

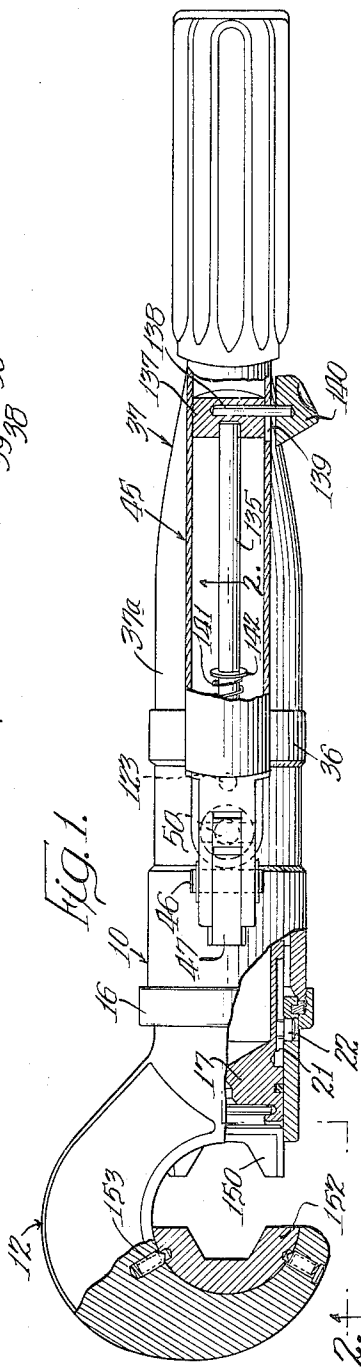
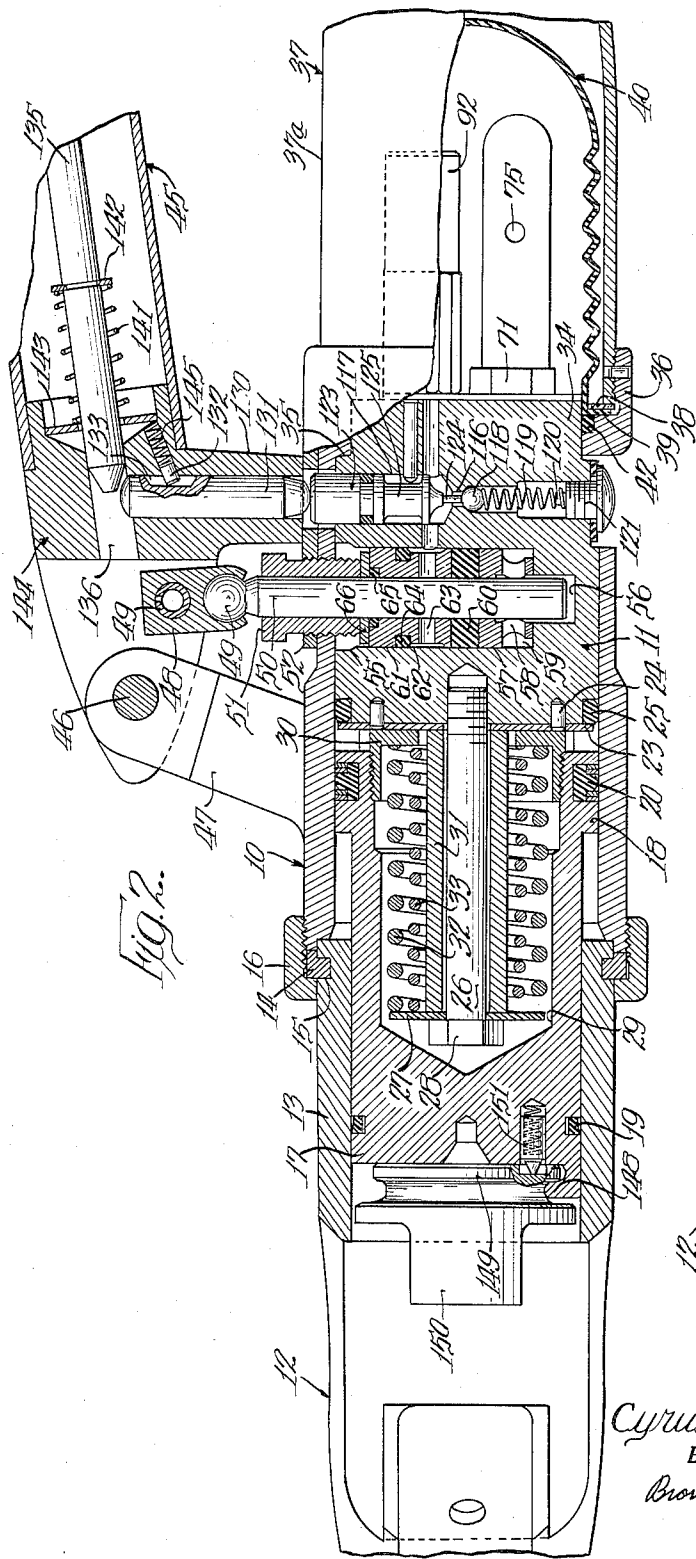
Jan. 3, 1956

