraulic pressure applied to the work through an elastic wall, said device comprising: means providing a die having a cavity therein in which work supported by the die may be shaped; means for positioning the die on the table of the press with its cavity opening toward the press head means; a body member having a bore extending vertically therethrough, the upper portion of said bore providing a cylinder; an elastic wall closing the bore at the underside of the body member; sealing means on said wall and the body member for securing said wall in sealing relationship to the body member, so that said elastic wall, together with the wall of the bore forms a liquid receptacle opening upwardly to said cylinder; means for operatively connecting the body member with the press head means, in line with the die, so that upon closure of the press the body member will be moved downwardly by the press head means toward the die to an operative position at which the exposed bottom portion of said elastic wall is in position to exert force upon a blank supported by the die; a liquid in said receptacle; a plunger slidable in said cylinder and adapted to have pressure exerted on its upper end by the press head means upon closure of the press; and sealing means in said cylinder cooperable with the plunger to provide a fluid tight seal between the cylinder and the plunger so that said plunger, together with said receptacle forms a closed liquid tight chamber, and whereby depression of the plunger by pressure exerted thereon by the press head means, when the body member is in its operative position, acts through the liquid in the chamber and the elastic wall to exert pressure upon a blank supported by the die to thereby deform the blank to the shape of the die cavity.

2. The device of claim 1 further characterized by the fact that the means for securing the elastic wall to the body member comprises an upright annular wall integral with the said elastic wall and together therewith forming a cup-shaped member, said upright wall overlying an adjacent wall of the body member; and a collar integral with and encircling said upright annular wall and received in a groove in said adjacent wall of the body member.

3. The device of claim 1 further characterized by the fact that said elastic wall is spaced upwardly from the bottom surface of the body member; an elastic disc of a size to cover the entire underside of the elastic wall; and means removably securing said disc to the body member, said disc providing a replaceable wear surface and being of a thickness to have its underside substantially flush with the bottom surface of the body member while its top surface is contiguous to the underside of said elastic wall.

4. The device of claim 1 further characterized by the fact that lower portion of the bore in the body member is larger in diameter than the upper portion thereof which provides the cylinder, so that as the plunger exerts pressure upon the liquid in the chamber, an upward component of force is engendered upon the body member as well as a downward component acting upon the elastic wall.

5. The device of claim 1 further characterized by the provision of a spring reacting between the body member and the plunger and yieldingly urging the plunger upwardly out of its cylinder to thereby levitate the plunger and enable the elastic wall extending across the bottom of the liquid chamber to remain flat until pressure is exerted upon the plunger.

6. The device of claim 1 further characterized by the fact that the sealing means which provides a fluid tight seal between the cylinder and the plunger, comprises: an elastic gasket wall seated in a groove in the cylinder and engaging the side of the plunger; and a port communicating the liquid chamber in the body member with the groove radially outwardly of said elastic gasket wall so that pressure exerted upon the liquid in the chamber is manifested in said groove to force the elastic gasket wall against the side of the plunger.

7. A device for adapting a conventional press having a die supporting table and press head cooperable with one another to exert pressure upon work placed therebetween, to the forming of sheet metal blanks by hydraulic pressure applied to the blanks through an elastic wall, said device comprising: a die block having an upwardly facing die cavity therein; means for securing the die block to the table of the press with its cavity facing the press head; a body member cooperable with the die block to clamp a blank to be formed therebetween, said body member having a bore extending vertically therethrough, the upper portion of said bore providing a cylinder; a plunger slideably fitted in said cylinder; an elastic cup-like member secured in the lower portion of the bore to close the same, and with the sides of the bore and the underside of the plunger forming a closed liquid chamber; the plunger being secured to the press head to move in unison therewith; and means for securing the body member to the press head in a manner enabling the body member to move in unison with the plunger and press head and also to move axially relative thereto, said means comprising biasing means reacting between the press head and the body member and urging the latter downwardly, and tension rods, suspending the body member from the press head and limiting downward movement of the body member when the press is open whereby during descent of the press head the body member is first brought into blank clamping coaction with the die block and then the plunger is forced down into the bore of the body member to displace the liquid therein and force the elastic bottom wall of the cup-shaped member toward the blank to thereby force the blank into the cavity of the die.

