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HYDRAULIC APPARATUS

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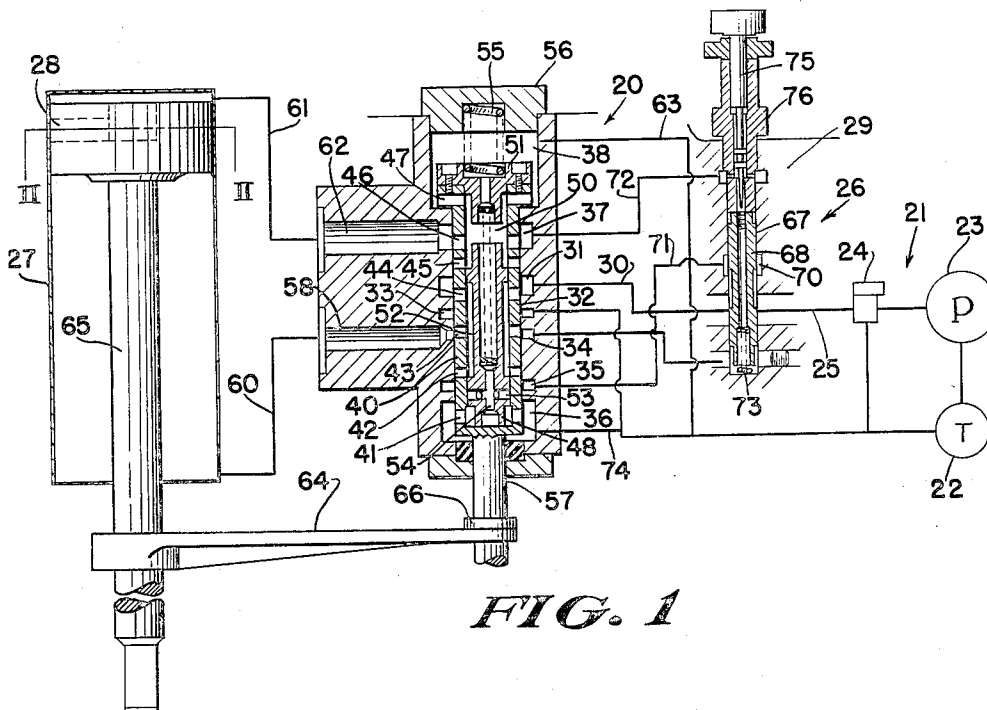


