Jan. 28, 1958 E. J. SARGENT 2,821,141

HYDRAULIC WELL PUMP

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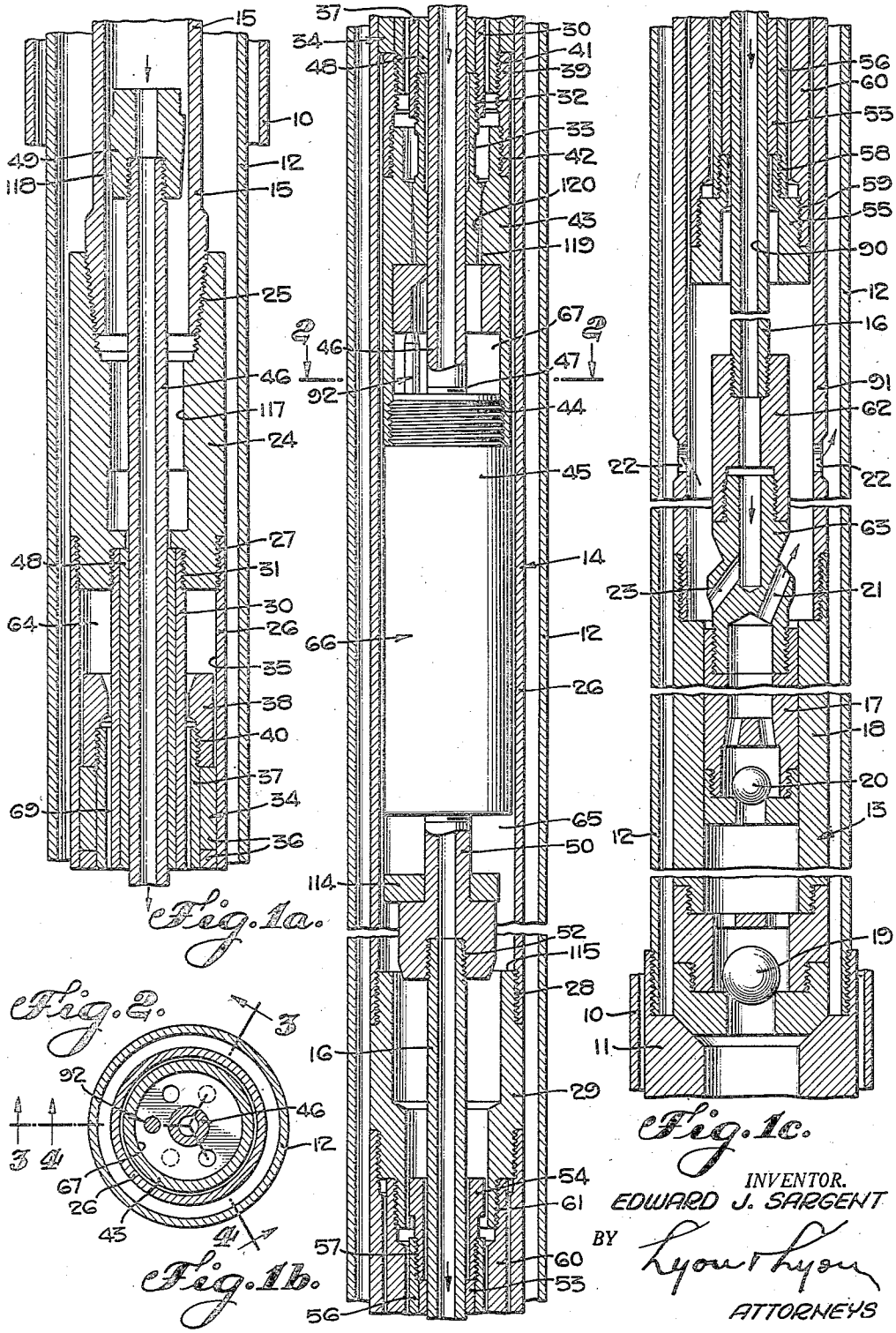


Fig. 1a.

Fig. 2.

Fig. 1b.

Fig. 1c.

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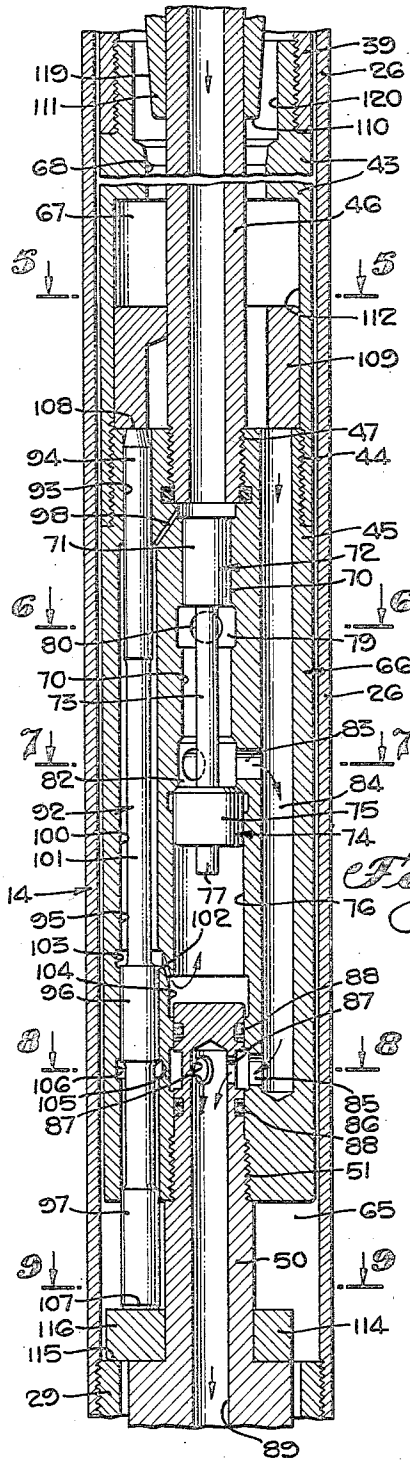


Fig. 3.

