

May 24, 1960

R. A. PAULTON
METAL FORMING PRESS

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3 Sheets-Sheet 1

Fig. 1

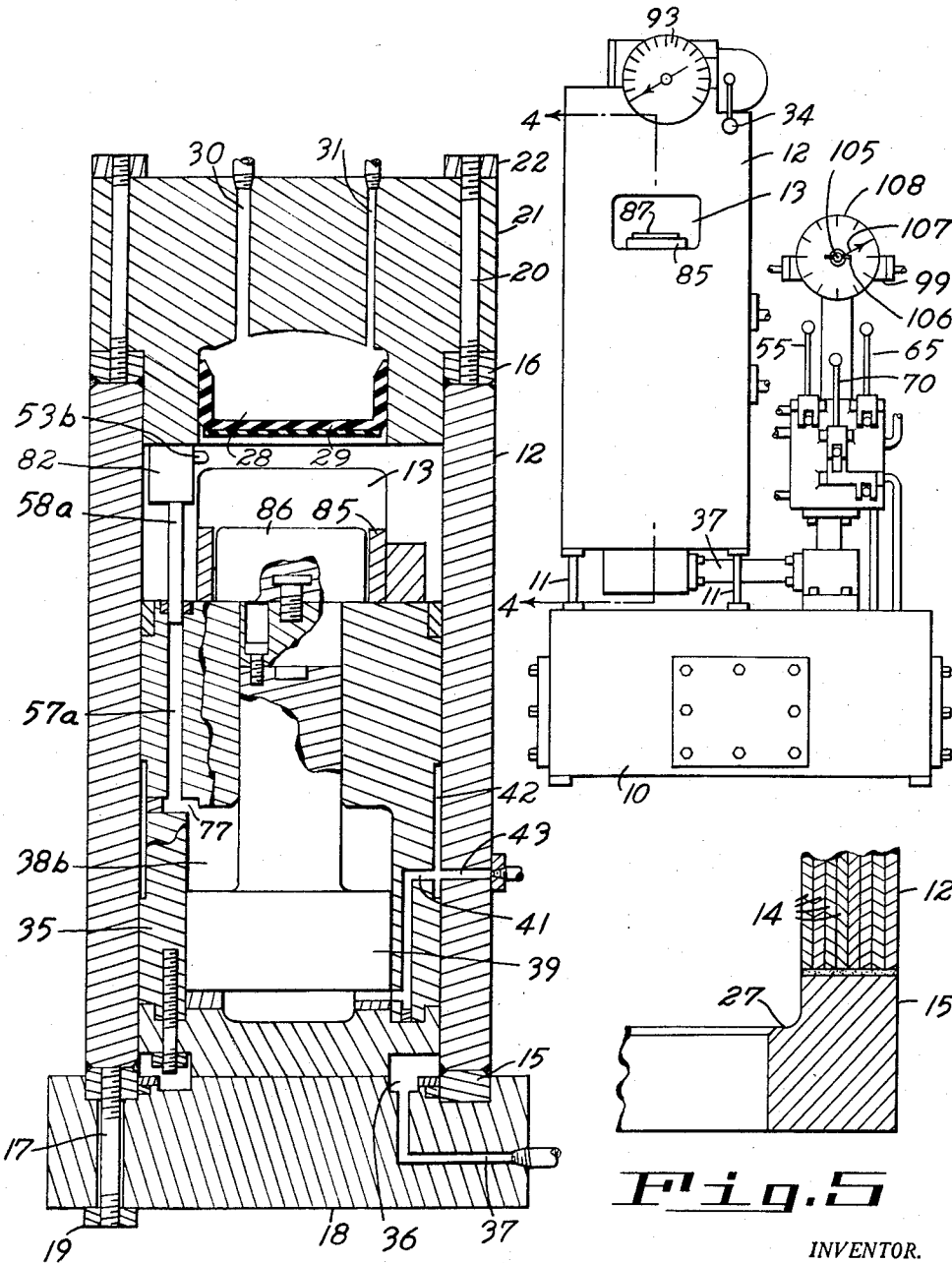