C. E. HOADLEY
HYDRAULIC TOOL

2,729,063

Filed May 14, 1954

2 Sheets-Sheet 1



INVENTOR.
Cyrus Earl Hoadley
BY
Brown, Jackson, Boettcher
& Kienner.

Attys.

Jan. 3, 1956

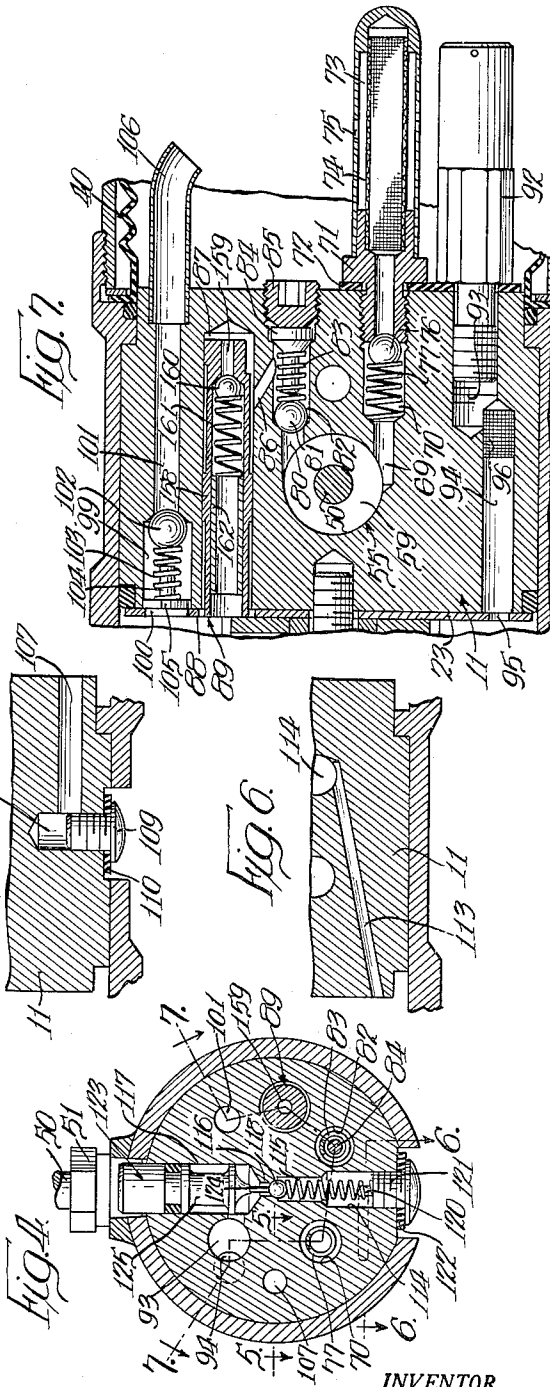
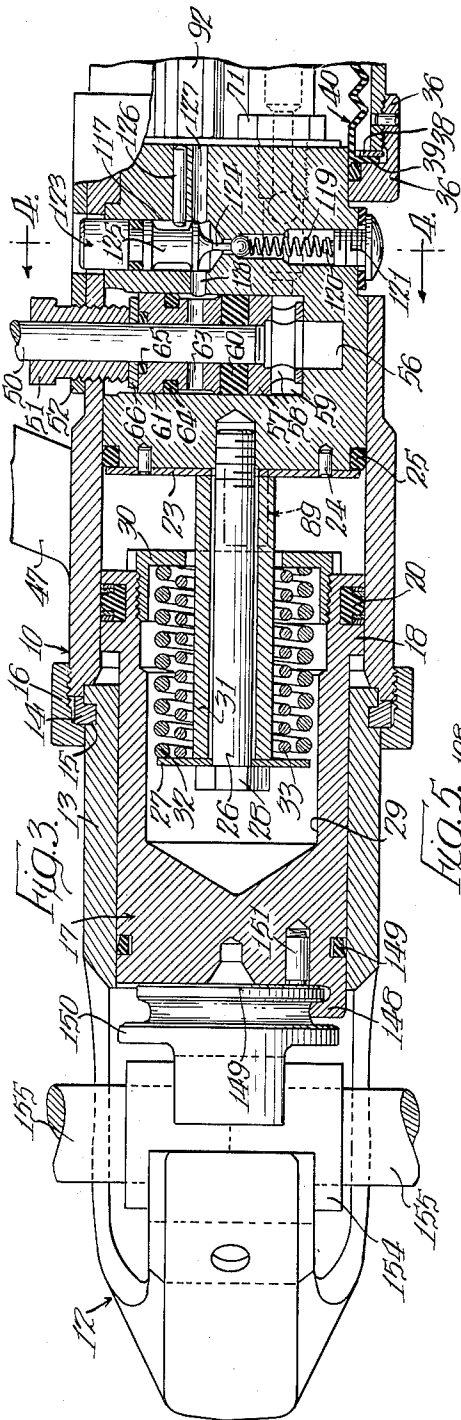
C. E. HOADLEY

