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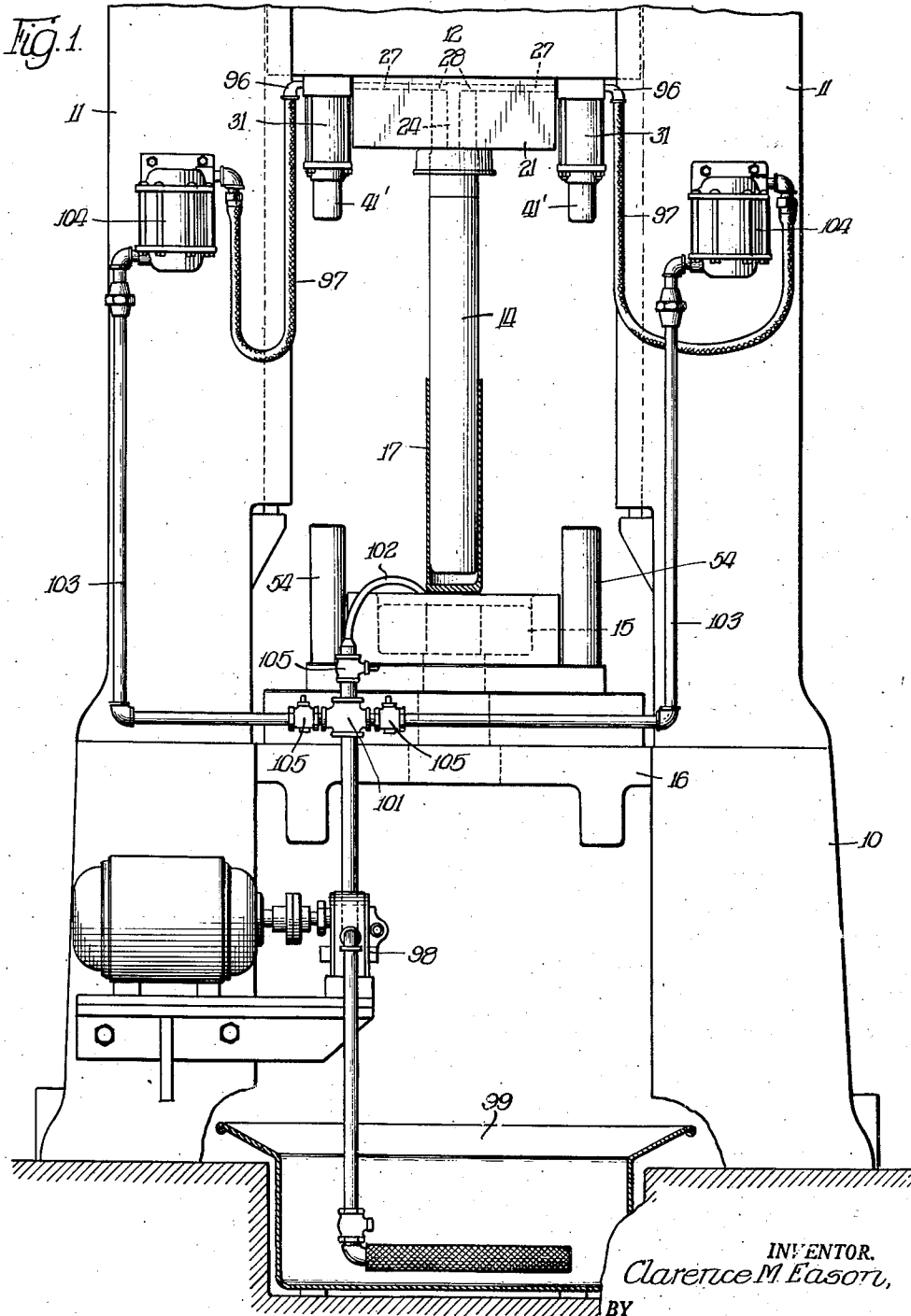
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2,378,069

