Dec. 27, 1955 R. BACCHI 2,728,193

RAM JACK

Filed July 7, 1953 4 Sheets-Sheet 1

FIG. 1

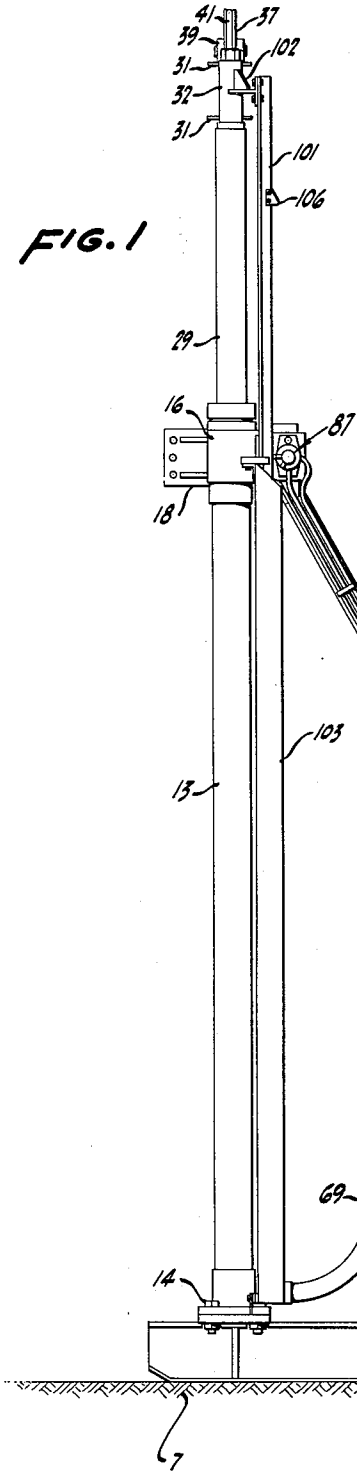
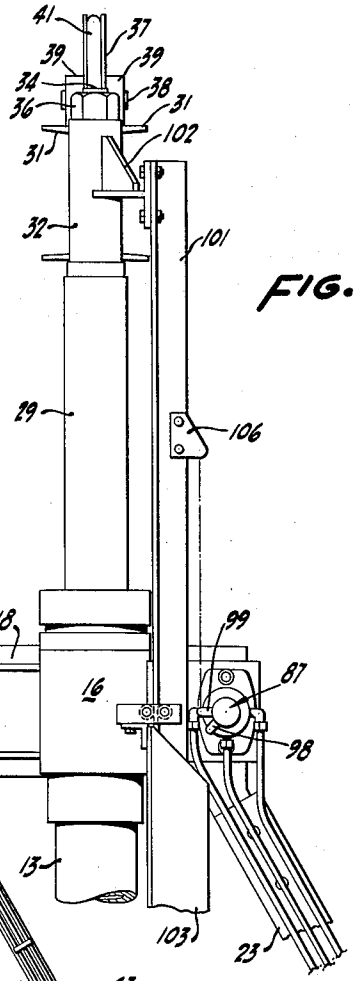