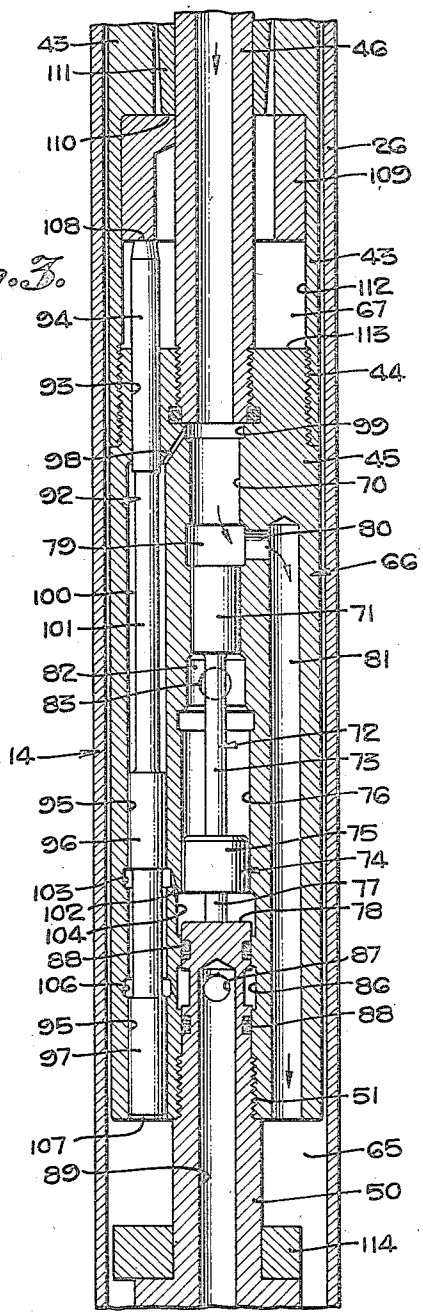


Fig. 4.

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HYDRAULIC WELL PUMP

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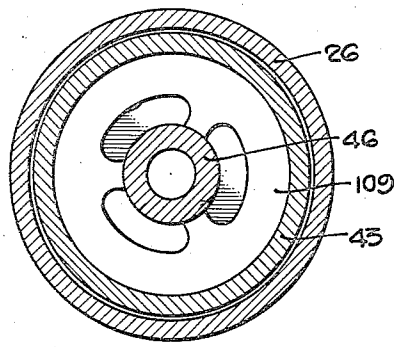


Fig. 5.

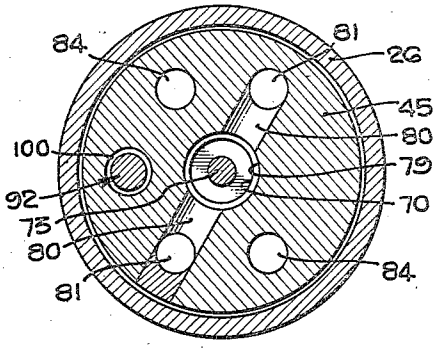


Fig. 6.

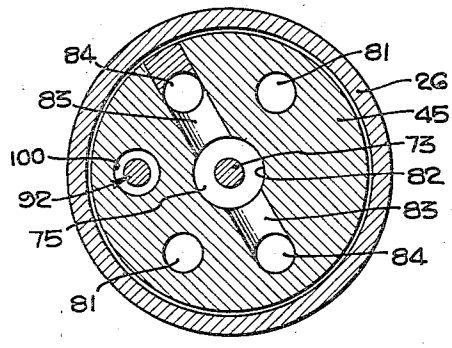


Fig. 7.

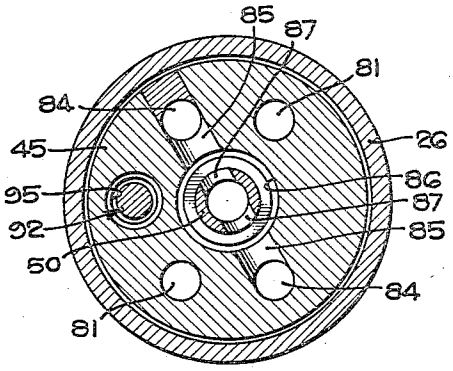


Fig. 8.

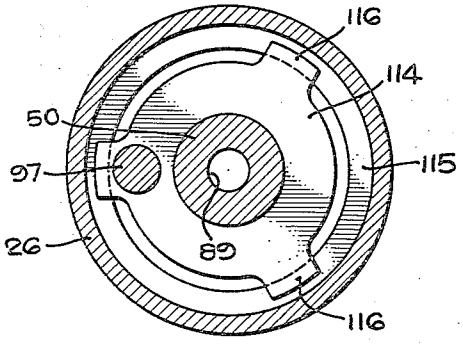


Fig. 9.

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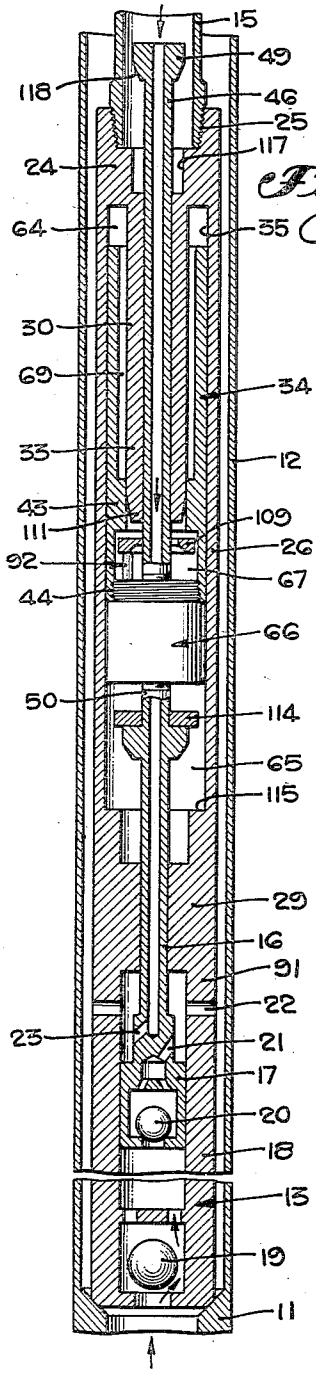


Fig. 10.