HYDRAULIC STRIPPING MECHANISM

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4 Sheets-Sheet 1



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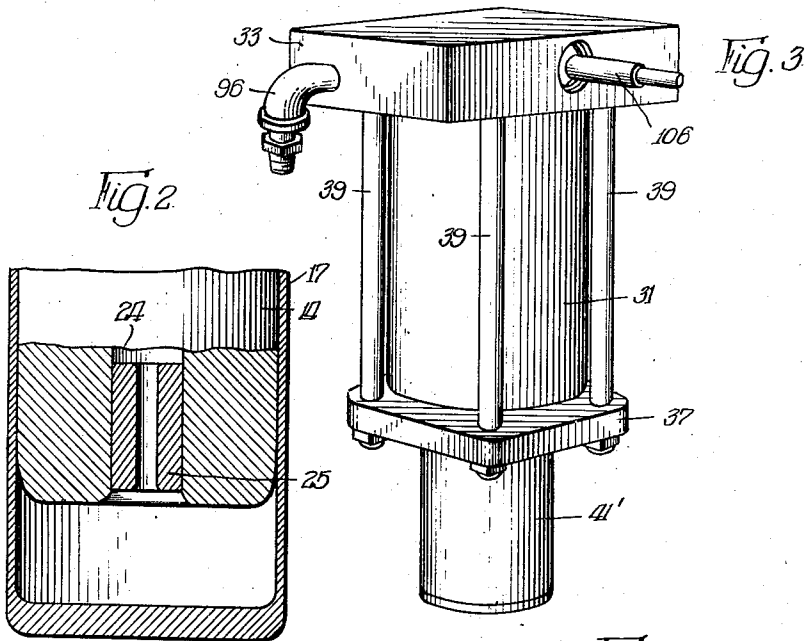
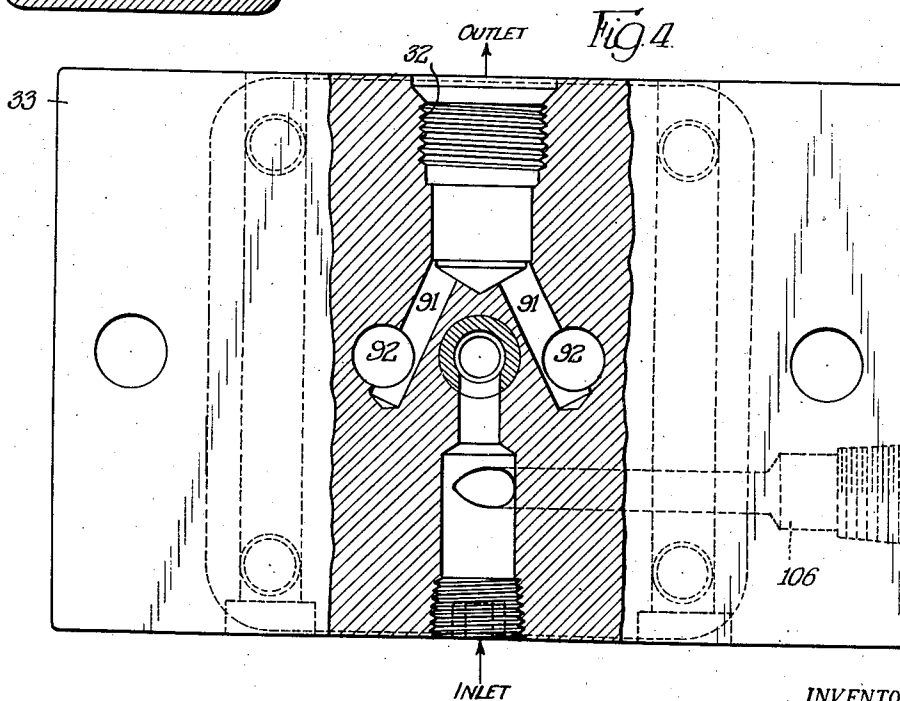
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HYDRAULIC STRIPPING MECHANISM

