HYDRAULIC TYPE FLUID TRANSMISSION
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6 Claims. (Cl. 60—52)

This invention relates to hydraulic type fluid transmission.

An object of the invention is to provide a novel type of pumping unit for reciprocating the sucker
rod of a deep well pump.

Another object of the invention is to provide a well pumping unit which will be substantially
balanced by fluid pressure, thus eliminating the cumbersome counterbalancing weights now com-
monly employed in connection with the walking beam for reciprocating the pump sucker rod now
in common use.

Wells, particularly oil wells, vary in depth from a few hundred feet to many thousands of feet;
and in pumping wells the load to be lifted in-
cluding the sucker rods and the liquid columns
vary from a few hundred pounds to many thou-
sands of pounds depending on the depth of the
well and the diameter of the pump plunger.

The liquid is pumped from these wells, at the
present time, by the use of a pumping unit which
includes a walking beam connected to the pump
sucker rod and this walking beam is counter-
balanced by heavy counterweights so as to bal-
ance the sucker rod upon down stroke thereof.

This type of pumping unit is heavy and cum-
bersome and requires special equipment and skill to
properly operate the same and to keep the load
on the walking beam properly balanced. Chang-
ing conditions in the well also readily throw this
type of pumping unit out of balance thus causing
extra vibration and wear.

It is one of the main objects of the present
invention to overcome the disadvantages referred
to by providing a pumping unit wherein the
sucker rods and a major percentage of the weight
of the load being lifted are balanced by air under
pressure and the pump is actuated hydraulically.

The pumping unit herein described is compar-
atively light since the walking beam, reduction
gearing and counterbalancing weights of the
conventional type of pumping unit are elimi-
inated thus requiring less material for the founda-
tion and supporting structure for the unit.

It is another object of the present invention
to provide a pumping unit of the character de-
scribed whereby the unit can be easily and quickly
brought back to normal balance, should it become
unbalanced, without stopping the operation of
the unit.

The invention also embodies means whereby the
speed of operation of the well pump may be
easily varied and controlled.

Another feature of the invention resides in the
provision of a pumping unit which may be readily
adjusted to a position to allow the pulling of the
sucker rods and well pump from the well without
dismantling or disturbing the pumping unit itself.

With the above and other objects in view the
invention has particular relation to certain novel
features of construction, operation and arrange-
ment of parts, an example of which is given in
this specification and illustrated by the accom-
panying drawings, wherein:

Figure 1 is a side elevation of the complete
unit installed on a well.

Figure 2 is an enlarged, fragmentary, eleva-
tional view taken at right angles to the view shown
in Figure 1.

Figure 3 is a plan view, partly in section, of
the pressure controlling assembly shown in Fig-
ure 2.

Figure 4 is a plan view of the unit taken on the
line 4—4 of Figure 1.

Figure 5 is an enlarged, vertical sectional view
of the power cylinder and the pressure controlling
unit associated therewith.

Figure 6 is a fragmentary, sectional view taken
on the line 6—6 of Figure 3, and

Figure 7 is a fragmentary, side elevation illu-
strating the mounting of the power cylinder on the
well head structure.

Referring now more particularly to the draw-
ings wherein like numerals of reference designate
the same parts in each of the figures, the numeral
1 designates the upper end of the well tubing
which may have a tubing head 2 connected thereto.

In the present illustration this tubing head
is in the form of a T-connection thus providing
a lateral flow line 3 for the liquid being pumped.

Mounted on this tubing head, and secured
thereto, is the tubular section 4 whose upper
end is provided with a conventional stuffing box
construction 5 through which the upper end of the
well sucker rods 6 reciprocate.

This sucker rod extends down into the well
and is connected, at its lower end, to the pump
plunger which reciprocates in the conventional
pump barrel connected to the lower end of the
well tubing.