FIG. 1

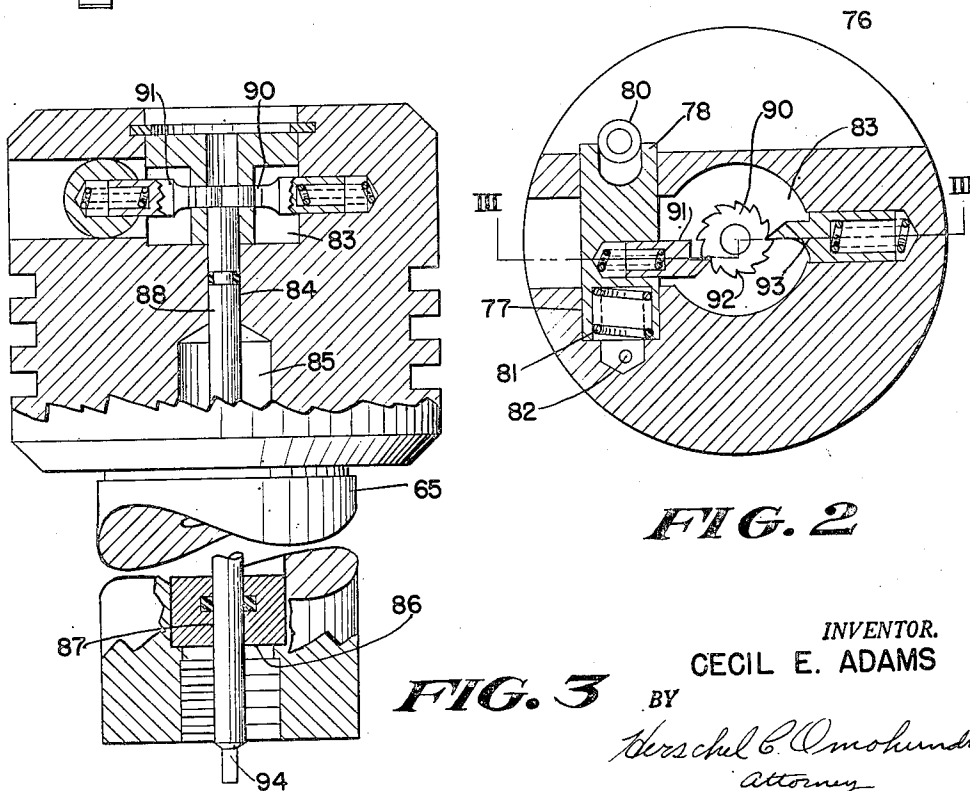


FIG. 2

FIG. 3

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HYDRAULIC APPARATUS

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13 Claims. (Cl. 121—7)

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This invention relates to hydraulically operated mechanism and is particularly directed to hydraulic presses and attachments therefor. More particularly, the invention relates to a machine for performing riveting operations of a particular character.

In some manufacturing operations it is desirable to use a tool which reciprocates and revolves or indexes a portion of a revolution at a time. One such instance is found in a riveting operation where a chisel-like instrument is repeatedly engaged with a rivet end and partially turned between successive engagements.

An object of the present invention is to provide a hydraulically reciprocated device having a motion transmitting element journaled therein which is caused to revolve or rotate at least a part of a revolution each time the device is reciprocated.

Another object of the invention is to provide a power unit having a ram and control mechanism therefor which will automatically regulate the flow of fluid pressure from a source to the power unit to effect relatively short reciprocatory movements of the ram and to provide the ram with a longitudinally extending, journaled shaft and fluid pressure responsive means for causing the shaft to rotate or index when the ram reciprocates.

A still further object of the invention is to provide the piston of a power unit with a second piston-like device which is biased in one direction by a spring or other resilient means and which is exposed to the fluid pressure at the ends of the first piston, the second piston having suitable means for transmitting movement thereof by the spring to a rotary member, the second piston being moved in opposition to the spring by the existence of a higher fluid pressure at a selected end of the first piston than at the other end.

Another object of the invention is to provide the piston of the power unit, mentioned in the preceding paragraph, with suitable means for preventing reverse movement of the rotary member when the second piston is moved by differential fluid pressures at opposite ends of the first piston.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view of a hydraulic

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circuit for a machine having a reciprocating piston and ram, the latter being provided with a tool formed in accordance with the present invention.

Fig. 2 is a detail horizontal sectional view taken through the piston of the machine shown in Fig. 1, the plane of the section being indicated by the dotted line II—II of Fig. 1.

Fig. 3 is a detail vertical sectional view taken through the piston and ram projecting therefrom on the plane indicated by the line III—III of Fig. 2.

Referring more particularly to the drawing, the hydraulic circuit shown in Fig. 1, is designated generally by the numeral 20, this circuit includes a source of fluid pressure 21 having a reservoir 22, a power-driven pump 23 and a relief valve 24 which may be of any suitable construction capable of controlling the pressure in the fluid circuit 20. A fluid line 25 extends from the relief valve 24 to a control valve 26, which may also be of any suitable type, the one disclosed being similar to that shown in my copending application, Serial No. 669,657, filed May 14, 1946, now Patent No. 2,488,109. This control valve governs the flow of fluid pressure from the source 21 to either end of a power cylinder 27 to effect the reciprocation of a piston 28 disposed for movement therein. While the valve 26 has been shown and described in detail in the above-mentioned copending application, it will be sufficiently described herein to facilitate a complete understanding of the present invention. The valve 26 includes a body 29 having an inlet port in direct communication with the line 25, this inlet port is connected by passage 30 with a recess 31 which surrounds a vertically extending bore 32. This bore is surrounded by other recesses 33 to 38, inclusive, which are spaced longitudinally of the bore and openly communicate therewith.