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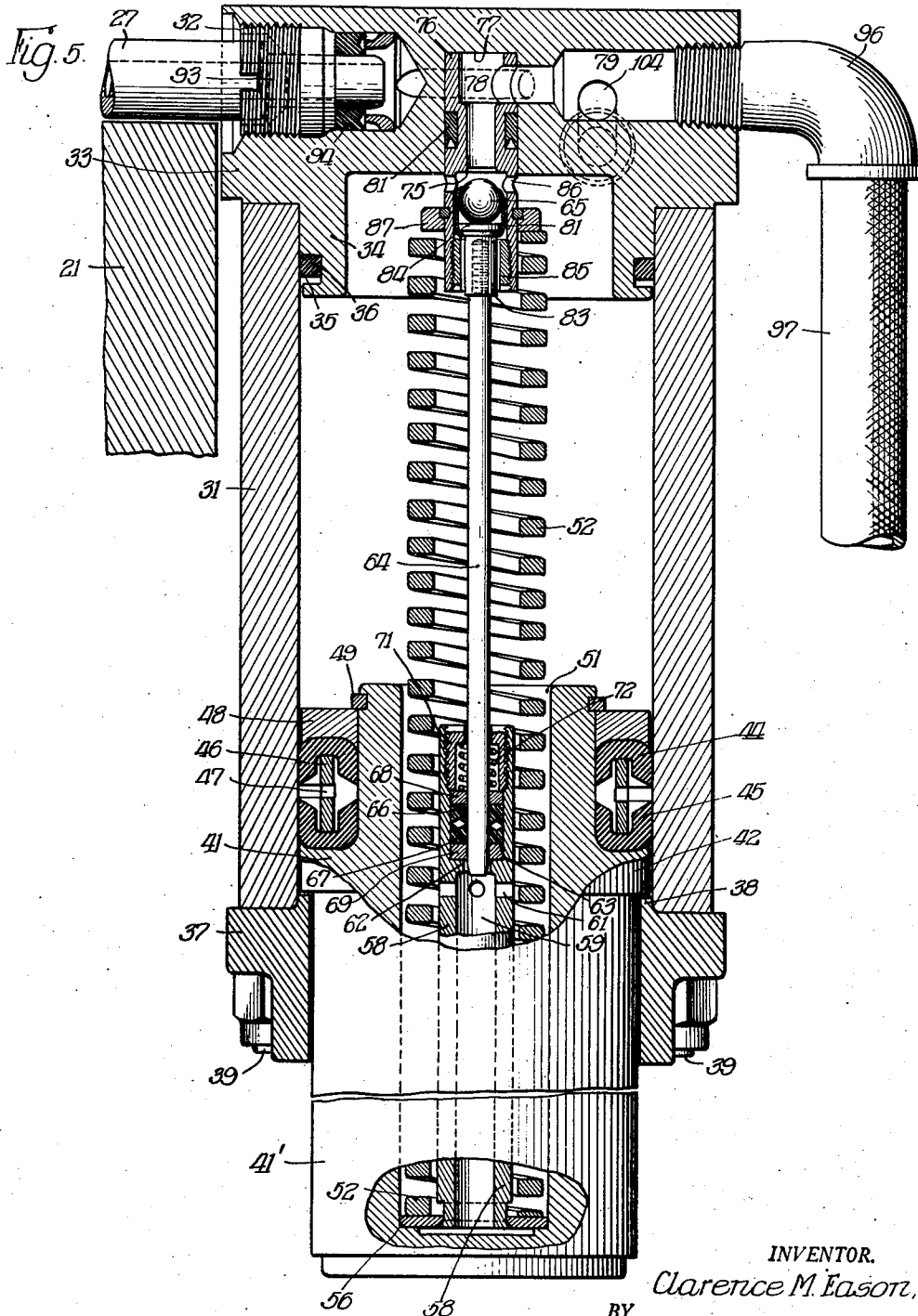
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HYDRAULIC STRIPPING MECHANISM

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HYDRAULIC STRIPPING MECHANISM

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Fig. 6

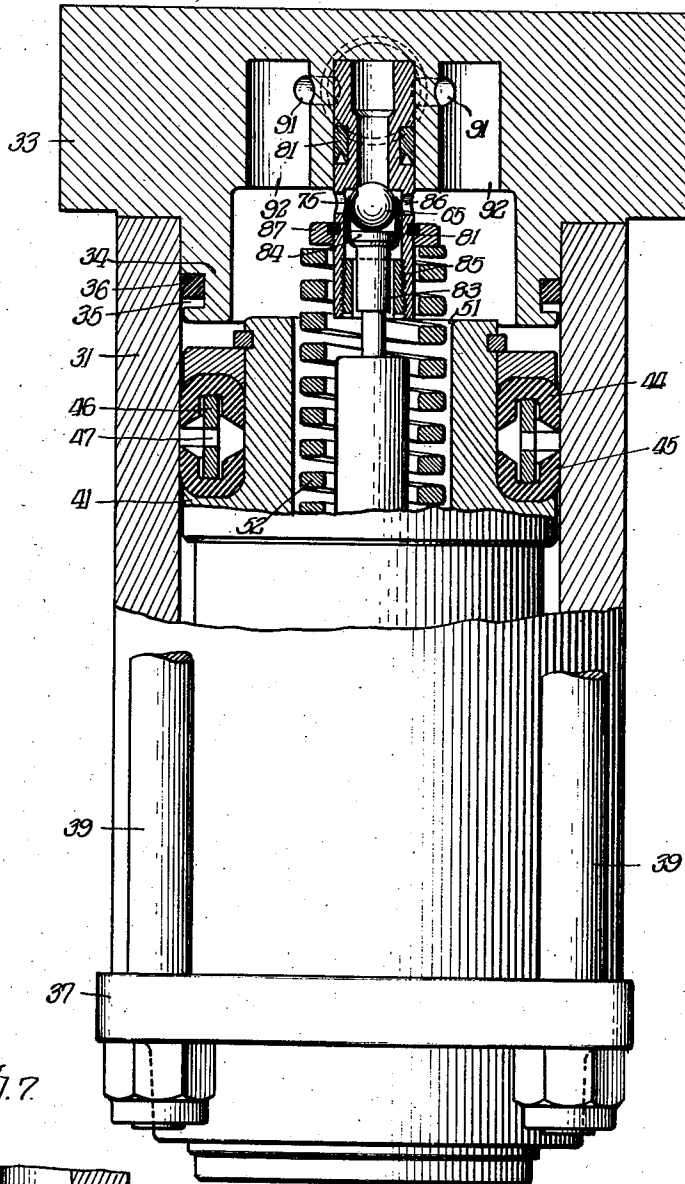
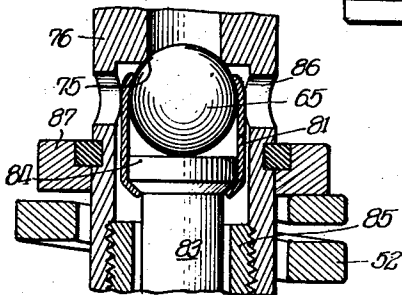


