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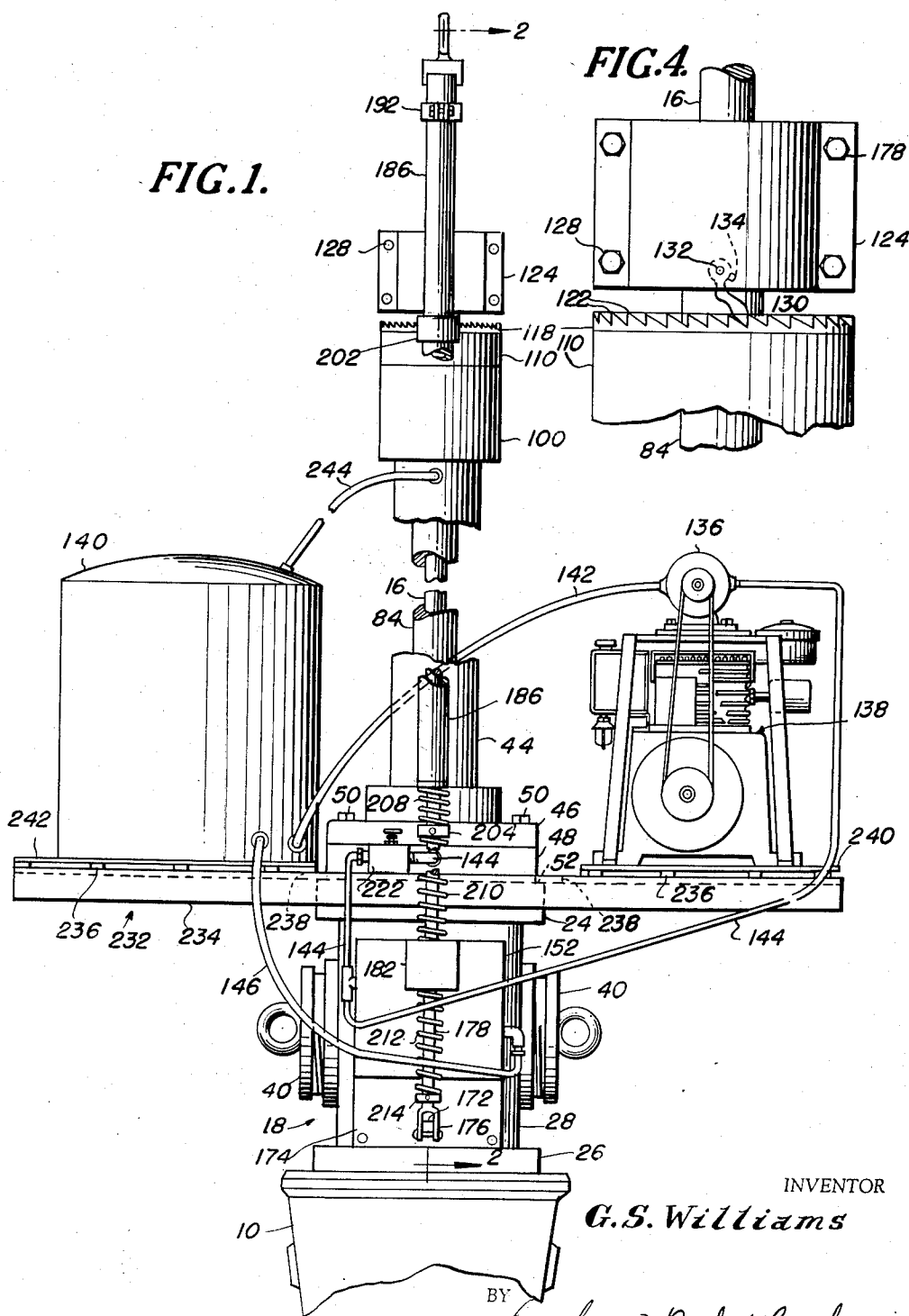
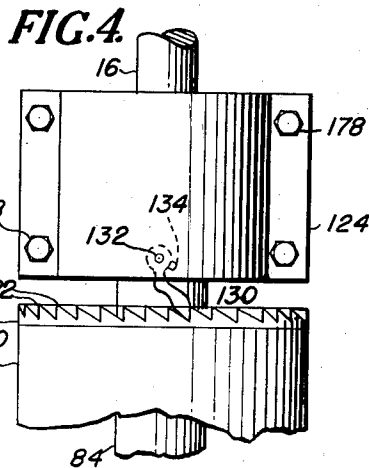
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HYDRAULIC PUMPING JACK FOR OIL WELLS