The bore slidably receives a sleeve member 40 which is in turn provided with a series of longitudinally spaced rows of laterally extending ports 41 to 47, inclusive, which serve to connect the interior of the sleeve with certain of the grooves in the body in various longitudinal positions of the sleeve therein. The sleeve 40 receives, for sliding movement, a shuttle valve spool 48 which is normally urged toward one end of the sleeve by a coil spring 50, this member being disposed between the end of a socket in the spool and a cap 51 secured to the upper end of the sleeve 40. The spool 48 has an annular groove 52 formed in the outer surface thereof and a

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series of laterally extending ports 53 extending therethrough adjacent the lower end, these ports intersecting a longitudinal passage 54 extending from the socket in the spool to the lower end thereof. The sleeve is normally urged toward its lowermost position in the body 28 by a coil spring 55 disposed between the cap 51 and a second cap 56 used to close the open upper end of the bore 32. To effect the movement of the sleeve 40, a shipper rod 57 projects from the lower end thereof through the bottom cover of the body 29 to any suitable mechanism by which motion can be imparted either manually or automatically.

When the parts of the valve mechanism are in the position shown, fluid flowing into the valve from the line 25 will flow through the passage 30 to the recess 31 from which it will flow through ports 44 into the interior of the sleeve 40 at the annular groove 52, this fluid will flow outwardly from the sleeve through the ports 43 to the recess 34 which is connected by a passage 58 with a conduit 60 leading to the lower end of the power cylinder 27. This fluid applies an upward force on the under side of piston 28 causing the same to move in an upward direction and exhaust fluid from the upper end of the power cylinder 27 through conduit 61 and passage 62 to recess 37. This fluid flows through ports 46 in sleeve 40 to the interior thereof and outwardly therefrom through ports 47 to recess 38 which is connected by conduit 63 with reservoir 22. As long as fluid flows to the power cylinder and from the latter to the reservoir in this manner piston 28 will move in an upward direction. As the piston approaches the upper end of the power cylinder, an arm 64 projecting from the ram 65 which depends from the piston 28 will strike a collar 66 secured to the shipper rod 57. The upward movement of the piston will thus be transferred to the shipper rod and from the latter to the sleeve 40 to move the same in an upward direction until registration between ports 43 and recess 34 will be interrupted. At this time fluid flow from the interior of the sleeve 40 to the recess 34 can no longer take place and the piston 28 will discontinue its upward movement. The ram will then be in an elevated, idle position.

If it is desired to initiate another cycle of movement of the ram, a suitable control element, not shown, will be actuated to cause the shipper rod to move in an upward direction moving the sleeve 40 upwardly until ports 41 in the sleeve register with recess 35 in the body. At this time fluid under pressure in passage 30 will flow upwardly in a bore 67 around a valve spool 68 positioned therein to a recess 70. From this recess the fluid will flow through the passage 71 to recess 35 from which it will flow through ports 41 to the interior of the sleeve 40 beneath the shuttle valve spool 48. The force of this fluid will move the shuttle valve in an upward direction until groove 52 therein establishes communication between ports 43, which are then in registration with groove 31, and ports 45 registering at this time with groove 37. When the shuttle valve is elevated in this manner, fluid from the pressure source will flow through passage 30 to recess 31, into the interior of the sleeve 40 and upwardly to recess 37 from which it will flow through passages 62 and 61 to the upper end of power cylinder 27. This fluid will tend to force piston 28 downwardly and discharge fluid from the lower portion of power