FIG. 2



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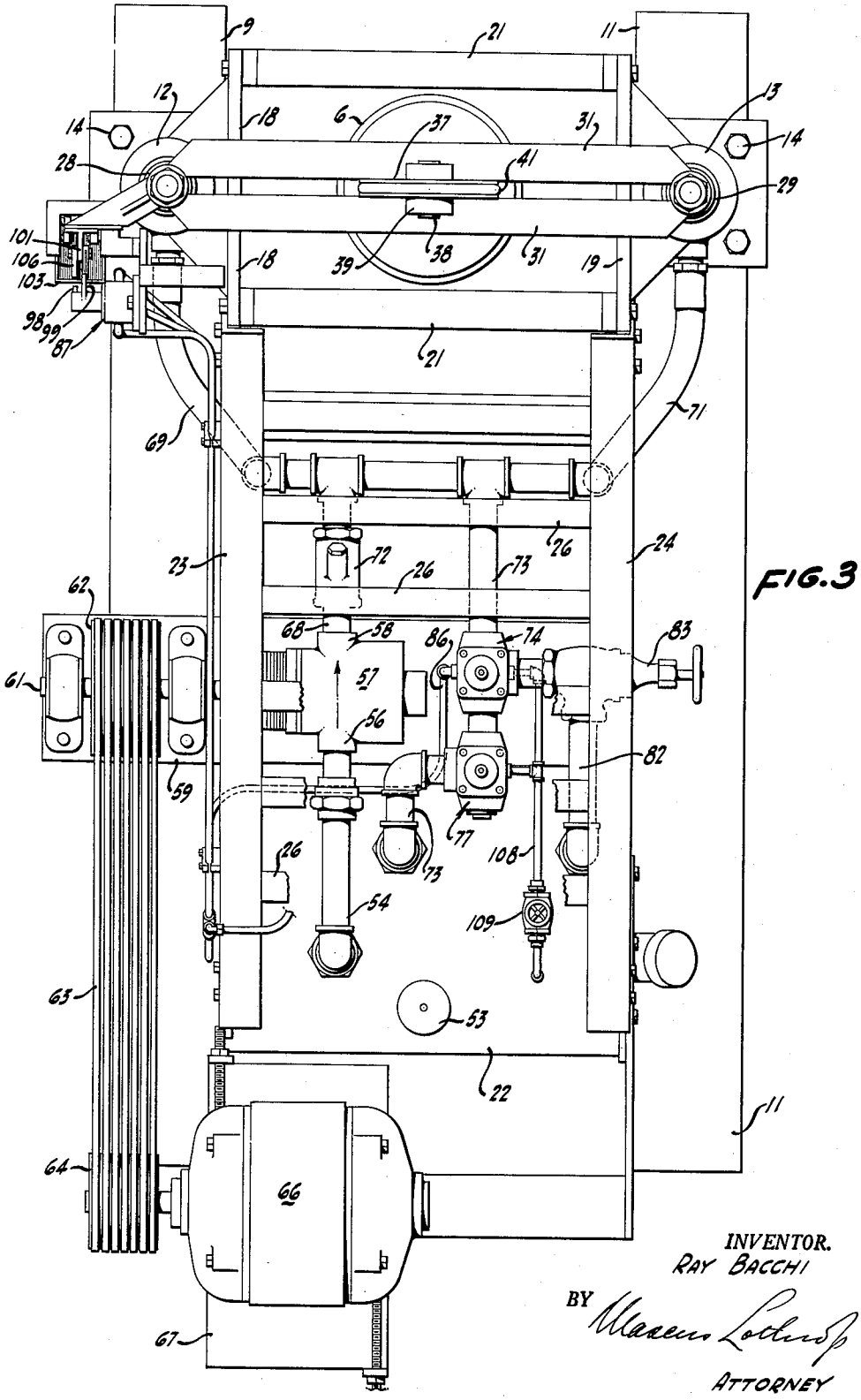