This well pump has not been shown in the
drawings for the reason that its construction is
well known to those familiar with the pumping
art. Upon upstroke of the sucker rods 6 and the
pump plunger a column of liquid will be elevated
and a portion of it discharged through the line 3
and upon down stroke of the pump plunger an
additional load of liquid will be accumulated above
the plunger to be moved upwardly upon the next
upstroke of the sucker rods.

The unit hereinafter described has been spe-
cially designed for balancing the sucker rods and
a portion of the liquid load and for hydraulically
actuating the unit to reciprocate the sucker rods.

Suitably secured to the upper end of the well
tubing 1 is a frame 7.

Pivoted, at one end, to the frame there are the
side supports 8, 8 and the other ends of these
side supports are secured to the frame 7 by means
of a removable rod 9.
Mounted on the supports 8 are the upstanding tubular supporting legs 10, 10, four being shown. Supported on the upper ends of these legs there is a platform 11. Rods, as 12, extend downwardly through the corners of the platform 11. The upper ends of these rods are formed with heads 13 which engage the platform and the lower ends of the rods are secured to the side supports 8.

There is a vertical power cylinder 14 whose lower end extends through the platform 11 and is secured thereto, preferably by welding. Mounted on the upper end of the power cylinder beneath the platform there is a closure cap 15 and fitted upwardly through said cap and, preferably welded thereto, there is a lower pressure cylinder 16 whose lower end is formed with a conventional stuffing box 17 which surrounds and forms a fluid tight seal with the rod 6. Secured on the upper end of the power cylinder there is a cap 18 and an upper pressure cylinder 19 is fitted downwardly through said cap and secured thereto preferably by welding. The upper end of the cylinder 19 is closed.

Within the power cylinder 14 there is a close fitting piston 20 and formed integrally with said piston there are the lower and upper plungers 21 and 22 of a size to fit snugly into the corresponding lower and upper cylinders 16 and 19.

It will be noted from an inspection of Figure 5 that the cylinders 16, 19 extend inwardly a distance beyond the caps through which they extend.

There is a pressure controlling unit associated with the power cylinder which includes an outer jacket 23 and an inner cylinder 24 fitted therein, both enclosed, at the ends, by the end plates 25 and 26 bolted, or otherwise secured, to the respective ends of the unit.

Leading from the cylinder 16 beneath the cap 15 there is a pressure line 27 which enters the upper end of the cylinder 24 through the upper end plate 28 and leading from the upper cylinder 19 above the cap 18 there is a pressure line 28 which enters the lower end of the cylinder 24 through the lower end cap 26.

Formed on one side of the jacket 23 there is a manifold 30 provided with the ducts 30 and 31 which lead from the respective lower and upper ends thereof inwardly and whose inner ends are inwardly turned through the wall of, and enter, the cylinder 24.

A conducting line 32 leads from within the lower end of the power cylinder 14 opposite the cylinder 16 and enters the lower end of the duct 30 and a conducting line 33 leads from the upper end of the power cylinder, opposite the cylinder 18 and is connected into the upper end of the duct 31.

Also formed on one side of the jacket 23 there is a manifold 34 having a duct 35 leading from its lower to its upper end and which is connected by the lower and upper ports 36 and 37 into the cylinder 24.

There is a main pressure tank 38 which is equipped with a valve controlled connection 39 for the attachment of a filling device.

A pressure line 40 leads from the bottom of the tank and is connected into the intake 41 of a hydraulic pump 42. This pump may be driven in any suitable manner. As shown it is operatively connected with and driven by an electric motor 43.

Leading from the discharge side of the pump 42 there is a pressure line 44 which enters the cylinder 24 through the side port 45. This side port is located approximately midway between the ends of the cylinder 24.

A return line 46 leads from the lower end of the duct 35 and is connected into the pump intake 41, as shown in Figure 4. The upper end of duct 35 is closed by a plug 35a.