2,729,063

HYDRAULIC TOOL

Filed May 14, 1954

2 Sheets-Sheet 2



INVENTOR.
Cyrus Earl Hoadley

BY
Brown, Jackson, Baettchen + Kimmner,

Attys.

1

2,729,063

HYDRAULIC TOOL

Cyrus Earl Hoadley, Bradley, Ill., assignor to Manco Mfg. Co., Bradley, Ill., a corporation of Illinois

Application May 14, 1954, Serial No. 429,837

4 Claims. (Cl. 60—52)

This invention has to do with hydraulic tools, and is concerned more particularly with hydraulic tools for use in industrial operations of various sorts.

In the use of hydraulic tools for crimping or compressing operations, and similar purposes, opposed dies are commonly employed one of which is carried by a ram moved outwardly of a cylinder under hydraulic pressure. The required pressure in certain operations is quite high and, in general, the outward movement of the ram is quite slow—at the same rate at which the ram is moved after it encounters the resistance of the work piece—in order that the requisite high pressure may be attained. The operation of the known hydraulic tools referred to is, in general, quite slow and undesirably time consuming.

My invention is directed to a hydraulic tool capable of comparatively high speed operation, in which the ram is projected at relatively high speed and under relatively low effective pressure until it encounters resistance of the work piece, at which time the rate of advance of the ram is automatically reduced so that it is then projected at relatively low speed and under relatively high pressure. That permits of the tool being operated much more rapidly than the presently known hydraulic tools above referred to. The ram of the tool of my invention is yieldingly urged inwardly of the cylinder and release valve means is provided whereby, upon completion of the operation, the pressure in the cylinder is released and the ram is quickly returned to its retracted or innermost position in the cylinder, which further contributes to speed of operation of the tool. The release valve for releasing pressure in the cylinder normally is closed and held closed under cylinder pressure and means is provided for optionally opening that valve in the operation of one of two handles, one of which functions as a lever for operating a pump which withdraws hydraulic fluid, such as a suitable oil, from a reservoir and delivers it to the cylinder under appropriate pressure. The release valve and the operating means therefor constitute an important feature of my invention. A further important feature of my invention is the mounting of the head member of the tool for turning movement relative to the cylinder through a full circle in either direction, and the connection between the head member and the ram so that the latter turns with the head member as a unit, the dies carried by the head member and the ram also turning therewith. A further important feature of my invention is the provision of means whereby hydraulic fluid or oil leaking under high pressure about the pump plunger and associated elements may be drained back into the reservoir under low pressure, thus avoiding objectionable leakage of the oil or other hydraulic fluid. Further objects and advantages of my invention will appear from the detail description.

In the drawings:

Figure 1 is a plan view, partly broken away and in section, of a hydraulic tool embodying my invention;

Figure 2 is a fragmentary lengthwise sectional view, on an enlarged scale, taken substantially on line 2—2 of Figure 1, certain parts being broken away and certain

2

other parts being shown in elevation, with the pump plunger in its inner position;

Figure 3 is a view similar to Figure 2, with the pump plunger in its outer or retracted position and the dies mounted on the tool head and the ram and closed on a work piece;

Figure 4 is a sectional view taken substantially on line 4—4 of Figure 3, certain parts being shown in elevation;

Figure 5 is a fragmentary sectional view on an enlarged scale taken substantially on line 5—5 of Figure 4;

Figure 6 is a fragmentary sectional view, on an enlarged scale, taken substantially on line 6—6 of Figure 4; and

Figure 7 is a sectional view, on an enlarged scale, taken substantially on line 7—7 of Figure 4.