FIG. 3

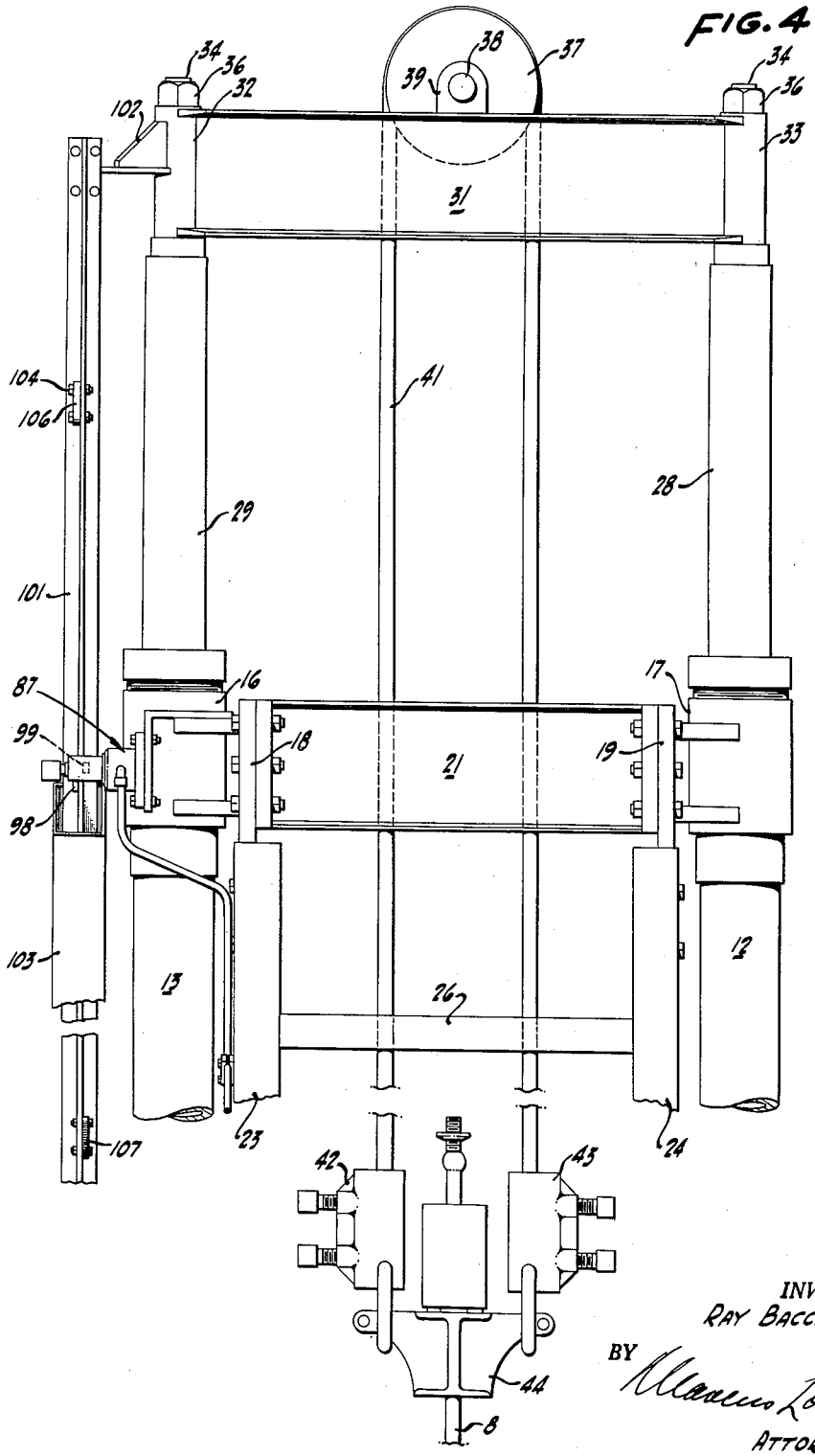
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FIG. 4



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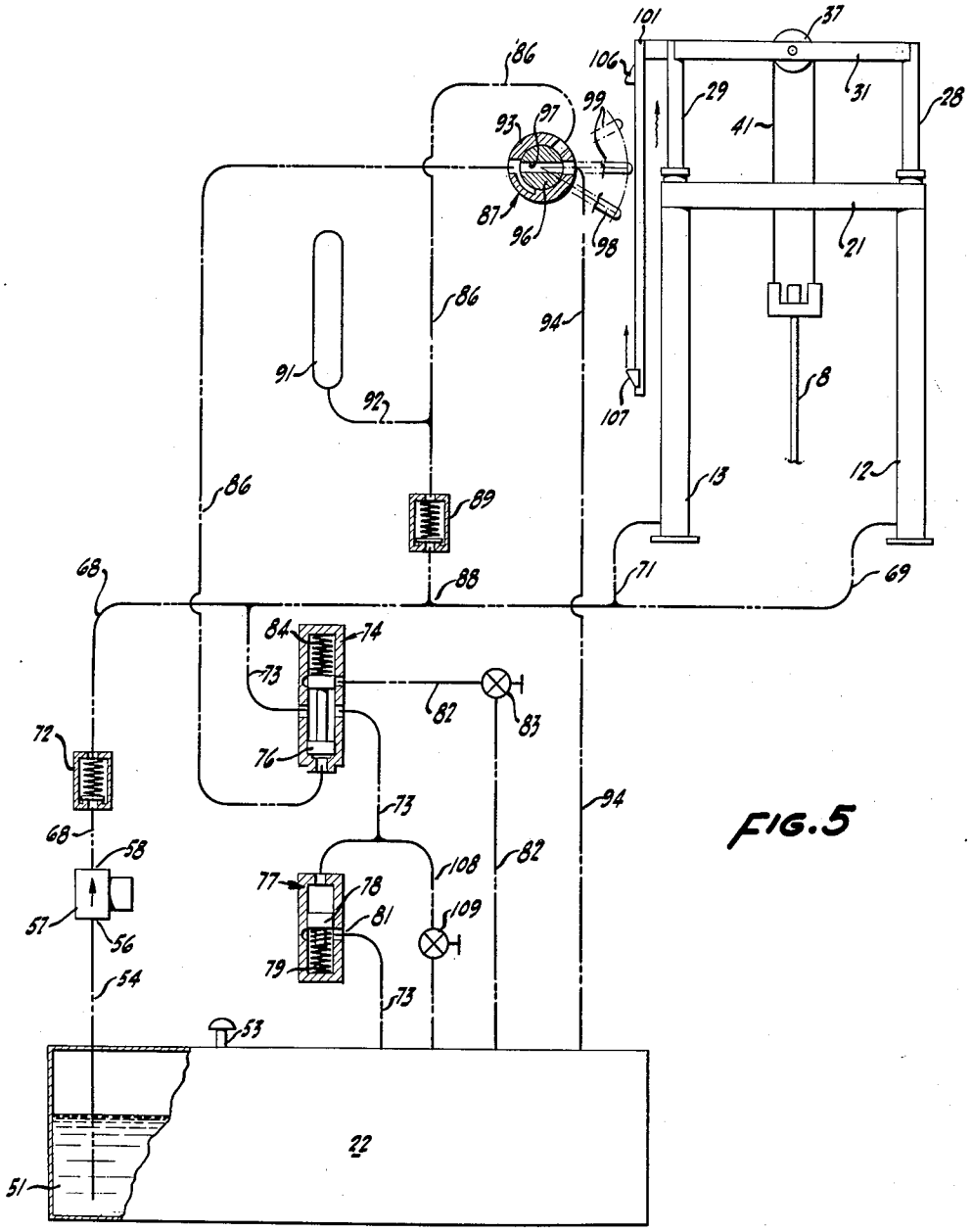