Fig. 5

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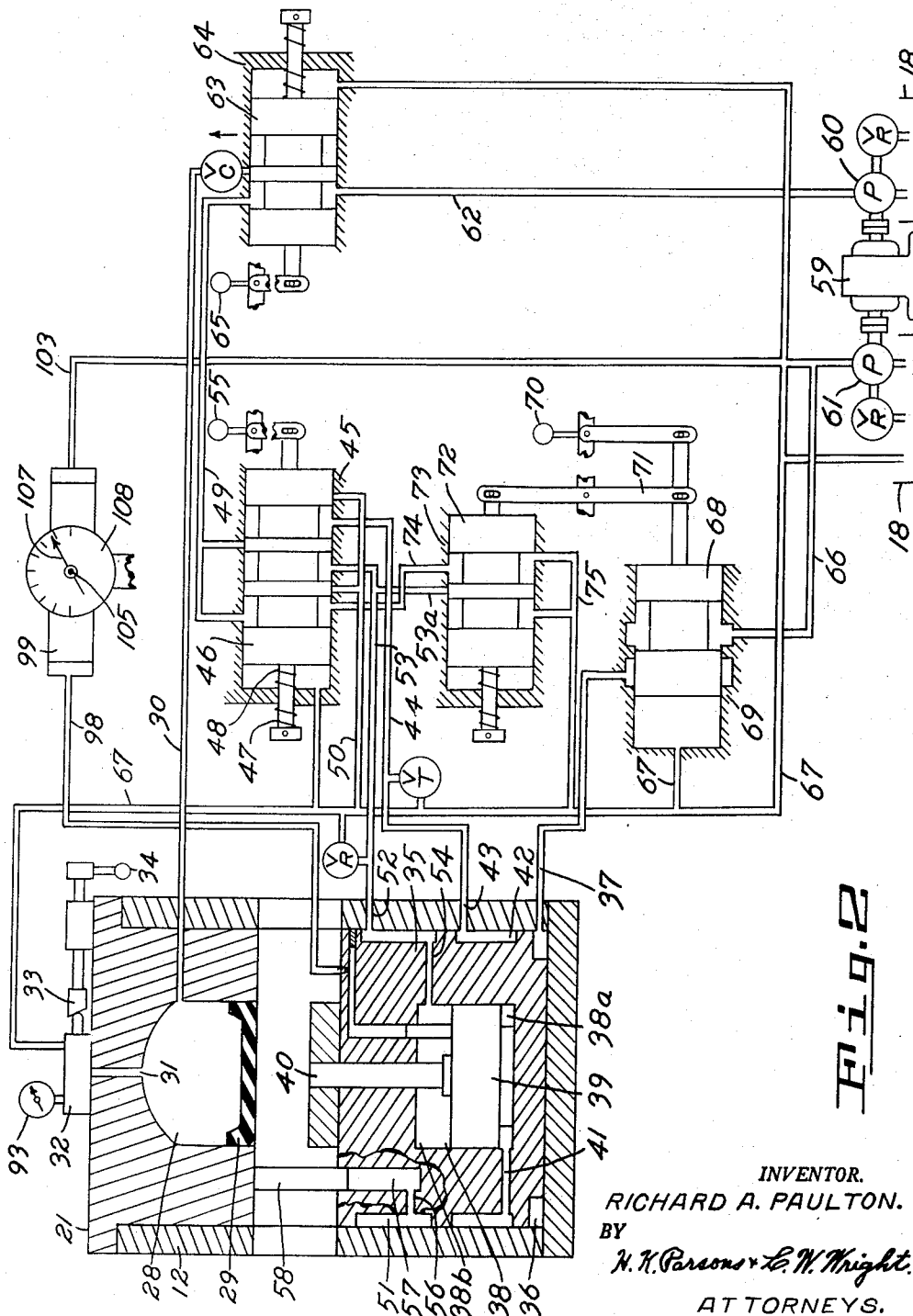
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3 Sheets-Sheet 3