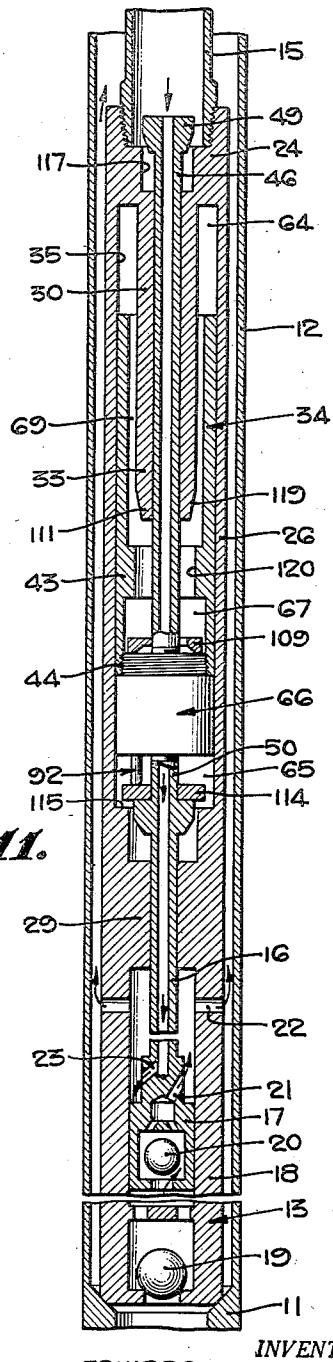


Fig. 11.

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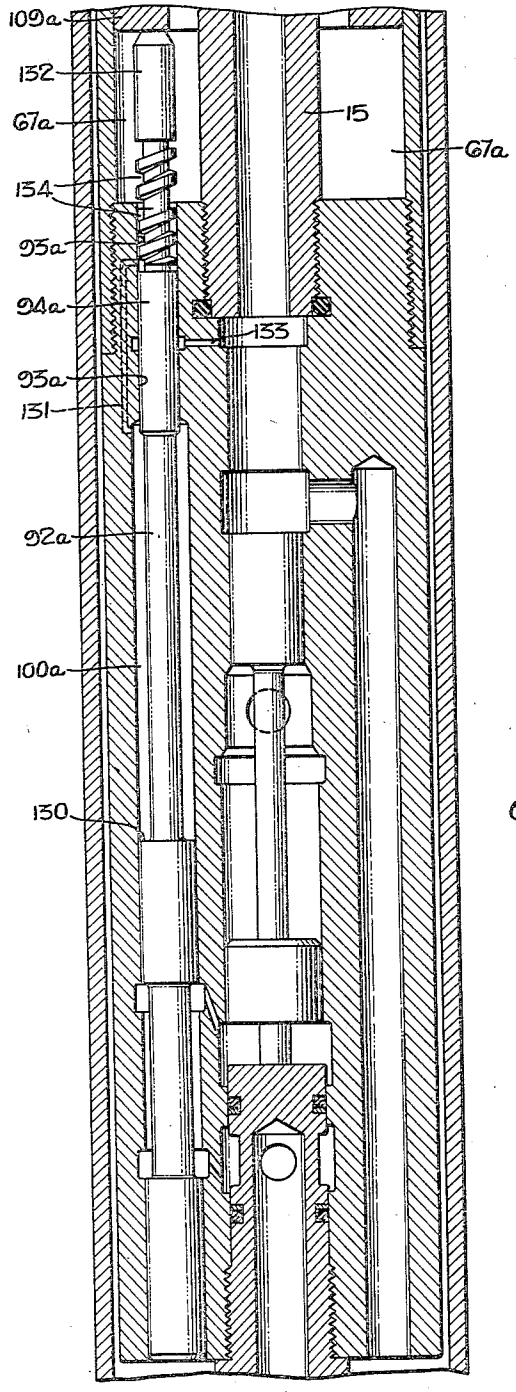


Fig. 12.

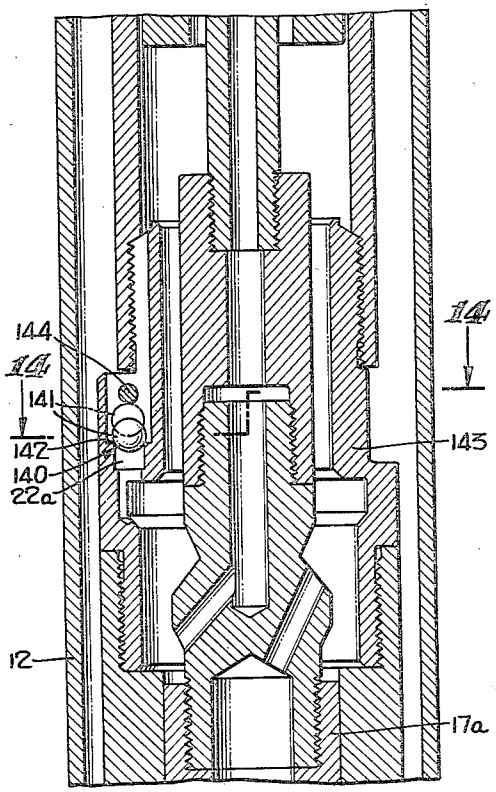


Fig. 13.

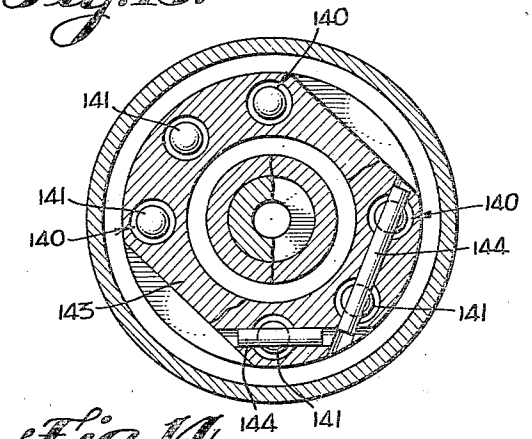


Fig. 14.

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2,821,141

HYDRAULIC WELL PUMP

Edward J. Sargent, Los Angeles, Calif., assignor to Sargent Rodless Pump Company, a corporation of California

Application November 30, 1953, Serial No. 395,078

15 Claims. (Cl. 103—46)

This invention relates to well pump devices and it is particularly directed to improvements in hydraulic motors adapted to be positioned in a well bore to operate a reciprocating pump. This invention is a continuation-in-part of Serial No. 150,208, filed March 17, 1950 for a Fluid Motor for Well Pump, now abandoned.

Hydraulically operated deep well pumps have been used with some success, but conventional types of such devices have been made of a large number of complicated parts requiring extremely close tolerances in manufacture. It is an important object of this invention to provide a hydraulically operated motor for a deep well pump, the motor being of simplified construction and employing many standard pump parts and being capable of operation with convention type reciprocating well pumps.

