Nov. 21, 1939. C. J. COBERLY 2,180,400

METHOD AND APPARATUS FOR CONTROLLING FLUID OPERATED PUMPS

Filed May 13, 1936 3 Sheets-Sheet 1

Fig. 1.

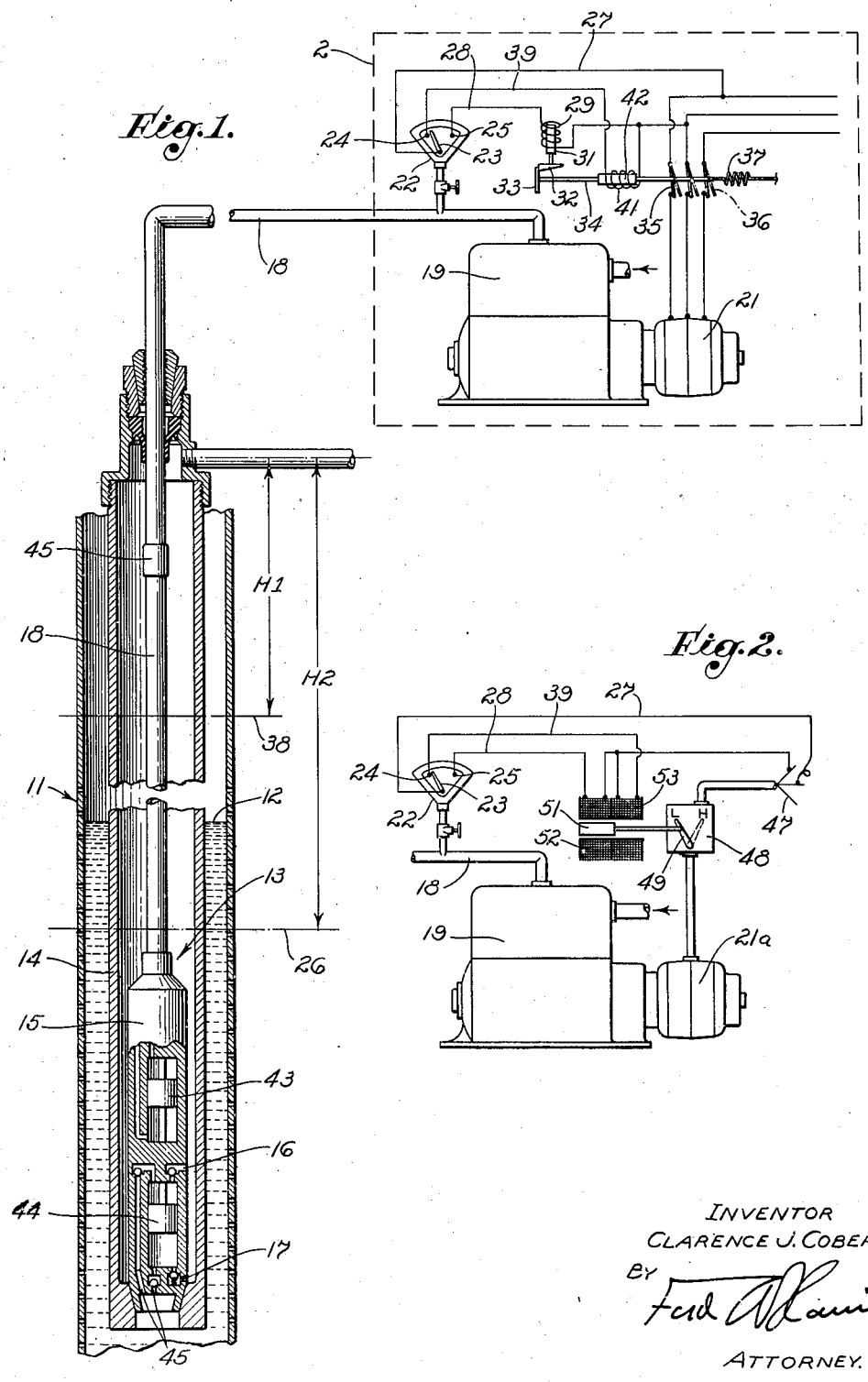

Fig. 2.

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Fig. 3.

