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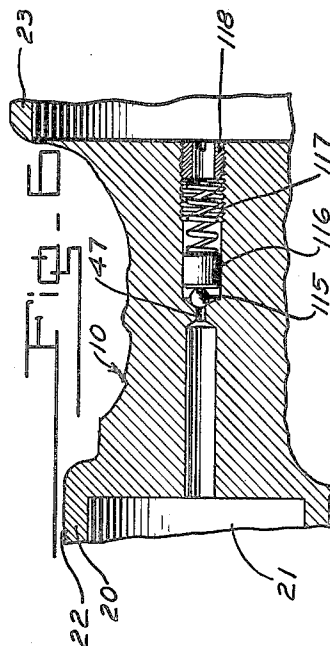
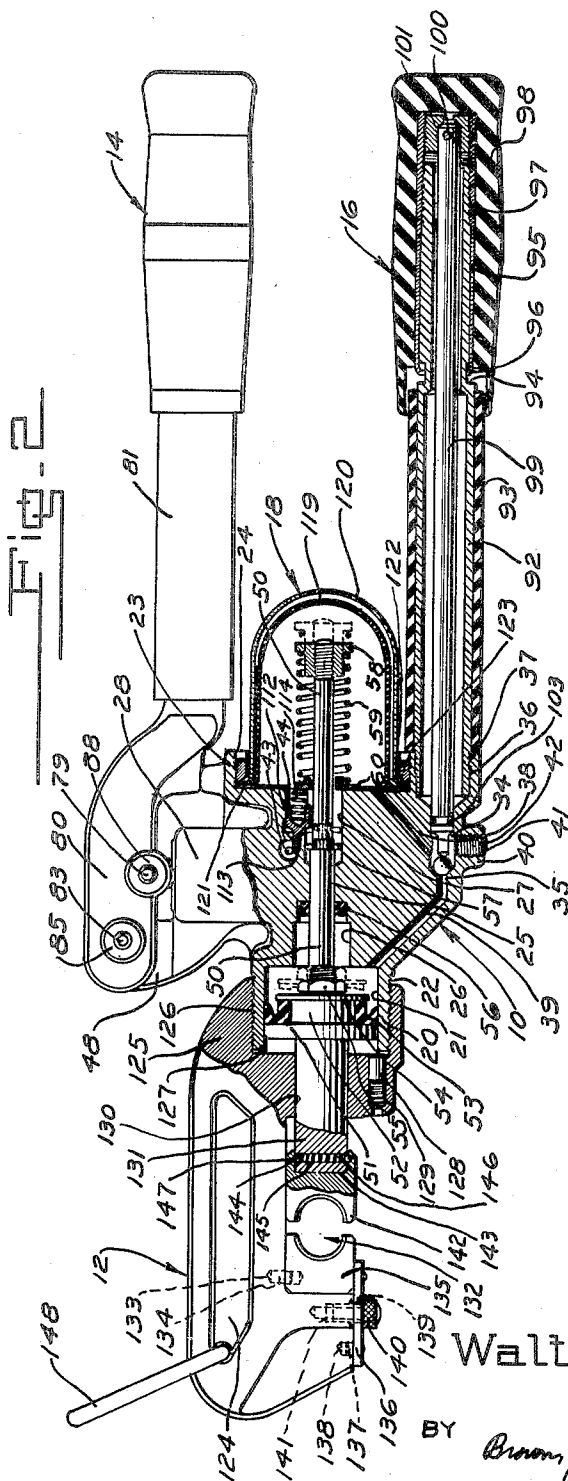
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PISTON ACTUATED HYDRAULIC PRESSURE TOOL

Filed June 20, 1951

3 Sheets-Sheet 2



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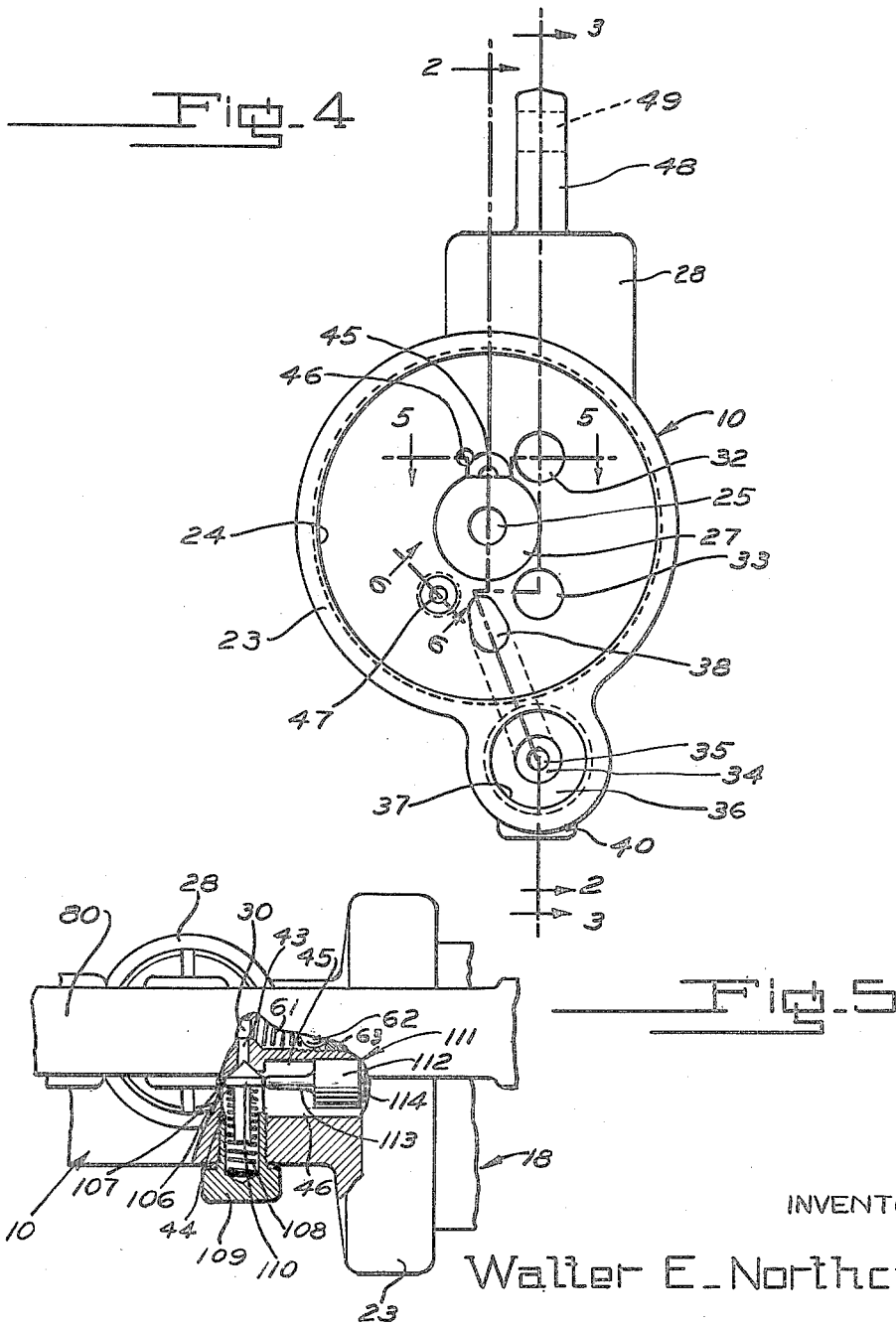
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PISTON ACTUATED HYDRAULIC PRESSURE TOOL