Filed March 31, 1954

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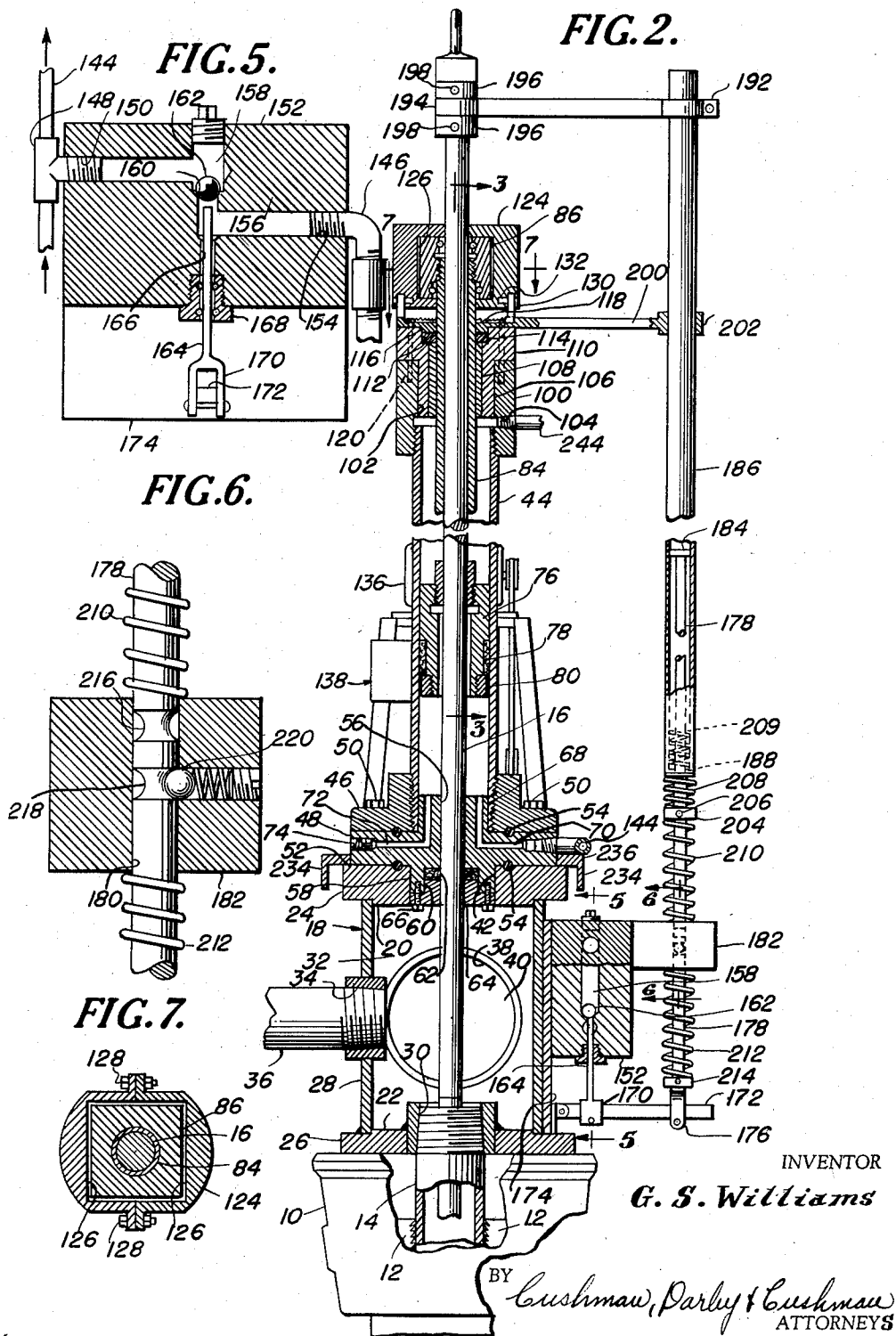
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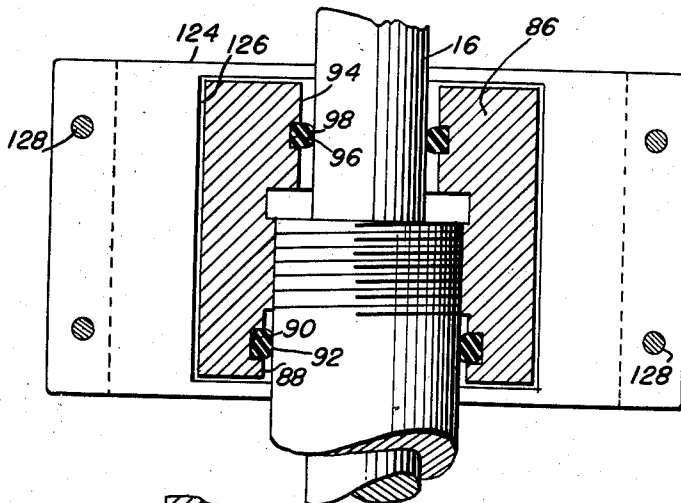


FIG. 3.