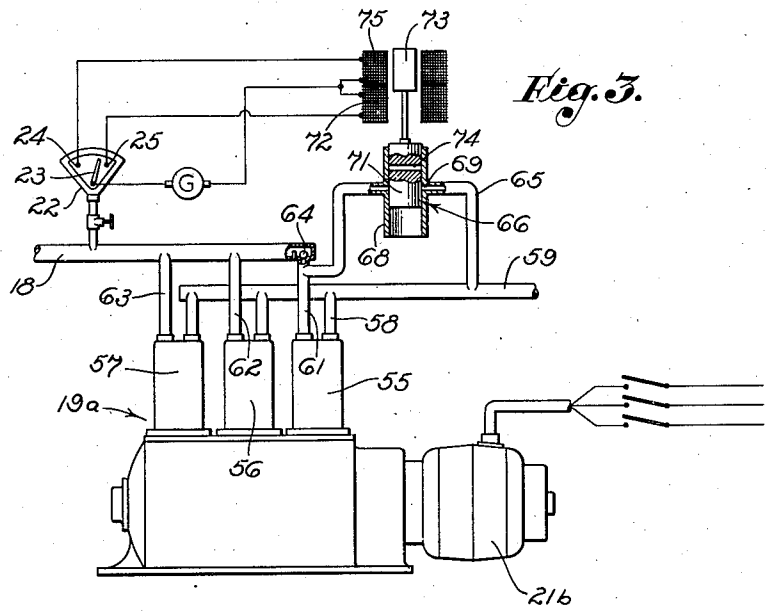
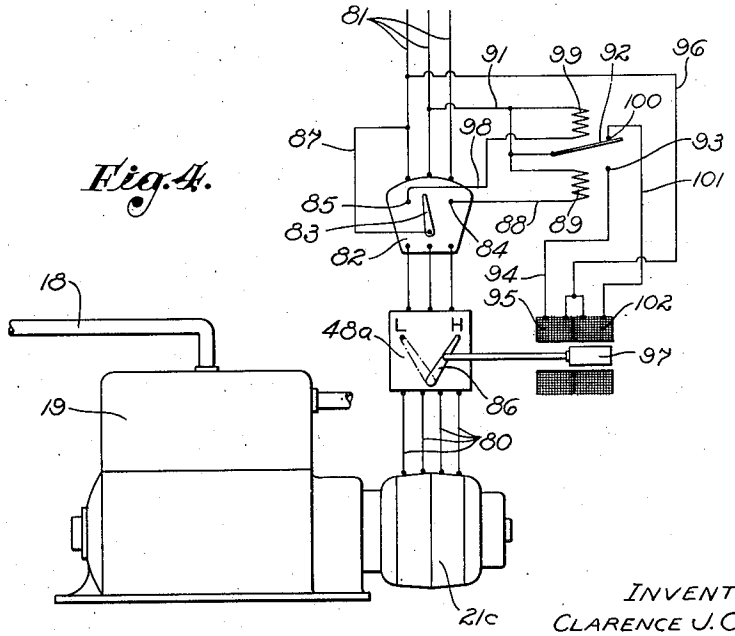


Fig. 4.



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METHOD AND APPARATUS FOR CONTROLLING FLUID OPERATED PUMPS

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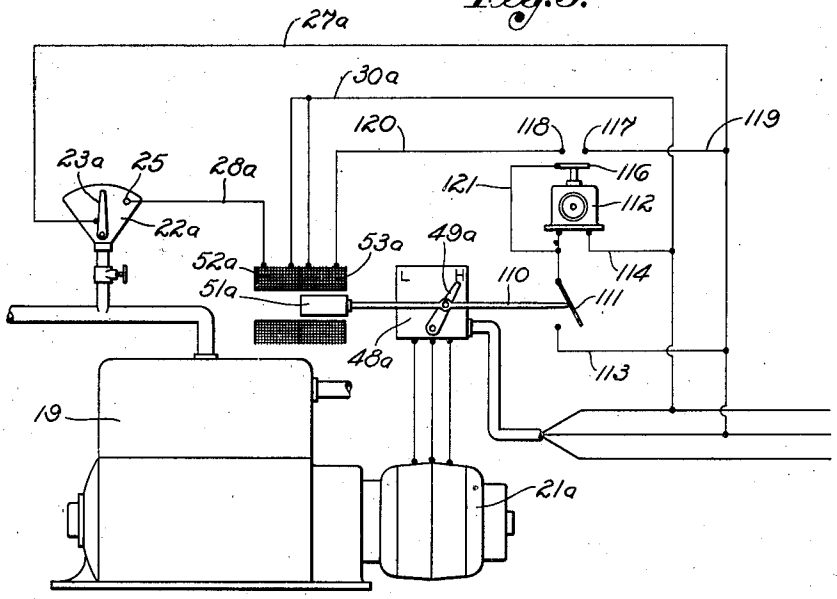
Fig. 5.