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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PISTON ACTUATED HYDRAULIC PRESSURE TOOL

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9 Claims. (Cl. 60—52)

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The present invention relates to manually operated hydraulic tools, such as crimping and cutting tools actuated by hydraulic ram, and in particular to the hydraulic actuating mechanism.

An object of the present invention is to provide a hand operated tool having relatively movable dies, cutters, or the like, movable toward one another with substantial force to effect bending, forming, crimping, cutting or the like, of hard materials, particularly metals, with the expenditure of little physical effort.

Another object of the present invention is to provide a tool including a manually operated hydraulic pump adapted to reciprocate a ram or piston for effecting a work stroke or movement of a die, cutter, or the like, wherein the manual effort required is slight and the application of force to the work piece is great.

Another object of the invention is the provision of a tool including a manually operated two-stage or compound pump for rapidly moving a die or the like into engagement with the work piece and thereafter slowly moving said die or the like with respect to the work piece with application of considerable force to do work on the work piece.

A further object of the invention is the provision of a completely self-contained tool, comprising a fluid reservoir, a fluid pump and a ram movable to effect work, the pump being manually operated and providing a large mechanical advantage between the operating lever of the pump and the ram.

A still further object of the invention is to provide a tool of the character defined in the preceding paragraph having a compound pump including a high volume-low pressure unit and a low volume-high pressure unit, the two units co-operating to provide rapid movement of the ram to bring a die or the like carried thereby into engagement with the work piece, the low volume-high pressure unit thereafter effecting movement of the ram to apply force to the work piece and perform work thereon.

In addition to the foregoing, it is an object of the present invention to provide a tool of the character described having automatic valve means for by-passing the output of the low pressure pump unit back to the fluid reservoir after the die or the like has been moved into engagement with the work piece and while the high pressure pump unit effects the performance of work.

Another object of the invention is to provide in a tool of the character described, automatic safety valve means for relieving hydraulic pressure

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acting on the ram when the pressure rises to a predetermined maximum.

It is also an object of the present invention to provide a manually operated hydraulic ram for actuating dies, cutters, or the like for performing work on a work piece, the pump being of a compound nature and having a by-pass valve for one stage of the pump when the ram actuating pressure exceeds a predetermined value. The hydraulic ram of the present invention also includes a relief valve for venting the ram pressure chamber to the reservoir when the pressure in the ram chamber exceeds a predetermined maximum, a manually operable valve for venting the ram chamber to the reservoir and a pair of handles, one handle being manually oscillatable to operate the compound pump and the other being adapted to effect actuation of the last named valve for relieving the pressure in the ram chamber.

Another object of the invention is to provide a hydraulic tool having a pair of handles, one oscillatable to operate a pump to actuate a ram in its working stroke and the other rotatable to operate a valve for venting the ram pressure chamber to a fluid reservoir to accommodate the return stroke of the ram.

A still further object of the invention is the provision of a hydraulic tool that is compact, operated with a minimum of physical effort, economical of manufacture and maintenance, sturdy and of long life.

Other objects and advantages of the invention will become apparent in the following detailed description of a preferred embodiment of the invention, wherein reference is made to the accompanying drawings, in which:

Figure 1 is a plan view of the tool, a portion of the pump body being cut away to show the low pressure pump by-pass valve and latch means for that valve;

Figure 2 is a side view, partly in section and partly in elevation, taken substantially along the line 2—2 of Figure 4;

Figure 3 is a vertical sectional view of the pump mechanism, with the ram, the material working members, and the members defining the fluid reservoir, removed, taken substantially along the line 3—3 of Figure 4;

Figure 4 is an enlarged end elevation of the body of the tool, the view being taken from the right hand side of Figures 2 and 3, but showing only the body;

Figure 5 is a plan view, partly in section, on an enlarged scale, the cross sectioned portion

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being taken substantially along the line 5—5 of Figure 4; and

Figure 6 is a partial sectional view of the automatic relief valve taken substantially along the line 6—6 of Figure 4.

Referring to the drawings, the hydraulic tool of the present invention comprises a body 10 defining a pump chamber and a ram chamber, a tool head 12 upon which dies, cutters, or the like are mounted for actuation by the ram, a pump actuating handle 14, a supporting and valve actuating handle 16 and a fluid reservoir 18.

