

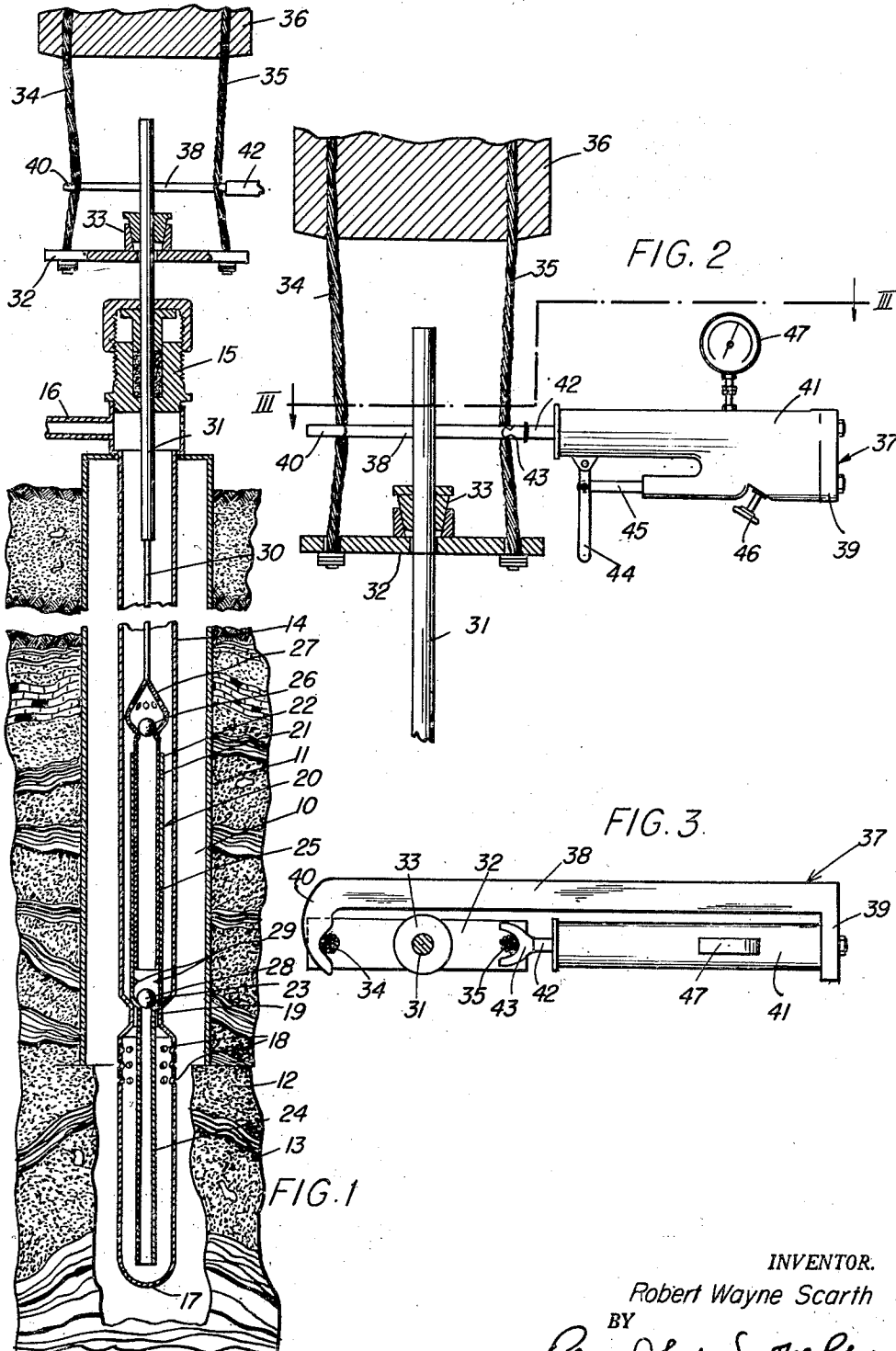
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WELL PUMP TESTING APPARATUS

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WELL PUMP TESTING APPARATUS

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This invention relates to a well tester, and more particularly a tester for use in connection with oil well pumping operations to indicate variations of the load supported by reciprocating elements of the well pump.

In oil well pumping operations, it is important to determine these changes of load throughout the course of reciprocations of the pump elements. Such changes indicate not only the operating condition of the well but also, to a great extent, the nature of any difficulty experienced in such operation.

