This invention relates to an automatic oil well pumping and timing device and has as its primary object the provision of an automatic means which will energize and de-energize a pump motor in accordance with the level of fluid in the bottom of the well.

An additional object of the invention is the provision of a device of this character which will actuate the pump when the fluid level in the well reaches a predetermined high point, and which will maintain the pump in operation during the lowering of the fluid to a predetermined low level, at which time the pumping motor will be de-energized.

A further object of the invention is the provision of an automatic means whereby after the pump has been de-energized upon the achievement of a predetermined low level in the well, that a rise in fluid level will not reactivate the motor until a predetermined high level has been reached.

A further important object of the invention is the provision of a recording means in association with such a device, which will record on a suitable chart the periods of time during which the pump is running as well as the periods of time during which the pump is not running.

As a conclusive to a clearer understanding of this invention, it may here be pointed out that in the oil fields there are so-called stripper wells. These wells have been substantially exhausted but may produce, with suitable pumping, from one to forty or fifty barrels daily. Such wells have very low bottom hole pressure. An important object of the invention is the provision of means to be utilized in such wells whereby the pump is only actuated when the fluid level is above the perforations in the tubing, which are a few feet under the pump. In the event that a well has been pumped off, that is, pumped below the level of the perforations in the tubing, it is extremely harmful to the equipment in that the pump will suck gas out of the casing above the fluid, which in certain instances, will gas lock the pump. Additionally, gas in the tubing will travel to the top of the well where the polish rod is traveling through the stuffing box. This will heat the polish rod and burn out the gaskets in the stuffing box, in the absence of lubricant and cooling fluid. Subsequent to this, when the fluid reaches the top it will spray. Herefore, such wells have been shut down and started again largely by guesswork, and in many instances severe damage has been done to the equipment.

An important object of this invention is, therefore, the provision of a means including float actuated switches located in the well and relatively close to the bottom thereof, which will energize and de-energize the motor actuating the pump in the manner previously described so that the pump will operate only when the fluid has reached a predetermined level, and be automatically de-energized when the fluid has been pumped to a predetermined lower level, without being actuated, when the level has again built up in the well to the desired high level.

It should also be pointed out that the chart in association with the float switches will disclose a definite pattern for an individual well, and any unusual deviation from this pattern, indicated on the chart automatically, would be an indication of difficulty in the pumping system or other equipment. It is a further important object of this invention to Thus record the time required for running the pump to reduce the fluid level the required distance, as well as the time required for the well to refill such distance, in order that deviations in the normal pattern of a given well may be readily detected.

A further important object of the invention is the provision of an indicating means which may be employed in a single central location in conjunction with a plurality of wells, the individual performance of each well being indicated separately on the chart.

Still other objects of the invention reside in the combinations of elements, arrangements of parts, and features of construction, all as will be more fully pointed out hereinafter and shown in the accompanying drawings wherein there are disclosed preferred embodiments of this inventive concept.

In the drawings:

FIGURE 1 is a schematic view of one form of apparatus constructed in accordance with the invention, in association with a well, the well having two float switches therein in their up position, indicating that the fluid level is at least up to the uppermost switch, in which position the upper switch is in circuit closing position and the lower switch in circuit opening position.

FIGURE 2 is a view similar to FIGURE 1, parts thereof being omitted, showing the upper switch in its lower position or circuit opening position, and the lower switch in its up position or circuit opening position, indicating that the fluid level is somewhere between the two switches.

FIGURE 3 is a view similar to FIGURES 1 and 2, but indicating both the upper and lower switches in their down position, with the upper switch being in circuit opening position and the lower switch being in circuit closing position, indicating that the level of fluid in the well is below the lowermost switch.

FIGURE 4 is a fragmentary view partially in section, and partially in elevation, showing a detail of the lowermost float switch, which is substantially identical in construction to that of the upper switch.

FIGURE 5 is an enlarged sectional view taken substantially along the line 5—5 of FIGURE 4 as viewed in the direction indicated by the arrows.

FIGURE 6 is a sectional view showing schematically the control for the recording mechanism in accordance with the position of the float switches, FIGURE 6 showing the position of certain-solenoid controlled elements when the switches are in the position of FIGURE 1.

FIGURE 7 is a view similar to FIGURE 6, certain parts thereof being omitted, showing the position of certain mechanism for controlling the motor when the switches are in the position of FIGURE 2.

FIGURE 8 is a view similar to FIGURE 7 showing the mechanism when the float switches are in the position of FIGURE 3.

FIGURE 9 is a fragmentary, partially schematic view, of the upper float switch shown in full lines in circuit closing position, and in dotted lines in circuit opening position.

FIGURE 10 is a view similar to FIGURE 9 but showing the lower switch in full lines in up circuit or circuit open position and in dotted lines in circuit closing or down position.