FIG. 5

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United States Patent Office 2,728,193 Patented Dec. 27, 1955

2,728,193

RAM JACK

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Application July 7, 1953, Serial No. 366,506

6 Claims. (Cl. 60—51)

The invention relates to devices for actuating pumps, particularly pumps disposed at the bottom of oil wells. The usual pump reciprocates and is connected to the surface mechanism through the medium of a polish rod available for mechanical attachment at the head of the well. Various kinds of pumping jacks are utilized for the purpose of actuating pumps and hydraulic jacks make up a large proportion of the structures utilized practically. In most instances hydraulic jacks are relatively complex and expensive and are not economically suited for use on wells which are relatively small producers.

It is therefore an object of the invention to provide a ram jack of relatively simple construction and design which can be economically made and is applicable especially to pumping wells which are relatively small producers.

Another object of the invention is to provide a ram jack which can be moved from time to time to different wells to be pumped.

A still further object of the invention is to provide a ram jack having good control of the pumping stroke without the necessity of utilizing delicate or expensive control mechanisms.

A still further object of the invention is to provide a ram jack operating at a relatively low pressure so as to use a relatively economical oil pump.

A still further object of the invention is to provide a ram jack in which the stroke of the pumping unit can be readily regulated to any desired value within wide limits.

A still further object of the invention is to provide a ram jack which does not involve a substantial superstructure with heavy machinery far above the ground, but rather a structure in which the machinery is located and the weight is concentrated close to the ground.

Other objects, together with the foregoing, are attained in the embodiment of the invention described in the accompanying description and illustrated in the accompanying drawings in which:

Figure 1 is a side elevation of a ram jack constructed in accordance with the invention.

Figure 2 is a side elevation similar to Figure 1 but showing to an enlarged scale the upper portion of the ram jack of Figure 1.

Figure 3 is a plan to the scale of Figure 2 of the ram jack of the invention.

Figure 4 is a front elevation of the upper portion of the ram jack, the scale being the same as in Figures 2 and 3, with some portions of the figure broken away to reduce its size.

Figure 5 is a diagram showing the piping arrangement of the ram jack.

While the ram jack of the invention can be embodied in a number of different ways depending partly upon the environment in which it is to be generally utilized and depending upon various manufacturing techniques, it has successfully been incorporated in an arrangement as described and illustrated herein. In that embodiment, the

structure is for use primarily with an oil well 6 (Figure 3) of the customary kind extending from the surface of the ground 7 and having a polish rod 8 extending down the well to a pump (not shown) for discharging the contents thereof. Reciprocation of the polish rod 8 through a suitable stroke operates the pump within the well.

In accordance with the invention, the ram jack includes a pair of skids 9 and 11 designed to rest upon the ground and to be readily moved thereover from place to place as the jack unit is utilized with different wells from time to time. The skids 9 and 11 serve as a foundation for a pair of substantially identical ram cylinders 12 and 13. The bases of the ram cylinders 12 and 13 are detachably connected by fasteners 14 to the respective skids 9 and 11 and are each located alongside of and together straddle the oil well 6.