The body of the tool comprises a cylinder 10 and a cylindrical pump block 11 fitting snugly in one end of cylinder 10. A C-shaped head member 12 is provided with a cylindrical neck 13 having adjacent its inner end an outwardly opening circumferential groove. A split ring 14, of angle cross-section, extends into groove 15 of neck 13 and seats on the outer end of cylinder 10. A flanged coupling ring 16 is threaded on the outer or forward end of cylinder 10 and engages over the ring 14, thus coupling neck 13 to cylinder 10 for turning movement relative thereto through a complete circle, the height or radial extent of the ring 14 being such that binding between neck 13 and cylinder 10 does not occur while any objectionable looseness or play between the parts is avoided. As will be clear from Figures 2 and 3, the neck 13 of head 12 provides an outer extension of cylinder 10 of reduced interior diameter. The neck 13 slidably receives a main piston or ram 17 provided at its inner end with a base 18 of increased diameter which fits snugly in the cylinder 10. Ram 17 is provided with a dirt scraper ring 19 and the base member 18 is provided with suitable sealing means 20. Referring more particularly to Figure 1, ram 17 is provided at one side thereof with a lengthwise slot or keyway 21. A key 22, mounted in neck 13 and retained therein by the coupling ring 16, extends into the keyway 21 providing therewith a key and slot connection between neck 13 and ram 17 whereby the latter turns with head 12 while being free for reciprocation to appropriate extent in neck 13 and cylinder 10.

A facing disc 23 is mounted on the inner end of pump block 11 and positioned thereon by dowels 24. The inner end portion of block 11 is of reduced diameter and receives an O sealing ring 25 of known type. A bolt 26 is threaded into the inner end of block 11 coaxially therewith and receives at its outer end a washer 27 seating on head 28 of the bolt. The bolt 26 and associated parts are disposed within a bore 29 of substantial diameter in the ram 17 extending from the inner end thereof. A flanged spring retaining ring 30 is threaded into the inner end of base 18 of ram 17 and a spacer sleeve 31, disposed about bolt 26, extends between the facing disc 23 and washer 27 effective for maintaining them in spaced apart relation. Two compression springs 32 and 33 are mounted about spacer 31 and are confined between washer 27 and the flange of ring 30. It will be clear, from what has been said, that the ram 17 is yieldingly urged inward of cylinder 10 by the compression springs 32 and 33 so as normally to be in its position shown in Figure 2, with the flange of ring 30 seating against the facing disc 23, which is restrained against movement away from block 11 by the spacing sleeve 31.

The outer end portion of pump block 11 is of reduced diameter, as shown at 34 in Figures 2 and 3. Likewise the outer end portion of the cylinder 10 is of increased wall thickness providing an interior circumferential shoulder 35 against which the outer end of block 11 seats and through which the reduced extension 34 thereof extends. Outwardly beyond the shoulder 35 the cylinder 10 is

3

provided with a lengthwise flange 36 which is interiorly threaded for reception of the base portion 37a of a handle 37. The base portion 37a of handle 37 is cylindrical, as will be clear, and screws into flange 36, seating on a clamping ring 38 which seats on the outer face of an outwardly extending circumferential base flange 39 of a reservoir 40 formed of a suitable plastic and preferably possessing some elasticity. The inner or base end of reservoir 40 fits snugly about the reduced outer end extension 34 of the block 11 and shoulder 35 of cylinder 10 is provided in its axially outer face with a circumferential groove which receives an O sealing ring 42 fitting tightly about extension 34. As will be understood from what has been said, the handle 37 is fixed to the outer or rearward end of cylinder 10 and the base portion 37a thereof houses the reservoir 40.

The second handle 45 is pivoted at its forward end, by means of a pin 46, on an arm 47 secured to cylinder 10 and extending substantially radially therefrom, the forward end of the arm 45 being slotted for reception of the arm 47, as will be clear from Figures 1 and 2. A connector block 48 is pivoted at its upper end, by means of a tubular pin 49, in the slotted forward end of handle 45. The lower or inner end of connector block 48 has a ball and socket connection 49 to the upper end of a pump plunger 50 slidable through a packing nut 51 which is threaded through the wall of cylinder 10, including a reinforcing element or pad 52 welded or otherwise suitably secured to the cylinder wall. The handle 45 thus constitutes a lever for operating the pump plunger 50.