cylinder 27 through passages 60 and 58 to recess 34. This fluid will flow through ports 42 in sleeve 40 to the ports 53 in the shuttle valve and from the latter ports into the longitudinal passages formed in the shuttle valve. Due to the restricted size of the passage 54, a back pressure will be generated on the fluid being discharged, this back pressure being transmitted through the lower end of the passage in spool 48 to the interior of the sleeve 40 beneath the spool valve 48, this back pressure beneath the shuttle valve holds the same in an elevated position against the action of the spring 50. As long as fluid is supplied under pressure to the upper side of the piston 29 and the latter member is moving in a downward direction, this back pressure will exist to hold the shuttle valve elevated. This manner of performing such operation is desirable because the flow of fluid under pressure from passage 30 through line 71 to the under side of the shuttle valve will be discontinued when the flow of fluid to the recess 37 is initiated. The admission of fluid under pressure to recess 37 causes a flow through line 72 to the upper portion of bore 67 above spool 68. This fluid forces spool 68 downwardly against the action of its spring 73 and interrupts communication between passage 30 and line 71.

When ram 65 engages an obstruction which offers sufficient resistance to movement thereof to cause the fluid pressure in the supply source to increase sufficiently to cause relief valve 24 to bypass fluid from pump 23 directly back to reservoir 22, ram 65 will cease to move. At this time fluid discharge from the lower end of power cylinder 27 will stop and the back pressure will be dissipated. Spring 50 will then return shuttle valve 48 to its lowermost position in which the source of fluid pressure will be connected with the lower end of the power cylinder 27. Piston 28 and ram 65 will then move in an upward direction, as previously described. As soon, however, as shuttle valve 48 is shifted by spring 50, recess 37 will be connected with reservoir 22 and fluid above spool valve 68 may be discharged to the reservoir permitting valve 68 to move to its original position wherein communication between passages 30 and 71 is again established. At this time fluid under pressure will be again supplied to the lower end of the sleeve 40 beneath shuttle valve 48 and the latter will be elevated to connect the upper end of the power cylinder 27 with the source of fluid pressure. Piston 28 will then cease to move in an upward direction and be caused to move downwardly. This manner of operation which results in the performance of short reciprocations by the piston 28 will be continued as long as shipper rod 57 is held in an elevated position in which ports 41 register with recess 35.

When it is desired to interrupt the short stroking operation, the shipper rod 57 may be lowered to interrupt communication between ports 41 and recess 35 at which time the lower end of the sleeve 40 will communicate with recess 36, which recess communicates through passage 74 with reservoir 22. The shuttle valve 48 may then drop to the position in which the source of fluid pressure will be connected with the lower end of power cylinder 27 and piston 28 will be moved in an upward direction. When this piston approaches the upper limit of its movement, the flow of fluid to the lower end of the power cylinder will be interrupted in the manner previously set forth. The length of the short strokes may

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be varied through the adjustment of a valve 75 arranged in a body 76 which is inserted in the upper end of bore 67. The mechanism and the operation above described is substantially identical with the mechanism set forth in my copending application above mentioned.

The present application is directed to a rotary tool attachment for such a machine. This tool attachment is illustrated in detail in Figs. 2 and 3 of the drawing. In one form of the attachment the piston 28 is relieved at one side, as at 76, and has a horizontal bore 77 formed therein to slidably receive a piston 78. This piston is guided by the head of a screw 80 which is disposed in the bifurcated end of the piston 78 and serves to prevent the same from revolving. A coil spring 81 is disposed between the inner end of the piston 78 and the inner end of the bore 77, the coil spring serving to urge the piston 78 in an outward direction. Communication is established between the under side of piston 28 and the inner end of bore 77 through a passage 82 formed in the piston 28. Thus when pressures are equalized at opposite ends of piston 28, coil spring 81 will tend to move the piston 78 outwardly of the bore 77, this outward movement being limited by the screw 80. When fluid pressure above piston 28 increases, this pressure will be applied to the outer end of piston 78 and will move the same in opposition to the force of the coil spring 81.