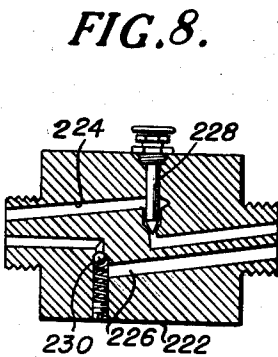
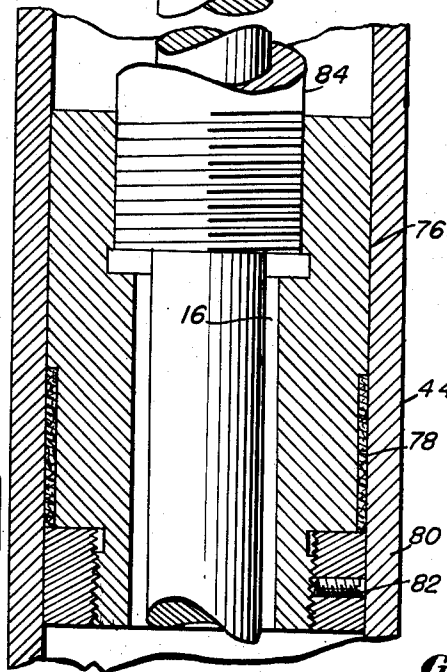


FIG. 8.



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HYDRAULIC PUMPING JACK FOR OIL WELLS

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Application March 31, 1954, Serial No. 420,060

18 Claims. (Cl. 103—46)

This invention relates to a motor for reciprocating a string of sucker rods that operate a pump in a well, and more particularly pertains to an improved hydraulic pumping jack for stripper oil wells.

Hydraulic pumping jacks for stripper wells are known in the art, but heretofore such devices have been relatively complicated and quite expensive. Since stripper wells are of low production, it obviously is desirable to provide pumping means for such wells that is as inexpensive yet as efficient as possible. In addition to being relatively expensive, hydraulic pumping jacks presently in use are not conveniently attachable to a well and require the use of numerous gaskets and packing glands for effecting a seal between the polish rod and a fluid-receiving chamber connected to the well tubing, as well as between the hydraulic cylinder of the pumping jack and the polish rod.

The power unit for hydraulic pumping jacks usually consists of a pump driven by a motor, either internal combustion or electric, and a tank or sump for the hydraulic fluid. Heretofore, such power units have been mounted on a platform or frame resting on the ground at one side of the well. Many oil wells are located on land that is agriculturally productive, and full use of the land for agriculture is obviously highly desirable. Full use could not be had in prior art installations, however, since the power unit platform obviously diminished the amount of land available for cultivation and the growing of crops, particularly when a number of wells were present.

It is highly desirable to impart a partial rotation or turn to the polish rod of an oil well pump at each cycle of reciprocation thereof, in order to operate wipers in the well tubing, maintain the joints of the sucker rods tight, and for other reasons well known in the art. Although such rotating means has been provided heretofore in walking-beam type of reciprocators for oil well pumps, no provision has been made in hydraulic pumping jacks for achieving this highly desirable mode of operation.

Accordingly, it is an object of this invention to provide a hydraulic pumping jack for an oil well which will overcome the aforescribed disadvantages of the prior art.

It is another object of this invention to provide an improved hydraulic pumping jack of simple design, with consequent economies of manufacture, installation, and operation.

It is another object of this invention to provide an improved hydraulic pumping jack that is combined with a compact power unit therefor supported upon the jack structure to minimize the amount of land that is unavailable for cultivation because of the presence of the jack and its power unit.

It is another object of this invention to provide a hydraulic pumping jack with means for partially rotating a polish rod at each cycle of reciprocation thereof.

It is another object of this invention to provide a hydraulic pumping jack with means for partially rotating

both the polish rod and the jack piston and piston rod at each cycle of reciprocation thereof.

It is a further object of this invention to provide an improved hydraulic pumping jack with a novel base structure that is supportable on a casing head and has a fluid-receiving chamber therewithin directly attachable to the well tubing.

Other objects and advantages of the invention will become apparent from the following description and accompanying drawings, in which:

Figure 1 is a front elevational view of a hydraulic pumping jack and power unit therefor embodying this invention, the jack being shown installed on a well.

Figure 2 is a vertical sectional view taken substantially on line 2—2 of Figure 1.

Figure 3 is an enlarged fragmentary vertical sectional view taken substantially on line 3—3 of Figure 2.

Figure 4 is an enlarged fragmentary rear elevational view taken on line 4—4 of Figure 2.

Figure 5 is an enlarged fragmentary sectional view taken on line 5—5 of Figure 2.

Figure 6 is an enlarged fragmentary sectional view taken on line 6—6 of Figure 2.

Figure 7 is an enlarged fragmentary sectional view taken on line 7—7 of Figure 2.

Figure 8 is a vertical sectional view of the down-stroke control valve shown in Figure 1.