Fig. 7



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UNITED STATES PATENT OFFICE

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HYDRAULIC STRIPPING MECHANISM

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Application April 7, 1944, Serial No. 529,992

5 Claims. (Cl. 113—50)

The present invention relates to hydraulic stripping mechanism for punch presses and the like. The present invention embodies improvements upon the construction of hydraulic stripping mechanism disclosed in my copending application Serial No. 446,311, filed June 8, 1942.

In performing deep drawing operations on a hydraulic press, punch press or other like machine, it is frequently difficult to effect release of the drawn blank from the punch upon the completion of the drawing operation when relying upon mechanical stripping devices of the prior art. These mechanical stripping devices frequently cause excessive mutilation of the upper edge of the blank where the mechanical stripper engages the blank. This is particularly true when performing deep drawing operations on tubular shells, such as steel cartridge cases, where the punches used in the last one or two draws have only a very slight taper and hence have a tighter binding action. Steel shells appear to be more difficult to strip from the punches than brass shells, and it may require the exertion of several thousand pounds pressure on the steel shell to strip it from the last punch in the series of drawing operations. When the stock has been drawn down to a shell of relatively thin wall, the exertion of a high stripping pressure as a mechanical force against the upper edge of this thin walled shell is very likely to mutilate the upper edge of the shell so badly as to require that a considerable portion of the upper edge of the shell be cut off as waste scrap. Such difficulties in mechanical stripping, with the resultant mutilation of the shells, are entirely avoided by the improved hydraulic stripping mechanism disclosed in my aforesaid copending application Serial No. 446,311, and also disclosed in my present application.

One of the general objects of the present invention is to provide improved hydraulic stripping mechanism which will strip the shell from the punch by the exertion of a hydraulic pressure between the lower end of the shell and the punch.

More specifically, it is one of the principal objects of the embodiment shown in this application to provide means for automatically releasing any liquid which may be trapped between the punch and the shell at the time that the punch is becoming seated in the shell and is starting to force the shell down through the die. This liquid is the liquid which is used to lubricate and cool the punch and die surfaces and the blank, such liquid also being employed as the hydraulic stripping liquid for stripping the shell from the punch. If a substantial volume of this liquid becomes trapped between the lower end of the punch and the bottom of the shell at the start of the seating and drawing operation, and if the pressures

imposed upon this trapped liquid become sufficiently high, there is the possibility that such trapped liquid will distort the shell. This possibility is completely avoided by an improved venting arrangement which I have embodied in the hydraulic stripping mechanism herein disclosed. Such venting arrangement enables any trapped liquid to be vented from between the lower end of the punch and the lower end of the shell at the start of the drawing operation, while still enabling the hydraulic stripping mechanism to exert extremely high hydraulic pressures between the lower end of the punch and the lower end of the shell at the conclusion of the drawing operation, for stripping the shell from the punch.