Another object is to provide an hydraulically operated motor of this type employing a plunger member reciprocable in a relatively stationary barrel, the plunger member having an upward tubular extension forming a sliding seal with respect to the barrel so that the plunger member and extension function as a differential piston, together with a valve assembly on the plunger member arranged to alternately pressurize and vent the chamber formed within the barrel below the said plunger member.

Another object of the present invention is to provide such a hydraulic motor for a well pump having a relatively short and simplified form of valve assembly for controlling operation of the motor.

Another object is to provide a valve assembly of this type having a main valve member of the differential piston type and a pilot valve member of the differential piston type, together with suitable passage means in an enclosing housing so that each of the members is positively held in each of two positions by pressure fluid.

Other objects and advantages will be apparent hereinafter.

In the drawings:

Figures 1*a*, 1*b*, and 1*c*, show a transverse sectional view of a preferred embodiment of my invention, the figures being separated into three portions because the length of the assembly is too long to be conveniently shown intact. Figure 1*b* comprises an extension of the lower end of Figure 1*a*, and Figure 1*c*, is an extension of the lower end of Figure 1*b*.

Figure 2 is a transverse sectional view taken substantially along the lines 2—2 of Figure 1*b*.

Figure 3 is an enlarged sectional view of the valve assembly taken along the lines 3—3 of Figure 2.

Figure 4 is a view similar to Figure 3 showing the valve parts in another position and taken along the lines 4—4 of Figure 2.

Figures 5, 6, 7, 8, and 9, are transverse sectional views taken respectively along the lines 5—5, 6—6, 7—7, 8—8, and 9—9, of Figure 4.

Figures 10 and 11 are diagrammatic sectional views showing operation of the fluid motor and pump.

Figure 12 is a sectional view similar to Figure 3 and showing a modified form of my invention.

Figure 13 is a sectional view similar to Figure 1*c* showing a further modification of my invention.

Figure 14 is a transverse sectional view taken substantially on the lines 14—14 as shown in Figure 13.

Referring to the drawings:

A casing 10 extends into the well bore and an eduction tubing 12 extends within the casing 10 and carries a well pump assembly 13 of conventional type at its lower end. The well pump assembly 13 may rest on the shoe 11. A hydraulically operated motor generally designated 14 is provided for operating the pump assembly 13. The motor 14 is carried on the lower end of a motive fluid supply conduit 15, known in the art as "macaroni." The fluid motor 14 with the well pump 13 at its lower end may be lowered into position within the eduction tubing 12.

The general scheme of operation calls for supplying hydraulic pressure fluid to the macaroni 15 to cause the hydraulic motor 14 to reciprocate the lower tube or stem 16, which projects from the lower end of the motor. This stem 16 is connected to operate the reciprocable plunger 17 of the well pump 13. The plunger 17 operates within the stationary pump housing 18 in the usual manner, causing well fluid to pass upwardly through the shoe 11 past the standing valve 19 and traveling valve 20, through the ports 21 and 22 into the tubing 12. Motive fluid exhausted from the hydraulic motor 14 passes through ports 23 and 22, mixing with the fluid produced from the well. Both the well fluid and exhausted hydraulic actuating fluid pass upwardly in the tubing 12 to the surface.

In accordance with my invention a connector collar 24 is supported by threads 25 from the lower end of the macaroni 15. A cylindrical working barrel 26 is connected by threads 27 to the upper collar 24 and the lower end of this barrel is connected by threads 28 to the lower collar 29. A stationary sleeve 30 extends downwardly from the upper collar 24 in coaxial relation with the barrel 26. This sleeve 30 is connected by threads 31 to the upper collar 24. At its lower end the sleeve 30 is connected by threads 32 to the stationary abutment piece 33.

An annular reciprocating plunger assembly generally designated 34 forms a fluid-tight seal with the inner surface 35 of the barrel 26. This plunger assembly may be of relatively great length and is preferably formed of a plurality of stacked length sections 36 having a close fit with the barrel surface 35 and held in assembled relation by means of an inner sleeve 37 having nuts 38 and 39 connected to its opposed ends by means of threads 40 and 41, respectively.

The lower nut 39 is provided with threads 42 for connection with the upper end of the connector sleeve 43. The lower end of this sleeve 43 is connected by threads 44 to the upper end of the relatively short valve housing 45. The valve housing 45 in a commercial form of my invention is less than one foot in length, whereas the length of the plunger assembly 34 is four feet or longer, and the barrel 26 may be upwards of ten feet long. A tube 46 is secured to the valve housing 45 by means of threads 47 and extends upwardly to the interior of the abutment piece 33, sleeve 48, upper collar 24 and into the interior of the macaroni 15. A hollow cap 49 may be provided on the upper end of the tube 46. The tube 46 is slidably mounted within the sleeve 48 and has a close fit therewith. From this description it will be seen that the valve housing 45, plunger assembly 34 and tube 46 are reciprocable as a unit within the stationary barrel 26.

A tube 50 is connected to the valve housing 45 by means of threads 51 and extends downwardly within the stationary barrel 26. Threads 52 connect the member

50 with the hollow stem 16, which extends downwardly to the close fitting stationary sleeve 53. The sleeve 53 is held in position between nuts 54 and 55, which are connected to the tube 56 by means of threads 57 and 58, respectively. The lower nut 55 is connected by threads 59 to the sleeve 60, which is in turn supported by threads 61 from the lower end of the lower collar 29. Reciprocation of the valve housing 45 within the barrel 26 causes the stem 16 to reciprocate in the sealing sleeve 53. At its lower end the stem is threadedly connected to collar 62, which in turn is connected to the cross-over collar 63, which is provided with the ports 21 and 23, previously described. Reciprocation of the stem 16 causes the pump plunger 17 to move under its operative cycle within the pump barrel 18.

The plunger assembly 34 cooperates with the barrel 26 to provide an upper chamber 64 and a lower chamber 65. The function of the valve assembly generally designated 66 is to direct flow of motive fluid from the macaroni 15 to the chamber 65 and, alternately, to vent said chamber to the interior of the tubing 10, to cause the plunger assembly 34 and valve assembly 66 to reciprocate within the barrel 26.