The cylinders are closed at the bottom and extend upwardly to an open top. On the upper portion of the cylinders, there are provided reinforcements 16 and 17 carrying structural pads 18 and 19. Extending between the pads and removably connected thereto are bridge members 21 which serve as structural connectors and, having substantial depth, also as stiffening members. These secure the cylinders 12 and 13 in fixed relationship so that the assembly of the cylinders with the skids and the bridge members forms a good, substantial structure.

As an additional stiffener, the skids 9 and 11 are spanned at their ends opposite the cylinders by an intervening oil sump tank 22 firmly secured to the skids and extending upwardly to serve as a base for a pair of braces 23 and 24. These are constructed of structural shapes, at their lower ends secured by appropriate fasteners to the tank 22 and at their upper ends secured to the pads 18 and 19. The braces 23 and 24 are at intervals spanned by rungs 26, serving not only as additional braces, but also as an access ladder to the upper portion of the ram unit. The assembly is therefore a rigid, although light, structure with much of the weight concentrated reasonably close to the ground.

The cylinders 12 and 13 receive rams 28 and 29 or plungers at their upper ends connected together by a tie beam 31 having sockets 32 and 33 at its extremities fitting over studs 34 projecting from the rams 28 and 29 and detachably held in position by suitable nuts 36. The rigidity and spacing of the rams 28 and 29 is maintained because of the stiffness and depth of the tie beam 31.

The rams 28 and 29 are adapted to reciprocate within the cylinders 12 and 13 and are flexibly connected to the polish rod 8 by an equalizing structure. This includes a pulley 37 mounted on a cross shaft 38 secured in blocks 39 on the tie beam 31. A cable 41 is trained around the pulley 37 and its opposite ends depend between the bridge members 31 and are secured by cable clamps 42 and 43 to a fastener 44 at the upper end of the polish rod 8. Any minor misalignment or irregularity in the motion of the rams 28 and 29 is compensated for by the cable 41. Thus the polish rod 8 is subjected to reciprocating forces only without any substantial side thrust in any direction.

The weight of the pump in the well, the weight of the polish rod 8, and the weight of the rams 28 and 29 and all of the interconnected structure, is imposed upon fluid within the ram cylinders 12 and 13 and, in accordance with the invention, there are provided means for governing the flow of hydraulic fluid into and out of the cylinders 12 and 13 to provide the desired reciprocation of the polish rod 8.

The sump tank 22 contains a charge 51 of actuating liquid, preferably oil substantially free of contaminants, such as gas, air or water, and hence serving as a substantially solid, force transmitting medium. The oil sump tank 22 is provided with a clean out plate 52 for ready access to the interior and is also connected by a vent 53

to the outside so that the pressure inside the sump tank is that of the atmosphere.

Leading from the body of oil 51 in the sump tank 22 is a pipe 54 extending to the inlet 56 of a relatively inexpensive and compact pump 57, either positive displacement or centrifugal, and having an outlet 58. The pump is conveniently mounted on a bracket 59 utilizing the sump tank 22 as a base. The drive shaft 61 of the pump 57 is provided with a pulley 62 connected by belts 63 to the pulley 64 of a driving motor 66. As shown, this motor is electrically impelled and is mounted on an adjusting base 67 extending from the oil sump tank 22 as a support. In other installations, the electric motor 66 is replaced by an internal combustion engine or the like, it being only necessary to adapt the base 67 and the drive structure for that purpose. The motor 66 drives the pump 57 at substantially a constant speed depending upon the upstroke pumping speed desired, the amount of power consumed by the motor 66 depending upon whether the pump 57 is pumping fluid against a high pressure or is running substantially idle against a low pressure.

From the outlet 58 of the pump 57 an extensive conduit 68 extends ultimately to the base of the jack cylinders 12 and 13, the terminal part of the conduit 68 branching to form a connector 69 to the cylinder 12 and a connector 71 to the cylinder 13. Throughout its extent, the conduit 68 is entirely open to the cylinders 12 and 13 except that adjacent the outlet 58 of the pump 57 there is interposed a check valve 72 of the customary kind arranged so that, while it permits flow away from the pump 58, it precludes flow back through the conduit 68 toward the pump 57.