The pump plunger 50 extends inwardly through the radially extending bore 55 in block 11 extending radially thereof and opening through one side of block 11. The bore 55 is of materially greater diameter than pump plunger 50 and is coaxial therewith, being provided, at its inner end, with an extension 56 of reduced diameter but appreciably greater diameter than the pump plunger 50. A lower spacer 57 is disposed in the inner end portion of bore 55 and fits about the plunger 50, this spacer having a body portion of reduced diameter provided with radial openings 58 and extending a material distance outwardly of bore 55, providing at the inner end portion thereof a pump chamber 59 which is disposed inwardly of bore 55 beyond the outer end or head of spacer 57, which outer end fits snugly in bore 55, as shown in Figures 2 and 3. A packing member or disc 60 seats on the outer end of spacer 57 and fits snugly about plunger 50 and in the bore 55. An outer spacer 61 fits about plunger 50 and the end portions thereof fit snugly in the bore 55. The body of spacer 61 is of reduced diameter, providing an annular space 62 thereabout, and is provided with radial openings 63 extending from the center thereof to the space 62. Spacer 61 is provided with a circumferential groove receiving an O sealing ring 64 and is also provided, at its outer end, with an annular recess about the plunger 50 receiving a sealing ring 65. A washer 66 disposed about plunger 50 seats on the outer end of spacer 61 and, in conjunction with the packing nut 51, provides means for subjecting the spacer and packing assembly to suitable endwise pressure for maintaining the seals about the elements thereof.

Block 11 is provided with a pump intake passage 69 (Figure 7) opening into the pump chamber 59 at one side thereof. Passage 69 is provided with an outer portion 70 of increased diameter into the outer end of which is threaded a fitting 71 seating on a sealing gasket 72 confined between fitting 71 and the outer end of block 11. A tubular shield 73 is secured on fitting 71 and houses a strainer 74, shield 73 being provided with an opening 75 for admission of oil from the reservoir 40. The inner end of fitting 71 is formed to provide a seat for a ball check valve 76 normally held seated by a compression spring 77 mounted in the enlarged portion 70 of passage 69, as shown.

The pump discharge passage 80 opens into the other

4

side of pump chamber 59 and is controlled by a ball check valve 81 mounted in an enlargement 82 of passage 80 and normally held seated by compression spring 83 in the enlargement 82. Spring 83 is disposed about a pin 84 restrained against outward movement by a screw plug 85 threaded into an enlarged outer end portion of the enlargement 82 of passage 80. Pin 84 restricts the extent of opening of valve 81 so as to facilitate reseating thereof, as is known. An inclined passage 86 opens from the enlargement 82 of the pump discharge passage 80 into a bore 87 in block 11 extending lengthwise thereof from its inner face, the disc 23 being provided with an opening 88 about the inner end of bore 87. A tubular piston 89, to be referred to more fully presently, is slidably mounted in the bore 87. It will be understood, from what has been said, that when the handle 45 is oscillated about the pivot 46, hydraulic fluid, preferably oil, is withdrawn from the reservoir 40 and is discharged under pressure from the pump chamber 59 into the bore 87.

A pressure relief safety valve 92, of known type, is threaded into a bore 93 extending from the outer end of block 11, this valve also seating on the gasket 72. The inner end of bore 93 opens into the outer end of a bore 94 extending from the inner end of block 11, the disc 93 being provided with an opening 95 aligned with bore 94. It will be understood that the bores 93 and 94 together constitute a relief passage controlled by the valve 92 which opens when the pressure in the cylinder reaches a predetermined high value. Preferably a filter 96, which may be a sintered metal filter, is mounted in the bore 94 to guard against deposition of dirt or foreign substances in the relief valve, particularly on the seat thereof.

Block 11 is further provided with a bore 99 extending from its inner end and concentric with an opening 100 of somewhat less diameter than bore 99 in the disc 23. A bore 101 of reduced diameter opens into the outer end of bore 99 which is provided with a seat for a ball check valve 102 normally held closed by a light compression spring 103 disposed about a pin 104 of a spider 105 seating against disc 23, the spring 103 holding valve 102 seated under comparatively light pressure. A short tube 106, secured in the outer end of block 11, opens into the outer end of bore 100 and extends into the reservoir 40, the outer end of this tube being bent toward the center of reservoir 40. The tube 106 together with the bores 100 and 99 constitutes a passage, controlled by the valve 102, for admitting oil from the reservoir 40 to the cylinder 10 during outward movement therein of the ram 17, for a purpose which will be explained presently. A bore 107 (Figures 4 and 5) extends from the outer end of block 11 and opens into a radial bore 108 into the outer portion of which is threaded a screw plug 109 the head of which seats on a sealing washer 110. The bores 107 and 108 together provide a passage for replenishing the supply of oil in the reservoir 40 as may be required.