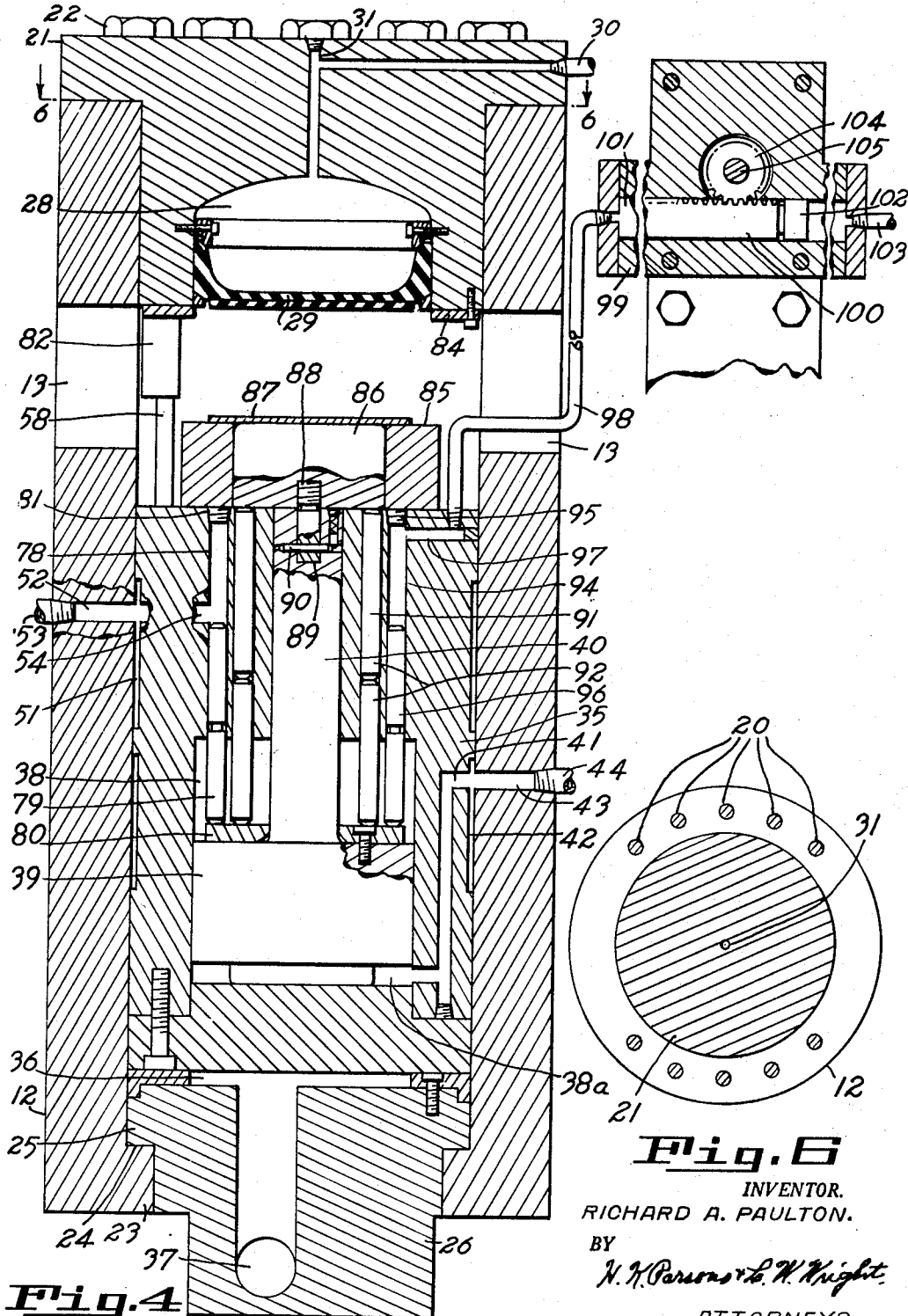


Fig. 6

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METAL FORMING PRESS

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4 Claims. (Cl. 113—45)

This invention relates to improvements in hydraulically operated metal forming presses and has particular reference to a simplified form of press structure designed adequately to withstand pronouncedly high forming pressures.

One of the objects of the present invention is the provision of a novel improved frame structure for hydraulic forming presses.

A further object of the invention is the provision of an improved press structure having minimum overall dimensions and relationship of parts to produce maximum rigidity.

A further object of the invention is the provision of an improved compact press structure for high pressure forming operations embodying a minimum of nested or telescoping jointly and relatively moving parts for reaction on a contained work piece, together with a simplification of pressure connections, controls, and positioning mechanisms.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification, considered in conjunction with the accompanying drawings forming a part thereof, and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

Figure 1 is an elevation of a simplified form of press embodying the improved features of the present invention.

Figure 2 is a diagrammatic view indicating the basic structural elements and simplified movement control mechanism.

Figure 3 is a vertical section through one form of press structure.