Piston 28 is also provided with a recess 83 which enters the piston from the upper end thereof. The piston is further provided with a central opening 84 which extends from the recess 83 to an axial recess 85 formed in the ram 65. This recess 85 receives a bearing 86 at its lower end, the bearing having an opening 87 which cooperates with opening 84 to journal a shaft 88 in the ram and piston 28. Within the recess 83 the shaft 88 is provided with a ratchet wheel 90. This ratchet is disposed in horizontal registration with the piston 78, the latter receiving a spring-pressed pawl 91 for transmitting movement of the piston 78 to the ratchet. When the piston 78 is moved into the socket 77 by pressure above piston 28 the pawl 91 will engage one of the teeth 92 on the ratchet, then, when fluid pressures at the opposite ends of piston 28 are equalized, or the pressure beneath piston 28 becomes greater than the pressure thereabove, spring 81 will move piston 78 in an outward direction causing ratchet wheel 90 to rotate through a portion of a revolution. This ratchet wheel is restrained against reverse rotation by a second spring-pressed pawl 93, carried by the piston 28 on the opposite side of the ratchet wheel 90 from pawl 91. It will be seen that as piston 28 is reciprocated in power cylinder 27, ratchet 90 and shaft 88 will be repeatedly indexed or rotated through portions of a revolution. The lower end of the ram 65 may be provided with any suitable tool which will be driven when shaft 88 rotates, by the flattened end 94 thereof. The tool selected will depend entirely upon the work to be performed; this tool will be indexed on each reciprocation of the piston 28 whether the latter performs short or long strokes. The indexing operation of the tool will take place during the movement of the ram in an upward direction when the tool is disengaged from the article being worked upon; the least resistance to turning movement will be offered at this time and no tendency to twist, break or deform the tool will result.

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While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

I claim:

1. In a hydraulic system, a source of fluid pressure; a power unit having a cylinder and piston; flow control means between said pressure source and said power unit to cause the reciprocation of said piston; an automatic reversing valve in said flow control means, said reversing valve being operative to cause repeated reciprocations of said piston through strokes of lengths less than the normal stroke length thereof; a shaft projecting from and journaled in said piston; and pressure responsive means in said piston for imparting intermittent rotary movement to said shaft, said pressure responsive means being operated when fluid pressure is applied to one end of said piston to move the same in one direction.

2. In a hydraulic system, a source of fluid pressure; a power unit having a cylinder and piston; flow control means between said pressure source and said power unit to cause the reciprocation of said piston; an automatic reversing valve in said flow control means; means in said flow control means for actuating said reversing valve after said piston has moved through a predetermined fraction of the retraction stroke to cause said piston to resume forward travel; a shaft projecting from and journaled in said piston; and pressure responsive means in said piston for imparting intermittent rotary movement to said shaft, said pressure responsive means being operated when fluid pressure is applied to one end of said piston to move the same in one direction.

3. In a hydraulic system, a source of fluid pressure; a power unit of the type having a cylinder and piston; control means between said pressure source and said power unit, said control means being operative to alternately direct fluid pressure to opposite ends of said cylinder to effect reciprocatory movement of said piston; a fluid pressure responsive element carried by said piston, said element being exposed to fluid pressures at the opposite ends of said piston; means operative when substantially equal pressures exist at opposite ends of said piston to urge said pressure responsive element in one direction; and a revoluble motion transmitting member carried by said piston and actuated by said pressure responsive element.

4. Hydraulic apparatus comprising a cylinder; a piston disposed for reciprocation in said cylinder; a shaft extending longitudinally of said piston, said shaft being journaled for rotation; a second piston disposed for movement in said first piston, the ends of said second piston being exposed to the pressure at opposite ends of said first piston; and means for transmitting motion from said second piston to said shaft to effect rotation thereof.