The pump 57 is continuously rotated and is effective to take oil 51 from the sump tank 22 at atmospheric pressure and to increase the oil pressure sufficiently to displace the rams 28 and 29 upwardly from the cylinders 12 and 13. To work with the pump, there is provided in accordance with the invention, a mechanism for controlling the flow of oil to and from the cylinders in such a fashion that the rams reciprocate appropriately.

For that reason, there leads off from the conduit 68, between the check valve 72 and the branches 69 and 71, a shunt pipe 73 passing through a main valve 74 and extending ultimately to the sump tank 22. A valve shuttle 76 in the main valve 74 is effective in the position shown in Figure 5 to permit flow through the shunt pipe 73 from the conduit 68 through a pressure relief valve 77 and through the remaining part of the shunt pipe 73 back to the sump tank 22. The pressure relief valve 77 includes a plunger 78 having a spring 79 effective to oppose the pressure of the fluid acting upon the piston 78 and, when overcome, to permit the translation of the piston 78 to uncover a port 81 so that the shunt pipe is then continuously open. The effect of the pressure relief valve 77 is to prevent excess pressure in the shunt pipe ahead of that valve.

The piston 76 of the main valve 74 has another, opposite position. In this location, while the shunt pipe 73 is still open, there is also opened, by displacement of the piston 76, an alternate path to the sump tank 22 through a return pipe 82. In the return pipe 82 is disposed a hand operated valve 83 so that the return pipe can be restricted as desired to control the downstroke speed of the rams 28 and 29.

The main valve 74 is provided with a hydraulic actuator in that the piston 76 at one end is provided with a return spring 84 opposing pressure on the piston 76 communicated thereto through a tube 86 extending from the main valve 74 to a control valve 87. From the control valve 87, the tube 86 extends to a junction 88 with the conduit 68 so that when circumstances are appropriate, hydraulic fluid under pressure in the conduit 68 flows through the tube 86 and through the control valve 87 to the main valve 74, and, if the pressure is high enough, overcomes the urgency of the spring 84 and displaces the piston 76 to open the shunt pipe 73, not only to its indirect return through the pressure relief valve 77 to the sump tank, but also to the return pipe 82 open directly to the sump tank.

Interposed in the tube 86, between the junction 88 thereof with the conduit 68 and the control valve 87, is a check valve 89 effective to permit the flow from the junction 88 and the conduit 68 toward the control valve 87 but to prevent backflow in the reverse direction. Also open to the tube 86 between the check valve 89 and the control valve 87 is a hydraulic accumulator 91 joined by a short pipe 92 to the tube 86. This accumulator is of the customary kind and involves a chamber of air or other elastic arrangement effective upon the liquid within the lower part of the accumulator to maintain pressure within the tube 86 when other sources of pressure are ineffective.

The control valve 87 includes a ported valve body 93 to which the various pipe connections are made and is also connected by a drain line 94 extending directly to the oil sump tank 22. Within the control valve is a rotary plug 96 having a bore 97 therethrough. This is effective to establish communication between the tube 86 and the drain line 94, in the position shown in Figure 5, or, in an alternative position, is effective to establish communication between the several parts of the tube 86 to permit free flow therethrough. In this position the drain line 94 is isolated.

The plug 96 is rotated between its two extreme positions by the joint operation of a pair of radial extensions 98 and 99 projecting at different polar attitudes from the plug and being displaced axially of the plug. The extensions 98 and 99 (Figure 4) are disposed to lie on opposite sides of a T-bar 101 extending generally parallel with the ram 29 and in fact suspended from a bracket 102 projecting outwardly from the sleeve 32 so that the T-bar 101 moves concomitantly with the reciprocation of the rams 28 and 29. The T-bar 101 is protected by an encasing tube 103. On opposite sides of the flange of the T-bar 101 are cams 106 and 107, respectively designed to travel in paths into which the extensions 98 and 99 project.

The effect of the cams on the travelling T-bar 101 is to engage the extensions 98 and 99 at the opposite etxremities of the reciprocating movement of the rams 28 and 29 and to actuate the valve plug 96 accordingly. Since the cams 106 and 107 can be disposed in any position desired within the length of the T-bar 101, the stroke of the rams can be regulated in amount and can also be regulated in position.