The load on the reciprocating elements of an oil well pump is usually of great magnitude. Under present practice, the distortion of a steel ring held under compression by the load, or the stretch of a steel bar within its elastic limits, is employed for measuring the load and its variations. Instruments calibrated to read the force indicated by such distortion or stretch are associated with the ring or the bar to give the desired indications. These instruments, however, are expensive and complicated, are not portable, and require that the pumping apparatus be shut down during their installation, with undesirable loss of time.

The present invention provide a simple, inexpensive tester for determining and indicating changes in the weight of the load on the oil pumping apparatus. The tester is easily portable and may be applied to the pumping equipment without shut-down of the latter.

According to the invention, the tester comprises a light portable mechanism which is applied to a pair of the flexible reins of an oil pumping apparatus, by which the plunger of the pumping apparatus is reciprocated. The mechanism is applied and operated so as to deflect the reins with respect to one another and to measure the force required to maintain the deflection.

The tester is applied to the reins substantially at right angles to their normal parallel extent, so that the force required to maintain a given relative deflection of the reins is a definite function of the load on the reins. Furthermore, this force varies in definite relationship to the varying load on the reins, of which it constitutes a small but substantially constant proportion. A light-weight deflecting mechanism is thus made possible. Means is embodied in the deflecting mechanism for indicating the deflecting force, which is a measure of the load on the reins during the cycle of pumping reciprocation.

An illustrative embodiment of the invention is shown in the accompanying drawings, wherein:

Fig. 1 is a broken longitudinal midsection through an oil well, an oil well pump, apparatus for operating the pump, and a portion of the mechanism for relatively deflecting the reins;

Fig. 2 is an elevation, on an enlarged scale, of the oil well tester illustrating its application to the reins shown in Fig. 1; and

Fig. 3 is a cross-section taken on the line III—III of Fig. 2.

An oil well and a conventional pumping apparatus are shown in Fig. 1 in order to illustrate the application and

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functioning of the novel tester. Here there is shown an oil well comprising a bore 10, lined by a casing 11, the lower end of which rests upon a firm foundation 12. The bore extends below the foundation 12, penetrating the oil-producing zone 13. A continuous string of pipe 14 extends from a point near the bottom of the bore 10 substantially centrally through the casing 11 to the surface of the ground, and provides a passage through which the pump oil may flow out of the well. A stuffing box 15 closes the upper end of the string of pipe 14, for a purpose which will presently appear, and a spout 16, connected into the string of pipe immediately below the stuffing box, permits outflow of the pumped oil above the ground. The string of pipe 14 has a closed lower end 17 which is positioned in the bore 10 well down in the oil-producing zone 13. In order that oil may enter the string of pipe without carrying with it any appreciable quantity of sand, mud or solids, a number of perforations 18 are provided above the closed lower end 17 of the pipe. Furthermore, a constriction 19 is formed in the pipe a short distance above the perforations 18 therein for coaction with an oil pump 20 which will now be described.

The oil pump 20 includes a pump cylinder 21 with an open top 22 having at its lower end an inwardly-tapered shoulder 23, beyond which the cylinder continues in an integral coaxial tubular gas anchor 24. The pump cylinder has a diameter appreciably less than that of the string of pipe, in the lower part of which it is positioned with its integral gas anchor projecting through the constriction 19 and nearly to the closed lower end of the pipe. The inwardly tapered shoulder 23 of the pump cylinder rests upon and forms a closure with the constriction 19, preventing oil in the string of pipe from returning to the well.

The oil pump 20 also includes an open-ended hollow pump plunger 25 which has a close sliding fit within the cylinder 21. A ball check valve 26, carried within a perforated valve housing 27 at the top of the plunger, prevents return of oil into the hollow plunger on the up stroke but permits oil to leave the plunger and enter the string of pipe 14 on the down stroke. Coacting with the ball check valve 26 in the pumping operation is a second ball check valve 28 in the bottom of the pump cylinder 21, which normally seats upon the inner surface of the inwardly tapered shoulder 23 to cut off communication with the gas anchor. A plurality of prongs 29, annularly spaced and projecting inwardly of the pump cylinder 21 slightly above the seated check valve 28 limit upward movement of the latter.

The pump plunger 24 is connected in usual manner by a string of sucker rods 30 to a polished rod 31, which passes through the stuffing box 15 and is reciprocated to operate the pump. The polished rod has a highly finished surface in order that its reciprocation through the stuffing box may not destroy the packing. The polished rod is supported on a horizontal carrier bar 32 by a polished rod clamp 33 of known construction. The carrier bar is in turn connected by flexible cable reins 34 and 35 to reciprocating means, generally indicated at 36. Thus, the oil pump is operated by vertical movement of the reciprocating means.

