No. 828,680. PATENTED AUG. 14, 1906.

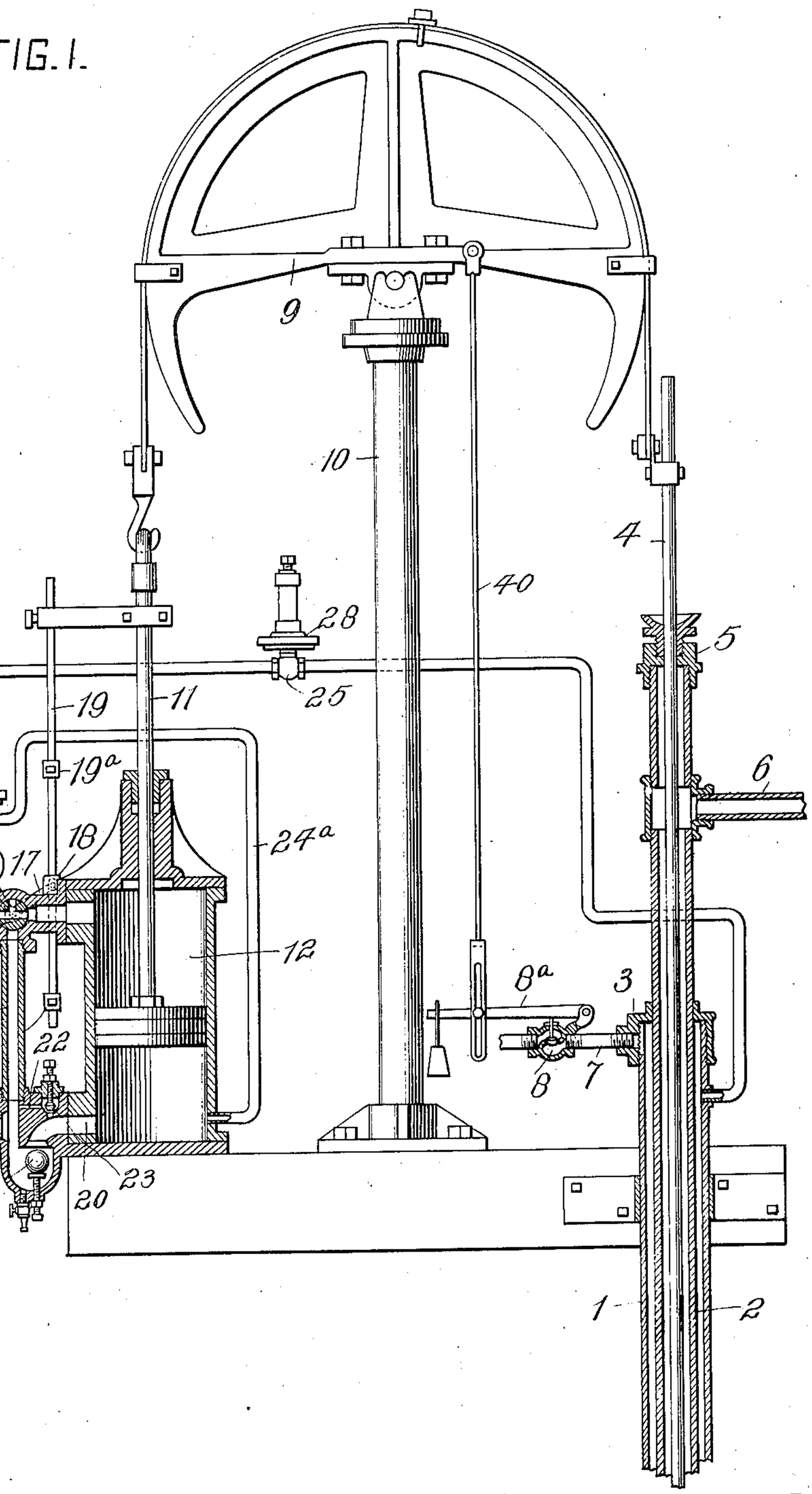
M. W. QUICK.