This automatic venting at the start of the drawing operation, without interfering with the high stripping pressures at the conclusion of the drawing operation, is preferably accomplished by venting the trapped liquid back through the very same cylinder or cylinders which later transmit the extremely high hydraulic pressures to the space between the punch and shell. Because of this venting back through the cylinders, I term this function a "back-venting" function, such being one of the distinctive features of the present invention.

Other objects, features and advantages of the invention will be apparent from the following detail description of a preferred embodiment thereof. In the accompanying drawings illustrating such embodiments:

Figure 1 is a fragmentary elevational view showing my improved hydraulic stripping mechanism applied to a hydraulic press;

Figure 2 is a fragmentary sectional view showing how liquid may become trapped between the lower end of the punch and the lower end of the shell;

Figure 3 is a perspective view of one of the hydraulic cylinders of the stripping mechanism;

Figure 4 is a fragmentary horizontal sectional view through the head block of the pressure cylinder;

Figure 5 is a fragmentary vertical sectional view through the hydraulic cylinder of the stripping mechanism, showing the piston or ram element of this device in its lower position, with the controlled back venting valve open;

Figure 6 is a similar fragmentary sectional view showing the piston or ram element in its raised position with the controlled back-venting valve closed; and

Figure 7 is a fragmentary detail view of the back-venting valve, drawn on a larger scale.

In Figure 1 I have shown my improved hydraulic stripping mechanism applied to a conventional construction of hydraulic press comprising the usual bed or base structure 10 formed with

upwardly extending sides 11 between which reciprocates a vertically moving cross-head 12. In a hydraulic press the cross-head 12 is reciprocated by an overhead hydraulic cylinder (not shown), and in a crank type of punch press this cross-head or ram is reciprocated through a conventional pitman connecting to a crankshaft, as is well known.

The punch or male die which moves down inside of the shell is indicated at 14, this punch being detachably secured to the underside of the reciprocating ram or cross-head 12. The female die through which the shell case is drawn is indicated at 15, this die being detachably secured to the stationary bolster or bed plate 16. The drawn tubular shell is indicated in its entirety at 17. In the illustrated arrangement, this tubular shell 17 may be considered as typical of a cartridge case for guns ranging as large as 75, 90 or 105 mm. or larger. The tubular shell 17 may also be regarded as composed of steel, which represents a more difficult stripping problem than a brass shell.

The upper end of the punch 14 is releasably mounted in a mounting block 21, as by threading, bolting, clamping or in any other suitable manner, and this mounting block 21 is secured to the underside of the reciprocating cross-head 12. An axial passageway 24 extends down through the punch to its lower end, a flow controlling plug 25 being preferably seated in the lower end of the bore 24. Two high pressure passageways 27 extend outwardly in diametrically opposite directions from the upper end of the punch 14, these passageways being either formed as short sections of high pressure tubing, or as passageways cored out in the mounting block 21. These passageways 27 communicate through high pressure connections 28, 28 with the upper end of the bore 24 in the punch.

Each passageway 27, 27 extends to a hydraulic cylinder 31, there being two of these cylinders at diametrically opposite sides of the punch so as to equalize the stresses imposed on the ram and its guideways when the high stripping pressures are created in these hydraulic cylinders. As shown in Figures 4 and 5, the outer end of each high pressure tube 27 enters a tapped bore 32 in a head casting 33 which constitutes the upper closure head of each high pressure cylinder 31. A depending annular skirt or flange 34 extending downwardly from the head 33 is formed with an external groove 35 in which is mounted an expansible ring 36 composed of rubber, Neoprene or the like. A bottom stop ring 37 having an inwardly extending stop shoulder 38 is bolted to the lower end of the cylinder 31 by long cap screws or stud bolts 39 which have their upper ends anchored in the head block 33. Reciprocating in each high pressure cylinder 31 is a piston or ram 41 which is formed with a reduced lower portion 41' adapted to pass down through the lower stop ring 37, an outwardly extending shoulder 42 on the piston being adapted to strike the shoulder 38 of the ring 37 for limiting the downward movement of the piston. The upper portion of the piston 41 is formed with a reduced neck around which are assembled an upper sealing ring 44 and a lower sealing ring 45. These two rings are preferably constructed in the form of cup leathers of U-shaped cross-section which are held in the spaced apart relation illustrated by an intermediate spacing ring 46. This spacing ring has a plurality of transverse holes 47 therethrough at spaced intervals for the purpose of equally dis-

tributing pressures from the outside to the inside of the ring. A retaining member 48 holds the assembly in place, and this retaining member is secured to the piston by a locking ring 49 which snaps into an annular groove in the reduced neck portion of the piston. The upper cup leather 44 functions as the suction sealing leather for the purpose of preventing the entrance of air into the cylinder on the down stroke of the piston 41, and the lower cup leather 45 functions as the pressure sealing leather for preventing oil leakage past the piston when the piston is forced upwardly in the cylinder in the hydraulic stripping operation. The oil pressures within the cylinder 31 may rise to approximately 10,000 lbs. per square inch in the hydraulic stripping operation. The tapered edges of the U-shaped cup leathers augment the ability of these leathers to maintain an effective seal under these pressures.