Operation of the pumping apparatus is well understood. Oil enters the bore 10 from the oil-producing zone 13, and any sand, mud or solids settles to the bottom of the bore. The oil rises in the bore and enters the pipe through the perforations 18. Gas rises inside the casing 11, but does not enter the string of pipe 14 unless the gas column extends down to the perforations 18 and thence below the lower end of the gas anchor 24.

Upon rearward movement of the reciprocating means 36, the hollow plunger 25 moves upwardly and the ball check valve 26 remains closed. At the same time the

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second ball check valve 28 is lifted from its seat by the pressure of oil, or gas, beneath it and the release of pressure, or suction, above it; and oil enters the pump cylinder 21 through the gas anchor 24. On the up-stroke, the increased displacement effected by drawing the plunger 25 partly out of the pump cylinder 21 raises the oil level in the string of pipe 14 and causes oil to flow out of the spout 16. Such upward movement is opposed by the head of oil above the pump, and substantially the entire weight of the column of oil together with the weight of the sucker rod is transmitted to the cable reins 34 and 35. If the ball check valve 26 fails to close, or if excessive pressure enters the bore 10 from the oil producing zone 13, the weight carried by the reins 34 and 35 is reduced, and tension on the latter slackens.

Upon downward movement of reciprocating means 36, the weight of the string of sucker rods 30 moves the hollow plunger 25 downwardly in the pump cylinder 21 and the second ball check valve 28 returns to its seat thereby closing the connection between the pump cylinder and the gas anchor. Thereupon the first-named ball check valve 26 rises from its seat and oil flows from the pump cylinder out of the perforated valve housing 27 into the string of pipe 14. The seated second ball check valve thus sustains the entire weight of the column of oil, and only the weight of the polished rod, the string of sucker rods and the pump plunger is sustained by the cable reins 34 and 35. Tension on the reins therefore slackens on the downstroke.

If the ball check valve 28 at the bottom of the pump cylinder 21 fails to seat properly, then, on the downstroke, it cannot sustain the weight of the column of oil in the string of pipe. The ball check valve 26 in the plunger 25 therefore remains closed, and the weight of the oil column remains upon the cable reins 34 and 35 during the down-stroke. On the other hand, if the valve 26 in the plunger fails to close, then the entire weight of the oil column remains upon the valve 28 in the bottom of the cylinder and the reins will not assume this increased load on the up-stroke. If gas enters the pump cylinder, the load on the reins remains normal during the up-stroke; but on the down-stroke the load upon the reins is not relieved until the gas becomes compressed in the cylinder sufficiently to support the entire oil column and open the valve 26 in the pump plunger. Should the pump become completely gas-locked, then the only difference in weight carried by the reins on the up- and down-strokes will be that due to the inertia of the supported column of oil and the sucker and polished rods.

Thus the tension on the reins fluctuates, and the change in tension on the reins gives an indication not only of the operating condition of the oil well but also, to a great extent, of the nature of any difficulty. An oil well tester according to the invention provides simple, inexpensive means for continually indicating the changes in tension on the reins during pumping. The tester is light in weight and is easily handled, and it can be applied to the reins without stopping the pumping operation.

The tester 37 comprises a frame 38 having an abutment 39 formed at one of its ends and having its opposite end 40 so formed as to engage and bear against one of the flexible cable reins. In the embodiment here illustrated, and as best shown in Fig. 3, the end 40 of the frame is formed as an arm or hook to engage and bear against the outer side of a portion of one rein of the pair of cable reins, here the rein 34 which is farther from the tester body than the rein 35.

Means is carried by the frame 38 for applying pressure to deflect the reins relatively to one another. As here shown, a hydraulic jack or fluid pressure cylinder 41 is fixed to the abutment 39 of the frame 38 and includes a piston rod 42 extending outwardly thereof which carries a member 43 formed with a rein-engaging surface to engage and bear against the outer side of a portion of the other rein 35 of the pair of cable reins. Thus, 75

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by pumping a pressure fluid into the jack 41, the reins 34 and 35 may be deflected with respect to one another, such deflection being resisted by the tension on the reins. The reins are illustrated as deflected toward each other, but obviously such is not necessarily the case, and the parts of the tester might be arranged for opposite relative deflection of the reins without the contemplation of the invention.