8. A device of the character described comprising: a body member having a bore therethrough; a plunger reciprocable in the bore; a cup-shaped member having elastic walls; means securing the edge of the cup-shaped member to the body member with the bottom wall of the cup-shaped member in line with and facing the inner end of the plunger so that the body member, plunger and cup-shaped member coact to form a closed chamber; a liquid filling said chamber; a die having a cavity to shape a sheet metal blank; means mounting the die and the body member in alignment and for relative movement toward and from one another, so that a blank to be formed may be placed in position between the die and the elastic cup-shaped member when the body member and die are separated and so that the blank will be clamped

between the body member and the die when the latter are brought together; and means for forcing the plunger into the chamber to displace the liquid and thereby hydraulically apply force through the elastic wall of the cup-shaped member onto a blank clamped between the body member and the die to force the blank to take the shape of the die cavity.

9. The device of claim 8 wherein the die comprises complementary segments mounted for movement toward one another so as to enable forming parts having undercut or reentrant cavities; and further characterized by the fact that the elastic cup-shaped member has a normal unexpanded shape and size to move freely into and out of the die cavity.

10. A device for adapting a conventional press having a die supporting table and a press head cooperable with one another to exert pressure upon work placed therebetween, to the forming of sheet metal blanks by hydraulic pressure applied to the blanks through an elastic wall, said device comprising: means for mounting a die upon the table of the press comprising a die holder having a wall adapted to encircle the die and having a substantially flat top surface to support the blank to be formed; a body member having a substantialy flat bottom surface to coact with the top surface of the die holder to hold the blank in position, said body member having a bore extending vertically therethrough, the upper portion of said bore providing a cylinder; an elastic wall closing the bottom of the bore; sealing means on said wall and said body member for securing said wall in sealing relation to said body member, so that said elastic wall together with the wall of the bore forms a liquid receptacle; a liquid in said receptacle; a plunger slidably fitted in said cylinder; sealing means in said cylinder cooperable with said plunger to provide a fluid tight seal between the cylinder and plunger, said plunger together with said receptacle forming a fluid tight chamber; means for securing the body member to the press head to move in unison therewith in line with the die holder so that upon closure of the press a blank may be clamped between the top of the die holder and the bottom of the body member; and means through which the press may act to force the plunger down into the liquid chamber and thereby exert pressure upon the blank through said elastic wall, whereby the blank is shaped to the cavity of the die.

11. A device for use with a conventional press having inner and outer press heads movable toward a die supporting table upon closure of the press, for adapting the press to the forming of sheet metal blanks by hydraulic pressure applied to the blanks through an elastic wall,

said device comprising: a body member having a bore opening vertically therethrough; die holding means depending from the underside of the body member radially outwardly from the bore; an elastic cup having its rim secured to the bottom of the body member with its side wall depending from the body member but spaced radially inwardly from said die holding means, said elastic cup closing said bore in the body member at the underside thereof; a plunger slidable in the bore and closing the bore at the top thereof, so that the wall of the bore, the elastic cup and the plunger coact to form a closed liquid chamber; spring means reacting between the plunger and the body member to levitate the plunger; a liquid filling said chamber so that descent of the plunger distends the walls of the elastic cup; a die block comprising complementary movable die segments of a size such that when said segments are engaged with one another, they are engageable by side die holding means to be held thereby against separation, the engaged die segments conjointly defining an upwardly opening cavity of a size and shape to freely embrace the elastic cup when the liquid in the cup is not under pressure; means for securing the body member to the outer press head with the bottom of the body member directly over and facing said die, and with the plunger in position to be depressed by the inner press head, so that upon closure of the press the body member is moved downwardly by the outer press head to dispose the lower portion of said elastic cup in the die cavity and to effect engagement of said die holding means with the engaged die segments to thereby hold the same against separation; a surface on the upper end of the plunger engageable by the inner press head during closure of the press for translating closing motion of the press into descent of the plunger against the upward bias thereon; and means mounting the die segments upon the press table for substantially horizontal movement toward and from their cavity defining positions.

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