Referring now to Figures 1 and 2 of the drawings, there is shown an assembly of a hydraulic pumping jack and a support for the power unit therefor embodying this invention. The assembly is mounted directly on the casing head 10 of a well, which head has conventional slips 12 supporting well tubing 14 that projects somewhat above the casing head and has an exteriorly-threaded upper end. In some instances, the tubing 14 will be supported in the well by conventional means (not shown) other than the slips 12 and will have an extension or adapter (not shown) secured thereto and projecting above the casing head 10. Within the well tubing 14 is the usual string of sucker rods (not shown) operating a pump (not shown) down in the well, the sucker rods being reciprocated by a conventional polish rod 16 connected thereto and extending vertically upwardly from the well tubing. Reciprocation of the polish rod 16 serves, on its upstroke, to discharge fluid from the upper end of the tubing 14, as is well known in the art.

Supported directly on the casing head 10 is a hollow jack base 18 which may be circular in horizontal outline and has substantially flat top and bottom walls 20 and 22 provided with peripheral flanges 24 and 26, respectively, which project beyond the circular side walls 28 of the base. The bottom wall 22 is provided with a central interiorly-threaded opening 30 that is directly engaged with the upper threaded end of the well tubing 14 for discharge of fluid from the latter directly into a fluid-receiving chamber 32 within the base 18. In some instances, for example, when the well tubing 14, or an adapter connected thereto, projects a substantial distance above the casing head 10, it may be desirable to interpose an adapter type of support fitting (not shown) between the base 18 and the casing head and to bolt the fitting and the base together by bolts extending through the base bottom flange 26 and a complementary flange on the fitting. The base 18 has an interiorly-threaded aperture 34 in its side wall 28 for connection of a discharge line 36 to conduct oil from within the fluid-receiving chamber 32 to a storage tank or the like. The base 18 preferably is also provided with diametrically-disposed large clean-out openings 38 or hand-holes in its side wall 28, each normally closed by a threaded closure plug 40. The top wall 20 of the base 18 is provided with a central enlarged aperture 42 aligned

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with the aperture 30 in the bottom wall 22 and through which the polish rod 16 extends.

A jack barrel or cylinder 44 concentrically enclosing the polish rod 16 has a lower flange fitting 46 threaded thereon and is mounted vertically on the jack base 18 with a circular adapter plate 48 clamped therebetween. The cylinder 44 is secured to the base 18 by screws or studs 50 extending vertically through the flange fitting 46, the adapter plate 48, and into the top wall 20 of the base. It will be seen that the fitting 46 and plate 48 are of somewhat smaller diameter than the base flange 24, to provide an upwardly-facing annular ledge 52. Preferably, annular packing rings 54 are received in registering annular grooves in the opposed faces of the flange fitting 46 and the adapter plate 48 and in the opposed faces of the adapter plate and the top wall 20 of the jack base 18. The adapter plate 48 has a central bore 56 coaxial with and constituting a bearing for the polish rod 16. At its underside the adapter plate 48 has an annular boss 58 that fits within the central aperture 42 in the top wall 20 of the jack base 18 and is provided with an annular packing recess 60 within which chevron packing 62 is compressed by a gland-type follower 64 secured to the boss, as by screws 66. The upper side of the adapter plate 48 is provided with an annular boss 68 that fits snugly within the lower end of the jack cylinder 44. Extending radially into the plate 48 from one side thereof is a fluid passage 70 that passes upwardly through the boss 68 and opens into the lower end of the jack cylinder 44 for the admission and exhaust of pressure fluid thereto and therefrom. At its opposite side, the adapter plate 48 is provided with a similar passage 72 that is closed, at its outer end, by a bleeder valve 74 for the removal of air from the cylinder 44 at the start of the operation thereof.

It may here be noted that any leakage of the pumped oil in the base chamber 32 upwardly along the polish rod 16 past the packing 62 is opposed and prevented by the high pressure of hydraulic operating fluid in the cylinder 44. If any leakage occurs it will be of hydraulic fluid into the chamber 32, but such leakage would result in inconsequential dilution of the pumped oil and merely serve to increase the quality of the latter.

Reciprocable within the cylinder 44 is a tubular piston 76 which concentrically encloses or surrounds the polish rod 16 and has chevron packing rings 78 secured thereon by a packing nut 80 threaded onto the lower end of the piston and secured in place by a set screw 82. Threaded into the top of the piston 76 and snugly enclosing the polish rod 16 is a tubular piston rod or sleeve 84 that projects out of the top of the jack cylinder 44 and has a non-circular nut 86 threaded onto the upper and outer end thereof. At its lower end, the nut 86 is provided with a smooth-walled counterbore 88 (Figure 3) provided with a circumferential packing groove 90 within which an O-ring is disposed for sealing engagement with the smooth outer surface of the tubular piston rod 84 below the threads thereon. Above its interior threads, the nut 86 is provided with a smooth-walled bore 94 of reduced diameter, which bore is provided with a circumferential packing groove 96 within which an O-ring 98 is disposed for sealing engagement with the periphery of the polish rod 16 which projects upwardly through the nut 86. Hence, an effective seal is provided that prevents leakage of pressure fluid moving upwardly between the polish rod 16 and the piston sleeve or rod 84.