In the operation of this structure, the oil pump 57 runs continuously so that fluid is discharged under pressure into the conduit 68 and past the check valve 72 and through the branches 69 and 71 into the bottom portions of the cylinders 12 and 13. At the same time, fluid can flow through the shunt pipe 73 and through the main valve 74 to the pressure regulating valve 77. The strength of the spring 79 is such that the valve 77 does not open at the normal pressure necessary to lift the rams 28 and 29 within the cylinders. The pressure relief valve 77 opens only in the event something should go wrong with the machinery and the rams should arrive at the end of their possible stroke without reversal or should otherwise become jammed or stuck.

Liquid within the conduit 68 can also travel through the check valve 89 into the accumulator 91 to charge it to the system pressure, with the fluid pressure also being communicated through the remainder of the tube 86 to the control valve 87. When the valve is in the position shown in Figure 5, the flow stops at that point. Consequently, the rams 28 and 29 are lifted, also lifting the polish rod 8, and effecting an upward jack movement.

As the ram jacks approach the upper part of their set stroke, the lower cam 107 is effective to engage the extension 99 and to lift it into the dotted line position shown in Figure 5, thereby moving the valve rotor 96 into its other position. In this other position, the drain line 94

is cut off and communication is established between the two portions of the tube **86**. The pressure stored in the accumulator **91** is effective to cause flow into the end of the main valve body **74** and to displace the valve spool **76** upwardly, in Figure 5, against the control spring **84** and to open the tube **68** to the return pipe **82**, the valve **83** being open for this purpose. The pressure within the shunt pipe **73** and the return pipe **82** then drops immediately to atmospheric pressure or thereabouts so that the pressure within the conduit **68** also drops substantially to atmospheric. Backflow from the tube **86** is prevented since the check valve **89** closes and the necessary hydraulic fluid to actuate the main valve is derived primarily from the accumulator **91**.

Since the pressure within the conduit **68** drops substantially to atmospheric, the weight of all the parts on the rams is imposed upon the fluid in the lower portion of the cylinders **12** and **13** and is expelled by reverse flow through the conduit **68** and through the shunt pipe **73** and into the return pipe **82** back to the sump tank **22**. Although the pump **57** is continuously revolving, it needs to pump only against the substantially atmospheric pressure in the conduit **68** during the return part of the cycle.

In the event of electric power failure, the return flow builds up of a sufficient pressure to drive the pump **57** backwardly and to permit a too rapid return of the oil. Should backflow start, the check valve **72** closes so that the pump **57** is not driven as a hydraulic motor and no oil short circuits.

The lowering or return cycle continues until such time as the rams **28** and **29** have descended sufficiently for the cam **106** to strike against the extension **98** and to revolve the valve plug **96** back again to the position shown in Figure 5. The main valve **74** is thus immediately opened through the tube **86** to the drain line **94** and the spring **84** is effective to displace the valve spool **76** back into the position shown in Figure 5 with the return pipe **82** blocked and the shunt pipe **73** open to the sump tank **22** only through the pressure relief valve **77**. When the valve spool **76** is translated into the Figure 5 position, there is no other escape for the output of the pump **57** and the pressure in the conduit **68** then rises again to lift the rams upwardly. When the pressure increases in the conduit **68**, there is flow from the junction **88** into the tube **86**, at least in a sufficient amount again to charge the hydraulic accumulator **91** up to the normal upstroke pumping pressure of the pump **57**.

As the rams arrive at their uppermost position, the control valve **87** is again actuated and the cycle is indefinitely repeated as described.

In the event, upon shutdown, the rams are near the upper part of their stroke and it is desired to lower them for any reason, it is possible without disturbing the pressure relief valve **77** to accomplish that end. This is achieved by permitting flow through a duct **108** extending from the shunt pipe **73** to the sump tank **22** under control of a hand valve **109**. Normally the valve **109** is closed but when it is open, then flow to atmospheric pressure can readily occur from the conduit **68** through the shunt pipe **73** and through the duct **108** even though the pressure relief valve **77** is still closed. Before starting the ram unit again, the valve **109** is closed. By appropriate manipulation of the valve **109**, the ram unit can manually be made to short stroke or to operate entirely at the will of the user.

In accordance with the invention, there has been provided a ram unit which is readily movable on its skids from one well to another, is readily connected by flexible cable to the polish rod and is effective because of the dual ram straddle mounting to impose substantially equalized hydraulic forces on the polish rod. The ram unit is relatively low in height because of the inverted open ended cylinders, yet is well aligned and is a stiff structure. It operates through the medium of a relatively inexpensive pump having an automatic control system incorporating a hydraulic accumulator. This insures that the hydraulically actuated main valve is always provided with sufficient operating fluid and pressure, yet the entire hydraulic structure, as well as the mechanical structure, is relatively simple, straight-forward and economical.