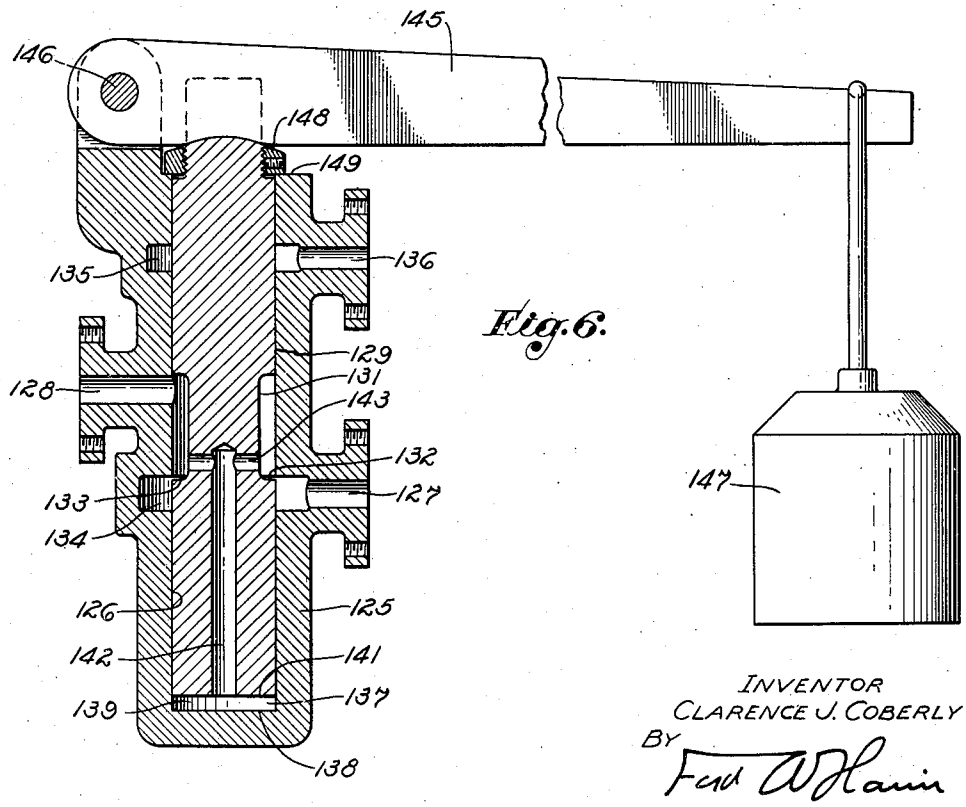


Fig. 6.

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UNITED STATES PATENT OFFICE

2,180,400

METHOD AND APPARATUS FOR CONTROLLING FLUID OPERATED PUMPS

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Application May 13, 1936, Serial No. 79,475

18 Claims. (Cl. 103—46)

My invention relates to the art of pumping fluids from wells, and relates in particular to the pumping of oil from deep wells.

In the pumping of oil from wells it is found that there is much difficulty encountered in operating the pump in accordance with the capacity of the well. By "capacity of the well" is meant the rate at which the oil flows from the formation into the well. If a pump of greater capacity than that of the well is employed, the well will be continually pumped off; that is, the oil will be pumped down to the level of the inlet of the pump. On the other hand, if a pump of smaller capacity is employed, a production in keeping with the full capacity of the well will not be attained.

An object of my present invention is to provide an automatic control for a pumping device which will automatically deliver from the well its entire capacity without the well being pumped off.

It is an object of the invention to provide a method of pumping wherein the capacity of the oil pump is reduced when the well has been pumped down to a definite or prescribed level, and the capacity of such pump is again increased when the oil in the well rises to a prescribed high level.

It is a further object of the invention to provide a method of the above character wherein control of the pump capacity is accomplished through the variation in the power required to operate the pump. For example, as the level of oil in the well drops, the pumping head is increased, with the result that more power must be consumed in operating the pump. Accordingly, when the power required approaches a prescribed high value, the capacity of the pump will be reduced automatically and will operate at a lowered capacity until the pumping head is decreased by the rise in the level of the oil in the well.

A further object of the invention is to provide a method and apparatus for pumping a well in which a pump is operated by a fluid delivered thereto under pressure, and in which the control of the capacity of the pump is accomplished through the variations in pressure in the high pressure fluid delivered to the pump for operation of the same.

A further object of the invention is to provide a method and apparatus of the character prescribed in the preceding paragraph, in which the volume of pressure fluid delivered to the pump for its operation is automatically varied in accordance with prescribed pressure conditions.

Further objects and advantages of the invention will be made evident throughout the following part of the specification.

Referring to the drawings, which are for illustrative purposes only:

Fig. 1 is a schematic view showing a preferred form of my invention in which the capacity of the pump is reduced to zero value when the pumping head reaches a predetermined high value, or the level of the oil in the well reaches a predetermined low point.

Fig. 2 is a view to be substituted for that portion of Fig. 1 outlined by the dotted line 2, to show another form of the invention wherein the capacity of the pump is reduced by decreasing the speed of the same.

Fig. 3 is another view to be substituted for the area outlined by the dotted line 2 of Fig. 1, to show another means for reducing the capacity of the pump.

Fig. 4 is also a view to be substituted for the area of Fig. 1 indicated by the dotted line 2, showing still another alternative form of the invention.

Fig. 5 is an additional view to be substituted for the area of Fig. 1 indicated by the dotted line 2, showing a form of the invention in which means are provided responsive to the increase in the pumping head of the well for reducing the capacity of the pumping equipment, with means, other than pressure operated, for restarting the pump at a later time.

Fig. 6 is a schematic view showing an alternative form of control mechanism which may be used in the practice of the invention.