APPARATUS FOR PUMPING OIL WELLS.

APPLICATION FILED NOV. 8, 1901.

2 SHEETS—SHEET 1.

FIG. 1.



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2 SHEETS—SHEET 2.

FIG. 2.

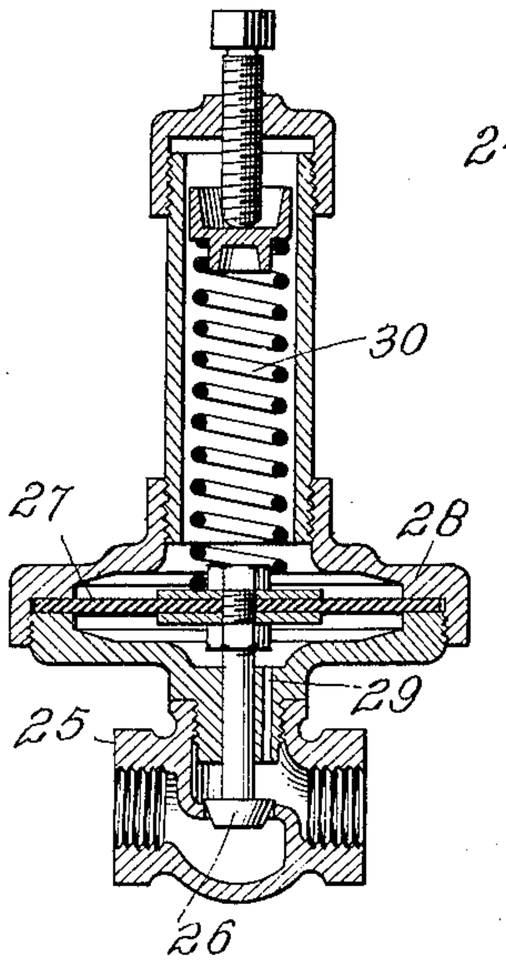


FIG. 3.

