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MONITOR FOR PUMPING SYSTEMS

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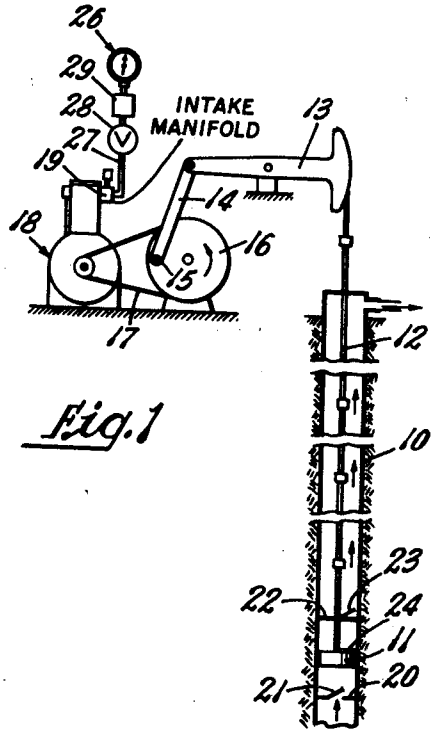

Fig. 1

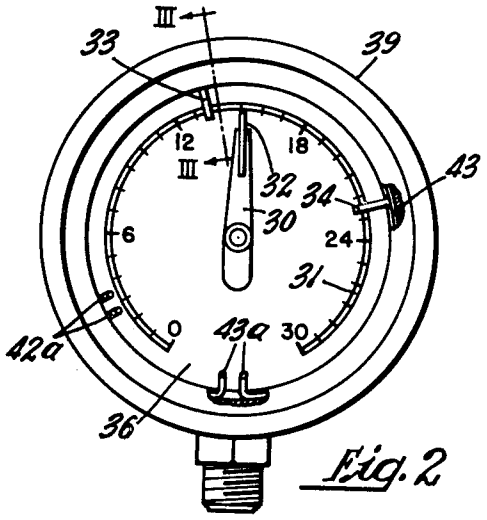

Fig. 2

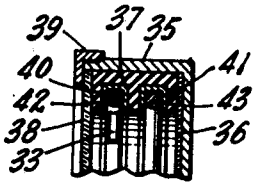

Fig. 3

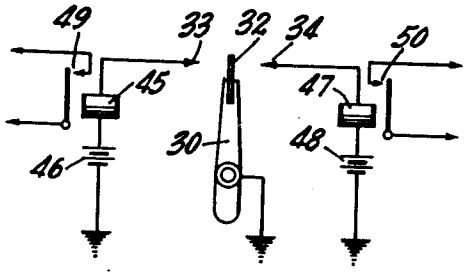

Fig. 4

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MONITOR FOR PUMPING SYSTEMS

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1 Claim. (Cl. 73—151)

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This invention relates to indicating devices for automatically indicating an abnormal condition in a pumping system involving a pump driven by a prime mover and is particularly adapted for use in systems of this type in which the pump is driven by an internal combustion engine.

An object of the invention is to provide a monitoring device that will produce an indication in response to any condition that produces a change in the load on a pump.

A more specific object is to provide a monitoring device of the type referred to which is particularly simple and inexpensive.

Another object is to provide a monitoring device of the general type indicated that is capable of responding to a wide variety of abnormal conditions.

Other more specific objects and features of the invention will become apparent from the detailed description to follow.

Briefly, the present invention, as applied to a pump driven by an internal combustion engine, comprises a pressure gauge connected to the intake manifold of the engine and having electrical contacts adapted to be closed by a departure of the intake manifold pressure from a predetermined range. The contacts can be so arranged as to close a circuit in response to either an increase in the pressure above or a decrease in the pressure below a predetermined range, or it can be responsive to both conditions.