In Fig. 1 a strainer pipe 11 is shown in the oil producing zone of a well, with oil therein at a level 12. Into this body of oil a pumping device 13 is extended. In the form of the invention disclosed, the pumping device 13 comprises a discharge pipe 14 and a fluid operated pump 15 having its discharge openings 16 and 17 placed so as to deliver the discharge of the pump into the production pipe 14. The fluid operated pump 15 is fed with a fluid under pressure through a pressure fluid delivery pipe 18 into which a pressure fluid such as clean oil is pumped by means of a pump 19 driven by a motor 21. As diagrammatically shown, a pressure actuated switch 22 is connected to the delivery pipe 18, this switch having a movable contact 23 and stationary contacts 24 and 25. Assuming that the electric motor 21 is of constant speed type, it will be perceived that the pump 19 will deliver a constant volume of pressure fluid into the delivery pipe 18.

Under ordinary conditions of operation, the capacity of the pump 19 will be such that the volume of pressure fluid delivered thereby will be sufficient to actuate the fluid operated pump 15 at such speed that oil will be pumped from the well a little faster than it enters the well from the formation so that the oil level 12 will gradually drop. As the fluid level 12 drops, the height or head against which the oil must be pumped upwardly through the discharge pipe 14 increases, and as this head increases, the pressure in the delivery pipe 18 likewise increases. This increase, and the subsequent decrease, in the pressure in the delivery pipe 18 may be employed to control the operation of the pumping equipment so as to reduce the capacity thereof in accordance with the drop in the level 12 of the oil in the well. In the form of the invention shown, the movable contact 23 of the pressure switch 22 moves rightwardly as the pressure in the delivery pipe 18 increases, and when the level of the oil in the well has dropped to a plane 26, the increased pressure in the delivery pipe 18 will have swung the movable contact 23 into engagement with the contact 25. The contacts 24 and 25 may both be adjustable so as to vary the pressures at which engagement therewith is made by the movable contact 23. When the contact 23 engages the contact 25, current will flow through a conductor 27 and a conductor 28 so that a solenoid winding 29 which is connected to the conductor 28 will be energized. The energization of the coil 29 will attract an armature 31 so as to pull a latch dog 32 upwardly out of engagement with a shoulder member 33 which is connected through a rod 34 with switch blades 35 which are at the present time held in closed position as shown by full lines. The release of the latch 32 will permit the blades 35 to be swung into open position, as indicated by dotted lines 36, by the pull of a spring 37. Therefore, when the level 12 of the oil in the well has reached the prescribed low point or plane 26 so that the pumping head corresponds to a dimension H2, the switch of the motor 21 will be automatically opened. In other words, the capacity of the pumping equipment will be automatically reduced, and in this instance it will be automatically reduced to zero value. The effect may be stated in another way; that is, the volume of the actuating fluid delivered by the pump 19 through the delivery pipe 18 will be automatically reduced.

The pump 15 will now stop, and due to the cessation of the pumping action the level of oil in the well will gradually rise toward the plane 38. As the level of oil 12 rises in the well, the pumping head will be gradually decreased, and the stored energy of the pressure fluid in the delivery pipe 18 will either slowly or intermittently operate the pump as the pumping head decreases so that there will be a gradual drop in the pressure in the fluid in the delivery pipe 18 to such point that the movable contact 23 will move leftwardly and will finally engage the stationary contact 24, with the result that current will pass through the conductor 27, a conductor 39, and a solenoid winding 41 so that a solenoid core 42 mounted on the rod 34 will be moved leftwardly to carry the switch blades 35 into closed position, whereupon the latch 32 will reset and hold the rod 34 in its leftward position. The motor 21 will now be energized and the pump 19 will be driven so as to again deliver pressure fluid through the delivery pipe 18 to the pump 15.

The following is in explanation of the action which takes place during the rise in the oil level 12 from the plane 26 to the plane 38. The pressure fluid in the delivery pipe 18 is under pressure and accordingly is compressed to a smaller volume than it would have at atmospheric pressure. Likewise, the pipe 18 is expanded, with the result that even though the pump 19 may stop, there is still considerable pressure in and on the fluid in the pipe 18 tending to move the power piston 43 of the pump 15 and thereby actuate the pumping piston 44 against the head of the oil in the discharge pipe 14. As the pressure of oil from the well is increased in the pump inlets 45 as the level 12 rises, the pumping load or head against which the pump 15 must operate is decreased, and the stored energy or pressure of fluid in the pipe 18 acts against the power piston 43 to either slowly or intermittently move the pumping piston 44 of the fluid operated motor forming a part of the pump 15, and each time the piston 43 reciprocates, there will be a discharge of pressure fluid from the delivery pipe 18 so that the pressure existing in the pipe 18 will reduce substantially in proportion to the rise in the level 12 of the oil in the well. Also, the reduction in pressure in the pipe 18 may be influenced by small leakages of pressure fluid through the joints of couplings in the pressure pipe 18 such as indicated at 46, and also by leakages of pressure fluid past the valve parts of the fluid operated motor which are not shown in this diagrammatic view but are of the character disclosed in my copending application Serial No. 720,061, filed April 11, 1934, and entitled "Fluid operated deep well pump."