The piston 41 is cored out with a relatively long central bore or well 51 therein into which extends a heavy compression spring 52 normally tending to hold the stop shoulder 42 of the piston down against the lower stop ring 37. As the high pressure cylinder 31 moves down with the cross-head 12 in the operation of forcing the tubular shell down through the female die 15, the lower end of the piston 41' engages the top of a striker post 54 at just about the time that the tubular shell has been forced completely through the female die 15 and is ready to be stripped from the punch 14. From this point on the piston 41 has relative movement within the cylinder 31, i. e. the piston stands stationary and the cylinder moves down over the piston in the continued downward movement of the cross-head. It will be understood that this same operation is, of course, also occurring in the case of the other high pressure cylinder 31 mounted on the other side of the cross-head. The spring 52 is compressed in this movement of the cylinder 31 down over the piston 41. The lower end of the spring 52 seats on a ring 56 which bears constantly against the bottom of the central bore 51 in the piston 41. This ring 56 has a peened or other suitable connection with a long guide sleeve 58 which extends up axially within the spring 52. A bore 59 in the lower portion of the sleeve 58 is provided with outwardly radiating vent holes 61 near its upper end, and above these vent holes is formed an inwardly extending shoulder 62. A counterbore 63 extends upwardly above the shoulder 62, and extending down through this counterbore and into the lower bore 59 is a valve actuating rod 64 which serves to actuate a ball valve 65 at its upper end. Disposed within the counterbore 63 and surrounding the rod 64 are two friction grip washers 66 and 67 which exert a slidable clutching action on the rod. Above and below the washers 66 and 67 are supplementary clutching washers 68 and 69. These several washers may be composed of different materials suitable for obtaining a friction gripping action on the surface of the rod 64; in the preferred construction I have made the two intermediate washers 66 and 67 of Neoprene and the two outer washers 68 and 69 of leather. The washer assembly is held in place by a threaded gland ring or bushing 71 which screws down into the threaded upper end of the counterbore 63. Confined within this threaded bushing is a compression spring 72 which also serves to keep the friction washers compressed into firm frictional contact with the surface of the rod 64. In the operation of this friction clutch mechanism 66-69, the friction

washers exert upward force through the valve rod 64 to force the ball valve 65 to its seat when the piston 41 has relative movement in an upward direction in the cylinder, and these friction washers exert a downward force through the rod 64 to pull the ball valve 65 off of its seat when the piston 41 has relative movement downwardly within the cylinder.

The ball valve 65 is operative to control a port 75 which functions as an inlet port when liquid is entering the cylinder 31 from the liquid circulating system, and which also functions as the back-venting port for back-venting trapped liquid out of the tubular shell and out of the cylinder 31 in the operation of seating the punch in the shell and forcing the shell down through the female die. The valve port 75 is formed intermediate the ends of a valve cage 76 which is pressed up into a central bore 77 formed in the head block 33. The fluid passageway 78 of this valve cage opens laterally into an inlet bore 79 which has connection with the pump of the circulating system, and which may also have connection with the coolant nozzle at the stationary die, as I shall presently describe. A sealing ring 81 composed of Neoprene or like material may be set into an annular groove in the valve cage 76 to prevent any possibility of leakage of the high pressures up along the outer side of the valve cage.

The ball valve 65 is mounted in a confining ring or sleeve 81 which has an inwardly turned upper lip embracing the ball above its horizontal diametric plane, whereby the confining ring is operative to pull the valve 65 forcibly downwardly away from the seat 75. The upper end of the valve rod 64 has threaded attachment within a coupling sleeve 83 which is formed with an enlarged flange 84 at its upper end. The lower edge of the ball confining ring 81 is crimped inwardly under this flange 84 so that downward pull exerted through the valve rod 64 is operative through the sleeve or bushing 83 and ring 81 to pull the ball valve downwardly off of its seat 75. A threaded guide bushing 85 screws into the internally threaded lower end of the valve cage 76 and serves to limit the downward movement of the valve 65 in a direction away from the seat 75. There is sufficient lateral play in the vertical movement of the ring 81 within the valve cage or of the sleeve 83 within the bushing 85 to insure that the ball valve will be self-centering when it engages the valve port 75. Ports 86 open outwardly through the wall of the valve cage immediately below the valve port 75. The upper end of the compression spring 52 can bear against either the head block 33 or against the valve cage 76. The latter arrangement is preferable, and is obtained by having the spring bear against a thrust ring 87 which abuts against a suitable shoulder or stop ring carried by the valve cage.