5. Hydraulic apparatus comprising a cylinder; a piston disposed for reciprocatory movement in said cylinder; a second piston disposed for reciprocation in the first piston, said second piston being exposed at opposite ends to the fluid pressures at opposite ends of the first; resilient means normally tending to move said second piston in one direction; shaft means journaled in said first-mentioned piston; and means for

transmitting motion imparted to said second piston by said resilient means to said shaft.

6. Hydraulic apparatus comprising a cylinder; a piston disposed for reciprocatory movement in said cylinder; a second piston disposed for reciprocation in said first piston, said second piston being exposed at opposite ends to fluid pressures existing at opposite ends of the first-mentioned piston; spring means normally urging said second piston in one direction; shaft means journaled in said first-mentioned piston; a ratchet wheel secured to said shaft means; pawl means for transmitting movement to said ratchet wheel when said second piston is moved by said spring means; and means for preventing reverse movement of said ratchet.

7. In a hydraulic apparatus the combination of a reciprocatory piston; a source of fluid pressure; control means between said pressure source and said piston, said control means being operative to cause said piston to automatically reciprocate through a fraction of the normal stroke length thereof; a motion transmitting element journaled in said piston; and fluid pressure responsive means for imparting a rotative impulse to said motion-transmitting element on each reciprocation of said first-mentioned piston.

8. A hydraulically indexed tool comprising a power unit having a cylinder with a piston disposed for reciprocation therein; a ram projecting from said piston; a shaft extending longitudinally through said ram, said shaft being journaled for rotary movement; and means in said piston operative when fluid pressures are substantially equalized on opposite ends of the piston to effect rotary motion of said shaft.

9. A hydraulically indexed tool comprising a power unit having a cylinder with a piston disposed for reciprocation therein; a ram projecting from said piston; a shaft extending longitudinally through said ram, said shaft being journaled for rotary movement; and means for turning said shaft part of a revolution upon each reciprocation of said piston, said means being held against operation by fluid pressure during the advancement of said piston in said cylinder.

10. A hydraulically indexed tool comprising a power unit having a cylinder with a piston disposed for reciprocation therein; a ram projecting from said piston; a shaft extending longitudinally through said ram, said shaft being journaled for rotary movement; means for turning said shaft part of a revolution upon each reciprocation of said piston, said means having a second piston exposed at one end to fluid pressure applied to the first-mentioned piston to advance the same in said cylinder; yieldable means tending to move said second piston in opposition to

such fluid pressure, said yieldable means being operative when such fluid pressure is reduced; and means for transmitting motion from said second piston to said shaft.

11. A hydraulically indexed tool comprising a power unit having a cylinder with a piston disposed for reciprocation therein; a ram projecting from said piston; a shaft extending longitudinally through said ram, said shaft being journaled for rotary movement; means for turning said shaft part of a revolution upon each reciprocation of said piston, said means being set for operation by the application of fluid pressure to said piston to advance the same in said cylinder and operated when fluid pressure is applied to said piston to retract the same in said cylinder; and means for preventing reverse turning movement of said shaft while said means for turning the same is being set for operation.

12. In a hydraulic system of the type having a source of fluid pressure, a power cylinder with a piston and ram and control mechanism between said source and said power cylinder operative to alternately connect said source with said cylinder at opposite ends of said piston; an indexed tool comprising a shaft extending longitudinally of said piston and ram and journaled therein; a second piston mounted for reciprocation in the first-mentioned piston and exposed at opposite ends to the pressures at the ends of said first-mentioned piston; and means for transmitting motion from said second piston to said shaft, said means being operative when fluid pressure is applied to the first-mentioned piston to effect retraction of said ram.

13. In combination with a hydraulically actuated power cylinder having a piston and a body movable therewith, a shaft journaled for rotary movement in said body; means for imparting intermittent rotary movement to said shaft comprising a second piston exposed at opposite ends to the pressures on opposite sides of the first-mentioned piston; means for transmitting motion from said second piston to said shaft when said second piston moves in one direction; and means for prohibiting reverse rotation of said shaft when said second piston moves in the opposite direction.

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