In Fig. 2, which is to be substituted for the portion of Fig. 1 in the area outlined by the dotted line 2 in order to produce the complete pumping equipment, I have shown means wherein the reduction of the pump capacity is not to zero value but may be to any prescribed low value. In Fig. 2 the pressure pump 19 is equipped with a variable speed motor 21*a* which is of sufficient torque at either speed to operate the pump 19 against the maximum pressure in the delivery pipe 18. The electric wires 47 through which the motor 21*a* is energized are carried into a diagrammatically shown speed-changing switch 48 having an external lever 49 adapted to move from the position L as shown in full lines to the position H as shown in dotted lines. Connected to the lever 49 is an armature 51 adapted to be moved between two extreme positions by electromagnetic windings 52 and 53. When the movable contact 23 of the pressure switch 22 is moved into engagement with the stationary contact 25 as the result of the rise in fluid pressure in the delivery pipe 18, current will flow through the conductor 27 and the conductor 28 which energizes the magnet winding 52, with the result that the control lever 49 is pulled leftwardly into L or low speed position, so that when a predetermined high pressure of fluid is produced in the pipe 18 as the result of the drop in the oil level 12 to the plane 26, the motor 21*a* will be reduced in speed so that the pump will be operated at reduced speed, and the volume of oil delivered into the pressure pipe 18 will be of reduced value, with the result that the speed of operation of the pump 15 in the well will be reduced to a low value wherein the quantity of oil pumped from the well will be less than the quantity of oil flowing into the well from the formation. Accordingly, the level 12 will rise, and as this level 12 rises, the pumping head

against which the pumping equipment must operate will decrease, and when the level 12 has reached the plane 38, the reduced pressure in the pipe 18 will have resulted in the movement of the contact 23 leftwardly into engagement with the stationary contact 24 so as to close a control circuit consisting of the conductor 27, conductor 39, and the magnet winding 53, the energization of which magnet winding will result in the movement of the armature 51 rightwardly so as to carry the lever 49 into high position H, whereupon the motor 21a will be driven at high speed, and likewise the speed of the pump 19 and the volume of fluid delivered thereby into the pipe 18 will be increased to bring the capacity of the pumping equipment to a point a little greater than the capacity of the well, or, in other words, the rate of flow of oil from the formation into the well. By use of a device such as shown in either Fig. 1 or Fig. 2, the entire capacity of the well may be produced, and this may be accomplished without the well being pumped off. Also, the production of the well will be at maximum if the level in the well is held constantly at a point slightly above the inlet of the pump. At this time it should be pointed out that it is of exceptional importance to maintain a definite level of oil in the well above the inlet openings of the pump, since gas conditions may be in this manner best controlled. There is under such condition of operation a minimum liability for the formation of a gas lock in the intake of the pump and a minimization of danger of the pump racing due to the entry of a body of gas into the pumping cylinder.

In Figs. 1 and 2 I have shown forms of my invention wherein the change in the capacity of the pump device is accomplished through changes in the speed of the driving motor. This same desirable effect may be accomplished in other ways. For example, as shown in Fig. 3, a multicylinder pressure pump 19a may be employed, and this pump may be driven by a constant speed motor 21b. Each of the cylinders 55, 56, and 57 is shown connected through pipes 58 with an inlet header 59. Discharge pipes 61, 62, and 63 are shown connecting the cylinders 55 to 57 with the pressure pipe 18. A valve 64 is shown at the upper end of the discharge pipe 61 where it leads into the header or delivery pipe 18 for preventing a reverse flow downwardly through the discharge pipe 61 into the cylinder 55. A by-pass 65 having a valve 66 therein connects the discharge pipe 61 with the inlet header 59. The valve 66 may comprise a casing 68 of cylindrical form having diametrally opposed ports 69 which are closed when a valve piston 71 is in raised position as shown in Fig. 3. At this time all three cylinders, with the pistons operating therein, will discharge into the delivery pipe 18 to operate pump 15 in the well at its maximum capacity. As the pressure increases in the pipe 18, the movable switch contact 23 will move toward the stationary contact 25 of the pressure switch 22, and when engagement of the contacts 23 and 25 is accomplished, a solenoid winding 72 will be energized, and an armature 73 will be moved downwardly so as to carry the piston 71 of the valve 66 to such position that a diametral port 74 therein will align with the ports 69 so that fluid may pass freely from the discharge pipe 61 back into the inlet header 59. Accordingly, there will be no pumping of fluid from the cylinder 55 into the delivery pipe 18, and accordingly the quantity of pressure fluid delivered by the pump 19a into the delivery pipe 18 will be reduced. Likewise, the capacity of the pumping equipment will be reduced as the result of the slowing down of the fluid operated pump 15. The pump 15 will then operate at reduced capacity until the level 12 of oil in the well rises to the prescribed high point, such, for example, as the plane 38, at which time the movable contact 23 will have moved leftwardly into engagement with the stationary contact 24 to cause energization of a solenoid winding 75, magnetic changes of which will move the armature 73 upwardly so as to carry the valve member 71 into such position that the ports 69 will be closed and the production of the cylinder 55 will then be caused to pass through the valve 64 into the delivery pipe 18, thereby restoring the capacity of the pumping device to its original high value, which is ordinarily to be greater than the capacity of the formation to deliver oil into the well.