The space 67 at the upper end of the valve housing 45 and within the connector sleeve 43 communicates with and forms a part of the chamber 64. The communication is established through the central opening 68 in the connector sleeve 43 and within the annular space 69 between the sleeves 37 and 30.

When pressure fluid is directed into the chamber 65, the plunger assembly 34 and valve assembly 66 are caused to move upwardly within the barrel 26. When the valve assembly 66 cuts off the flow of pressure fluid to the chamber 65, the pressure of actuating fluid acting on the cross sectional area of the tube 46 causes the plunger assembly 34 and valve assembly 66 to move downwardly. The lifting force on the stem 16 is relatively great because it is developed by the pressure of the motive fluid acting over the relatievly large effective area of the annular plunger assembly 34, minus the relatively small effective area of the tube 46. On the other hand the downward force applied to the stem 16 is relatively small because it is developed by the pressure of the motive fluid acting only on the relatively small effective area of the tube 46. The result is that a relatively large force is available to lift the pump plunger 17 while a relatively small force returns it to lower position. This is an ideal condition of operation of the conventional reciprocating pump 13.

The valve assembly for directing actuating fluid alternately into the chambers 64 and 65 is shown clearly in Figures 3 and 4. A central bore 70 is formed in the housing 45 and the upper end of this bore is proportioned to receive the enlarged head 71 of the valve element 72. A downwardly projecting stem 73 on the valve element 72 engages the upper end of the valve element 74. The valve element 74 is provided with a head 75 which is slidably received within the bore 76 in the valve housing 45. A downwardly projecting stem 77 on the valve element 74 is adapted to engage the upper end 78 of the tubular member 50. The valve elements 72 and 74 operate as a unit, and the reason for constructing them as separate parts is to enable the head portions 71 and 75 to fit their respective bores 70 and 76 with great accuracy, even though the bores may not be precisely coaxial.

A central enlargement 79 in the bore 70 communicates by radial ports 80 with the upper end of the pair of passageways 81 which extend longitudinally of the valve housing 45 and communicate with the chamber 65. An enlargement 82 at the lower end of the bore 70 communicates by lateral ports 83 with the second pair of longitudinally extending passageways 84. The passageways 84 communicate at their upper ends with the space 67 and at their lower ends with the lateral ports 85. The ports 85 communicate with an annular groove 86, which in turn is in communication with the lateral ports 87 formed in the tubular member 50. Sealing rings 88 positioned on the tubular member 50 above and below the annular groove 86 prevent leakage. It will be seen that the space 67, and hence the chamber 64, is in constant communication with the interior of the tubing 12 through passageways 84, ports 85 and 87, bore 89 in the tubular member 50, bore 90 in the stem 16, collar 62, cross-over collar 63, port 23 and port 22 in the pump barrel support tube 91.

A pilot valve 92 having an overall length greater than the length of the housing 45 is positioned for axial sliding movement in the housing 45. A relatively small bore 93 in the housing receives the upper end 94 of the valve 92 while spaced portions 95 of a larger bore receive the enlarged heads 96 and 97. Lateral ports 98 in the housing 45 establishes communication between the annular groove 99 and the upper end of the bore 70 and the annular space 100 between the bore 95 and the recessed portion 101 of the valve 92. A second lateral port 102 in the housing 45 leads from the annular groove 103 to the space 104 below the head 75 of the main valve element 74. A third lateral port 105 communicates between the annular groove 106 around the pilot valve and the annular groove 86 adjacent the ports 87. With the parts in position as shown in Figure 3, motive fluid under pressure is admitted to the interior of the tube 46, passes to bore 70 and out to port 80 and to the pssageway 81. The chamber 65 is thus pressurized causing the plunger assembly 34 and valve assembly 66 to move upwardly relative to the stationary barrel 26. The pilot valve 92 remains in the upper position, because the pressure on the relatively large area of the lower end 107 maintains it in that position.

When the plunger assembly 34 approaches the upper end of its travel the bumper ring 109 engages the lower end 110 of the abutment piece 111. The bumper ring 109 is slidably mounted within the bore 112 of the connector sleeve 43 and, therefore, the plunger assembly 34, connector sleeve 43 and valve assembly 66 may continue upward as a unit until the upper end 108 of the pilot valve 92 causes the bumper ring 109 to engage the end 110 of the abutment piece 111. At such time the engagement of the bumper ring 109 with the upper end of the pilot valve 92 effects shifting of the pilot valve 92 to the position shown in Figure 4. Pressure fluid in the tube 46 then passes through lateral port 98, annular space 100, lateral port 102, and into the space 104. This high pressure fluid then causes the main valve 72—74 to move upward within the bores 70 and 76 because the space between the valve parts 72 and 74 is vented to the lower pressure space through ports 83 and passageway 84, and because the cross sectional area of the valve head 75 is greater than the corresponding cross sectional area of the valve head 71. The pilot valve 92 stays in the position illustrated in Figure 4 because the high pressure in the annular space 100 applies a downward force on the enlarged head 96 which is greater than the upward force applied to the smaller head 94. In this respect the pilot valve 92 functions as a differential piston assembly. The space 67 above the pilot valve 92 remains at relatively low pressure and the chamber 65 below the valve assembly is connected to the low pressure existing in bore 89 via passageways 81, ports 80, bore 70, ports 83, passageways 84, and ports 85, 87. The high pressure motive fluid does not enter the bore 70 because the valve head 71 seals it off. The relatively high pressure of the actuating fluid then acts over the cross sectional area of the tube 46 within the sealing sleeve 48 to move the tube 46 and assembly 66 and stem 60 downward relative to the stationary barrel 26. This downward movement continues until the lower bumper ring 114 engages the upper end 115 of the lower collar 29. The lower bumper ring 114 is provided with lugs 116 which overlie the upper end 115 of the collar 29 as illustrated in Figure 9. When down-