Figure 4 is a vertical section of similar structure taken at right angles to Figure 3, as on the line 4—4 of Figure 1.

Figure 5 is an enlarged fragmentary view illustrating a detail of the press structure, and

Figure 6 is a section on line 6—6 of Figure 4, illustrating the location of the press frame securing elements.

In the drawings the numeral 10 designates the bed or base portion of the present invention which may be in the form of a hollow tank providing a receptacle for the hydraulic actuating medium. Supported on the bed, as by brackets 11, is the press frame structure in the form of a cylinder 12 having one or more windowlike apertures 13 for introduction and removal of the work piece.

The manner of construction of this frame structure is particularly illustrated in connection with Figures 3, 4, and 5 of the drawings. As shown in detail in Figure 5, for example, the cylinder 12 may be a high tensile strength body of multilayer form built up from the sheets or laminations 14 and is intended to take up and absorb the entire force exerted during a metal pressing or shaping operation eliminating the use of separate frame members, brace rods, struts or like elements hitherto employed in the past. Such structures in the past have necessarily been of very heavy form, as the forces utilized in shaping op-

2

erations are from 5,000 to 15,000 pounds to the square inch, and under these conditions previous structures have had the inherent difficulty of possible stretching or uneven yielding during a forming operation. Additionally, these forces have necessitated the construction of extremely large machines to provide the overall strength required and proper guiding of the moving forming elements.

In the present instance, however, the improved high tensile strength cylindrical shell provides not only the main frame member for the machine, but itself serves as the container for the various press elements including telescoping relatively movable parts minimizing the overall dimensions of the machine for a given capacity.

As particularly illustrated in Figures 3 and 5, there is welded to the lower end of the shell 12 a terminal ring portion 15 and to the upper end of the cylinder a second ring portion 16.

In the structure of Figure 3 the lower ring 15 carries the studs 17 extending downward through the bottom plate or closure 18 which is secured in position by the nuts 19. Likewise, as shown in that figure, the upper ring 16 serves as attaching member for the studs 20 retaining in place the cylinder head 21 secured as by nuts 22.

In Figure 4 the lower end of the cylinder 12 has been shown as formed with an inwardly extending flange 23 providing a shoulder 24 interlocking with the flange or head 25 on the base closure element 26 corresponding to the element 18.

The structure in Figure 5 is similar to that of Figure 4 with the exception that the shoulder 27 corresponding to the shoulder 24 of Figure 4 is formed as a part of the ring 15 in place of being formed integral with the shell 12, the elements 25 and 26 cooperating with the shoulder 27 in the same manner as illustrated in Figure 4.

For a general understanding of the operation of the press, forming the subject matter of the present invention, reference is made to diagrammatic view, Figure 2. As there shown, the head or dome 21 is provided with a die member comprising a cavity or recess 28 sealed at its lower side by flexible diaphragm 29. Communicating with the recess 28 is the conduit 30 for introduction of hydraulic medium having a branch 31 extending to the pressure relief valve 32 diagrammatically indicated as controlled by cam 33 and handle 34.

Disposed in the lower portion of the cylinder 12 is the main or die positioning piston 35 movable in a direction toward and from the die member in the dome 21 by the introduction or exhaust of hydraulic medium, as respects the pressure chamber 36 beneath the piston 35. A conduit 37 connected with this chamber determines the nature and extent of the flow of said hydraulic medium.

Centrally this piston is provided in its upper portion with a chamber or cylinder 38 in which moves piston 39 on the die plunger 40. A conduit 41 connects the lower cylinder 38a of the chamber 38 with groove 42 which extends circumferentially of the main piston 35 to maintain communication, during reciprocation of the piston, between cylinder 38a and the port 43 in the wall of the cylinder 12 coupled by conduit 44 with the valve bushing 45. Contained within this bushing 45 is a valve 46 movable from an intermediate neutral position, as established by springs 47 and 48 as indicated in Figure 2, to connect conduit 44 with either pressure conduit 49 to effect upward movement of the forming plunger 39—40 with respect to the piston 35 or with reservoir or return conduit 50 to relieve the pressure condition in chamber 38a.