Threaded onto the upper end of the jack barrel or cylinder 44 is a sleeve or collar 100 which projects upwardly beyond the end of the cylinder and has a smooth-walled interior bore 102 beyond the upper end of the latter. A breather port 104 in the sleeve 100 communicates with the cylinder 44 above the piston 76. Within the sleeve bore 102 is a bushing 106 for the piston rod 84 having a bushing liner 108 and a peripheral

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flange 110 at its upper end which overlies the end of the sleeve 100. At its upper end, the bushing 106 is provided with an annular packing recess 112 surrounding the piston rod 84 and within which a wiper ring 114 is disposed and held in place by an annular follower 116 formed on the underside of a ratchet plate 118. Screws 120 extend through the plate 118, the bushing flange 110 and into the sleeve 100 to secure these three members together. The ratchet plate 118 is provided along the periphery of its upper surface with an upwardly-facing annular series of ratchet teeth 122 (Figure 4), all inclined in one circumferential direction.

A two-part clamp 124, which has interior recesses 126 complementary to and somewhat loosely receiving the nut 86, is clamped by bolts 128 to the polish rod 16 about the nut. Thus, when the piston rod 84 moves the nut 86 upwardly, it carries the clamp 124, and consequently the polish rod 16, along therewith. Further, because of the complementary configuration of the exterior of the nut 86 and the interior recesses 126 of the clamp 124, rotation of the latter serves to rotate the tubular piston rod 84 and the piston 76. Two diametrically-disposed pawls 130 depend from the underside of the clamp 124 and are mounted for pivotal movement thereon by substantially radially-disposed pivot pins 132. Normally, these pawls 130 depend below the undersurface of the clamp 124 and are provided with stops 134 for maintaining the pawl, when free, at an angle to the vertical. Hence, when the polish rod 16 descends under the weight of the sucker rods, the pawls 130 engage with the ratchet teeth 122 and in their consequent pivoting movement impart a partial rotation to the clamp 124 and, consequently, to the polish rod 16, the tubular piston rod 84, and the piston 76.

Although the clamp 124 is shown as having portions extending beneath the undersurface of the nut 86, this construction is unnecessary, and the clamp may be constructed so that the nut and the piston rod 84 are free to move downwardly relative thereto, since the clamp always will be maintained in engagement with the upper surface of the nut by the weight of the sucker rods.

Fluid under pressure for operating the pumping jack is supplied by a constantly-operating pump 136 driven by a motor, shown in the drawings as an internal combustion engine 138, although an electric motor or other prime mover will serve as well. The pump 136 withdraws hydraulic fluid from a tank or sump 140 via a conduit 142 and delivers it under pressure, via a conduit 144, to the passage 70 in the adapter plate 48 and thence to the cylinder 44 beneath the piston 76. Consequently, the piston 76 moves up and raises the polish rod 16 to pump oil into the chamber 32 in the jack base 18. At the end of the upstroke of the polish rod 16, the pressure of the operating fluid is relieved to allow the polish rod to descend by the weight of the sucker rods, carrying with it the piston 76. At the end of the downstroke of the polish rod 16, the pressure of the operating fluid is reestablished for another pumping cycle.

The periodic relief and establishment of the pressure of the operating fluid is accomplished by valve mechanism operated by the movements of the polish rod 16 and controlling a by-pass conduit 146 connected to the pressure fluid supply conduit 144 and leading back to the sump 140. The two ends of a T 148 (Figure 5) are connected into the conduit 144, while the lateral outlet of the T is connected to the inlet port 150 of a valve block 152 secured to the side of the jack base 18. The outlet port 154 of the valve block 152 is connected to a return-flow or by-pass conduit 146. A flow passage 156 extending between the two ports 150 and 154 has a short vertical section 158 provided with an upwardly-facing valve seat 160 on which a ball check 162 normally is seated. A plunger 164 extends vertically upwardly through a small bore 166 in the valve block 152 aligned

with and opening into the passage section 158 so that the upper end of the plunger is beneath the ball check 162. A gland 168 carrying two spaced O-rings is threaded into the outer end of the bore 166 for sealing the passage of the plunger 164 thereinto. The lower end of the plunger 164 is provided with a fork 170 straddling a lever 172 pinned thereto. The inner end of the lever 172 is pivotally mounted on the side of the jack base 18, or on a plate 174 carrying the valve block 152, for swinging movement in a vertical plane to impart corresponding reciprocating movement to the plunger 164 to unseat, and permit seating of, the ball check 162.