ward movement of the lower bumper ring **114** is arrested by the collar **29**, it acts on the lower end **107** of the pilot valve to hold it stationary while the housing **45** continues its downward movement, thus shifting the pilot valve **92** back to the position shown in Figure 3. The main valve parts **72**, **74** move downwardly to the position shown since the lower bore **76** is no longer in communication with the high pressure motive fluid. The plunger assembly **34** again moves upwardly and the cycle repeats. It will be observed that the tube **46** constitutes in effect an upward extension of the annular plunger assembly **34**, and hence the tube **46** and plunger assembly **34** function as a differential piston. When pressure is applied below this piston by introducing motive fluid into the lower chamber **65** this differential piston generally designated **125** is raised within the barrel **26**. When the valve assembly **66** vents the lower chamber **65** to the low pressure conduits the pressure in the upper and lower chambers **64** and **65** respectively both contain fluid at relatively low pressure, and consequently the pressure of the motive fluid acting on the extension **46** drives the plunger assembly **34** downwardly within the barrel **26**. Means are provided for cushioning the plunger assembly **34** in the ends of its stroke, and this means preferably takes the form of dashpot mechanisms having one element associated with the plunger assembly **34** and another element associated with the barrel **26**. As shown in Figure 1*a*, the upper collar **24** is provided with a bore **117** which closely conforms to the tapered surface **118** on the hollow cap **49**. When the plunger assembly **34** approaches the lower end of its stroke the fluid trapped in the bore **117** by the cap **49** is caused to move outward under high velocity past the tapered surface **118**, thereby cushioning the downstroke of the plunger assembly **34**. The upper stroke is similarly cushioned by movement of the connector sleeve **43** and its bore **68** upward with respect to the outer tapered surface **119** on the abutment piece **33**. Fluid trapped within the annular space **64** is caused to pass outwardly under a high velocity between the taper surface **119** and the surface **120** on the abutment piece **43**.

The well fluid produced from the conventional well pump **13** passes upward to the port **21** in the cross-over collar **63**. It will be observed that the outlet from this port **21** is positioned above the location of the outlet from the port **23**. This construction insures that a jet of exhaust pressure fluid is directed against the upper end of the barrel **18** below the location of the outlet for well fluid into the housing **91**. The relatively clean exhaust fluid from port **23** prevents accumulation of sand or other foreign matter at the upper end of the pump plunger.

Sometimes the operation of the pump has been hampered by tendency to stop or hesitate at the lower end of the stroke. This has been found to occur when the pilot valve failed to remain in its uppermost position, and instead moved down to shift the porting to cause the main valve to shift and thereby reverse the direction of motion of the motor piston. It was found that failure of the traveling valve in the production pump to seat properly at the beginning of the upstroke resulted in failure to pick up the load of production fluid above the pump plunger. This in turn was reflected in an unusually low pressure within the annular space **65** below the motor piston or plunger assembly **34**. Since the pressure in this space **65** was relied upon to hold the pilot valve **92** in its uppermost position against the normally small force applied to the pilot valve in the annular space **100**, a reduction of pressure in the space **65** permitted the pressure in the annular space **100** to overbalance the forces acting on the pilot valve **92** and to move it down to its lowermost position. The entire pump assembly consequently reversed direction of movement. The phenomenon repeated so long as the traveling valve in the production pump failed to seat properly, with the result that the pump parts moved back and forth over a short stroke in the region of the lower end of the stroke of the pump.

The modified form of pilot valve and porting arrangement shown in Figure 12 has been found to overcome this difficulty. The porting is changed to the annular space **100***a* so that no pressure from the macaroni string **15** is admitted to this space **100***a* at any time. The resultant endwise force on the shoulder **130** tending to move the pilot valve **92***a* downward is thus eliminated. A port **131** connects the annular space **100***a* with the annular space **67***a* via the upper end of bore **93***a*. The space **67***a* always exists at exhaust pressure. The result is when the pilot valve **92***a* is in its uppermost position, as shown in Figure 12, the annular space **100** is connected via port **131** and the upper end of bore **93***a* to exhaust pressure existing in the annular space **67***a*. When the motor plunger assembly **34** reaches the upper end of its stroke the pilot valve **92***a* engages the ring **109***a* and is thereby mechanically shifted to its lower position. In such lower position the sealing portion **132** seals within the bore **93***a* to cut off communication between the space **100***a* and the space **67***a*. At the same time the necessary force required to hold the pilot valve **92** in its lower position is developed by motive fluid pressure from the macaroni **15** passing through port **133** and port **131** to annular space **100***a*. The pilot valve **92***a* may be provided with a helical relief passage **134** between the sealing parts **94***a* and **132**.

Another difficulty has been encountered in the operation of the device which was manifested by short stroking at the upper end of the pump stroke. It has been found that this was caused by "over pumping" the well, that is, by withdrawing the well fluid faster than the rate at which it flowed into the well, or by operation of the pump in a well having a very large proportion of gas to oil. In such case, gas rather than liquid filled at least a part of the space between the traveling valve **20** and the standing valve **19** in the production pump. When the direction of motion reversed at the top of the stroke, the weight of the column of production fluid within the tubing **12** above the traveling valve **20** applied a very large downward force to the entire moving assembly of the pump. This force of large magnitude was resisted only by the relatively small force of compression of the gas in the space above the standing valve **19**. As a result the pump plunger **17** and motor plunger assembly **34** and associated parts are propelled downward very rapidly. The absence of liquid below the pump plunger **17** in effect exerted a downward force on the pump plunger **17** and motor plunger assembly **34**. The downward movement of these two plungers then occurred so rapidly that motive fluid could not be exhausted from annular space **65** as rapidly as required. Back pressure then developed in the annular space **65** and this back pressure acting on the lower face of the pilot valve **92** moved it upward prematurely. The lower exposed face **107** of the pilot valve **92** is sufficiently great in area to overbalance the force applied in the annular space **100***a* even though the latter may have higher pressure intensity.

This difficulty of short stroking at the lower end of the stroke is overcome by means of the modified form of the apparatus as shown in Figures 13 and 14. A series of check valves **140** are installed in the outlet ports **22***a* which carry well fluid from the production pump into the tubing **12**. The function of the check valves **140** is to permit well fluid to be produced through them in an upward direction into the tubing **12** but to prevent reverse flow from the tubing into the production pump. At the upper end of the stroke of the pump plunger **17***a* the valves **140** close and thereby prevent application of heavy downward forces by the fluid column in the tubing **12** to the production pump plunger **17***a*. The moving parts of the fluid motor and pump then move downward to compress the gas above the standing valve **19** but the

heavy force caused by the hydraulic head in the tubing 12 is eliminated.