The high pressure conduit 27 opens into passageways 91 (Figure 6) which communicate with vertical bores or cavities 92 communicating with the chambered upper portion of the head block 33. A suitable high pressure coupling 93 screws into the threaded counterbore 32 of the head block for establishing a high pressure seal around the conduit 27, this coupling comprising a Neoprene sealing ring 94 functioning substantially the same as described of the high pressure couplings disclosed in my prior application Serial No. 446,311. The high pressure couplings 28 which join the inner ends of the tubes 27 to the bore 24 of the punch 14 may also be of the Neoprene ring

type disclosed in said copending application. Screwing into the threaded outer end of the inlet bore 79 (Figure 5) is any suitable pipe fitting or coupling 96 which has connection through a flexible conduit 97 with the source of liquid supply. It is customary to supply a liquid coolant to the die parts during the drawing operation, and in the preferred embodiment of my invention this liquid coolant is used as the hydraulic stripping medium for stripping the shell from the punch 14. This liquid coolant, which has an oil base or other suitable base appropriate for lubricating and cooling purposes, is circulated through a circulating system which is shown in Figure 1 as comprising a motor driven pump 98 which draws the liquid from a suitable sump 99 disposed beneath the press. The liquid is forced upwardly at a relatively moderate pressure of 15 or 20 pounds or so to a four-way fitting 101. Leading from one branch of this fitting is a discharge nozzle 102 which discharges coolant around the female die 15 and the exterior of the tubular shell 17. Leading from other branches of said fitting 101 are pipes 103 which extend to filters 104 feeding liquid to the flexible conduits 97. Valves 105 may be provided in the nozzle line 102 and in the pipe lines 103 for shutting off flow or for regulating the pressure of the flow. If desired, a branch passageway 106 may be formed in each head block 33, leading from the inlet chamber 79, for conducting coolant to a pressure release by-pass valve, thereby providing a ready avenue of discharge through which back-vented coolant can be quickly vented from each cylinder 31 without having to be forced back through the filters 104.

Referring now to the operation of the apparatus, in the normal position of the parts, the cross-head 12 stands in its raised position with the punch 14 entirely clear of the female die 15, and with the two high pressure cylinders 31 raised a substantial distance above the striker posts 54. At this time the circulating pump is forcing coolant liquid through the high pressure cylinders 31 and through the passageways 27 for discharging some of the coolant down through the axial bore 24 in the punch 14. Some of the coolant is of course also flowing through the discharge nozzle 102 to the female die. In this condition of the parts, the pistons 41 of the two high pressure cylinders are in their lower positions under the action of the springs 52 and under the pressure of the coolant liquid, in which position the valves 65 of each cylinder are held off their valve seats 75, as shown in Figure 5. As soon as the tubular shell 17 which is to be drawn is placed under the punch 14 the flow of coolant issuing from the lower end of the punch collects in this tubular shell. In the operation of forcing the shell and the punch downwardly through the female die 15 the shell is forced downwardly into a closer and closer fit with the punch so that there is an increasing likelihood of the liquid confined in the lower end of the shell becoming trapped between the shell and the punch. If there is no possibility of such trapped liquid being back-vented out of this space between the shell and the punch during the seating and drawing operation there is the possibility of extremely high pressures being developed in the trapped liquid, sufficient to distend the side wall or bottom wall of the shell or produce other malformations in the shell which would make it unfit for its intended use. The possibility of any such trapped liquid reaching these extremely high pressures is avoided by the above described back-