Referring to Figure 2, the body 10 is preferably an integral steel forging having a main portion that is generally cylindrical and provided at one end with an enlarged cylindrical extension 20 having a bore 21 therein forming a ram pressure chamber or cylinder. The cylindrical extension 20 is provided with an external thread 22 for the reception of the tool head 12. At its opposite end, the body 10 is provided with an enlarged cylindrical portion 23 for the reception of the members defining the fluid reservoir 18 and is provided with an internal thread 24 for securement of those members to the body 10. A cylindrical bore 25 is formed in the body along the longitudinal axis thereof, the bore 25 being provided at either end with counterbores 26 and 27 communicating with the ram chamber 21 and the fluid reservoir 18, respectively.

Referring now to Figures 1 and 3, the body 10 is provided, at one side of the axis of the bore 25, with a cylindrical portion 28 extending perpendicular to, but laterally spaced from, the axis of the bore 25. The cylindrical portion 28 is provided with a stepped bore 29 defining a pair of pump chambers 30 and 31. A pair of spaced parallel bores 32 and 33 are provided in the body 10 and extend normally to but in vertical alignment with the stepped bore 29 and intersect the pump chambers 30 and 31 respectively. Both bores 32 and 33 extend through the body 10 and communicate with the bore 21 and the cylindrical portion 23. The bores 32 and 33 are provided at each end with counterbores and tapped portions for the reception of valve mechanisms to be described hereinafter. Vertically aligned with, but spaced from the bores 32 and 33, is a valve chamber 34 defined by a counterbore of a bore 35. The bore 35 is open at the reservoir side of the body 10 and is provided with a second enlarged counterbore 36 provided with an internal thread 37 for the reception of the handle 16. Communicating with the chamber 34 is an inclined bore 38 which extends upwardly and toward the center of the body 10 from the chamber 34, the bore 38 opening into the cylindrical portion 23, as shown in Figure 4. Communicating with the bore 35 is an inclined bore 39, which extends upwardly and toward the center of the body 10 from the bore 35 and opens into the bore 21.

Immediately below the chamber 34, as shown in the drawings, the body 10 is provided with a boss 40 within which a tapped hole 41 is formed, the hole serving as a filling opening for the fluid reservoir and being normally closed by a plug 42 threaded into the bore 41.

As shown in Figures 1 and 5, a transverse bore 43 extends from one side of the body 10 into communication with the bore 32 and thus with the pump chamber 30. Bore 43 is provided at its outer end with a counterbore 44 for the reception of a valve to be described in detail hereinafter. A longitudinal bore 45, spaced from,

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but generally parallel to the bore 32, establishes communication between the reservoir and the counterbore 44. The bore 45 opens along its bottom edge into the counterbore 27. A second and smaller bore 46, co-extensive with an opening along one edge into the bore 45, see Figures 4 and 5, serves to provide a fluid by-pass of a latch member, to be described hereinafter, normally positioned in the bore 45. Referring to Figures 4 and 6, a longitudinal bore 47 extends through the body 10 from the bore 21 to the cylindrical portion 23 and is provided at each end with a counterbore. The bore 47 serves as a relief passage for fluid from the ram chamber 21 when pressure therein exceeds a predetermined maximum. At its upper end, the body 10 is provided with an upwardly extending portion 48 having a transverse bore 49 therein forming a fulcrum for the handle 14.

In the preceding description, the body 10 has been described with little reference to the members to be associated therewith for the purpose of defining the structure and formation of the body 10. The parts and members to be associated with the body and their association therewith will now be described.

Slidably mounted in the bore 25 is a piston rod 50 threadably connected at one end to a ram 51 defined by a radial flange having a diameter slightly less than the diameter of the bore 21 defining the ram pressure chamber or cylinder. The flange is slidably received in the bore 21 and forms the head of the ram or piston. Immediately inward from the flange, the ram 51 is provided with a cylindrical portion 52 about which is positioned an annular sealing ring 53. The sealing ring 53 is generally of the block-V type and is confined between the cylindrical wall of the cylinder 21 and the cylindrical part 52. An annular washer 54 is slidably received on the rod 50 and is held against the surface of the ring 53 by means of a lock nut 55. The lock nut 55 is slidable within counterbore 26 of the bore 25 and a seal 56 is positioned in the bottom of the counterbore 26 around the rod 50 to seal off the ram pressure chamber defined between the ram or piston 51 and the bottom of the bore 21 and the counterbore 26.

At its opposite end, the rod 50 is provided with a reduced extension and a washer 57 is press-fitted to a knurled portion of the rod at the inner end of the reduced extension, the washer 57 being received in the counterbore 27 of the bore 25. The washer 57 serves as a latch actuator as will be described hereinafter. At its outer end, the reduced extension is provided with a threaded portion upon which a flanged nut 58 is received. A compression spring 59 is confined between the flanged nut 58 and a flanged annulus 60 surrounding the rod 50 and seated against the end wall of the body 10. The spring 59 constitutes a return spring for the hydraulic ram and serves to bias the ram 51 toward the bottom of the pressure chamber defined by the bore 21.

Referring now to Figure 3, a spring 61 and a ball valve 62 are positioned in the counterbore on the reservoir side of each of the bores 32 and 33. A seat defining tubular stem 63 is threaded into each counterbore and forms at its inner end a valve seat for the ball 62. Each stem 63 is closed at its outer end and is provided with a circumferential groove 64 adjacent its outer end within which a cylindrical screen 65 is positioned. Radial holes 66 establish communication between the circumferential groove

64 and the central bore or hole in the stem 63. The spring 61 normally holds the ball valve 62 to its seat on the inner end of the stem 63. In the counterbore on the ram pressure chamber side of each of the bores 32 and 33, a ball valve 67 normally sealingly engages a seat formed by the counterbore and is urged thereagainst by a compression spring 68 compressed between the ball and a tubular stem 69 threaded into the counterbore. Ball valves 62 and 67 serve as inlet and outlet check valves respectively for each of the pump chambers 30 and 31.