As shown in Figure 2, piston 35 is provided with a second annular groove 51 of length to remain in communication with port 52 in the cylinder 12 during the prescribed length of stroke of piston 35. This port is connected by conduit 53 to the valve bushing 45 so that movement of valve 46 may be effective to couple pressure

conduit 49 with the conduit 53 for introduction of pressure into the upper cylinder portion 38b of general chamber 38 by way of conduit 54 in piston 35. Pressure thus introduced will tend to move piston 39 and plunger 40 downward relative to piston 35. The movement of valve 46 for effecting this downward movement will be to the right as the valve is viewed in Figure 2 and will be effective simultaneously to couple conduit 44 with drain conduit 50. The aforesaid movements of the valve 46 are suitably controlled by the intermediately pivoted manually operable handle 55 in the form of the invention here illustrated.

It will be noted that in Figure 2 there has been shown an auxiliary transverse porting or conduit at 56 coupling the groove 51 with the axially extending bore or minor chamber 57 in the upper portion of the piston 35. Pressure in this chamber will react against the piston rod or rods 58 carried by the head 21 tending to force the main piston 35 downward.

For operation of the press elements use has been shown of an electric motor 59 driving the high pressure pump 60 which may be of a type to develop a suitable forming pressure such as 10,000 to 15,000 pounds to the square inch and the low pressure pump 61. The availability of the output from pump 60 through conduit 62 alternatively through conduit 30 to the recess 28 or conduit 49 to the movable press elements is controlled by valve 63 contained in bushing 64 and operable by handle 65.

Likewise, the coupling of conduit 66 from the lower pressure pump 61 to conduit 37 or alternatively the coupling of conduit 37 to return or reservoir conduit 67 is controlled by valve 68 contained in bushing 69 operable by manual control lever 70.

Attention is invited to the fact that intermediately pivoted lever or link 71 connects the stem of valve 68 with the stem of valve 72 movable in bushing 73. When valve 68 is in the intermediate or neutral position shown, valve 72 provides connection from high pressure conduit 74 to reservoir conduit 75 and blanks off branch 53a of conduit 53. When valve 68 is shifted to the left to couple pressure conduit 66 with chamber 36 to raise piston 35, conduit 53a is coupled to reservoir conduit 75 thereby relieving pressure in groove 51. However, when valve 68 is shifted to the right as viewed in Figure 2, coupling conduit 37 with reservoir conduit 67, permitting downward movement of the piston 35, pressure conduit 74 is coupled through 53a, 53, 52, 54 to the upper chamber 38b tending to move plunger piston 39 downward not only with, but relative to, piston 35. At the same time, in the structure shown in Figure 2, this pressure condition will react against the piston rod 58 assisting gravity in effecting downward movement of the piston 35.

Attention is invited to the fact that in Figure 3 a conduit equivalent to conduit 53 and designated as 53b is coupled through the hollow trombone tube or rod 58a carried by stop block 82 to the bore or passage 57a connected at 77 to the chamber portion 38b. In this instance, the pressure reaction effects, however, are the same in that pressure in 57a reacting against the trombone rod 58a urges piston 35 downward while the pressure in 38b has a similar effect as respects the plunger piston 39.

A similar operation takes place in connection with the more highly organized structure of Figure 4. In this structure, however, in place of the pressure reaction being directly against the upper face of the piston 39, the main piston 35 is provided with concentrically arranged series of bores or passageways. These include the outer bores 78 containing the sliding piston rods 79 resting upon the wear plate 80 secured to the top of the piston 39. Threaded plugs 81 engaged in the body of the main piston 35 form closures for the upper ends of the bores 78. The pressure introduced through conduit 53 reacts against these plugs and the piston 35 to urge

the piston rods 79 downwardly and thus the piston 39 downwardly with respect to the piston 35.

It will be understood that a number of peripherally spaced stop blocks 82 may be employed. The block or blocks 82 aid in securing in position the abutment ring 84 positioned to engage the nest or work supporting member 85 which rests on the upper end of the piston 35 in circumscribing relation to the punch die 86. As the piston 35 moves upward into closed position it will carry with it the parts 85, 86, together with overlying work piece 87 to be formed, said work piece being of size that can be introduced or withdrawn from the interior of the press through the window or aperture 13 of the main cylinder 12.