The block 11 is further provided with an inclined bore 113 (Figures 4 and 6) extending from its inner end and opening into radial bore 114 of substantially greater diameter than the bore 113. Bore 114 is provided with an inner portion 115 of reduced diameter from the inner end of which extends a port 116 opening into the inner end of a bore 117 coaxial with bore 114 and opening through the opposite side of block 11. The inner end of portion 115 of bore 114 provides a seat for a ball check valve 118 normally held seated by a compression spring 119 disposed in bore 114 and extension 115 thereof, the outer end of this spring receiving a centering stud 120 extending from the inner end of a screw plug 121 threaded in the outer portion of bore 114, the head of plug 121 seating on a sealing washer or gasket 122. A valve operating button 123 is slidable in bore 117 and is provided at its inner end with a pin 124 disposed to contact valve 118 upon inward movement of the button 123. Button 123 is provided with a spool body 125 which cooperates

5

with a stop pin 126 mounted in block 111 for preventing withdrawal of button 123 from bore 117. A bore 127 extends from the outer end of block 11 and opens into bore 117 between the ends of the spool body 125 of button 123, and a port 128 opens from the lower end of bore 117 into the annular space 62 about the body of the outer spacer 61. The bores 113, 114 and 115, together with port 116, the lower portion of bore 117 and bore 127 together provide a release passage controlled by the valve 118, for releasing the pressure in the cylinder 10 and permitting return of the ram 17 to its innermost position, upon completion of an operation, as will be explained more fully presently. In the reciprocation of the pump plunger 50 by the handle 45, high pressure is created in the pump chamber 59 and a certain amount of high pressure oil leakage about the plunger and the associated spacer and packing member at the inner portion of the bore 55 may occur. Such oil as may thus escape from the pump chamber will enter the annular space 62 about the body portion of the spacer 61 and will readily flow therefrom through port 128, the inner portion of bore 117 and the bore 127 into the reservoir 40. In that manner, I avoid objectionable high pressure oil leakage about the plunger and associated parts.

The handle 45 is of tubular construction for a substantial portion of its length, as shown, and is provided, a short distance from its forward or inner end, with a boss 130 projecting from its inner side. This boss 130 slidably receives the plunger 131 movement of which in either direction is limited by a spring pressed stud 132 mounted in boss 131 and extending into a lengthwise groove 133 in plunger 131. The control rod 135 extends, at its forward end, into a bore 136 in handle 45 and has a disc 137 secured on its outer end and slidable in the handle 45. A pin 138 is secured in disc 137 and projects therefrom through a lengthwise slot 139 in handle 45, there being a knob 140 secured on the outer end of pin 138. A compression spring 141, disposed about the forward portion of rod 135, is confined between an abutment member 142 secured about rod 135 and a washer 143 seating in a recess formed in the slotted member 144 at the forward end of handle 45. The washer 143 also provides an abutment for the outer end of compression spring 145 for the stud 132. It will be seen that rod 135 normally is held in its outer position shown in Figure 2 by the compression spring 141. The plunger 131 is then in its outer position and the valve 118 is closed, being then held closed by the associated compression spring 119 supplemented by the pressure transmitted from the interior of cylinder 10, when the oil therein is under pressure. The boss 130 serves, in cooperation with pad 52, as a stop for limiting movement of handle 45 toward handle 37, as will be clear from Figures 1 and 2. Additionally, the boss 130 serves as a mounting and guide for the plunger 131. When the rod 135 is in its normal outer position movement of handle 45 to its position shown in Figure 2 does not affect button 123 and the release valve 118 remains closed. When it is desired to open the release valve, rod 135 is moved forward, by means of the knob 140, to operative position, so as to project the plunger 131 by contact of the conical forward end of rod 135 with the rounded upper end of plunger 131, as will be understood from Figure 2. Conveniently, though not necessarily, that is done before handle 45 is moved to its innermost position relative to handle 37. Thereafter, when handle 45 is moved to its innermost position, the plunger 131 contacts button 123 and forces the latter inward, thus opening release valve 118 and permitting flow of oil from the cylinder 10 back into the reservoir, in order that the ram 17 may be returned to its innermost position by the springs 32 and 33.