In the form of the invention shown in Fig. 4, the pressure switch 22 is not employed, but the change in the wattage consumed by a motor 21c is employed to vary the capacity of the pumping system. In this form of the invention a variable speed motor is employed with a speed controller 48a connected therewith through wires 80. Connected into the electrical circuit comprising conductors 81 leading into the speed changing device 48a is a wattmeter 82 having an indicating lever 83 which is so constructed that it will close electrical control circuits at different positions. For the purpose of explanation only, I have shown the lever 83 as consisting of a movable contact adapted to engage stationary or adjustable contacts 84 and 85. Assuming that the lever 86 of the speed controller 48a is in high speed position H so that the pump 19 will be driven at high speed and cause high speed operation of the pump 15 in the well so that the oil level 12 drops in the well, the pumping load will be increased, and the electrical consumption of the motor 21c will likewise increase, with the result that the movable contact 83 will move rightwardly toward the contact 84. When the load has increased to such a point that the contact 83 engages the contact 84, current will pass through a conductor 87, a conductor 88, a relay magnet winding 89, and a return conductor 91. A relay contact 92 will then be swung relatively downwardly from the position in which it is shown so as to engage a stationary contact 93 so that current will flow through the conductor 91, the contact 92 which is connected thereto, a conductor 94, a solenoid winding 95, and a conductor 96, thereby energizing the solenoid winding 95 and moving leftwardly an armature 97 which is connected to the lever 86 and swings the same into lower speed position L, thereby reducing the speed of the motor 21c and likewise reducing the capacity of the pumping equipment to a point below the capacity of the well. The pumping equipment will then operate at low speed until the pumping head against which the pumping equipment must operate has been reduced to the prescribed low value. During this time the electrical consumption of the motor will gradually decrease, and the movable contact 83 will move leftwardly and will engage the contact 85 so that current will flow through a conductor 98, a relay magnet winding 99, and the conductor 91. The relay contact 92 will then be swung relatively upwardly into engagement with a contact 100 so that current will now flow through the conductor 91, the movable relay

contact 92, a conductor 101, a solenoid winding 102, and the conductor 96, energizing the winding 102 and causing movement of the solenoid 97 rightwardly into high speed position H, thereby resuming high speed operation of the motor 21c until such time as the increase in the pumping load causes a change back to low speed operation, as previously described.

In Fig. 5 I show a pump 19 feeding a pressure fluid delivery pipe 18 which connects with the pumping unit 13 in the well. Connected to the pipe 18 is a pressure actuated switch 22a having a single contact 25a instead of a pair of contacts as shown in Figs. 1, 2, and 3. The motor 21a which drives the pump 19 has a speed controlling element 48a equipped with a lever 49a, adapted to be moved by an armature 51a which moves within solenoids 52a and 53a. As the pressure in the pipe 18 increases, the movable contact 23a of the pressure actuated switch 22a moves rightwardly and engages the contact 25a, closing a circuit consisting of a wire 27a, a wire 28a, the solenoid 52a, and a wire 30a. The solenoid 52a, being thus energized, moves the core 51a leftwardly and swings the lever 49a of the speed controlling element 48a leftwardly into low speed position L. An extension 110 connected to the armature 51a is at this time moved leftwardly and permits the closing of a switch contact 111 so that a timing device 112 may be caused to operate. This timing device may be of the synchronous motor character, and the same may be energized through a circuit consisting of wires 113 and 114. The motor 21a will be now driven at slow speed for a period of time predetermined by the characteristics of the timing device 112. This timing device 112 is shown with a movable contact 116 adapted to engage stationary contacts 117 and 118. When the movable contact 116 is raised from the position in which it is shown into engagement with the contacts 117 and 118, current will flow through wires 119 and 120, through the solenoid 53a, and through the wire 30a, energizing the solenoid 53a and moving the armature 51a rightwardly so as to swing the control lever 49a of the speed control element into high speed position H. The rightward movement of the armature 51a moves the extension 110 so as to open the switch 111, but the circuit through the timing device 112 is maintained by a conductor 121 which connects the contact 111 with the contact 116. The circuit which feeds the timing device 112 is kept closed until the contact 116 is moved to lowered position by a flow of current through the wire 119 and the contact 116, the wire 121, and the wire 114; therefore, the timing device 112 does not stop with the contact 116 in engagement with the contacts 117 and 118 but continues its operation until the movable contact 116 is moved into open relation to the contacts 117 and 118. A consideration of Fig. 5 shows clearly that the invention embodies the idea of reducing the volume of the actuating pressure fluid of the pumping system to a reduced value, or to zero value, when the pressure in the pipe 118 is raised to a predetermined value. Although Fig. 5 shows an automatic timing means for again increasing the volume of the pressure fluid, it will be recognized that the lever 49a, after being automatically moved to low speed position L, may be subsequently returned manually to high speed position H.