A pump sleeve 70 is threaded into the stepped bore 29 and extends downwardly to provide adjacent its lower end a high volume-low pressure pump chamber in the chamber 30. The bore in the sleeve 70 is stepped, and ports 71 are provided in the sleeve to establish communication between the chamber 30 and the lower end of the bore in the sleeve. Adjacent its upper end, the sleeve 70 is provided with a circumferential groove within which a Neoprene "O" ring seal 72 is received to prevent leakage past the sleeve. At its upper end, the sleeve 70 is provided with a counterbore 73 within which a Neoprene "O" ring seal 74 is received. Neoprene is the preferred material for the "O" ring seals 72 and 74, since Neoprene is not subject to deterioration due to contact with hydraulic fluids. It is apparent that other materials may be utilized for the formation of the "O" rings and other seals as desired.

A lock nut 75 is threaded into the bore 29 to lock the sleeve 70 in place and retain the seal 74 within the counterbore 73. A pump plunger piston 76 is slidably mounted in the sleeve 70 and is provided with an enlarged portion slidably mounted in the bore of the sleeve 70 and a reduced end portion extending into the reduced lower end of the bore 29. The shoulder on the plunger 76 between the enlarged and reduced portions thereof provides a pump piston reciprocable within the bore of the sleeve 70 to comprise a high volume-low pressure pump. The lower end of the plunger 76 is reciprocable within the reduced lower end of the bore 29 to comprise a high pressure-low volume pump. The "O" ring seal 74 sealingly grips the piston 76 to prevent leakage past the piston.

At its upper end, the plunger 76 is provided with an enlarged head 77 provided with a slot 78 therein for the loose reception of an actuating pin 79 connected to the handle 14. The handle 14 comprises a head member 80 and a tubular shank 81. The head 80 consists of a generally arcuate forging having parallel but offset end portions joined by an arcuate portion. Handle head 80 is bifurcated, at 82, for the reception of the upwardly projecting portion 48 of the body 10. The bifurcated portion 82 of the handle 14 is pivotally secured to the upstanding portion 48 by a pin 83 extending through aligned bores in each leg of the bifurcated portion 82 and of the bore 49 in the body portion 48. The pin 83 is preferably provided at one end with an integral head 84 and at its other end with a circumferential groove within which a "C" washer or clip 85 is received to hold the pin in position.

The head 77 of the plunger 76 is also received in the bifurcated portion 82 of the handle 14 and is secured therein in a manner similar to the connection of the bifurcated portion 82 and the body portion 48, by the pin 79 which has a head 87 and a circumferential groove within

which a "C" washer or clip 88 is received. The pin 79 is loosely received in the slot 78 to accommodate the horizontal component of the oscillation of the handle 14 in an arcuate path about the pin 83. When the handle 14 is manually oscillated, the vertical component of the movement will be imparted to the plunger 77 and effect vertical reciprocation thereof in a pumping action. The shank 81 of the handle 14 is encased in a two-piece tube 90 of insulating material, one piece of which forms a hand grip 91.

The handle 16 comprises a first tubular portion 92 threaded into the counterbore 36 of bore 35, with the forward portion of the tube 92 being encased in a tube 93 of insulating material. Just beyond the end of the tube 93, the tubular portion 92 is provided, intermediate its length, with a circumferential groove 94. Rotatably mounted on the outer end of the tubular portion 92 is a second metallic tube 95 which is provided at its forward edge with an inturned flange 96 loosely received within the groove 94 to prevent dissociation of the tubular portions 92 and 95. The tubes 92 and 95 are provided with mating threaded portions 97. The tube 95 is encased in a handle grip 98 of insulating material and is secured to a rod 99 extending coaxially through the tubes 92 and 95 by means of a pin 100 and a block 101. The rod 99 extends through the tubes 92 and 95 and into the counterbore of the bore 35 forming the chamber 34. Adjacent its forward edge, the rod 99 is provided with a circumferential groove 102 within which an "O" ring seal 103 is received to prevent leakage of fluid past the rod 99 from chamber 34. The rod 99 has a reduced and rounded forward end arranged to engage a ball valve 104 positioned in the chamber 34. The ball 104 is adapted to be moved to a conical seat 105 formed at the end of the chamber 34 to close the port or bore 35. The groove 94 in the tubular handle portion 92 is of a width to accommodate relative linear movement between the tubes 92 and 95. The threaded portions 97 of the tubes have a large pitch angle so that the threaded portions 97 form a "fast thread" for moving the rod 99 forwardly and rearwardly a relatively great distance upon slight rotary movement of the hand grip 98 to seat and unseat the ball valve 104.

A conical by-pass valve member 106 is slidably positioned in the counterbore 44 of the transverse bore 43 and is arranged to close the bore 43. The valve 106 is held against conical seat 107 formed at the inner end of the counterbore 44 by a spring 108 confined between the valve and a plug 109 threaded into the counterbore 44. The spring 108 exerts a predetermined force on the valve 106 so that the valve 106 will be automatically opened upon attainment of a predetermined pressure in the pump chamber 30. The conical portion of the valve 106 terminates in a cylindrical surface 110 which is aligned with the axis of the bore 45 when the valve is closed, as shown in Figure 5. A by-pass latch 111 is slidably mounted in the bore 45 and comprises a cylindrical portion 112 slidably received in the bore 45 and a reduced nose portion 113 having a rounded end. The end of the nose 113 normally engages the cylindrical surface 110 of the valve 106 (see Fig. 5) and is urged thereagainst by a spring 114 confined between the cylindrical portion 112 of the latch 111 and the flanged annulus or collar 60. The nose 113 of the latch 111 is adapted to cooperate with the conical portion of the valve 106 to cam the

valve to full open position under the urge of the spring 114 after the valve 106 has been cracked or partially opened by fluid pressure in the pump chamber 30. The conical surface of the valve and the nose of the latch constitute cooperating cam surfaces effective to fully open the valve 106 after the cylindrical surface 110 has been moved out of engagement with the nose 113 of the latch. The latch holds the valve 106 in open position to establish communication between the chamber 30 and the fluid reservoir through the bores 43 and 46. The cylindrical portion 112 of the latch 111 extends into the counterbore 27 of the bore 25 along one edge and is arranged to be engaged by the latch actuator washer 57 on the piston rod 50 on the return stroke of the piston.