The lever 172 extends outwardly from beneath the valve block 152 and has its outer end pivotally connected to a fork 176 on the lower end of a trip rod 178 which extends upwardly through a vertical bore 180 in a bearing block 182 (Figure 6) secured to or integral with the front of the valve block 152. The upper end of the rod 176 has an enlarged head or flange 184 (Figure 2) slidably received within a tube 186 that has a restriction 188 at its lower end for engagement with the head on the rod. The tube 186 is reciprocated with the polish rod 16 by an arm 190 having a clamp 192 on one end thereof encircling the upper end of the tube and a bearing 194 on the other end thereof surrounding the polish rod. Collars 196 are secured by set screws 198 on the polish rod 16 on opposite sides of the bearing 194, so that vertical movement can be imparted to the arm 190 and, consequently, to the tube 186 by movements of the polish rod, while the latter is free to rotate relative to the lateral arm. Preferably, a guide arm 200, which may be integral with the ratchet plate 118, extends radially therefrom and terminates in a bearing 202 encircling the tube 186.

A collar 204 is affixed to the trip rod 178, as by a set screw 206, beneath the lower end of the tube 186, and a coil compression spring 208 encircles the rod and is interposed between the collar 204 and the lower end of the tube 186. A similar spring 209 encircles the rod within the tube 186 and is interposed between the restriction 188 on the latter and the head 184 on the rod. Further, coil compression springs 210 and 212 are interposed between the collar 204 and the top of the bearing block 182 and between the undersurface of the bearing block and a collar 214 affixed to the rod 178 above the fork 176 at the lower end thereof. Within the bore 180 of the bearing block 182, the trip rod 178 is provided with a pair of vertically-spaced circumferential grooves 216 and 218 (Figure 6) engageable by a spring-pressed ball detent 220. The collars 204 and 214 are positioned on the rod 178 so that the two springs 210 and 212 are substantially equally slightly compressed when the ball detent 220 engages the trip rod 176 midway between the two grooves 216 and 218.

From the construction described, it will be seen that on the upstroke of the polish rod 16 the tube 186 is carried upwardly thereby. At the end of the upstroke, the restriction 188 at the lower end of the tube 186 will engage the spring 209 and compress the same against the head 184 on the rod 178 until the latter is pulled upwardly, thus, moving the plunger 164 upwardly and unseating the ball check 162 to relieve the pressure of the operating fluid and allow the polish rod and the piston 76 to descend under the weight of the sucker rods. Because the trip rod 178 is relatively heavy, the ball detent 220 engages within the lower groove 218 therein to maintain the trip rod in its ball-check-unseating upper position during descent of the tube 186 with the polish rod 16. As the tube 186 descends, the lower end thereof engages the compression spring 208 and gradually increases the compression thereof until it is sufficient to overcome the ball detent 220 and force the trip rod 178 downwardly, to thereby permit the ball check 162 to reseat with the consequent reestablishment of the pres-

sure of the operating fluid in the jack cylinder 44 and the start of another upstroke of the polish rod. The trip rod 178 is held in this lower position by the detent 220 engaging the groove 216 therein. The two compression springs 210 and 212 on opposite sides of bearing block 182 serve to dampen the movements of the trip rod 178 and prevent overrun of its detent-engaging positions, while the springs 208 and 209 insure that the rod 178 will move from one detent-engaged position to the other once movement of the rod has been initiated by the tube 186, so that the seating and unseating of the ball check 162 will be decisive.

The length of stroke of the polish rod 16 can be adjusted by vertical adjustment of the tube 186 relative to the polish rod by means of the clamp 192. It also is desirable to regulate the downstroke time of the polish rod 16. For this purpose a valve block 222 (Figure 8) having parallel passages 224 and 226 therethrough is connected into the conduit 144 between the T 143 and the cylinder 44. One passage 224 in the valve block 222 is controlled by a throttle valve 228, which may be in the form of a needle valve, while the other passage 226 may have a spring-pressed ball check valve 230 therein which closes on the exhaust of pressure fluid from the jack cylinder 44. By adjusting the throttle valve 228, the time of the downstroke of the polish rod 16 may be regulated, and also this downstroke is cushioned because of the restriction occasioned by the throttle valve. The throttle valve's by-passing check valve 230 is employed primarily to increase the speed of the upstroke, but, since the upstroke is desirably relatively slow in a stripper well, the check valve 230 and its passage 226 may be omitted in appropriate instances, and the speed of the upstroke controlled substantially entirely by pump pressure, which, in turn, is dependent upon the rate of operation or R. P. M.'s thereof that is controlled by the throttle setting of the engine 138.

The pump 136, its prime mover 138 (here shown as an internal combustion engine), and the sump 140 for hydraulic fluid are mounted as a compact unit on a substantially rectangular frame 232 comprising side angle bars 234 having inturned flanges straddling and resting on the ledge 52 on the top wall 20 of the casing base 18. The side bars 234 of the frame may be connected together by transverse bars 236 welded thereto, and ledge-engaging transverse bars 238 flush with the inturned flanges on the side bars 234 may provide additional support for the frame. The frame 232 projects on opposite sides of the pumping jack to provide two platforms 240 and 242, one on each side of the jack. On one platform 240 the pump 136 and its prime mover 138 are mounted, while on the other platform 242 the sump 140 for hydraulic fluid is mounted. Thus, the weight on both platforms 240 and 242 may be substantially equal. This compact mounting of the power unit on the pumping jack enables the entire assembly to be enclosed in a small economical housing (not shown). Preferably, a conduit 244 connects the breather port 104 of the cylinder 44 to the sump 140 to vent thereto any hydraulic fluid or vapors that might leak past the piston 76.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the specific embodiments shown and described for the purpose of illustrating the principles of this invention are subject to modification without departure from such principles. Hence, this invention includes all modifications encompassed within the spirit and scope of the following claims.