FIGURE 11 is a fragmentary plan view of a modified form of recording apparatus wherein the performance of a plurality of wells are indicated on a single chart; and

FIGURE 12 is a schematic cross sectional view of the chart of FIGURE 11 showing the actuating mechanism therefor.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Having reference now to the drawings in detail, there is generally indicated at 20 a well head control apparatus from which a pipe 21 extends into a well bore 22 of a stripper well, the pipe extending nearly to the bottom of
the well and being provided adjacent its bottom with per-
fect water. A first or lower float switch assembly, gen-
erally indicated at 24, is secured about the pipe 21 at a
position closely above and adjacent to the perforations 23.
A second or upper float switch assembly 25 is positioned
a suitable distance above switch assembly 24, the switch
assemblies and their operation to be more fully described
hereafter. An electrical contacting switch 26 is connect-
ing from both switch assemblies 24 and 25 to a control and
recording mechanism 27a, which may be contained in a
housing 27, having a visual opening 28 therein. The hous-
ing 27 is provided with a conduit 29 through which extend
wires 30 and 31 (see FIGS. 6, 7, and 8) which extend from a
suitable source of electrical power. A conduit 33 ex-
tends from the casing 27 to the motor 34 which serve to
operate a suitable pump (not shown) in the tube 21 ad-
ja cent the lower switch assembly 24.

Referring now to the switch assemblies 24 and 25, each is
part of a clamping band 35 which is provided with projec-
ting ends 36 which are clamped about tube 21 by means of a
bolt and nut 37. The clamping bands termi-
minate at one side in a plate 38 which has a reverted end
portion 39 forming a sleeve in which is mounted a pivot
pin 39a, the pin extending into the ends of opposite floats
40 which extends from some of which, 41, contains a
mercury switch. The parts heretofore described are common to both switch
assemblies 24 and 25, the distinction being shown more
clearly in FIGURE 9 wherein a second mercury switch 42
of float 41 of second switch assembly 25 is provided with
wires 43 and 44 leading to contacts in the end of mercury
tube 42, most nearly adjacent pivot pin 39a. The arrange-
ment is such that when the second switch assembly
25 is tilted to its uppermost position, the circuit, to be
more fully described hereinafter, is closed, the circuit
being broken when the second switch assembly 25 moves to its lower or dotted line position. First mercury
switch 42 of first switch assembly 24 is substantially
identical and is mounted on an identical float 41 with
the exception of the fact that wires 45 and 46 extend to suit-
able contacts in the end of mercury tube 42a remote from
the pivot pin 39a so that when the first switch assembly 24
is in its uppermost position indicating that the level of
fluid is thereabow, a circuit, to be more fully described
hereinafter through wires 45 and 46, is opened, but when
the float 41 of first switch assembly 24 drops to its lower-
most position indicating that the level of fluid is there-
below, a circuit is closed through wires 45 and 46.

Assuming that the switch assemblies are both in their
uppermost position as indicated in FIGURES 1 and 6,
an actuating circuit is established from wire 43 to a first
solenoid coil 50, the circuit comprising line 39, terminal
51, line 44, switch assembly 25, line 43, solenoid coil, line
52 from the other side of first solenoid 50, terminal 53,
and wire 31. Closure of the first solenoid 50 serves through a rod 54 to pivot an actual arm 55 against a
spring contact finger 56 which engages a contact 57 car-
ried thereby with an opposed contact 58 carried by a sec-
ond spring finger 59. Fingers 56 and 59 are normally
separated by a coil spring 60. From the contact 58, a
wire 61 forming part of a motor circuit leads to one side of
motor 34, the other side of which is connected directly
to wire 31, the arrangement being such that closure of
contacts 57 and 58 energizes the motor 34 which in turn
actuates the pump. Simultaneously with the actuation of
the pump 14, wires 62 and 63 forming part of a recording
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circuit and which extend from terminals 64 and 65 in wires
61 and 31, respectively, energize a second solenoid 66
which through a link arrangement 67, moves a pen or
styles 68 about a pivot 69 into engagement with a record-
ing disc 70. The pen or styles 68 is rotated by any suitable timing mechanism of conventional character (not shown). Along
as the upper switch assembly 25 is in circuit closing posi-
tion the motor 34 will be energized through the contacts
57 and 58, and simultaneously the period of activation will
be recorded on the time chart disc 70 by pen 68, since the
second solenoid coil 66 is energized to move the pen into
operative position as long as the motor 34 is running.
Since, however, it will take a very short time to lower
the fluid level in the well bore to an extent sufficient to tilt
switch assembly 25 to its down or circuit open position,
and de-energize first solenoid 50, means are provided for
maintaining contacts 57 and 56 in closed position me-
chanically reenergizing the energization of the first
solenoid 50. Such means take the form of a latch means
including a latch 71 mounted on the end of a latch arm 72
which is pivotally mounted as at 73 in casing 27. A spring
74 normally biases latch arm 72 into the position shown in
FIGURE 6 with the spring arm 76 held in position to en-
gage its contact 77 with the associated contact 58. This
condition prevails during the pumping of the well down to a level below switch assembly 24, at which time switch
assembly 24 moves to its down position and closes a
latching circuit through wires 48 and 46 to an additional
or third solenoid coil 75, the circuit being through wire 39,
terminal 51, wire 76a, third solenoid coil 75, wire 45,
switch assembly 24, and wire 46 back to line 31. Ener-
gization of the additional or third solenoid coil 75 causes
movement of a link 76 which pivots the arm 72 to the
position shown in FIGURE 8, at which time the spring
76a returns spring arm 76 away from its associated spring arm 59, and breaks contact between the contacts 57 and 28
to de-energize the motor.