In oil fields where oil wells are being pumped, it is most frequently desirable to produce an indication when the oil supplied to the pump is supplanted by gas, causing the pump to deliver only gas for a considerable interval of time. Such a condition is indicated in accordance with the present invention because the load on the engine is reduced, thereby causing it to run faster and develop a higher vacuum (lower pressure) in the intake manifold. Another condition that can obtain is for the sucker rod string to break, thereby disconnecting the pump from the engine. This likewise reduces the load on the engine and causes an increase in the vacuum in the intake manifold. The extent to which the load on the engine is reduced by such a circumstance will depend upon the point in the well where the sucker rods part. However it has been found in practice that even though the rod breakage occurs very near the bottom of the well, the resultant reduction in load is sufficient to materially increase the vacuum in the intake manifold of the engine.

It is also possible for situations to arise which increase the load on the engine, thereby decreasing the vacuum (increasing the pressure) in the intake manifold, and the invention can be used to indicate such situations.

A full understanding of the invention may be had from the following detailed description with reference to the drawing, in which:

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Fig. 1 is a schematic diagram of an oil well pump driven by an internal combustion engine and showing apparatus in accordance with the invention attached thereto;

Fig. 2 is a front elevation view with parts broken away of a vacuum gauge equipped with adjustable electrical contacts that can be employed in the practice of the invention;

Fig. 3 is a detail sectional view taken in the plane III—III of Fig. 2; and

Fig. 4 is a schematic diagram of a circuit that can be employed in the practice of the invention.

Referring first to Fig. 1, there is indicated schematically a deep well having a casing 10, the extreme lower portion of which constitutes a pump cylinder containing a piston 11 which is adapted to be reciprocated by a string of sucker rods 12 which extends up through the well to the surface and is connected to one end of a walking beam 13. The other end of the walking beam is shown connected by a connecting rod 14 to a crank 15 on a pulley 16 which is connected by a belt 17 to an internal combustion engine 18 having an intake manifold 19. The showing of the pump and the well is of course highly schematic.

The portion of the casing 10 constituting the pump cylinder is shown closed at the bottom by a partition 20 containing an intake valve 21, and closed at the top by a partition 22 having an outlet valve 23. The piston 11 contains a valve 24. The result is that when the piston moves upwardly its valve 24 is closed and it forces fluid through the valve 23 and up through the casing while at the same time admitting fluid into the barrel below the piston through the intake valve 21. On the other hand, during the downward stroke of the piston 11 the valves 21 and 23 close, but the piston valve 24 opens to permit fluid below the piston to move therethrough as the piston descends.

In normal operation, the load on the engine 18 varies periodically during different portions of each pump cycle, but the average pressure in the intake manifold 19 remains constant so long as the load on the engine remains constant. The load in turn remains constant so long as the supply of oil to the pump cylinder remains constant. However, various abnormalities in the system cause a change in the pressure in the intake manifold 19, which change is caused to produce an indication.

Thus referring to Fig. 1, there is shown connected to the intake manifold 19 a pressure gauge 26, connection being effected through a pipe 27, a regulating valve 28 and a reservoir 29.

The purpose of the valve 28 and the reservoir 29 is to filter from the gauge 26 the relatively

rapid periodic fluctuations of the pressure within the intake manifold which result from the cyclical operation of the engine 18 and the cyclical operation of the pump. Any desired degree of filtering can be obtained by adjusting the valve 28 and properly choosing the size of the reservoir 29. The smaller the opening of the valve 28 and the larger the capacity of the reservoir 29 the more momentary or periodic variations in pressure are prevented from reaching the gauge 26. However if the filtering is carried too far, the time for response of the gauge 26 to a change in the pressure in the intake manifold 19 is excessively increased, so that a compromise must be made.

The valve 28 and the reservoir 29 also make it possible to produce an integrating effect, whereby the gauge 26 will be actuated to the same extent either by a large change in pressure in the intake manifold 19 acting for a short time, or a small change which remains in effect for a longer time. In other words the gauge 26 can be made to respond quickly to a complete cessation of oil flow into the well and can also be made to respond to a diminished flow of oil over a longer period. In many instances it is highly desirable to produce a prompt indication of a radical change in the flow of oil, whereas it is not necessary to produce an indication of a small change in the oil supply unless the change persists for some time.