Referring now to Figures 4 and 6, a ball valve 115 is positioned in the bottom of the counterbore of the bore 47 on the fluid reservoir side thereof. The ball 115 is held against a seat in the bottom of the counterbore by a plug 116 and a spring 117 confined between the plug 116 and a plug 118 threaded into the counterbore. The valve 115 serves as a pressure relief valve for the ram pressure chamber when the pressure therein exceeds a predetermined maximum.

The fluid reservoir is defined by a resilient sack or bag 119, preferably formed of Neoprene, having a cylindrical open end. A similarly shaped metallic dome 120 having a depth slightly greater than the normal depth of the sack 119 surrounds the sack and protects it against damage and in addition restricts the amount of expansion of the sack 119. The metallic dome 120 is provided with a plurality of vent holes to accommodate free expansion and contraction of the resilient sack 119. Both the sack 119 and the dome 120 are provided with a radial flange 121 and 122, respectively, at their open ends and the flange 121 of the sack 119 is confined between the end wall of the body 10 and the flange 122 of the dome 120 within the cylindrical portion 23 of the body 10. An annular nut 123 is threadably engaged with the thread 24 on the cylindrical portion 23 and is screwed down against the flange 122 of the dome 120 to tightly secure the dome 120 and the sack 119 to the body 10 and to effect a seal, by means of the flange 121 of the sack 119, between the body 10, the sack 119 and the dome 120. When mounted on the body 10, the sack 119 encloses the piston rod 50, the nut 58, the spring 59, the inlet valves 62 and the inlet valve stems 63.

The foregoing description has been directed to the formation, construction and assembly of the various parts and elements of the hydraulic ram and pump. Assuming now that the fluid reservoir is filled by removing the plug 42 and pouring fluid into the reservoir through the bore 41, the chamber 34 and the bore 38, and that the ram is arranged to engage a work piece, the operation of the hydraulic tool is as follows: The handle grip 98 of the handle 16 is rotated in a clockwise direction, as viewed from the right hand side of Figures 1 to 3, to move the rod 99 toward the body 10 to force the valve 104 against its seat 105 to close the port 35 and bore 39 communicating with the ram pressure chamber 21. The handle 14 is then oscillated to effect reciprocation of the plunger 76. As the plunger 76 is moved in an up stroke, a vacuum is created within the pump chambers 30 and 31 causing the inlet ball valves 62 to be unseated. As the valves 62 are unseated, a quantity of fluid is sucked into the chambers 30 and 31 from the reservoir defined by the sack 119. The screens 65 on the stems 63 serve to

prevent the entry of solid particles or extraneous material into the pump chambers. As the handle 14 is moved in its down stroke, the hydraulic fluid in the chambers 30 and 31 is put under pressure until the outlet check valves 67 are opened and the fluid is forced into the ram chamber 21. Both pistons are utilized in forcing fluid into the ram chamber 21 and due to the volume of fluid forced into the chamber, the piston or ram 51 will be rapidly moved to the left, as viewed in the drawings, against the urge of the spring 59. Upon continued reciprocation, the pressure in the chamber 21 will increase until it is sufficient to effect unseating of the valve 106 on a downstroke of the plunger 76. As soon as the valve 106 is unseated, the rounded nose 113 of the latch 111 will engage the conical surface of the valve 106 and cause same to be moved or cammed away from the valve seat 107, thus opening the port or bore 43 establishing communication between the pump chamber 30 and the fluid reservoir through the bores 43 and 46. Upon continued reciprocation of the plunger 76, the chamber 30 will be bypassed to the fluid reservoir so that the pump defined by the enlarged portion of the plunger 76 and the chamber 30 will be ineffectual. Thereafter, pressure will be built up in the ram chamber 21 solely by the pump defined by the reduced end portion of the plunger 76 and the chamber 31. This pump is effective to force a relatively small quantity of fluid into the ram chamber 21 under high pressure. Upon continued oscillation of the handle 14, pressure is further built up in the ram chamber 21 by means of the fluids forced therein by the reduced lower end of the plunger 76. It is during this last defined pumping cycle that the hydraulic ram is adapted to perform its designated work.

Should the pressure in the chamber 21 exceed a predetermined safe maximum pressure for the material utilized in the construction of the apparatus, the pressure relief valve 115 will be automatically opened against the urge of the spring 117 to vent the ram chamber 21 to the fluid reservoir. The relief valve 115 will be effective only to reduce the pressure in the chamber 21 to the aforesaid predetermined maximum. In actuality, however, the valve 115 after being unseated by fluid pressure has a greater area thereof exposed to the fluid and due to this increased area and the velocity of flow through the bore 47, the valve 115 will remain unseated until the pressure is somewhat below the predetermined maximum, at which time the spring 117 will return the ball 115 to its seat to close the relief port 47.

In normal operation, or after the relief valve has been automatically actuated, the ram cylinder 21 is vented to the fluid reservoir to allow or accommodate the return stroke of the piston or ram 51 under the force of the spring 59. Venting of the ram cylinder 21 is accomplished by imparting a slight rotary twist to the handle grip 98 of the handle 16 in a counterclockwise direction, as viewed from the right hand end of the Figures 1 to 3. Due to the "fast thread" formed by the threaded portions 97, the rod 99 is moved a sufficient distance rearwardly by a slight twist of the handle grip 98 to permit unseating of the ball valve 104 to accommodate venting of the ram pressure chamber 21 through the bores 39 and 35, the chamber 34 and the bore 38 to the fluid pressure reservoir. As the piston 51 is moved in its return stroke by the spring 59, the latch actuator or annulus 57 engages the

cylindrical portion 112, or the shoulder defined between the reduced nose portion 113 and the cylindrical portion 112, of the latch 111 to move the latch rearwardly out of engagement with the valve 106, whereupon the valve 106 is urged by the spring 108 into engagement with its seat 107 to again render the pump chamber 30 operative. When the pressure chamber has been completely vented and the piston 51 has been returned to its normal position by the spring 59, the handle grip 98 is rotated in the opposite direction, clockwise as viewed from the right hand of the Figures 1 to 3, to again seat the ball 104 whereupon the apparatus is in readiness for repetition of the cycle just described.