The parts remain in this position, with the motor inop-
erative, and the pen 68 out of engagement with its time
chart through the de-energization of solenoid 66 simul-
taneously with the de-energization of motor 34 until fluid
seeps into the well, to an extent to move switch assembly
24 to its up position, at which time third solenoid 75 is
de-energized, and the spring 74 moves the switch latching
arm 72 back to the position shown in FIGURE 7. At this
time all of the mechanism is de-energized and remains
d-energized during the refill phase of the well, until the fluid
level reaches a point at which it moves upper float switch
assembly 25 upwardly to its circuit closing position, at
which time energization of first solenoid 50 re-energizes
motor 34 and its associated pump, and starts the cycle
again described.

In some instances it is desired that a record of the
pumping activity of a plurality of wells be simultaneously
recorded. In this case the chart mechanism takes the
form shown in FIGURES 11 and 12, wherein a roller type
chart 89 is mounted on a drive roller 81 and an idler roller
82, by means of a mechanical indexing means as shown in
this case taking the place of the disc chart 70. A plurality
of pens 89 are provided, each one being associated with
operating mechanism including float switch assemblies 24
and 25 and their associated circuitry in a different well.
However, in this instance of multiple wells, individual
solenoids 66a are provided for each well similar to the
second solenoid 66 shown in FIGURE 6. Each solenoid
66a is activated upon the energization of the appropriate
motor and its associated well to move a link 67a which
moves an operating arm 68a which is pivotally mounted
in any desired manner on a pivot 69a. A spring holder
84 biases, by means of a spring 85 the arm 68a down-
wardly towards the position shown in the right hand side
of FIGURE 12. Energization of the solenoid 66a over-
comes the bias of spring 85 and by means of the engage-
ment of a split or bifurcated end 86, engaging the end of a
pen carrying lever 87, pivoted as at 88, causes a record-
ing pen 89 to engage the chart 89. As the chart moves
linearly beneath the engaged pen point 89, as shown in the
left hand side of FIGURE 12, a continuous time record is
kept of the operation of each individual well. When the
solenoid 66a is energized in the manner previously des-
cribed, spring 85 moves its associated pen 89 out of
engagement with the record roll 80, the particular pen
remaining in non-recording position until such time as its
associated solenoid is re-energized in the manner pre-
viously described.
From the foregoing it will now be seen that there is herein provided an improved automatic control for oil wells, and more particularly for stripper wells, which accomplishes all of the objects of this invention, and others, including many advantages of great practical utility and commercial importance.

As many embodiments may be made of this inventive concept, and as many modifications may be made in the embodiments hereinbefore shown and described, it is to be understood that all matter herein is to be interpreted merely as illustrative, and not in a limiting sense.

I claim:

1. Apparatus for controlling the pumping of oil wells through pump means operatively connected to tubes extending into said wells and having a plurality of perforations adjacent their lower ends comprising a first float switch assembly pivotally mounted on the tube in a well directly above the perforations therein, a second float switch assembly pivotally mounted on the tube a desired distance above said first float switch assembly, said first float switch assembly including a first mercury switch having a pair of spaced contacts and a quantity of mercury sufficient to close said contacts when said first float switch assembly is tilted downwardly by droppage of the fluid level in the well below said first float switch assembly, said second float switch assembly including a second mercury switch having a pair of spaced contacts and a quantity of mercury sufficient to close said last-mentioned contacts when said second float switch assembly is tilted upwardly by rising of the fluid level in the well above said second float switch assembly, a motor to drive the pump means operatively connected to the tube, means defining a motor circuit, a pair of contact fingers having normally spaced contacts in said motor circuit, a first solenoid coil operatively connected to said contact fingers to close the space between said last-mentioned contacts, means defining an actuating circuit including the contacts in said second mercury switch and said first solenoid coil to energize said first solenoid coil and thereby close said motor circuit when said second switch assembly is tilted upwardly, latch means normally biased to hold said contacts on said fingers in closed relationship, an additional solenoid coil operatively connected to said latch means to release the same, and means defining a latching circuit including said contacts in said first mercury switch and said additional solenoid coil to energize said additional solenoid coil and thereby release said latch means when said first mercury switch is tilted downwardly.

2. A structure in accordance with claim 1 wherein one of said fingers is spring biased to maintain its associated contact in spaced relationship to the contact on said other finger, said latch means including a spring biased pivotally mounted latch arm having a latch thereon engageable with said one finger to retain the same in contact engaging position after said first solenoid means has been energized and until said additional solenoid means is energized.

3. A structure in accordance with claim 1 further comprising a recording means including a movable chart and a pen, and means defining a recording circuit energized when said motor circuit is closed and including a third solenoid operatively connected to said pen to move the same into recording engagement with said chart.

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