Check valves, generally designated 140, include balls 141 adapted to close against upwardly facing seats 142 provided on the stationary part 143. Any suitable means such as, for example, the transverse pins 144 may be provided for limiting upward movement of the balls 141.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a reciprocating fluid motor-driven deep well pump assembly adapted to be lowered into an eduction tubing on the lower end of a motive fluid supply conduit, the combination of a fluid motor having a reciprocating part driven by pressure of motive fluid supplied through said conduit, the motor also having a tube depending from said reciprocating part and carrying exhaust fluid from the motor, a pump positioned below the motor and having a reciprocating tube carrying fluid produced from the well, a member connecting said tubes together, the member having ports respectively connected to said tubes and arranged to direct the exhaust fluid from the motor tube outwardly at a low elevation and to direct the well fluid from the pump tube outwardly at a high elevation.

2. In a reciprocating fluid motor for operation of a well pump, the combination of: a stationary barrel adapted to be positioned within a well bore, a unitary assembly including a plunger, the plunger being mounted to reciprocate in said barrel, said assembly having axially extending tubes fixed with relation thereto and extending above and below the plunger, upper and lower stationary sleeves encircling the tubes forming sliding seals between each of the tubes and the barrel and to define an upper chamber within the barrel and above the plunger and a lower chamber within the barrel and below the plunger, the upper sleeve extending between the plunger and the tube in telescopic relation, said unitary assembly including a valve assembly secured thereto and having first passage means establishing communication between the upper tube and said lower chamber, a valve on the valve assembly movable to close the first said passage means, the valve assembly having a second passage means establishing constant communication between said lower tube and said upper chamber.

3. In a reciprocating fluid motor for operation of a well pump, the combination of: a stationary barrel adapted to be positioned in a well bore, a unitary assembly including an annular plunger reciprocable in said barrel, said assembly having axially extending tubes fixed with relation thereto and extending above and below the plunger, sealing means including stationary sleeves encircling the tubes to form sliding seals between each of the tubes and the barrel, the upper sleeve extending between the plunger and upper tube in telescopic relation, the sealing means, plunger and barrel cooperating to form a first chamber within the barrel above the plunger and a second chamber within the barrel below the plunger, a valve assembly secured to the plunger and having first passage means establishing communication between the upper tube and the lower chamber, a valve on the valve assembly movable to close said first passage means, the valve assembly having a second passage means establishing constant communication between the lower tube and the upper chamber.

4. In a reciprocating fluid motor adapted to be lowered into an eduction tubing on the lower end of a motive fluid supply conduit into position for operating a driven mechanism such as a well pump, the combination of: a barrel, means for securing the barrel relative to the motive fluid supply conduit, an annular plunger reciprocable in said barrel, a valve assembly secured relative to the lower end of the plunger and movable therewith, a first tube secured relative to the valve assembly and projecting upwardly therefrom through the interior of the annular plunger into communication with the motive fluid supply conduit, a second tube secured relative to the valve assembly and projecting downwardly therefrom for operating the driven mechanism, means forming upper and lower sliding seals between each of said tubes and the barrel, said means, tubes and valve assembly defining an upper chamber within the barrel above the plunger and a lower chamber within the barrel below the plunger, the valve assembly having passage means establishing communication between the upper tube and the lower chamber, a valve on the valve assembly movable to close said passage means, and means establishing constant communication between the lower tube and the upper chamber.

5. In a reciprocating fluid motor for operation of a well pump, the combination of a stationary barrel adapted to be positioned in a well bore, a plunger assembly including an annular plunger reciprocable in said barrel, a valve housing secured to the plunger and movable therewith, a motive fluid delivery tube fixed to the valve housing and projecting through the annular plunger, means cooperating with the plunger and barrel to form an upper chamber within the barrel above the plunger and a lower chamber within the barrel below the plunger, the valve housing having a passage establishing communication between the motive fluid delivery tube and the lower chamber, a valve in the valve housing movable to close said passage, and means providing a second passage establishing constant communication between the upper chamber and space outside both said chambers.

6. In a reciprocating fluid motor for operation of a well pump, the combination of: a stationary barrel adapted to be positioned in a well bore, a relatively long annular plunger reciprocable in said barrel, a relatively short valve housing secured to the lower end of the plunger and movable therewith, a motive fluid delivery tube fixed to the valve housing and projecting through the annular plunger above the barrel, means cooperating with the plunger and barrel to form an upper chamber within the barrel above the plunger and a lower chamber within the barrel below the plunger, the valve housing having a passage establishing communication between the motive fluid delivery tube and the lower chamber, a valve in the valve housing movable to close said passage, means providing a second passage establishing constant communication between the upper chamber and space outside both said chambers, and means to deliver motive fluid under pressure into said tube.

7. In a reciprocating fluid motor for operation of a well pump, the combination of: a stationary barrel adapted to be positioned in a well bore, an annular plunger reciprocable in said barrel, a valve housing secured to the lower end of the plunger and movable therewith, a tube fixed to the valve housing and extending axially through the plunger, sealing means including a stationary sleeve encircling the tube to form a sliding seal between the tube and the barrel, the sleeve extending within the plunger in telescopic relation, the valve housing having passage means establishing communication between said tube and a lower chamber defined within the barrel below the plunger, a valve member in the valve housing movable to close said passage means, means including a pilot valve in said valve housing for controlling movement of the valve member between open and closed positions, the said sleeve having abutment means thereon operative to effect shifting of the pilot valve relative to the valve housing at the upper end of the stroke of the plunger.

8. In a reciprocating fluid motor for operation of a well pump, the combination of: a stationary barrel adapted to be positioned in a well bore, a relatively long annular plunger reciprocable in said barrel, a relatively short valve housing secured to the lower end of the plunger and movable therewith, a tube fixed to the valve

housing and extending axially through the plunger, sealing means including a stationary sleeve encircling the tube to form a sliding seal between the tube and the barrel, the sleeve extending within the plunger in telescopic relation, the valve housing having passage means establishing communication between said tube and the space within the barrel below the plunger, a valve member in the valve housing movable to close said passage means, means including an axially shiftable pilot valve in said valve housing for controlling movement of the valve member between open and closed positions, the said sleeve having abutment means thereon operative to effect shifting of the pilot valve relative to the valve housing at the upper end of the stroke of the plunger.