As is conventional in forming presses of the type here disclosed, the punch die 86 is preferably provided with a stud 88 fitting in a socket 89 in the die plunger 40 where it is secured by a locking pin 90. In the form shown, in Figure 4, the punch is of appreciably greater diameter than the plunger 40. To provide adequate rigid support for the overhanging portion of the punch die, piston 35 is formed with the bores or passages 91 in which are mounted the pressure rods 92 resting at their lower ends on the member 80 and of length to just engage the underside of the punch die 86.

In the operation of the press, valve 68 (Fig. 2) is moved to the left by control lever 70 whereupon pressure is introduced into the chamber 36 moving the entire piston structure, die nest element and work upwardly until the nest 85 is suitably seated against abutment ring 84 or the underside of member 21, the parts being then in what is termed closed position, the work piece 87 engaging the underside of the flexible diaphragm 29. At the same time that valve 68 is moved to the left by control lever 70, valve 72 is moved to the right by link 71, thus connecting conduit 53a with reservoir through conduits 75 and 67. The groove 51 is thereby also connected to reservoir, releasing the rods 58 and permitting the main piston 35 to move upwardly. Valve 63 is then moved to the right by handle 65 whereupon pressure to a suitable amount as indicated by gauge 93 is introduced into the recess 28. Handle 65 is then returned to the position shown in Fig. 2 after which valve 46 is moved to the left by handle 55, thereby connecting conduit 44 to pressure conduit 49. As a result, pressure is introduced into the chamber 38a reacting against piston 39 to move the same upward relative to the main piston 35 tending to project die 86 or plunger 40 into recess 28 by deflection of the diaphragm under pressure which reacts against the work piece 87 to cause the same to be shaped in accordance with and conform to the contour of punch die 86. When the die has been advanced sufficiently to cause the work to be shaped to the desired form the cycle of operation is reversed by manipulating handle 55 to move valve 46 to the right so as to connect pressure from the conduit 49 to the conduit 53 and thereby to the groove 51. Hence, pressure is introduced into chamber 38b to lower the piston 39, and into bore 57 to raise the rods 58. Movement of valve 46 to the right also connects conduit 44 with conduit 50 so that fluid in chamber 38a may flow to reservoir. At the same time, control lever 70 is manipulated to move valve 68 to the right to connect chamber 36 to reservoir through conduits 37 and 67. Thus, the entire piston assembly 35-39 is retracted to shift the parts to the open position shown in the drawings and the piston 39 retracted or moved downward into the piston 35 so that the work will be disengaged by and stripped from the plunger die 86.

To facilitate visual determination of the amount of movement imparted to the element 39-40 use may be made of a suitable automatic gauge or indicator mechanism such as shown in detail in Figure 4. As there shown, a bore or passage 94, similar in extent to the bores or passages 78, is sealed at its upper end by a plug 95 and contains in its lower portion the sliding plunger

5

96. The intermediate portion of the bore is connected through passage 97 in piston 35 and suitable means, such as the flexible conduit 98 with one end of the cylinder 99. Intermediately slidably mounted in the cylinder 99 is the rack bar 100 having the piston portions 101 and 102 at its ends. Pressure in 98 will react against piston 101 while conduit 103 connects the passage end of the cylinder with pressure conduit 66 for reaction of the pressure in 66 against the piston 102. Intermediately engaging the rack portion of member 100 is the pinion 104 on shaft 105 rotatably mounted in the body of cylinder 99. This shaft projects forwardly from the cylinder and has adjustably secured thereon by the wing nut 106 a position indicating pointer 107 cooperating with the dial 108 carried by cylinder 99. The bore 94, passage 97, and conduit 98 are preferably filled with a viscous fluid medium such as a heavy grease which can be displaced in one direction by the upward force exerted on plunger 96 by piston 39, this displacement of the contained fluid medium serving to move member 100 to the right as viewed in Figure 4. As the piston 39 moves downward, pressure in conduit 103 will react to move member 100 to the left and restore the intervening power transmitting medium and plunger 96 to initial position as shown in Figure 4. By this construction a very accurate and dependable measure is given to the exact amount of movement of piston 39 and thus of the plunger die element while at the same time the adjustability of pointer 107 permits easy setting of the indicating mechanism for different desired conditions of operation.

From the foregoing description the essential novel features of the present invention should be clearly apparent. It will be particularly noted that there has been provided an improved press structure, preferably of laminated high tensile strength material which provides both the complete press frame structure and the main press cylinder and die element supports and which eliminates the necessity of independent heavy frames, brace rods, struts and the like hitherto deemed necessary in connection with high pressure presses of the nature here involved.