I claim:

1. In a cased well having a casing head supporting well tubing from which a polish rod projects, the combination comprising: a hollow base supported on the casing head and having a fluid-receiving chamber therein connected directly to the well tubing with the polish rod projecting vertically through said chamber; a

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discharge line connected to said chamber; a vertical cylinder mounted on top of said base concentrically about the projecting end of the polish rod; a common wall closing the lower end of said cylinder and the top of said chamber with the polish rod sealingly extending through said wall; a piston in said cylinder; means connecting said piston to the polish rod for lifting the latter by upward movement of said piston; means for supplying fluid under pressure to said cylinder beneath said piston to lift the polish rod; and means operable by movements of the polish rod for alternately establishing and relieving the pressure of said fluid.

2. The structure defined in claim 1 in which the base has an aperture in the lower wall thereof threadedly engaged with the well tubing.

3. A hydraulic pumping jack for a cased well having a casing head supporting well tubing from which a polish rod projects, the combination comprising: a hollow base adapted to be supported on the casing head over the tubing and polish rod and having a fluid-receiving chamber therewithin through which the polish rod extends; means on said base for direct connection to the well tubing to place the latter in open communication with said chamber; means for connecting a discharge line to said chamber; a vertical cylinder on said base for concentrically enclosing the polish rod; a common wall closing the lower end of said cylinder and the top of said chamber and having an aperture therein for passage of the polish rod; packing means for said aperture and the polish rod; a piston in said cylinder; means connected to said piston for lifting the polish rod by upward movement of the former; means for supplying fluid under pressure to said cylinder beneath said piston; and means operable by movements of the polish rod for alternately establishing and relieving the pressure of said fluid.

4. A hydraulic pumping jack for a cased well having a casing head supporting well tubing from which a polish rod projects, the combination comprising: a hollow base having a fluid-receiving chamber therewithin and vertically aligned apertures in the top and bottom thereof, said base being adapted to be supported on the casing head with the tubing directly connected to said bottom aperture for flow of fluid from the tubing directly into said chamber and the polish rod projecting through said chamber and said top aperture; means for connecting a discharge line to said chamber; a cylinder mounted on top of said base for concentrically enclosing the polish rod; plate-like means clamped between said cylinder and said base, said means having a central aperture for the polish rod and a passage for the admission and exhaust of pressure fluid to and from the lower end of said cylinder; packing means for the polish rod where it passes through said central aperture; a piston in said cylinder; means for lifting the polish rod by upward movement of said piston; and means automatically operable by reciprocating movements of the polish rod for intermittently supplying fluid under pressure to said passage.

5. In a hydraulic pumping jack for a well pump polish rod the combination comprising: a vertical cylinder concentrically enclosing a section of the length of the rod with the latter projecting above said cylinder; a tubular piston in said cylinder; connections between said piston and the rod for lifting the latter by upward movement of said piston; and interengageable means on said cylinder and on the rod for partially rotating the latter on each cycle of reciprocation thereof.

6. In a hydraulic pumping jack for a well pump polish rod the combination comprising: a vertical cylinder concentrically enclosing a section of the length of the rod with the latter projecting above said cylinder; a tubular piston in said cylinder; connections between said piston and the rod for lifting the latter by upward movement of said piston; an upwardly-facing annular series of inclined ratchet teeth on the upper end of said cylinder;

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means secured to the polish rod above said cylinder; and at least one pawl carried by said means for pivotal movement about a substantially radial axis relative to the rod, said pawl depending below said means for engagement with a tooth of said series on the terminal portion of each downstroke of the rod for partially rotating the latter.

7. In a hydraulic pumping jack for a well pump polish rod the combination comprising: a vertical cylinder concentrically enclosing a section of the length of the rod with the latter projecting above said cylinder; a tubular piston in said cylinder; a tubular piston rod concentrically enclosing the polish rod; connections between said piston rod and the polish rod for lifting the latter on upward movement of said piston; and interengageable means on said cylinder and on both rods for partially rotating the polish rod and said piston and piston rod on each cycle of reciprocation thereof.

8. In a hydraulic pumping jack for a well pump polish rod the combination comprising: a vertical cylinder concentrically enclosing a section of the length of the rod with the latter projecting above said cylinder; a tubular piston in said cylinder; a tubular piston rod concentrically enclosing the polish rod and projecting out of the upper end of said cylinder; clamp means secured to the polish rod above the upper end of said piston rod; means effecting non-rotative engagement between said clamp means and said piston rod; an upwardly-facing annular series of inclined ratchet teeth on the upper end of said cylinder; and at least one pawl carried by said clamp means for pivotal movement about a substantial radial axis relative to the polish rod, said pawl depending below said clamp means for engagement with a tooth of said series on the terminal portion of each downstroke of the polish rod for partially rotating the latter and said piston.