The ram 51 is adapted to carry or be operatively associated with a material working member which is preferably associated with a work supporting member or tool head. The tool head may take any one of a plurality of forms, but is preferably in the form of a C-clamp. The C-clamp comprises a generally C-shaped body 124 having at one end thereof an integral cylindrical portion 125 provided with an internally threaded bore 126 adapted to be threadedly connected with the thread 22 of the cylindrical portion 20 of the body 10. The threaded connection between the body 10 and the C-clamp 12 is particularly or purposely arranged to be a semi-permanent connection in which the clamp 12 is not readily removed from the body 10 but is capable of slight relative rotary movement with respect to the body 10. As shown in Figures 2 and 3, cam slots 127 are formed in the end face of the cylindrical portion 20 and a number of slots may be provided as desired, but according to the present invention, it is preferred that two cam slots be provided, spaced 180° apart. Each slot is identical having an inclined surface leading into the slot from the bottom, as shown in Figure 3. A spring pressed plunger 128 is mounted in a stepped bore 129 (see Figure 2) in the cylindrical portion 125 of the clamp 12 and is urged into the slots 127. A straight wall of the slot, at the upper edge thereof as shown in Figure 3, prevents rotation in one direction but the inclined surface acts to cam the plunger 128 out of the slot to accommodate relative rotation in the opposite direction until the plunger 128 slides into the other slot on the inclined wall thereof and engages the straight wall of that slot to prevent further relative rotation in that direction. It is therefore seen that the C-clamp 12 is oscillatable in a 180° arc with respect to the body 10.

The C-clamp may be removed from the body 10 by reaching into the bore 129 and catching the spring therein and compressing same with a wire hook or the like to relieve the pressure on the plunger 128 and thus accommodate a free rotational movement between the C-clamp 12 and the body 10 to permit removal of the C-clamp 12. Preferably, the plunger 128 is provided with a threaded bore (not shown) into which a screw may be threaded to provide a handle for retracting the plunger from the end face of the portion 20 of the body 10.

The C-clamp 12 is provided with a bore 130 aligned with the bore 21 of the cylindrical portion 20. An end extension 131 of the ram 51 extends through the bore 130 and is adapted to carry a die, a cutter, or the like at its free end.

The C-clamp 12 provides a flat-sided groove 132 for the reception of dies, cutters, or the like material working members. Within the upper wall of the groove 132, as viewed in Figure 2,

the C-shaped body portion 124 is provided with a bore 133 for the reception of a pin 134 on one of the material working members 135. A retainer plate 136 is positioned adjacent the free end of the clamp 12 at the outer side of the groove 132. The plate 136 is provided with a pin 137 arranged to be received in a bore 138 in the body 124. Intermediate its end, the plate 136 is provided with a hole 139 through which a thumb screw 140 extends for threaded engagement in a tapped hole 141 in the body 124. The pin 137 and the thumb screw 140 serve to retain the plate 136 on the body 124 and to prevent relative rotation between the plate and the body. The plate 136 has a free end portion extending over the groove 132 and serving to hold the material working member 135 in the groove in cooperation with the pin 134. If desired, a pin may be provided in the free end of the plate 136 for engagement in a recess in the member 135. The material working member 135 is preferably substantially square or rectangular in cross section so as to be firmly retained against relative rotational movement due to engagement of its flat or planar sides with the flat or planar sides of the groove 132.

To remove the member 135 from the groove 132, the thumb screw 140 is loosened to such degree that the pin 137 is freed from the bore 138 to accommodate rotation of the plate 136 about the screw 140. If desired, a spring washer may be interposed between the plate and the body to move the plate away from the body when the screw is loosened. By turning the plate 136 sideways, the member 135 can be slidably removed from the groove 132. As is apparent, the member 135 is stationary and presents a working face adapted to cooperate with the juxtaposed face of a movable material working member.

The member 135 cooperates with a movable member 142 which is also rectangular or square in cross section and is arranged to have one flat side thereof engaging the flat upper side, as viewed in Figure 2, of the groove 132 to prevent relative rotation between the member 142 and the C-clamp 12. At the end opposite its work piece engaging face, the member 142 is provided with a bore 143 having a circumferential groove 144 therein. The bore 143 is of such size as to slidably receive the end portion 131 of the ram 51.

The reduced end portion 131 of the ram 51 is provided with a diametral bore 145 within which a spring 146 and a pair of balls 147 are received. As the member 142 is slid onto the end 131 of the ram 51, the balls 147 are cammed inwardly by the edge of the member 142 adjacent the bore 143 against the urge of the spring 146 until the balls are aligned with the groove 144 in the bore 143, at which time the balls 147 are forced into the groove by the spring 146 to form a ball-type-detent for retaining the member 142 on the end 131 of the ram. If desired, the balls 147 may be welded or otherwise secured to the spring 146 to prevent disassociation of the members when the material working member 142 is removed from the end 131 of the ram. Preferably, however, the material surrounding the bore 145 at each end thereof is swaged to reduce the diameter of the bore 145 after insertion of the spring 146 and the balls 147 to prevent removal of the balls, but to allow the balls to project slightly from the surface of the ram portion 131 for engagement in the groove 144.

Due to the fact that balls 147 engage in a groove in the material working member, the

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member is rotatable with respect to the ram 51. It is apparent, therefore, that when the clamp 12 is oscillated with respect to the body 10, the member 142 will be moved with the clamp 12, and both will rotate with respect to the body 10 and the ram 51.

To provide means for readily storing or transporting the tool of the present invention, a resilient ring or loop 148 is secured in a known manner to the C-clamp 12.