The gauge 26 may be of various types but one particular construction that can be employed is shown in Figs. 2 and 3. Referring to these figures, the gauge has the usual hand 30 and scale 31. It differs from a conventional gauge in having an electrical contact 32 on the hand 30 which cooperates with a pair of adjustable contacts 33 and 34 respectively. The contact 32 may be electrically connected to the hand 30 which in turn is electrically connected to the case of the gauge through the usual actuating mechanism. On the other hand the contacts 33 and 34 are insulated from the case. Thus as shown in Fig. 3, the portion of the peripheral wall 35 of the gauge that projects in front of the usual dial 36 may contain a ring 37 of electrically insulating material, which ring is positioned between the dial 36 and the glass window 38 of the gauge, the window being shown retained in position by the usual threaded flange 39. The insulating ring 37 is provided with two internal annular grooves which contain annular channel-shaped metal rings 40 and 41 which contain a pair of split rings 42 and 43 respectively. As shown in Fig. 2 the ends of the ring 43 are bent at right angles to form inwardly extending end portions 43*a*. Likewise the ends of the ring 42 are bent inwardly as indicated at 42*a*. By pinching the two ends 43*a* together the ring 43 can be rotated within the channel-shaped ring 41 to position the contact 34 in any desired position. Similarly the contact 33 can be adjusted by pinching the ends 42*a* together and rotating the ring 42. The contact member 34 which is secured to the ring 43, and the contact member 33 which is secured to the ring 42 are so bent as to both lie in the path of travel on the contact 32 on the hand 30.

The positions of the contacts 33 and 34 can be determined by experiment so that an increase in the manifold pressure beyond a predetermined value will carry the contact 32 against the contact 34 and a decrease in pressure below the predetermined range will close the contact 32 on the contact 33.

The contacts 33 and 34 can be connected either in the same or in different circuits. In the schematic circuit of Fig. 4 they are shown in different circuits. Thus in this circuit the hand 30 carrying the movable contact 32 is shown connected to ground, but the contact 33 is connected to ground through a relay 45 and a battery 46, whereas the contact 34 is connected to ground through a relay 47 and a battery 48. Obviously in the arrangement of Fig. 4, if the contact 32 closes on the contact 33, the relay 45 is actuated to close contacts 49, whereas if the contact 32 closes on contact 34 the relay 47 is actuated to close a pair of contacts 50. The contacts 49 can be connected in any desired alarm circuit and the contacts 50 can similarly be connected in any form of alarm circuit.

It will be apparent from the foregoing description that the apparatus is exceedingly simple; compact and inexpensive. At the same time it has been found in practice that it is very reliable in responding to slight changes in the oil production of the well to which it is applied. In addition, it is responsive to any other condition, such as improper operation of or shut-down of the engine 18, which is a desirable feature.

Although for the purpose of clearly explaining the invention, a specific embodiment thereof has been disclosed and described in detail, various changes from the exact arrangements shown in the drawing will be apparent to those skilled in the art and the invention is to be limited only to the extent set forth in the appended claim.

I claim:

Apparatus comprising: a reciprocating well pump; an internal combustion engine connected to said pump for driving it, said engine having an intake manifold; a chamber; a pressure switch connected to said chamber and responsive to pressures above and below a predetermined range corresponding to the manifold pressure range during normal operation of said pump; and means defining a restricted passage connecting said chamber to said manifold, said restricted passage being substantially smaller than necessary to filter cyclical pressure changes occurring during each pumping cycle of said reciprocating pump, whereby said switch is actuated relatively promptly in response to a substantial departure of the manifold pressure from said predetermined range, and is actuated in response to a slight departure of the manifold pressure from said predetermined range only in response to continuation of said slight departure for a substantial interval of time.

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