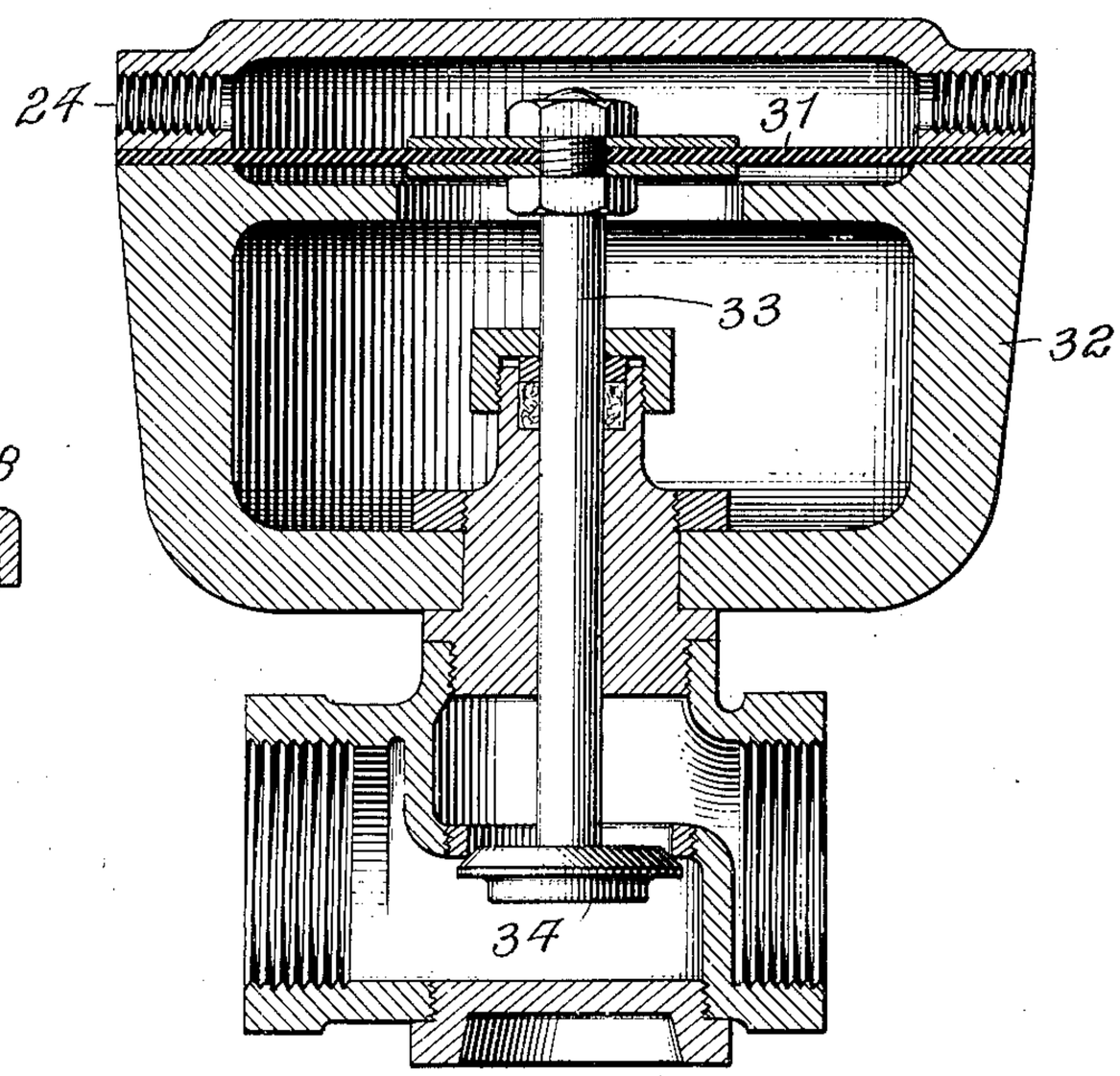


FIG. 4.

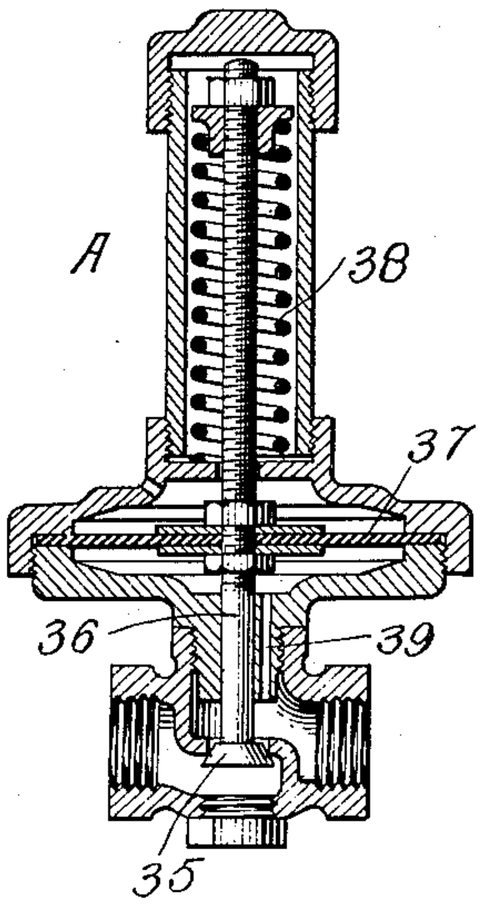


FIG. 6.