In Fig. 6 I have shown a form of the invention in which the pressure of fluid in the pipe 18 acts directly to reduce the volume of pressure fluid delivered into the pipe 18 and subsequently to the fluid operated pump unit 13. A casing 125 is provided having a bore 126, an inlet passage 127 connected to a source of fluid under pressure, and an outlet passage 128 to which the pipe 18 is connected. The passages 127 and 128 connect with the bore 126 in offset relation, and in the bore 126 is a movable member 129 which, to avoid the use of separate packing means, is ground to a close fit in the bore 126. The member 129 has a recess 131 leading upwardly from an annular shoulder 132 which, in ordinary operation of the device, is disposed slightly below the upper shoulder 133 of an annular shoulder 134 at the inner end of the inlet passage 127. The upper part of the channel or groove 131 in the member 129 is at all times in communication with the outlet passage 128. An annular channel 135 is formed in the upper part of the bore 126 and around the upper part of the member 129 for collection of the fluid which leaks upwardly through the bore 126 past the part of the member 129 above the channel 131. The passage 136 extends outwardly from the channel 135 through which this leakage fluid may be carried to a suitable means for disposal.

The lower end 137 of the bore 126 is closed by a wall 138, and the chamber 139 formed between this wall 138 and the lower end 141 of the member 129 is connected to the channel 131 of the member 129 through an axial passage 142 and radial passages 143. Accordingly, the pressure of the fluid in the pipe 18 and in the channel 131 is transmitted to the downwardly presented faces of the member 129, and tends to force the member 129 upwardly, or outwardly, in the bore 126 of the casing 125. This outward movement of the member 129 is resisted by a lever 145 which is hinged at 146 and has a weight 147 connected to the outer end thereof. The downward offset of the shoulder 132 relative to the shoulder 133 is determined by the position of an adjustment nut 148 which is threaded on the upper end of the member 129 and is adapted to engage the shoulder 149 formed in the upper part of the bore 126. The weight 147 is computed so that the lever 145 will bear downwardly against the upper end of the member 129 with a force calculated to resist a predetermined fluid pressure in the chamber 139 at the lower end of the member 129, this pressure in the chamber 139 representing the maximum pressure which is to be permitted in the pipe 18. In the operation of this form of the invention, the drop of the level of oil in the well and the consequent increase in the pumping head will cause an increase in the pressure of fluid in the pipe 18 and in the chamber 139, until the upward pressure against the member 129 exceeds the downward pressure exerted thereon by the lever 145, at which time the member 129 will move upwardly so as to carry the shoulder 132 upwardly past the shoulder 133 and cut off the flow of pressure fluid from the inlet passage 127 to the outlet passage 128 of the flow controlling device shown in Fig. 6.

Although I have herein shown and described my invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements or mechanisms which may be used in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but is to be accorded the full scope of the following claims.

I claim as my invention:

1. A method of operating a well pump so as to obtain substantially the maximum capacity of the well, comprising: operating the pump so that its capacity is greater than the capacity of the well whereby the level of liquid in the well will drop; reducing the capacity of the pump when the power required to operate the same reaches a predetermined high value; continuing the operation of the pump at such reduced capacity so that the level of liquid in the well will again rise so as to reduce the power required to operate the pump; and then increasing the capacity of said pump when the power required to operate the same reaches a predetermined low value.

2. A method of the character described for operating a well pump, comprising: operating the pump so that its capacity will be near the capacity of the well; noting the power required to operate said pump and reducing the capacity thereof when the power required for its operation increases to a value indicating that the liquid in the well has dropped to a prescribed low level; operating the pump at reduced capacity so that the level of liquid in the well rises; and increasing the capacity of the pump when the level of liquid in the well has reached a prescribed high level.

3. A method of the character described for operating a well pump, comprising: operating the pump so that its capacity will be near the capacity of the well; noting the power required to operate said pump and reducing the capacity thereof when the power required for its operation increases to a value indicating that the liquid in the well has dropped to a prescribed low level, so that the level of liquid in the well will rise; and increasing the capacity of the pump when the level of liquid in the well has reached a prescribed high value.

4. A method of pumping a well by the use of a pump actuated by a fluid operated motor fed with a flow of pressure fluid to drive the same, the pump and motor being positioned in the well and operating to pump fluid from the well comprising: reducing the flow of pressure fluid to the motor when the pressure thereof reaches a prescribed high value in response to an increase in load on said motor.

5. A method of pumping a well by the use of a pump actuated by a fluid operated motor fed with a flow of pressure fluid to drive the same, comprising: continuing the operation of said pump until the level of liquid in the well drops; reducing the flow of pressure fluid when the pressure thereof reaches a prescribed high value so that the capacity of the pump will be less than the capacity of the well; allowing the level of fluid to rise in the well; and then increasing the flow of pressure fluid.

6. A method of pumping a well by the use of a pump actuated by a fluid operated motor fed with a flow of pressure fluid to drive the same, comprising: feeding a flow of pressure fluid to said motor to operate said pump; discontinuing the feeding of said flow of pressure fluid to said motor when the pressure of the fluid reaches a predetermined high value; allowing the liquid in the well to rise to a higher level; and resuming the feeding of said flow of pressure fluid to said motor.