What is claimed is:

1. A ram jack comprising a ram cylinder, a ram reciprocable in said cylinder, an oil sump tank, an oil pump, a pipe leading from said sump tank to the inlet of said pump, a normally continuously open conduit leading from the outlet of said pump to said ram cylinder, a shunt pipe extending from said conduit to said sump tank, a main valve in said shunt pipe and movable between an open position and a closed position, a hydraulic operator for moving said valve between said positions, a tube leading from said conduit to said hydraulic operator, a control valve in said tube, and means on said ram for operating said control valve.

2. A ram jack comprising a ram cylinder, a ram reciprocable in said cylinder, an oil sump tank, an oil pump, a pipe leading from said sump tank to the inlet of said pump, a normally continuously open conduit leading from the outlet of said pump to said ram cylinder, a shunt pipe extending from said conduit to said sump tank, a main valve in said shunt pipe and movable between an open position and a closed position, a hydraulic operator for moving said valve, a tube leading from said conduit to said hydraulic operator, a drain line, a control valve in said tube and having two positions in one of which said tube is open to said hydraulic operator and in the other of which said conduit is blocked from said operator and said operator is connected to said drain line, and means dependant upon the position of said ram for operating said control valve.

3. A ram jack comprising a ram cylinder, a ram reciprocable in said cylinder, an oil sump tank, an oil pump, a pipe leading from said sump tank to the inlet of said pump, a conduit leading from the outlet of said pump to said ram cylinder, a shunt pipe extending from said conduit to said sump tank, a main valve in said shunt pipe, a hydraulic operator for said valve, a tube leading from said conduit to said hydraulic operator, a check valve in said tube blocking flow toward said conduit, a hydraulic accumulator in said tube between said check valve and said operator, a drain line extending to said sump tank, a control valve in said tube between said accumulator and said operator, said control valve having two positions in one of which said tube is open to said hydraulic operator and in the other of which said hydraulic operator is open to said drain line, and means on said ram for operating said control valve.

4. A ram jack comprising a ram cylinder, a ram reciprocable in said cylinder, an oil sump tank, an oil pump, a pipe leading from said sump tank to the inlet of said pump, a conduit leading from the outlet of said pump directly to said ram cylinder, a shunt pipe extending from said conduit to said sump tank, a main valve in said shunt pipe, a hydraulic operator for said valve, a tube leading from said conduit to said hydraulic operator, a check valve in said tube blocking flow toward said conduit, a hydraulic accumulator in said tube between said check valve and said operator, a drain line extending to said sump tank, a control valve in said tube between said accumulator and said operator, said control valve having two positions in one of which said tube is open to said hydraulic operator and in the other of which said hydraulic operator is open to said drain line, a check valve in said conduit between said pump outlet and said shunt pipe blocking flow toward said pump outlet, and means effective in the two extreme reciprocated positions of said ram in said cylinder for correspondingly positioning said control valve.

5. A ram jack comprising a ram cylinder, a ram reciprocable in said cylinder, an oil sump tank, an oil pump, a pipe leading from said sump tank to the inlet of said pump, a normally continuously open conduit

leading from the outlet of said pump to said ram cylinder, a shunt pipe extending from said conduit to said sump tank, a main valve in said shunt pipe and movable between an open position and a closed position, a hydraulic operator for moving said valve between said positions, a tube leading from said conduit to said hydraulic operator, a control valve in said tube, a check valve in said tube for preventing flow toward said conduit, and means on said ram for operating said control valve.

6. A ram jack comprising a ram cylinder, a ram reciprocable in said cylinder, an oil sump tank an oil pump, a pipe leading from said sump tank to the inlet of said pump, a normally continuously open conduit leading from the outlet of said pump to said ram cylinder, a shunt pipe extending from said conduit to said sump tank, a main valve in said shunt pipe and movable between an open position and a closed position, a hydraulic

operator for moving said valve, a tube leading from said conduit to said hydraulic operator, a drain line, a control valve in said tube and having two positions in one of which said tube is open to said hydraulic operator and in the other of which said conduit is blocked from said operator and said operator is connected to said drain line, a check valve in said tube between said conduit and said valve for preventing flow toward said conduit, and means dependent upon the position of said ram for operating said control valve.

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