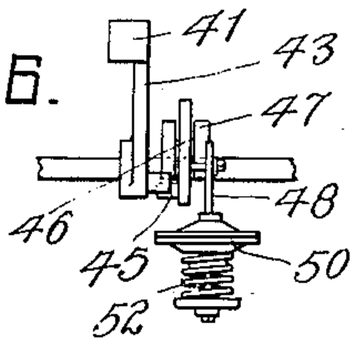
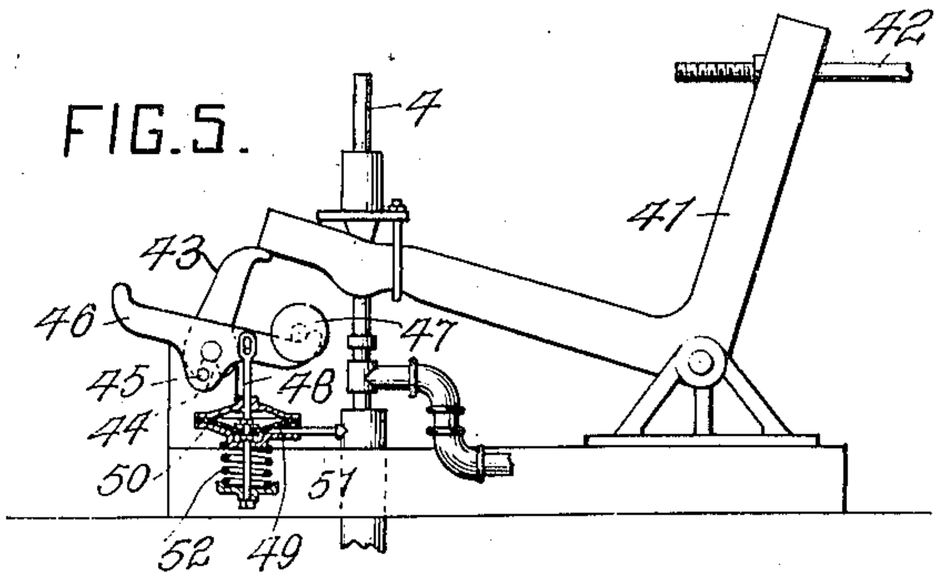


FIG. 5.



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APPARATUS FOR PUMPING OIL-WELLS.

No. 828,680. Specification of Letters Patent. Patented Aug. 14, 1906.

Application filed November 8, 1901. Serial No. 81,519.

To all whom it may concern:

Be it known that I, MILES W. QUICK, a citizen of the United States, residing at Titusville, in the county of Crawford and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Apparatus for Pumping Oil-Wells, of which improvements the following is a specification.

It has been the usual practice in pumping oil-wells to permit a practically free escape of gases from the well, and under the term "gases" as herein employed is included such volatile constituents of the oil as will assume a gaseous condition as soon as the oil is relieved of pressure. As a result of this continuous free escape of gas there will be a gradual separation and escape of the volatile constituents without any movement of the oil, which will remain dead in the interstices of the oil-bearing rock. This is shown by the fact that if the well be closed in, so that pressure can accumulate, thereby preventing a gradual separation of the volatile constituents from the oil, and the pressure in the well is then relieved or reduced there will be a quick expansion of the volatile constituents without a complete separation from the oil, which will be forced out of the rock by such expansion.

The invention described herein has for its object the maintenance of a pressure in the well during the operation of the pump, the stopping of the pump as soon as the oil has ceased to flow, and the automatic starting of the pump as soon as the pressure again reaches a certain predetermined point. The invention is hereinafter more fully described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a view, partly in section and partly in elevation, of my improved pumping apparatus. Figs. 2, 3, and 4 are vertical sections, on a large scale, of the controlling-valve mechanisms and the pressure device for controlling the fluid-pressure valve. Figs. 5 and 6 are detail views illustrating the adaptation of my improvement to another form of well-pumping apparatus.