It will further be apparent that by provision of a structure of this character an improved press has been provided in which the outer or stress resisting parts are substantially unitary in nature and in which the operating elements are slidable as an entirety within said unitary frame structure and also have a telescoping or relative supplemental movement and that by this particular arrangement the overall dimensions for a press of a given power performance capacity have been greatly reduced both as to height and width as respects hitherto known structures.

It will, of course, be understood that while there has been illustrated and described in connection with the disclosure of the essential novel features of the present invention a simplified form of manual control mechanism for determining the several essential movements and operations of the press structure that alternative forms of automatic or semi-automatic control structures may alternatively be utilized in connection with the basic novel features of the invention as hereinafter pointed out in the claims.

What is claimed is:

1. A forming press structure comprising a high tensile strength body in the form of a multilayer cylindrical shell having an inner axial bore, and having attaching rings welded to the ends of said shell, fastener studs secured to each of said attaching rings and projecting therefrom in a direction parallel with the axis of said shell, a base closure for one end of the bore fitting against one of said rings and formed with apertures to receive the fastening studs of said ring, means for securing the closure on the studs to provide a sealed pressure chamber at said end of the bore, a die positioning piston mounted in the bore and movable in the chamber, a head mounted on the studs of the ring at the other end of the

6

shell having apertures to receive its studs, means on these studs for securing the head in position, and a die member carried by the head, the shell having a lateral access aperture formed therein in proximity to the head for work piece introduction and withdrawal as respects the bore of the shell.

2. A hydraulic forming press comprising a cylindrical frame having a finished cylindrical bore therein, a closure secured to one end of said frame to form a cylinder head closing one end of said bore, a main piston fitted in said bore and having a head at one end which co-operates with said closure to form an expansible chamber in said cylinder, a work supporting member on the other end of said piston, a finished bore extending co-axially of said piston, a die plunger having a piston portion fitted in the bore in said main piston to form with said piston head an expansible chamber in said main piston, a press head secured to the other end of said frame, a die member carried by said head for cooperating with said die plunger to effect forming of the work placed on said work supporting member, a source of hydraulic actuating fluid, a wide annular groove in the outer face of said main piston intermediate the ends thereof, conduit means extending through the wall of said cylindrical frame for connecting said groove with said source of hydraulic fluid, additional conduit means formed in said main piston and extending from said groove to one end of said expansible chamber in said main piston for connecting said chamber with said source of hydraulic actuating fluid in all positions of said main piston, and valve means for controlling the connection of said source to said expansible chambers to first actuate said main piston and thereby move said work supporting member and die plunger into operative position with respect to said die member and thereafter to move said die plunger relative to said main piston in the direction of said die member to effect forming of the work.

3. A hydraulic forming press comprising a cylindrical frame having a finished cylindrical bore therein, a closure secured to one end of said frame to form a cylinder head closing one end of said bore, a main piston fitted in said bore and having a head at one end which cooperates with said closure to form an expansible chamber in said cylinder, a work supporting member on the other end of said piston, a finished bore extending co-axially of said piston, a die plunger having a piston portion fitted in the bore in said main piston to form with said piston head an expansible chamber in said main piston, a press head secured to the other end of said frame, a die member carried by said head for cooperation with said die plunger to effect forming of the work placed on said work supporting member, a source of hydraulic actuating fluid, valve means for controlling the connection of said source to said expansible chambers to first actuate said main piston and thereby move said work supporting member and die plunger into operative position with respect to said die member and thereafter to move said die plunger relative to said main piston in the direction of said die member to effect forming of the work, an axially extending passage in the work supporting end of said main piston, a pressure rod fitted in said passage and having a portion projecting from one end thereof for engagement with the piston portion of said die plunger, an indicator having a cylinder and a rack piston slidable therein for signifying the position of said die plunger, a conduit connecting one end of said cylinder with the other end of said passage, and a fluid medium filling the conduit, passage and cylinder between said pressure rod and said rack piston whereby movement of said pressure rod by the piston portion of said die plunger will be transmitted by the fluid medium to the rack piston to provide the desired indication.

4. The hydraulic forming press of claim 3 including a conduit connecting the other end of said cylinder to said

source of hydraulic actuating fluid for applying a restoring force to said rack piston and said pressure rod.

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