9. In a reciprocating fluid motor for operation of a well pump, the combination of: a stationary barrel adapted to be positioned in a well bore, a relatively long annular plunger reciprocable in said barrel, a relatively short valve housing secured relative to the plunger assembly and movable therewith, a tube fixed to the valve housing and extending axially through the plunger, sealing means including a stationary sleeve encircling the tube to form a sliding seal between the tube and the barrel, the sleeve extending within the plunger in telescopic relation, the valve housing having passage means establishing communication between said tube and the space within the barrel below the plunger, a valve member in the valve housing movable to close said passage means, means including a pilot valve in said valve housing for controlling movement of the valve member between open and closed positions, a floating abutment ring within the barrel and positioned below the annular plunger and above the valve housing, the said abutment ring being engageable with said sleeve and said pilot valve to effect shifting of the pilot valve relative to the valve housing at the upper end of the stroke of the plunger.

10. A control valve assembly for a fluid motor having a reciprocating plunger, comprising in combination: a valve housing, means whereby the housing may be secured to the plunger, the housing having an inlet opening for motive fluid at its upper end and an outlet opening for exhaust fluid at its lower end, a valve member comprising two separate contacting parts slidably mounted in axially aligned bores provided in the housing, one of the bores being smaller than the other and being in communication with the inlet opening, the housing having a passage communicating with the small bore and terminating at the lower end of the housing, the first valve part in the small bore being axially movable between an open position permitting flow from the inlet opening through the first passage, and a closed position preventing such flow, an axially shiftable pilot valve in said housing, and port means in the housing whereby the pilot valve may place the inlet opening in communication with the larger bore below the second valve part.

11. A control valve assembly for a fluid motor having a plunger, comprising in combination: a valve housing, means whereby the housing may be secured to the plunger, the housing having an inlet opening for motive fluid at its upper end, a valve member including two axially spaced portions slidably mounted in axially aligned bores provided in the housing, one of the bores being smaller than the other and being in communication with the inlet opening, an axially shiftable pilot valve in said housing comprising two axially spaced portions slidably mounted in axially aligned bores provided in the housing, one of the bores being smaller than the other, the housing having a port establishing communication between the inlet opening and the larger bore for the pilot valve, the housing having a port establishing communication between the larger bore for the pilot valve and the larger bore for the valve member, the housing having outlet passage means communicating with the smaller bore for the valve member, said outlet passage means being in communication with the inlet opening when the valve member is shifted in a direction away from the inlet opening.

12. A control valve assembly for a fluid motor having a plunger, comprising in combination: a valve housing, means whereby the housing may be secured to the plunger, the housing having an inlet opening for motive fluid at its upper end, a valve member including two axially spaced portions slidably mounted in axially aligned bores provided in the housing, the upper bores being smaller than the lower and being in communication with the inlet opening, a pilot valve in said housing having an over-all length greater than the length of the housing and being axially shiftable to extend from either end of the housing, the pilot valve comprising two axially spaced portions slidably mounted in axially aligned bores provided in the housing, one of the bores being smaller than the other, the housing having a port establishing communication between the inlet opening and the larger bore for the pilot valve, the housing having a port establishing communication between the larger bore for the pilot valve and the larger bore for the valve member, the housing having outlet passage means communicating with the smaller bore for the valve member, said outlet passage means being in communication with the inlet opening only when the valve member is in its lower position.

13. A control valve assembly for a fluid motor having a plunger, comprising in combination: a valve housing, means whereby the housing may be secured to the plunger, the housing having an inlet opening for motive fluid at its upper end, a valve member functioning as a differential piston and including two axially spaced portions slidably mounted in axially aligned bores provided in the housing, the upper bore being smaller than the lower and being in communication with the inlet opening, an axially shiftable pilot valve in said housing comprising two axially spaced portions comprising a differential piston slidably mounted in axially aligned bores provided in the housing, one of the bores being smaller than the other, the housing having a first port establishing communication between the inlet opening and the larger bore for the pilot valve between said spaced portions thereof, the housing having a second port establishing communication between the latter said bore and the larger bore for the valve member below the lower portion thereof, the housing having outlet passage means communicating with the smaller bore for the valve member and having additional low pressure passage means, the valve member, pilot valve and housing parts being so proportioned that when the pilot valve is in a first position pressure fluid in the inlet opening passes through the first and second ports to maintain the valve member in a first position wherein it isolates the inlet opening from the outlet passage means, and so that when the pilot valve is in a second position the latter said bore below the valve member is vented to the low pressure passage means through the second port so that the valve member is moved by the pressure of the motive fluid in the inlet opening to establish communication from the inlet opening to the outlet passage means.

14. A control valve assembly for a fluid motor having a plunger, comprising in combination: a valve housing, means whereby the housing may be secured to the plunger, the housing having an inlet opening for motive fluid at its upper end, a valve member including two axially spaced portions slidably mounted in axially aligned bores provided in the housing and connected by a first passage, one of the bores being smaller than the other and being in communication with the inlet opening, an axially shiftable pilot valve in said housing comprising two axially spaced portions slidably mounted in axially aligned bores provided in the housing and connected by a second passage, one of the bores being smaller than the other, the housing having a port establishing communication between the inlet opening and said second passage, the housing also having a port establishing communication between said

second passage and the larger bore for the valve member, the housing having an outlet passage communicating with the first passage and lower end of the housing, the pilot valve cutting off communication through the second port when the pilot valve is shifted in a direction toward the inlet opening, and the valve member cutting off communication through the outlet passage when the valve member is shifted in a direction toward the inlet opening.

15. In a reciprocating fluid motor and pump combination adapted to be lowered into an eduction tubing on the lower end of a motive fluid supply conduit, the combination of: a stationary assembly including a barrel for the fluid motor, a unitary reciprocating assembly including a plunger slidably received within the barrel, a valve housing fixed relative to the plunger, a motive fluid delivery tube fixed relative to the latter said assembly and extending upward from the valve housing, a spent fluid discharge tube fixed relative to the latter said assembly and extending downward from the valve housing, seal means on the stationary assembly slidably engaging each of said tubes and defining chambers within the barrel above and below the plunger, means in the valve housing constantly venting the upper chamber to the said discharge tube, valve means in the valve housing for alternately pressurizing the lower chamber from the motive fluid delivery tube and venting it to said discharge tube, a production pump having a stationary part and a reciprocating part, a stationary tubular element connecting the stationary part of the pump to said stationary assembly and provided with lateral ports, a reciprocating element connecting the reciprocating part of the pump to said discharge tube, means on the reciprocating element for discharging well fluid from the pump and spent motive fluid from the discharge tube into the interior of said stationary tubular element, and check valve means on the stationary tubular element permitting fluid flow through said lateral ports into the eduction tubing but preventing return flow therethrough.

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