In the practice of my invention the well is provided with a casing 1, a line of tubing 2, which extends through and forms a tight joint with the casing-head 3, and a pump-rod 4, extending through a stuffing-box on the head 5 of the tubing. The tubing 2 is provided with a liquid-outlet pipe 6 and the casing with a gas-outlet pipe 7, which is provided with a suitable valve mechanism 8, normally held closed by a weighted lever 8^a. The upper end of the pump-rod 4 is connected to the actuating-motor by any suitable means, preferably to one end of a walking-beam 9, pivotally mounted on the post 10. The opposite end of the walking-beam is connected to the piston-rod 11 of the fluid-pressure cylinder 12. The upper end of the cylinder is connected to a valve mechanism, which in turn is connected to a fluid-pressure-supply pipe 13 and by a pipe 14 to the exhaust-pipe 15. The valve mechanism controlling the flow of fluid-pressure to and from the upper end of the cylinder may be of any suitable form or construction—such, for example, as that shown—consisting of a rotary plug 16, having transverse passages so arranged that in one position of the plug the cylinder will be connected to the fluid-pressure-supply pipe and to the exhaust-pipe when the plug is shifted to the opposite position. The plug is provided with an arm 17, having its outer end connected to a sleeve 18, loosely mounted on the rod 19, which is connected to the piston-rod 11. Tappets 19^a are secured to the rod 19 in suitable positions to shift the valve as the piston reaches any desired points in its movement. It is preferred to connect a weighted arm to the valve, so as to hold it in its opposite positions as against accidental movement by reason of friction between the sleeve 18 and rod 19.

It will be observed that the motor is of the single-acting type, the piston being forced down by fluid-pressure and raised by the weight of the pump-rod as it drops down in the well. When the valve 16 has been shifted, as the piston reaches the lower limit of its stroke to cut off the fluid-pressure supply and connect the upper portion of the cylinder with the pipe or passage 14 the fluid from the cylinder will flow to the exhaust-pipe 15 and also through a port 20 into the lower end of the cylinder, thereby destroying any vacuum which the piston in its upward movement would normally tend to form. When there is any liquid in the well, it would buoy up the pump-rod to such an extent that the upward movement of the piston would be comparatively slow and regular; but if there is no liquid in the well the pump-rod would plunge down quickly when the valve 16 is shifted, and thereby effect a corresponding quick upward movement to the piston of the

cylinder. This sudden upward movement of the piston would cause such a quick rush of fluid from the pipe 14 toward the lower end of the cylinder as to lift the valve 21, controlling the port 20, closing such port, so that a vacuum would be formed under the piston and its further upward movement checked. In order to permit the further, but slow, upward movement of the piston, a by-pass 22, provided with a regulating-valve 23, is formed around the valve 21. By suitably regulating the valve 23 there will be a slow inflow of fluid, gradually destroying the vacuum and permitting a slow upward movement of the piston.