7. A method of pumping a well by the use of a pump actuated by a fluid operated motor fed with a flow of pressure fluid to drive the same, the pump and motor being positioned in the well and operating to pump fluid from the well comprising: reducing and increasing the volume of said flow of pressure fluid to the motor as the pressure of said pressure fluid respectively increases and decreases in response to increases and decreases in the load on said motor.

8. A method of pumping a well by the use of a pump actuated by a fluid operated motor fed with a flow of pressure fluid to drive the same, comprising: continuing the operation of said pump until the level of liquid in the well drops; reducing the flow of pressure fluid when the pressure thereof increases in response to a drop in the level of fluid in the well; and increasing the volume of said flow of pressure fluid when the decrease in the pumping head reduces the pressure of said flow of pressure fluid.

9. A well pumping device of the character described, including: a pump positioned in a well and adapted to pump fluid therefrom; a fluid operated motor also positioned in said well for operating said pump; means for feeding a pressure fluid to said motor to drive the same; a pressure responsive element connected to said pressure fluid feeding means, said pressure responsive element having a part moving back and forth in accordance with the rise and fall of the pressure of said pressure fluid; and control means connected to said moving part so as to be actuated thereby for reducing the flow of said pressure fluid when the pressure thereof rises to a prescribed value and increasing the flow of said pressure fluid when the pressure thereof drops to a prescribed value.

10. A well pumping device of the character described, including: a pump for placement in a well; a fluid operated motor for operating said pump; pressure tubing connected to said motor and adapted to supply pressure fluid to said motor to actuate it; power means adapted to supply said fluid to said tubing under pressure; a constant speed electric motor operatively connected to said power means; a pressure responsive element communicating with said pressure fluid and adapted to be actuated in response to a rise in pressure of said fluid; and control means operatively connected between said element and said electric motor for stopping said electric motor when the pressure of said fluid rises to a predetermined high value.

11. A well pumping device of the character described, including: a pump for placement in a well; a fluid operated motor for operating said pump; pressure tubing connected to said motor and adapted to supply pressure fluid to said motor to actuate it; power means adapted to supply said fluid to said tubing under pressure; a variable speed electric motor operatively connected to said power means; a pressure responsive element communicating with said pressure fluid and adapted to be actuated in response to a rise in pressure of said fluid; and control means operatively connected between said element and said electric motor for decreasing the speed of said electric motor when the pressure of said fluid rises to a predetermined high value.

12. A well pumping device of the character described, including: a pump positioned in a well and adapted to pump fluid therefrom; a fluid operated motor also positioned in said well for operating said pump; means adapted to supply pressure fluid to said motor to actuate it; and means operating in response to a rise in pressure of said pressure fluid to divert a portion

of the flow of said pressure fluid so as to reduce the flow of pressure fluid to said motor.

13. A method of pumping a fluid from a well, which comprises: pumping said fluid from said well at a rate faster than said well will normally produce; reducing the rate of said pumping as soon as the power required to pump said well rises to a predetermined high value due to the lowering of the fluid level in said well; allowing the fluid to flow into the well for a definite time interval; and increasing the rate of said pumping at the end of said time interval.

14. A method of operating a fluid operated pump in a well, including the steps of: supplying pressure fluid to actuate said pump so that the capacity of said pump will be greater than the capacity of the well; and reducing the supply of said pressure fluid when the pressure of said fluid reaches a predetermined high value.

15. A method of operating a fluid operated pump in a well, including the steps of: supplying pressure fluid to actuate said pump so that the capacity of said pump will be greater than the capacity of the well; reducing the supply of said pressure fluid when the pressure of said fluid reaches a predetermined high value; and increasing the supply of said pressure fluid when the pressure of said fluid reaches a predetermined low value.

16. A method of operating a fluid operated pump in a well, including the steps of: supplying pressure fluid to actuate said pump so that the capacity of said pump will be greater than the capacity of the well; reducing the supply of said pressure fluid when the pressure of said fluid reaches a predetermined high value; continuing the supply of said pressure fluid so as to operate said pump at reduced capacity until the pressure of said fluid reaches a predetermined low value; and increasing the supply of said pressure fluid when the pressure of said fluid reaches said predetermined low value.

17. A device for controlling the operation of a pump in a well, the pump being actuated by a fluid operated motor, there being power means for delivering high pressure fluid to the fluid motor to actuate it, the power means being actuated by an electric motor, including: electric switch means for de-energizing said electric motor; and means operatively connected to said switch means and operable in response to a predetermined increase in the pressure of said pressure fluid to operate said switch means to de-energize said electric motor.

18. A device for controlling the operation of a pump in a well, the pump being actuated by a fluid operated motor, there being power means for delivering high pressure fluid to the fluid motor to actuate it, the power means being actuated by an electric motor, including: electric switch means for reducing the speed of said electric motor; and means operatively connected to said switch means and operable in response to a predetermined increase in the pressure of said pressure fluid to operate said switch means to reduce the speed of said electric motor.

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