Section of the pressure line 44 and return line 46 are formed flexible as more accurately indicated in Figure 1 so that when it may be desired to pull the pump sucker rods and pump from the well the rod 9 may be removed and the power cylinder 14, its support and appendants may be swung out of the way as indicated in Figure 7 without dismantling or otherwise disturbing the pumping unit. The power line 44 and the return line 46 are connected by means of a by-pass connection 47 which is equipped with a valve 48 that may be normally opened or closed by a grip member 49 with which the valve is equipped. By opening the valve 48 the operating fluid from the pump may be caused to wholly, or partly, by-pass the cylinder 24 and enter the return line 46.

Mounted on the upper end of the pump pressure line 44 there is a suitable pressure gauge 50 by means of which the pressure of the operating fluid will, at all times, be revealed.

There is a pressure operative electric switch 51 which is wired in circuit with the motor, as shown in Figures 1 and 2.

Connected into the pressure line 44 there is a nipple 52, screwed into the outer end of which there is a T fitting 53. The inner end of the nipple 52 is formed with a valve seat 54 and co-operating with said seat there is an outwardly opening valve 55.

Screwed into the other end of the fitting 53 there is a plug 56 whose inner end is fitted with a deep socket 57 and the valve is provided with the stem 58 which works in said socket. Surrounding said stem and interposed between the inner end of the plug 58 and the valve 55 there is a strong coil spring 59 which normally holds the valve closed. The outer end of the plug 56 has an opening 60 therethrough to receive a handle 61 by means of which the plug may be turned.

The switch 51 is mounted on a T fitting 62 which is connected with the fitting 53 by means of a cross pipe 63 which may be opened and closed at will by means of a valve 64. The fitting 62 may be open for drainage purposes, or to release the pressure therein, by means of a suitable cock 65 connected to the lower end of the fitting 62.

When the pressure at which the unit will operate has been determined the plug 56 may be screwed outwardly to permit such pressure to enter the fitting 62 and the switch 51 will be set to remain closed at such pressure. The plug 56 may then be screwed inwardly to apply additional compressive force to the spring 59 so that the valve 55 will not open unless an excessive pressure is reached and in case of such excessive pressure the valve 55 will be opened and the pressure in the fitting 62 will be increased and unsealing of said increased pressure the switch 51 will be opened and the motor stopped.

Within the cylinder 24 of the controlling assembly there is a controlling piston assembly that will now be described.

This assembly includes a reduced piston body 66 fixed on which are the intermediate spaced pistons 67 and 68. There are also the end pis-
tons 69 and 70 having the inwardly extended stems 71 and 72 in the sockets 73 and 74 in the ends of the body 66. The pistons all fit snugly in the cylinder 24.

As illustrated in Figure 6 the piston assembly is in balanced position with the intermediate pistons 67 and 68 between the ports 38 and 37.

The entire system including the cylinders 14, 16 and 19, the pressure lines 27 and 28, the conducting lines 32 and 33, the controlling assembly, the pressure line and return line 44, 46, as well as the by-pass connection 47 and the cross-pipe 63 will be filled with a suitable operating liquid, such as a suitable oil. The pump 42 and the pressure line 40 leading from the tank 38 are also filled with this liquid. The tank 38 is only partly filled with liquid and sufficient fluid pressure is then introduced into tank and applied to the liquid therein and this pressure is transmitted to the operating liquid filling the system. The amount of pressure in the tank 38 is only slightly less than the pressure required to sustain the operating load, that is the pressure in the annular space 99 between the piston rod 34 and the cylinder 33, through the wall pipe of the well being pumped. The electric motor 43 and pump 42 will supply the additional power required to operate the well pump while pumping the well.

As is illustrated in Figure 5 the operating fluid has been applied through the pressure line 44 and the conducting line 32 to the lower end of the power cylinder 14 and the piston 20 has been elevated, that is a power stroke of the well pump has just been completed. The plunger 22 entering the cylinder 19 places the liquid in said last-mentioned cylinder under additional pressure which is transmitted through the pressure line 28 into the lower end of the cylinder 24 thus forcing the piston assembly in said cylinder upwardly and closing the duct 30, that is cutting it off from the pressure line 44 and opening the duct 31 to the pressure line 33. At the same time the lower end of the power cylinder 14 will be connected, through said conducting line 32 and duct 30 with the return line 45, through the port 36. The piston 20 will now be forced downwardly in the cylinder 14.