9. The structure defined in claim 8 in which the means for effecting non-rotative engagement includes a non-circular nut threaded onto the upper end of the piston rod and enclosed by the clamp means.

10. In a hydraulic pumping jack for a well pump polish rod having a vertical cylinder concentrically enclosing a section of the length of the rod with the latter projecting through and above the cylinder, a piston in the cylinder for lifting the rod, and valve means for supplying and exhausting pressure fluid to the cylinder beneath the piston, the combination comprising: vertically-movable rod means for operating the valve means; means rigid with the cylinder for guiding said rod means for vertical reciprocation; means for partially rotating the polish rod on each cycle of reciprocation thereof; and means swivelly connected to the polish rod above the cylinder and to the rod means for reciprocating the latter.

11. In a hydraulic pumping jack for a well pump polish rod having a vertical cylinder concentrically enclosing a section of the length of the rod with the latter projecting through and above the cylinder, a piston in the cylinder for lifting the rod, and a source of fluid pressure, the combination comprising: conduit means providing constantly open connection between the fluid pressure source the cylinder beneath the piston; a by-pass conduit connected to said conduit means; valve means controlling said by-pass conduit; and means automatically operable by the reciprocation of the polish rod for operating said valve means.

12. The structure defined in claim 11 including throttle valve means controlling the conduit means between the cylinder and the by-pass conduit.

13. The structure defined in claim 11 including throttle valve means and check valve means connected in parallel and interposed in the conduit means between the cylinder and the by-pass conduit.

14. The structure defined in claim 11 in which the valve means comprises a housing having a flow passage provided with an annular valve seat and a ball check seat-

able on said seat, and the valve-operating means includes a plunger for lifting said ball check off its seat.

15. The structure defined in claim 11 in which the valve means includes a valve block having a flow passage provided with a vertical section having an upwardly-facing annular valve seat and a ball check seated on said seat, and the valve operating means includes a plunger slidably and sealingly extending vertically into said block from the underside thereof for lifting said ball check from its seat, a lever pivotally mounted at one end thereof for vertical swinging movement and engageable with the lower end of said plunger, a vertically movable trip rod having its lower end connected to said lever to lift the same, a pair of vertically-spaced depressions in said trip rod corresponding to the extent of movement thereof between seated and unseated positions of said ball check, detent means engageable alternatively in said depressions for retaining said trip rod in positions corresponding to the seated and unseated positions of said ball check, and a lost-motion connection between the upper end of the polish rod and said trip rod for moving the latter between said positions thereof.

16. The structure defined in claim 15 including a guide bearing for the trip rod secured to the valve block, a collar fixed on said trip rod on opposite sides of said bearing, and a coil compression spring interposed between each said collar and said bearing, and in which the lost-motion connection includes a tube secured to the polish rod for vertical adjustment relative thereto and telescopically receiving the upper end of said trip rod, an enlargement on said trip rod within said tube, and a restriction in said tube beneath said enlargement and engageable therewith.

17. In pumping apparatus for a cased borehole having a casing head supporting well tubing from which a polish rod projects, the combination comprising: hydraulic jack means including a hollow supporting base adapted to be mounted on the casing head over the tubing and polish rod and having a fluid-receiving chamber therewithin directly connectable to the tubing; power cylinder means mounted vertically on said base for lifting the polish rod; valve means mounted on said base for controlling said power cylinder means; a horizontal

frame supported on said base and extending on opposite sides of said power cylinder means; a sump for hydraulic fluid supported on one side of said frame; a pump supported on the other side of said frame for withdrawing fluid from said sump and supplying the fluid under pressure to said valve means; and a motor for driving said pump supported on said other side of said frame.

18. A hydraulic pumping jack for a cased well having a casing head supporting well tubing from which a polish rod projects, the combination comprising: a hollow base adapted to be supported on the casing head over the tubing and polish rod and having a fluid-receiving chamber therewithin through which the polish rod extends; means on said base for direct connection to the well tubing to place the latter in open communication with said chamber; means for connecting a discharge line to said chamber; a vertical cylinder on said base for concentrically enclosing a section of the length of the polish rod with the latter projecting above said cylinder; a common wall enclosing the lower end of said cylinder and the top of said chamber and having an aperture therein for passage of the polish rod; packing means for said aperture and the polish rod; a tubular piston in said cylinder; means for connecting said piston to the rod for lifting the latter by upward movement of said piston; means for supplying fluid under pressure to said cylinder beneath said piston; means operable by movements of the polish rod for alternately establishing and relieving the pressure of said fluid; and interengageable means on said cylinder and adapted to be secured on the rod for partially rotating the latter on each cycle of reciprocation thereof.

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