In order to render the operation of the pumping mechanism automatic—*i. e.*, to set the pumping mechanism in operation when the desired pressure in the well has been reached, maintaining the pump in operation until the accumulated oil has been pumped out, and then stopping the operation of the pump—suitable valve and motor mechanisms are arranged in a line of pipe 24, extending from the well-casing 1 to the pump-operating mechanism. The first mechanism, which is employed for starting the pumping mechanism when the gas in the well attains the desired pressure, consists, as shown in Fig. 2, of a case or shell 25 and a valve 26, designed to seat with the pressure of the gas in the well. The stem of this valve is connected to a movable abutment or diaphragm 27, so arranged in a shell 28 as to be subjected on one side to pressure of gas entering the shell through a port 29 from the well side of the valve-case 25. The valve 26 is forced toward its seat by a spring 30, preferably arranged to bear against the diaphragm and acting in opposition to the gas-pressure entering through port 29. The tension of the spring 30 is adjusted to hold the valve closed until the desired pressure in the well has been reached, whereupon the valve 26 is raised from its seat and gas under pressure allowed to flow to a valve-shifting mechanism controlling the flow of fluid-pressure to the motor. As shown in Fig. 3, this mechanism consists of an abutment or diaphragm 31, arranged in a case or shell 32 and subjected on one side to gas-pressure from the pipe 24. The diaphragm is connected by a rod 33 to a valve 34, regulating the flow of fluid-pressure in the pipe 13, leading to the motor. The pressure of gas in the pipe 24 when the valve 26 is opened will shift the diaphragm 31 and valve 34, permitting fluid-pressure to flow to motor and put the same into operation. The operation of the pumping mechanism will continue until the liquid in the well is so exhausted as to permit of a plunging of the pump-rod, as heretofore described. Pressure of gas is maintained in the pipe 24 during the operation of the pump by a valve 35 of the mechanism A (shown in section in Fig. 4) seating with the pressure in the pipe. This valve is connected by a rod 36 to an abutment or diaphragm 37, arranged in a case or shell and subjected on the side away from the valve to atmospheric pressure. The valve is normally held to its seat by a spring 38, acting in opposition to atmospheric pressure. When the piston of the motor-cylinder is jerked up by the plunging of the pump-rod, thereby creating a vacuum under the piston, a vacuum is also formed in the portion of the pipe 24^a connecting the case of the valve 35 to the cylinder. As this portion of the pipe is connected to a space below the diaphragm by a port 39, it is evident that the formation of a vacuum in the lower end of the cylinder and pipe 24^a will produce a vacuum below the diaphragm, so that the atmospheric pressure on the opposite side of the diaphragm will overcome the tension of the spring and shift the valve 35 from its seat, thereby permitting such an escape of gas under pressure from the pipe 24 that the diaphragm 31 will be relieved of pressure and the valve 34 seated by fluid-pressure in the pipe 13 or by atmospheric pressure against the valve side of the diaphragm 31, thereby stopping the flow of fluid-pressure to the cylinder 12.

From the foregoing it will be readily understood that as soon as the liquid in the well is pumped off to such an extent that the pump-rod will plunge the fluid-pressure actuating the pump mechanism is cut off and the flow of gas from the well is stopped and that these conditions will continue until the gas-pressure in the well rises to a predetermined point. As soon as this pressure is reached the valve 26 is opened, and gas will flow along the pipe 24, the valve 35 having been closed as soon as vacuum in the cylinder is destroyed, and depress the diaphragm 31 sufficiently to open valve 34 to permit of the flow of fluid-pressure to the motor-cylinder.

As the maintenance of high pressure in the well during the pumping operation would prevent the flow of oil from the sand into the well and as the flow of oil to the well is facilitated by a reduction of pressure in the well, I provide for a reduction of pressure by a regulated escape of gas. This escape of gas can be effected and controlled in a variety of ways. A convenient means for the purpose consists of the valve 8, arranged to seat against the pressure in the well, a weighted lever 8^a normally holding the valve to its seat, and a lifting-rod 40, connected at one end to the walking-beam 9, while the opposite end is connected to the weighted lever 8^a. The connection between the walking-beam and the weighted lever is so constructed that the valve 8 will be opened during a portion only of the movement of the pump-rod, the duration of the opening being dependent upon the rate of accumulation of gas in the well.