The outer or forward end of ram 17 is provided with a forwardly extending semi-circular flange 148 which receives a circular base flange 149 of an inner die 150 seating on the end of ram 17. The flange 148 is undercut

6

and of substantially hook shape in cross section so as to engage over the flange 149, as shown, assuring movement of die 150 with ram 17. A spring pressed pin 151 is mounted in ram 17 and extends into an off-center recess in the base of die 150 to retain the latter in position on the ram, as is known. An outer die 152 is mounted in the C head 12 in opposition to the inner die 150, and is retained therein by spring pressed pins 153 mounted in head 12 and engaging in corresponding recesses in die 152. The dies 150 and 152 are suitably formed to shape a work piece therebetween, when subjected to pressure between the dies, to a desired non-circular form, conveniently hexagonal form, though any other suitable shape may be used. It may be assumed, for purposes of description, that the tool is used to compress a sleeve 154 of copper or other metal about the ends of two wires or rods 155 to be joined together, as indicated in Figure 3.

Referring further to Figure 7, the piston 89 is of tubular construction and is provided with an enlargement 158 at its midportion which fits snugly in the bore 187. At its outer end piston 89 is provided with a passage 159 opening therethrough, of reduced diameter, the inner end of which is shaped to provide a seat for ball check valve 160 normally held seated by a compression spring 161 within piston 89, confined between valve 160 and a tubular retainer 162 suitably secured in piston 89, conveniently by being a push fit therein. Assuming that the tool is to be used for the purpose stated, when the handle 45 is oscillated about its pivot 46, oil is withdrawn from the reservoir 40 and is delivered under substantial pressure to the bore 87, thus subjecting the piston 89 to considerable pressure, the valve 160 also being subjected to this pressure and held seated by spring 161, which is of adequate strength for that purpose. It will be noted that the diameter of the piston 89 is slight compared to the diameter of the base 18 of ram 17, and is approximately the same as the diameter of the pump plunger 50. Accordingly, during each inward stroke of the pump plunger 50 the piston 89 is projected a distance approximately equal to the length of the stroke of the plunger. In that manner, piston 89 is moved inwardly of the cylinder 10 at relatively high speed. At the start of its inward movement the piston 89 contacts the flange of the ring 30 and during continuation of the pumping operation forces the ram 17 outward at such high speed. The spring 161 is of such strength that the valve 160 remains closed so long as the resistance to the outward movement of ram 17 does not exceed that offered by the springs 32 and 33. Outward movement of ram 17 continues at relatively high speed until the die 150 contacts the work piece, such as the sleeve 154. When that occurs, the resistance to outward movement of ram 17 is substantially increased and it then becomes necessary to exert greater pressure on the handle 45 for forcing the oil into the cylinder. Under this increased oil pressure the valve 160 opens and oil is then delivered directly into the cylinder thereby greatly reducing the rate of outward movement of the ram 17 and correspondingly greatly increasing the effective pressure to which the ram is then subjected. The pumping operation is continued until the work piece, such as the sleeve 154, has been compressed and reformed to the desired extent, after which the control rod 135 is moved to its forward or operative position and, upon return of handle 45 to its innermost position, release valve 118 is opened, permitting return of the ram 17 to its innermost position by the springs 32 and 33. In that manner, the ram is moved outward at high speed under predetermined resistance to such outward movement, and when the resistance to outward movement of the ram is substantially increased the rate of such outward movement is decreased and the effective pressure to which the ram is subjected is greatly increased, such reduction in speed of the ram and increase in effective pressure exerted thereon occurring automatically and as a continuation of the pumping operation without necessity for interrupting the latter or interrupting travel of the ram. That is conducive to high

speed operation of the tool which, in operations of the character referred to, is desirable and effects a substantial saving in time. In the event the pressure exerted by the tool tends to exceed safe limits, the safety relief valve opens so as to relieve the pressure in the cylinder, as previously described.

It will be understood that changes in detail may be resorted to without departing from the field and scope of my invention, and I intend to include all such variations, as fall within the scope of the appended claims, in this application in which the preferred form only of my invention has been disclosed.