The hydraulic jack illustrated at 41 is of a type available commercially at automobile supply stores. The internal construction of its fluid pressure cylinder and fluid passages is similar to that of the hydraulic jack shown in U. S. Patent No. 2,583,923, issued January 29, 1952.

A lever 44, acting through a rod 45, is operable by an attendant and serves to build up pressure in the jack 41, to which the valve control handle 46 is applied in the usual manner. The valve operated by handle 46 controls the build up and the release of pressure in the jack, thereby enabling the attendant to position the piston rod 42 as may be desired. In order that the tester constantly may give an indication of the pressure exerted thereon by the deflected reins, a pressure indicator is connected to the tester. Such pressure indicator is here shown as a gauge 47 connected to the jack 41.

When the piston rod 42 is fully retracted within the hydraulic jack 41, the end 40 of the frame and the member 43 are separated by a distance greater than the distance between the parallel cable reins 34 and 35. So arranged, the tester is placed around the reins and, usually as the pumping operation proceeds, pressure is built up in the hydraulic jack 41 until the hooked end 40 and the member 43 grip the reins between them, the tester being applied to the reins substantially at right angles to their initial parallel extent. The tester accordingly rides up and down with the reins. Pressure is then increased, relatively deflecting the reins, until the pressure gauge 47 has, for example, a reading at about its middle range, which may be of the order of three or four hundred pounds.

Since the pressure required to deflect the reins is a function of the tension, and therefore the load on the reins, the pressure gauge 47 at all times gives an indication of the operating condition of the well and of the nature of any difficulty with such operation. Furthermore, because the deflecting force is a small proportion of the weight on the reins, it is possible to make the tester of light, portable and easily handled construction.

The tester may, of course, be constructed for permanent attachment to the reins. Moreover, testers constructed according to the invention are operable in connection with apparatus wherein the reciprocating means 36 and the center bar 32 are positioned close together.

The form of the invention here described and illustrated is presented merely as an example of how the invention may be embodied and applied. Other forms, embodiments and applications of the invention, coming within the proper scope of the appended claims, will of course suggest themselves to those skilled in the oil well pumping art.

I claim:

1. A portable well testing device adapted to be attached manually to a pair of well pump reins, said device comprising a frame having an abutment at one end thereof and a hook at its opposite end for engaging and bearing against one side of one of said reins, a hydraulic jack fixed to the abutment of said frame having a piston rod projecting outwardly therefrom toward the hook on said frame, said piston rod having on its outer end a member for engaging and bearing against a side of the other of said reins opposite to said one side, means for applying pressure within said jack to move its piston rod toward the hook on said frame with a force sufficient to deflect the reins toward one another, and a pressure gauge connected to said jack for indicating the pressure therein as the well pump is reciprocated and the tension on the reins fluctuates.

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2. A portable well testing device adapted to be attached manually to a pair of well pump reins, said device comprising a fluid pressure cylinder having a piston movable therein by fluid pressure, a first member connected to and movable with said piston and formed to engage one side of one of said reins, a second member operably connected with said cylinder and formed to engage a side of the other of said reins opposite to said one side, manually operable means connected with said cylinder for injecting a pressure fluid thereinto to move said piston relative to said cylinder and thereby move said members relatively under a force sufficient both to deflect said reins laterally in opposite directions and to support the weight of said device by the engagement of said members with said reins, a pressure indicator connected with said cylinder for indicating the fluid pressure therein, and manually operable means for releasing fluid pressure from said cylinder so that said members may move relatively to disengage said device from said reins.

3. A portable well testing device adapted to be attached manually to a pair of well pump reins, said device comprising a fluid pressure cylinder having a piston movable therein by fluid pressure, a first member connected to and movable with said piston and formed to engage one side of one of said reins, a second member

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operably connected with said cylinder and formed to extend transversely across the normal parallel extent of both of said reins, said second member being formed to engage a side of the other of said reins opposite to said one side, manually operable means connected with said cylinder for injecting a pressure fluid thereinto to move said piston relative to said cylinder and thereby move said members relatively under a force sufficient both to deflect said reins toward each other and to support the weight of said device by the engagement of said members with said reins, a pressure indicator connected with said cylinder for indicating the fluid pressure therein, and manually operable means for releasing fluid pressure from said cylinder so that said members may move relatively to disengage said device from said reins.

References Cited in the file of this patent

UNITED STATES PATENTS

2,189,552	Raphael	Feb. 6, 1940
2,324,174	Rodgers	July 13, 1943
2,396,916	Guthrie	Mar. 19, 1946

FOREIGN PATENTS

450,070	Great Britain	July 9, 1936
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