While preferring to employ a fluid-pressure

motor for operating the pump-rods, my improvement can be applied to other forms or constructions of pump-operating mechanisms, as shown in Figs. 5 and 6. The grasshopper 41 has its upper end connected to a rod 42, extending from a central station operating a number of pumps and the opposite end connected to the pump-rod 4. The connection with the operating-rod is such that if the lower end of the grasshopper be supported in its highest operative position the rod 42 will slide back and forth without shifting the grasshopper. In order to stop the operation of the pump, a catch or stop is arranged in suitable relation to the grasshopper to engage the same when the pump-rod is in its highest position, and thereby prevent any further operation of the pump until the grasshopper is released. This catch or stop is controlled by the pressure of gas in the well. A convenient form of stop mechanism is shown in Figs. 5 and 6 and consists of a pivotally-mounted prop or arm 43, adapted under conditions hereinafter stated to drop under the horizontal arm of the grasshopper when the latter is in its highest position. The arm or prop is provided with a notch or recess 44 for the reception of a pin 45 on the cradle 46. A rolling weight 47 is arranged on the cradle adapted to assist in shifting the cradle and arm and hold them in position. This cradle is connected by a rod 48 to a movable abutment, as the diaphragm 49, which is arranged in a case or shell 50, the space in the shell being connected by a pipe 51 to the well-casing. A spring 52 is connected to the diaphragm to prevent the latter being raised until the pressure in the well has reached a predetermined point. When the parts are in the position shown, the pump will not start until the pressure in the well is sufficient to overcome the tension of the spring and to lift the rolling weight. As soon as the cradle has been tipped from the angle shown, the notch or recess being made sufficiently long to permit this initial movement without affecting the prop, the weight will roll quickly to the opposite end of the cradle and jerk the prop or arm from under the grasshopper and the pumping will begin. As the pumping progresses gas is allowed to escape from the well by means substantially similar to that illustrated in Fig. 1. As soon as the pressure in the well drops to a point where the tension of the spring will overcome the pressure against the diaphragm and the gravity of the rolling weight the cradle will be again shifted, the weight will roll to the opposite end and throw the prop or arm in position to drop under the grasshopper when it reaches the limit of its upward movement, and thereby stop the operation of the pump until sufficient pressure to shift the cradle has again accumulated in the well.

It is characteristic of my improvements that the operation of pumping is controlled by conditions in the well. In the apparatus illustrated in Fig. 1 the pumping starts when the accumulation of pressure indicates conditions favorable to a flow of oil into the well and is stopped as soon as the oil is exhausted. The presence of an attendant is entirely unnecessary. In the construction shown in Figs. 5 and 6 the pumping is wholly controlled by pressure in the well. It is also characteristic of my invention that as the pumping mechanism begins to operate a valve is opened to permit the escape of gas from the well, so that the oil in the rock can flow freely into the well during the pumping operation. The valve is closed, preventing further escape of gas when the pumping mechanism is stopped, thereby preventing the oil from becoming dead, in which condition it would not flow readily to the well.

While I have shown and described the preferred construction, the claims are not limited in their broader terms to the construction or arrangements shown and described, as other forms and combinations within the spirit of the invention will readily suggest themselves to those skilled in the art.

I claim herein as my invention—

1. In an apparatus for pumping oil-wells, the combination of a pump, power mechanism for operating the pump, means for controlling the operating mechanism and means for operating said controlling means by pressure of gas in the well.

2. In an apparatus for pumping oil-wells, the combination of a pump, power mechanism for operating the pump, means for starting the operating mechanism and means for operating the starting means operated by gas-pressure in the well, substantially as set forth.

3. In an apparatus for pumping wells, the combination of a pumping mechanism, a valve connected to the well controlling the escape of gas therefrom, and means operative by pressures determined by conditions in the well for opening and closing said valve, substantially as set forth.

4. In an apparatus for pumping wells, the combination of a pumping mechanism, a valve connected to said well and controlling the escape of gas therefrom, and means operative by the pumping mechanism for opening and closing said valve, substantially as set forth.

5. In an apparatus for pumping oil-wells, the combination of a pump, a fluid-pressure motor for operating the pump, and a valve controlling the flow of fluid-pressure to the motor and means for controlling said valve by pressure of gas in the well, substantially as set forth.

6. In an apparatus for pumping oil-wells, the combination of a pump, a fluid-pressure motor for operating the pump, a valve controlling the flow of fluid-pressure to the mo-

tor, means for opening the valve by a predetermined pressure of gas in the well and means for closing the valve by the movement of the pump consequent on the exhaustion of liquid in the well to close said valve, substantially as set forth.

7. In an apparatus for pumping wells, a combination of a pumping mechanism, a valve controlling the flow of gas from the well, and means for opening said valve on the starting of the pumping mechanism, and for closing said valve on the stoppage of the pumping mechanism, substantially as set forth.

In testimony whereof I have hereunto set my hand.

MILES W. QUICK.

Witnesses:

HERBERT BRADLEY,

F. E. GAITHER.