In operation, a work piece is positioned in the groove 132 of the C-clamp 12 in engagement with the working face of the stationary material working member 135. Thereafter, the hydraulic ram and pump are operated, as described hereinbefore, to bring the working face of the material working member 142 into engagement with the work piece. The member 142 is rapidly moved into engagement with the work piece due to the rapid movement of the ram 51 under the urge of the fluid discharge of the two pumps. As the material working member 142 engages the work piece and commences the performance of work on the work piece, the pressure in the ram chamber 21 necessarily rises to accomplish the performance of work. As the pressure rises, the large volume pump (chamber 30) is automatically cut out of operation by the by-pass valve 106, as described hereinbefore, and the high pressure pump independently effects the build-up of pressure in the ram chamber 21 to perform work on the work piece. When the desired work has been performed, the pumping action is ceased and the hand grip 98 on the handle 16 is given a twist to accommodate opening of the valve 104 to vent the ram pressure chamber to the fluid reservoir. As the ram or piston 51 is returned to its original position under the urge of the spring 59, the washer 57 on the piston rod 50 engages the latch 111 to move same out of the path of the valve 106 and the valve 106 is closed by the spring 108 to return the entire mechanism to its original position. The material working member 142 is returned to its original position together with the piston 51 and the work piece is released and the material working members are cleared for the reception of another work piece.

In the preferred embodiment of my invention, the tool is adapted for utilization in crimping metallic sleeves about metallic wires or the like and in such application, the high volume-low pressure pump is designed for use up to a pressure of 400 pounds per square inch in the ram pressure chamber. Upon the attainment of 400 pounds per square inch, the by-pass valve 106 is opened to accommodate relief of the low pressure pump. Thereafter, the low volume-high pressure pump is designed to build the pressure in the ram pressure chamber up to 10,000 pounds with an approximate manual effort of 40 pounds. Upon the attainment of 10,000 pounds per square inch in the ram pressure chamber 21, the relief valve 115 is actuated to vent the chamber 21 to the fluid reservoir until the pressure in the ram chamber 21 is below the maximum pressure of 10,000 pounds per square inch. The handles 14 and 16 are provided with insulation as described hereinbefore, to render the tool particularly adapted for crimping sleeves or connectors to live or "hot" electrical conductors.

A particular use for which the tool of the present invention is adapted, is the crimping of connectors to high voltage electric power lines. Many power lines are run through tunnels, and

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in such tunnels, working space is very limited. To render the tool more readily usable in situations wherein working space is limited, the provision for oscillation of the tool head 12 with respect to the pump body 10 is made. Such provision renders the tool more conveniently usable in many situations.

Due to the detailed nature of the construction and operation of the tool of the present invention, the foregoing description has been directed in detail to the exact constructional features of a preferred embodiment of the invention. It will be apparent to those skilled in the art that various modifications, changes, and rearrangements can be made in the apparatus without departing from the spirit and scope of the present invention and without changing the end result or function of the tool. For example, in the preferred embodiment, threaded connections are utilized throughout to render the apparatus capable of ready assembly and disassembly. It will be apparent that other types of connections, such as press-fits, can be substituted for the threaded connections referred to. In addition, the various valve members have been specifically referred to as balls, or conical members, or whatever preferred construction they take in the preferred embodiment of the invention. It will be apparent that the exact type of the valve may be varied or changed as desired, without departing from the spirit and scope of the invention. Therefore, while references has been made to specific parts, elements and details of construction, the terminology utilized in the foregoing description and appended claims is to be construed as including within the scope thereof all equivalent structures, parts or elements.

While I have described a preferred embodiment of my invention, it is apparent that various changes, modifications and rearrangements can be made therein without departing from the spirit and scope of the invention, as defined by the appended claims.

I claim :

1. In a hydraulic tool, a pump body having a plurality of pump chambers, a fluid reservoir, a ram cylinder, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and said cylinder, check valves controlling said passages, means for venting one of the pump chambers to the reservoir in response to fluid pressure in said one chamber, comprising fluid passageway means including two passages in said pump establishing communication between said one pump chamber and the fluid reservoir, a by-pass valve reciprocally mounted in one of said passages, a latch reciprocally mounted in a second of said passages, spring means urging said latch into engagement with said valve, said valve and said latch presenting cooperating cam surfaces, spring means normally urging said valve to closed position, said last named spring means exerting a predetermined force on said valve, said valve being adapted to be opened by fluid pressure in said one pump chamber in excess of the pressure exertion of said last named spring means, said latch under the urge of said first named spring means camming said valve to full open position and retaining said valve in full open position after said valve has been opened by fluid pressure in said one pump chamber, and means for moving said latch out of engagement with said valve upon relief of pressure in said cylinder.

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2. In a hydraulic tool, a body having two pump chambers, a fluid reservoir, a ram cylinder, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and said cylinder, check valves controlling said passages, pump plungers operable in said chambers, means for operating said plungers in unison, a piston operable in said cylinder, said body being provided with a pair of angularly related by-pass passages establishing communication between one of said pump chambers and said fluid reservoir, a by-pass valve slidably mounted in one of said passages, spring means urging said valve to closed position, a latch slidably mounted in the other of said passages, spring means urging said latch into engagement with said valve, said valve and said latch presenting cooperating cam surfaces, said valve being arranged to be opened by fluid pressure in said one pump chamber when the pressure therein is sufficient to overcome said first named spring means, said latch under the urge of said second named spring means camming said valve to full open position and retaining said valve in full open position after said valve has been opened by fluid pressure in said one pump chamber, and a latch actuator operatively associated with said piston and arranged to engage said latch to move said latch out of engagement with said valve when fluid pressure in said cylinder is relieved and said piston is returned to its original position, whereby said valve is urged to closed position by said first named spring means.

3. In a hydraulic tool, a body having two pump chambers, a fluid reservoir, a ram cylinder, a piston operable in said cylinder, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and said cylinder, check valves controlling said passages, said body having a by-pass for venting one of said pump chambers to said reservoir, two pump plungers operable in said pump chambers, means for operating said plungers in unison, a normally closed valve controlling said by-pass yieldingly urged in closing direction and opened responsive to a predetermined high pressure in said one pump chamber, means for returning said piston to its retracted inward position, means for retaining said by-pass valve open independently of piston operating hydraulic pressure in said cylinder, and means for releasing said by-pass valve for closing responsive to retraction of said piston to its inward position.