I claim:

1. In a hydraulic tool, a body comprising a cylinder and a block at one end thereof, a ram operable in said cylinder, a hydraulic fluid reservoir, a first handle secured to said body, a second handle pivoted on said body for movement toward and away from said first handle, means comprising a pump plunger operated by said second handle for delivering hydraulic fluid under pressure from said reservoir to said cylinder, said block having a release passage opening from said cylinder into said reservoir, a normally closed release valve controlling said passage and closing toward said reservoir, a valve opening pin slidable in said block for movement in valve opening and valve closing directions, a release plunger slidable in said second handle and aligned with said pin when said second handle is in its extreme position toward said first handle, said release plunger normally being in retracted ineffective position, and means carried by said second handle for optionally projecting said release plunger and holding it projected, whereby said release plunger will move said pin toward said valve and open the latter when said second handle is moved to its limit toward said first handle.

2. In a hydraulic tool, a body comprising a cylinder and a block at one end thereof, a ram operable in said cylinder, a hydraulic fluid reservoir, a first handle secured to said body, a second handle pivoted on said body for movement toward and away from said first handle, means comprising a pump plunger operated by said second handle for delivering hydraulic fluid under pressure from said reservoir to said cylinder, said block having a release passage opening from said cylinder into said reservoir, a normally closed release valve controlling said passage and closing toward said reservoir, a valve opening pin slidable in said block for movement in valve opening and valve closing directions, said second handle having a boss disposed to contact said body and limit movement of said second handle toward said first handle, a release plunger slidable in said boss and aligned with said pin when said second handle is in its extreme position toward said first handle, said release plunger normally being in retracted ineffective position, and means carried by said second handle for optionally projecting said release plunger and holding it projected, whereby said release plunger will move said pin toward said valve and open the latter when said second handle is moved to its limit toward said first handle.

3. In a hydraulic tool, a body comprising a cylinder and a block at one end thereof, a ram operable in said cylinder, a hydraulic fluid reservoir, a first handle secured to said body, a second handle pivoted on said body for movement toward and away from said first handle, means comprising a pump plunger operated by said second handle for delivering hydraulic fluid under pressure from said reservoir to said cylinder, said block having a release passage open-

ing from said cylinder into said reservoir, a normally closed release valve controlling said passage and closing toward said reservoir, a valve opening pin slidable in said block for movement in valve opening and valve closing directions, said second handle having a boss disposed to contact said body and limit movement of said second handle toward said first handle, a release plunger slidable in said boss and aligned with said pin when said second handle is in its extreme position toward said first handle, said release plunger normally being in retracted ineffective position, and a control rod slidable in said second handle normally in retracted position clear of the outer end of said release plunger and movable to projected position for projecting said release plunger and holding it projected, whereby said release plunger will move said pin toward said valve and open the latter when said second handle is moved to its limit toward said first handle.

4. In a hydraulic tool, a body comprising a cylinder, a ram operable in said cylinder, a hydraulic fluid reservoir, a first handle secured to said body substantially parallel with the axis thereof, a second handle pivoted on said body for movement about its pivot axis toward and away from said first handle and fixedly held in its entirety against lengthwise movement toward said body, means comprising a pump plunger operated by said second handle for delivering hydraulic fluid under pressure from said reservoir to said cylinder, said body having a release passage opening from said cylinder into said reservoir, a normally closed release valve controlling said passage and closing toward said reservoir, a release valve opening pin mounted in said body substantially radially thereof and free therefrom for free sliding movement inwardly and outwardly of said body substantially radially thereof; said pin being movable inwardly of said body for opening said valve and movable outwardly of said body to accommodate closing of said valve, and means carried by said second handle and operable in the movement thereof toward said first handle for moving said pin inwardly of said body for opening said valve and holding it open, said last means comprising a member carried by said second handle and movable relative thereto to and from a position to contact said pin.

References Cited in the file of this patent

UNITED STATES PATENTS

1,799,298	Jakob	Apr. 7, 1931
1,876,023	Rosenberry	Sept. 6, 1932
2,096,574	Denny	Oct. 19, 1937
2,118,098	Merenda	May 24, 1938
2,223,223	Muller	Nov. 26, 1940
2,237,970	Pabst	Apr. 8, 1941
2,284,228	Page	May 26, 1942
2,290,361	Schettler	July 21, 1942
2,338,157	Allen	Jan. 4, 1944
2,372,942	Fischer	Apr. 3, 1945
2,394,655	Better	Feb. 12, 1946
2,539,739	Grime	Jan. 30, 1951
2,625,796	Traut	Jan. 20, 1953
2,688,231	Northcutt	Sept. 7, 1954

FOREIGN PATENTS

87	Great Britain	Jan. 10, 1863
453,094	Great Britain	Sept. 4, 1936
591,358	France	Apr. 8, 1925