venting arrangement wherein such trapped liquid is free to flow back through the high pressure conduits 27 into the two cylinders 31, and thence back out through the open ports 75 of these two cylinders. Hence, the maximum pressure which can be created in this trapped liquid is merely the pressure of the pump 98, which is usually in the neighborhood from 10 to 25 lbs. per square inch. The back-vented liquid can be forced back through the pump 98, or it may be discharged through passageways 106 or through other corresponding channels leading either to the discharge nozzle 102 or back to the sump 99. This back-venting connection remains open during substantially the entire drawing operation performed in the tubular shell, or until the lower ends of the high pressure pistons 41 engage the striker posts 54. This does not usually occur until after the tubular shell has been forced down completely through the female die 15, corresponding to the completion of the drawing operation. As soon as the lower ends of the two pistons 41 engage their respective striker posts their further downward movement is stopped, i. e. they have relative upward movement within their respective cylinders 31. The very first part of this relative upward movement acts through the friction clutching washers 66—69 to exert an upward force through rod 64 for pressing the ball valve 65 up against its seat 75. Thereupon, the back-venting connection through the high pressure cylinder is closed. Upon the engagement of the valve 65 with the seat 75 this valve becomes an intake check valve, and thereafter all hydraulic pressure created within the cylinder 31 is transmitted through the high pressure connection 27 to the axial bore 24 extending down through the punch 14. With the continued downward movement of the cross-head 12 the friction washers 66—69 slide along the rod 64 for continuously maintaining the valve 65 against the seat 75, aided by the high pressure which is continuing to rise in the cylinder 31. When the pressure in these two cylinders reaches a point capable of stripping the tubular shell from the punch the shell moves downwardly along the punch, thereupon quickly releasing the high stripping pressure. The entire stripping operation can be performed hydraulically, or it may be initiated hydraulically and completed mechanically. On the return stroke of the cross-head 12 the first relative movement of each piston 41 in a downward direction operates through the friction washers 66—69 to exert a downward pull on the valve rod 64 for pulling the ball valve 65 off its seat 75. The pressure continuously transmitted through the liquid coolant from the pump 98 also assists in forcing the valve 65 from its seat. Thereupon, the rapid inflow of coolant liquid in the cylinder from the pump prevents the creation of any suction condition within the cylinder, which suction condition might tend to draw air into the cylinder. The employment of the two high pressure cylinders 31 disposed at diametrically opposite sides of the punch 12 insures a balancing of the reaction forces exerted up through the cross-head from the hydraulic stripping mechanism.

While I have illustrated and described what I regard to be the preferred embodiment of my invention, nevertheless it will be understood that such is merely exemplary and that numerous modifications and rearrangements may be made

therein without departing from the essence of the invention.

I claim:

1. In a press comprising a reciprocating ram, the combination of punch and die members adapted to be moved toward and from each other by the reciprocation of said ram for drawing a tubular shell, a hydraulic cylinder and cooperating piston having relative motion therein responsive to the motion of said ram for creating a hydraulic stripping pressure between said punch member and said tubular shell, and valve means automatically responsive to relative motion between said hydraulic cylinder and piston for preventing the creation of high liquid pressures between said punch member and said tubular shell prior to the hydraulic stripping operation.

2. In a press comprising a reciprocating ram, the combination of punch and die members adapted to be moved toward and from each other by the reciprocation of said ram for drawing a tubular shell, a hydraulic cylinder and piston adapted by relative converging movement therebetween to create hydraulic stripping pressures between the shell and the punch at the end of the drawing operation, valve means for preventing liquid from becoming trapped between the shell and the punch in the drawing operation, and means responsive to the initial converging movement between said cylinder and said piston for closing said valve means.

3. In a press including a reciprocating ram together with punch and die members adapted to be moved toward and away from each other by the reciprocation of said ram for drawing a tubular shell, the combination therewith of a hydraulic cylinder and piston operative by relative converging movement therebetween to create hydraulic stripping pressures between the shell and the punch at the end of the drawing operation, valve means for venting liquid trapped between the shell and the punch in the drawing operation, and mechanically acting means responsive to the initial converging movement between said cylinder and piston for closing said valve means.

4. In apparatus of the class described including punch and die members having relative movement therebetween to effect a drawing operation on tubular shells, the combination of a hydraulic cylinder and piston adapted by relative converging movement therebetween to create hydraulic stripping pressures between the shell and the punch at the end of the drawing operation, valve means for venting liquid trapped between the shell and the punch in the drawing operation, and friction clutch means operative to close said valve in response to the initial converging movement between said cylinder and piston.

5. In apparatus of the class described including punch and die members cooperating with each other to produce a drawing operation on a metallic blank, the combination therewith of a hydraulic cylinder and piston adapted by relative converging movement therebetween to create hydraulic stripping pressures between the blank and the punch at the end of the drawing operation, a valve for venting fluid trapped between the blank and the punch in the drawing operation, a stem extending from said valve, and friction slippage clutch means carried by said piston and movable along said valve stem for imparting up and down movement to said valve.

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