4. In a hydraulic tool, a body having two pump chambers of materially different diameters, a hydraulic liquid reservoir, a ram cylinder, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and said cylinder, check valves controlling said passages, a piston operable in said cylinder yieldingly urged inward thereof, two pump plungers operable in said pump chambers, means for operating said plungers in unison, said body having a by-pass for venting the pump chamber of greater diameter to said reservoir and a vent passage for venting said cylinder to said reservoir, a vent valve normally closing said vent passage, means for releasing said vent valve for opening and thereby effecting venting of said cylinder to said reservoir and return of said piston from an outer position inwardly of said cylinder, a by-pass valve controlling said by-pass

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normally yieldingly held closed and opened responsive to a predetermined high pressure in said pump chamber of greater diameter, latch means effective for retaining said by-pass valve open independently of piston operating hydraulic pressure in said cylinder after it has been opened and during continued operation of said pump plungers, and means for disengaging said latch means and thereby releasing said by-pass valve for closing responsive to venting of said cylinder to said reservoir and return of said piston inwardly of said cylinder.

5. In a hydraulic tool, a body having two pump chambers of materially different diameters, a hydraulic liquid reservoir, a ram cylinder, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and said cylinder, check valves controlling said passages, a piston operable in said cylinder yieldingly urged inward thereof, two pump plungers operable in said pump chambers, means for operating said plungers in unison, said body having a by-pass for venting the pump chamber of greater diameter to said reservoir and a vent passage for venting said cylinder to said reservoir, a vent valve normally closing said vent passage, means for releasing said vent valve for opening and thereby effecting venting of said cylinder to said reservoir and return of said piston from an outer position inwardly of said cylinder, a by-pass valve controlling said by-pass normally yieldingly held closed and opened responsive to a predetermined high pressure in said pump chamber of greater diameter, latch means effective for retaining said by-pass valve open independently of piston operating hydraulic pressure in said cylinder, and means actuated by said piston effective for releasing said by-pass valve from said latch means responsive to return of said piston inwardly of said cylinder.

6. In a hydraulic tool, a body having two pump chambers, a liquid reservoir, a ram cylinder, a piston operable in said cylinder yieldingly urged inward thereof, a piston rod slidable in said body and attached to and movable with said piston, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and cylinder, check valves controlling said passages, two pump plungers operable in said chambers, means for operating said plungers in unison, means for venting one of said pump chambers to said reservoir comprising a normally closed by-pass valve yieldingly urged in closing direction and opened responsive to a predetermined high pressure in said one pump chamber, latch means effective for retaining said by-pass valve open independently of the piston operating pressure in said cylinder, means for optionally venting said cylinder to said reservoir, and cooperating means carried by said rod and latch means effective for releasing said by-pass valve for closing responsive to inward movement of said rod with said piston.

7. In a hydraulic tool, a body having two pump chambers, a liquid reservoir, a ram cylinder, a piston operable in said cylinder yieldingly urged inward thereof, a piston rod slidable in said body and attached to and movable with said piston, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and cylinder, check valves controlling said passages, two pump plungers oper-

able in said chambers, means for operating said plungers in unison, means for venting one of said pump chambers to said reservoir comprising a normally closed by-pass valve yieldingly urged in closing direction and opened responsive to a predetermined high pressure in said one pump chamber, a latch member yieldingly urged toward said by-pass valve engageable therewith for holding it open when said by-pass valve opens responsive to pressure in said one pump chamber, means for optionally venting said cylinder to said reservoir, and a member carried by said rod engageable with said latch member for moving the latter out of engagement with said by-pass valve in the inward movement of said rod with said piston.

8. In a hydraulic tool, a body having two pump chambers, a liquid reservoir, a ram cylinder, a piston operable in said cylinder yieldingly urged inward thereof, a piston rod slidable in said body and attached to and movable with said piston, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and cylinder, check valves controlling said passages, two pump plungers operable in said chambers, means for operating said plungers in unison, means for venting one of said pump chambers to said reservoir comprising a normally closed by-pass valve yieldingly urged in closing direction and opened responsive to a predetermined high pressure in said one pump chamber, a latch member adjacent and substantially parallel with said rod yieldingly urged toward said by-pass valve engageable therewith for holding it open when said by-pass valve opens responsive to pressure in said one pump chamber, means for optionally venting said cylinder to said reservoir, and a member carried by said rod engageable with said latch member for moving the latter out of engagement with said by-pass valve in the inward movement of said rod with said piston.

9. In a hydraulic tool, a body having two pump chambers, a liquid reservoir, a ram cylinder, a piston operable in said cylinder yieldingly urged inward thereof, a piston rod slidable in said body

and attached to and movable with said piston, said body having inlet and outlet passages for establishing communication between said reservoir and pump chambers and between said pump chambers and cylinder, check valves controlling said passages, two pump plungers operable in said chambers, means for operating said plungers in unison, means for venting one of said pump chambers to said reservoir comprising a normally closed by-pass valve yieldingly urged in closing direction and opened responsive to a predetermined high pressure in said one pump chamber, said by-pass valve comprising an inner tapered portion and an outer straight portion, a latch member adjacent and substantially parallel with said rod yieldingly urged toward said by-pass valve, said latch member comprising a body portion and a reduced nose portion disposed to contact said outer portion of said by-pass valve when the latter is closed and to contact the tapered portion of said by-pass valve when it is opened by pressure in said one pump chamber, said nose of said latch member cooperating with said tapered portion of said by-pass valve for moving the latter to full open position and retaining it in that position, and a member carried by said rod engageable with the body portion of said latch member for moving the latter out of engagement with said by-pass valve in the inward movement of said rod with said piston.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,044,857	Pfauser	June 23, 1936
2,096,574	Denny	Oct. 19, 1937
2,134,773	Arp	Nov. 1, 1938
2,165,504	Pfauser	July 11, 1939
2,250,551	Pfauser	July 29, 1941
2,311,468	Pfauser	Feb. 16, 1943
2,417,956	Strom	Mar. 25, 1947
2,555,421	Ronan	June 5, 1951

FOREIGN PATENTS

Number	Country	Date
432,823	Germany	Apr. 19, 1925