The plungers 21 and 22 are provided with channels, as 21a and 22a leading from the outer ends thereof longitudinally through said plungers with the other ends of said channels laterally turned through the corresponding plungers.

The outer ends of these channels are closed by the outwardly opening flap valves 21b, 22b so that on upward movement of a plunger the channel 22a through said plunger will be closed by the valve 22b but upon reverse movement of the plunger the valve 22b may open and vice versa. Provision is thus made so that there will be no vacuum created behind the piston as it moves forward by either direction.

Upon movement of the plunger 22 from the cylinder 19 the pressure above the piston 20 will pass through the channel 22a so that at all times during the downward movement of the piston 20 there will be sufficient pressure in the cylinder 24 beneath the valve assembly therein to maintain said assembly in elevated position, as is shown in Figure 5, with the duct 30 in communication with the duct 35, through the port 36, to allow the operating fluid beneath the piston 20 to enter the return line 46.

The pressure controlling unit will remain in the position shown in Figure 5 during said downward movement of the piston 20.

It may be here stated that the pistons 67, 68, 69 and 10 are fixed in relation to the body 66. This is accomplished by providing transverse pins 71 and 72 through the body and through the corresponding stems 71 and 72, as is indicated in Figure 5, and, if desired, this piston assembly may be made as a unit.

As the piston 20 approaches the limit of its downward movement the plunger 21 will enter the cylinder 18 applying pressure to the operating fluid trapped in said means whereby the pressure will be transmitted through the line 27 into the upper end of the cylinder 24 of the controlling assembly thus moving the piston assembly, in said cylinder 24, downwardly and connecting the line 33, through the duct 31 and port 31 with the return line 45 and connecting the line 32, through the duct 30, with the pressure line 44, thus initiating the return movement of the piston 20. The pressure of this operating fluid will move the piston 20 upwardly and the pressure of the operating fluid beneath the piston 20 will initially pass through the the duct 24a until the plunger 21 has cleared the cylinder 16 so that at all times during the upward movement of the piston 20 pressure will be applied through the line 27 against the upper end of the controlling valve assembly in the cylinder 24 to maintain it in its lower position until the piston 20 has moved to its final upper position, as shown in Figure 5 thus completing a cycle of movement.

Should it be desired to vary the speed of operation of the well pump, this may be done by the valve 46. This valve may be completely or partially opened so that the full pressure generated by the pump 42 may be applied to the piston 20 or the valve 48 may be partially opened to by-pass a portion of the pressure through the by-pass connection 41 to the return line 46 which will have the effect of slowing up the operating speed of the well pump.

When the pump stops the controlling piston assembly in the cylinder 24 will assume an intermediate position with the pistons 67 and 68 between the ports 36, 37, as shown in Figure 6. In order to move the controlling piston assembly off of center in starting the unit, the plunger 21 has provided a rod 79 having a T head 80 located between the pistons 67 and 68. Fastened to the outer end of the rod 79 there is a handle 81 by means of which said rod and T head may be turned to throw the controlling piston assembly off of center to start operation of the pump.

What I claim:

1. A pumping unit comprising, a power cylinder, a piston therein, means for connecting the piston to a well pump, a pressure controlling assembly operable by fluid pressure, pressure cylinders, one at each end of the pump, said cylinders arranged to work in the respective pressure cylinders conduits leading from the assembly and entering the power cylinder on opposite sides of the piston, a pressure line entered said assembly and a return line leading from the assembly, said assembly including controlling means operable to connect one of said conduits with the pressure line and the other of said conduits with the return line, pressure applying conduits, pressure applying means operable by the piston for applying pressure through said conduits, alternately, to opposite sides of the controlling means whereby application of pressure to opposite sides of the piston will be effected alternately.
2,645,900 7. A pumping unit comprising, a power cylinder, a piston therein, means for connecting the piston to a well pump, pressure cylinders at opposite ends of the power cylinder, plungers on the piston arranged to enter the pressure cylinder's a pressure controlling assembly, pressure conducting lines leading from said assembly and connected into said pressure cylinder on opposite sides of the piston, a source of fluid pressure and connected into said controlling assembly, a return line leading from said assembly to said source, said controlling assembly including valve means operable by fluid pressure and movable to one position to connect the pressure line with one of the conducting lines and to simultaneously connect the return line with the other conducting line, said valve means being movable to another position to reverse said connections, whereby fluid, under pressure, will be applied to opposite sides of the piston, alternately, and relieved from the forward sides of the piston conducting lines through which said fluid pressure may be relieved from the front of the piston, and means for causing a selected portion of the operating pressure fluid to by-pass the controlling assembly into the return line.

3. Pumping equipment comprising, a power cylinder, a piston therein, pressure cylinders at the ends of the power cylinder, plungers on the piston which enter the corresponding pressure cylinders at the ends of the piston stroke means for connecting the piston to a well pump, a pressure controlling assembly, conduits leading from said assembly and connected into said cylinder on opposite sides of the piston, conduits leading from said assembly and connected into each pressure cylinder a pressure tank, a hydraulic pump, a pressure line leading from the tank and connected into the pump intake, a pressure line leading from the discharge side of the pump and connected into the controlling assembly, a return line leading from said assembly and connected into each pressure cylinder, the controlling assembly including pressure controlling means movable to one position to connect the pressure line with one of said conduits and to simultaneously connect the return line with the other conduit, said pressure controlling means being movable to another position to reverse said connections whereby fluid, under pressure, will be applied to opposite sides of the piston alternately and relieved from the forward sides of the piston.

4. A pumping unit comprising, a power cylinder, a piston therein, means for connecting the piston to a well pump, pressure cylinders at opposite ends of the power cylinder, plungers on the piston arranged to enter the pressure cylinders alternatively to create pressure therein, a pressure controlling assembly provided with a cylinder and a piston assembly mounted therein, pressure lines leading from said pressure cylinders to the controlling assembly and connected into the cylinder thereof on opposite sides of said piston assembly, a pressure supply line leading from a source of fluid pressure and connected into the cylinder of the controlling assembly, a return line leading from said last mentioned cylinder to said source, conducting lines leading from the cylinder of the pressure controlling assembly and connected into the power cylinder adjacent opposite ends thereof, said power piston being arranged to force one plunger into one pressure cylinder and to thereby shift the piston assembly to relieve the other pressure line and connect the supply line, through a conducting line, with the power cylinder to reverse the movement of said piston assembly.

5. A pumping unit comprising a main power cylinder, a main piston therein, means for connecting the piston to a well pump, pressure cylinders at opposite ends of the power cylinder and of reduced transverse diameter, plungers on the piston arranged to enter the pressure cylinders alternatively to create pressure therein, a pressure controlling assembly provided with a cylinder and a piston assembly mounted in said cylinder, a pressure line leading from a source of fluid pressure and connected into the cylinder of the controlling assembly, a return line leading from said last mentioned cylinder to said source, a conducting line leading from the cylinder of the pressure controlling assembly and connected into the cylinder thereof on one side of said piston assembly, a pressure supply line leading from a source of fluid pressure and connected into the cylinder of the controlling assembly, a return line leading from said last mentioned cylinder to said source, a conducting line leading from the cylinder of the pressure controlling assembly and connected into the cylinder thereof on one side of said piston assembly, a conducting line having passages to connect said pressure line with the return line and to connect the pressure supply line with said conducting line, said piston assembly being arranged to be operated by the pressure in said pressure line to open said passageways and to thereby shift the piston assembly to open said passages and to complete said connections, and a valve-controlled relief passageway through said piston and plungers to relieve pressure from the pressure cylinders.

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