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WELL PUMPING SYSTEM AND RELATED CONTROL

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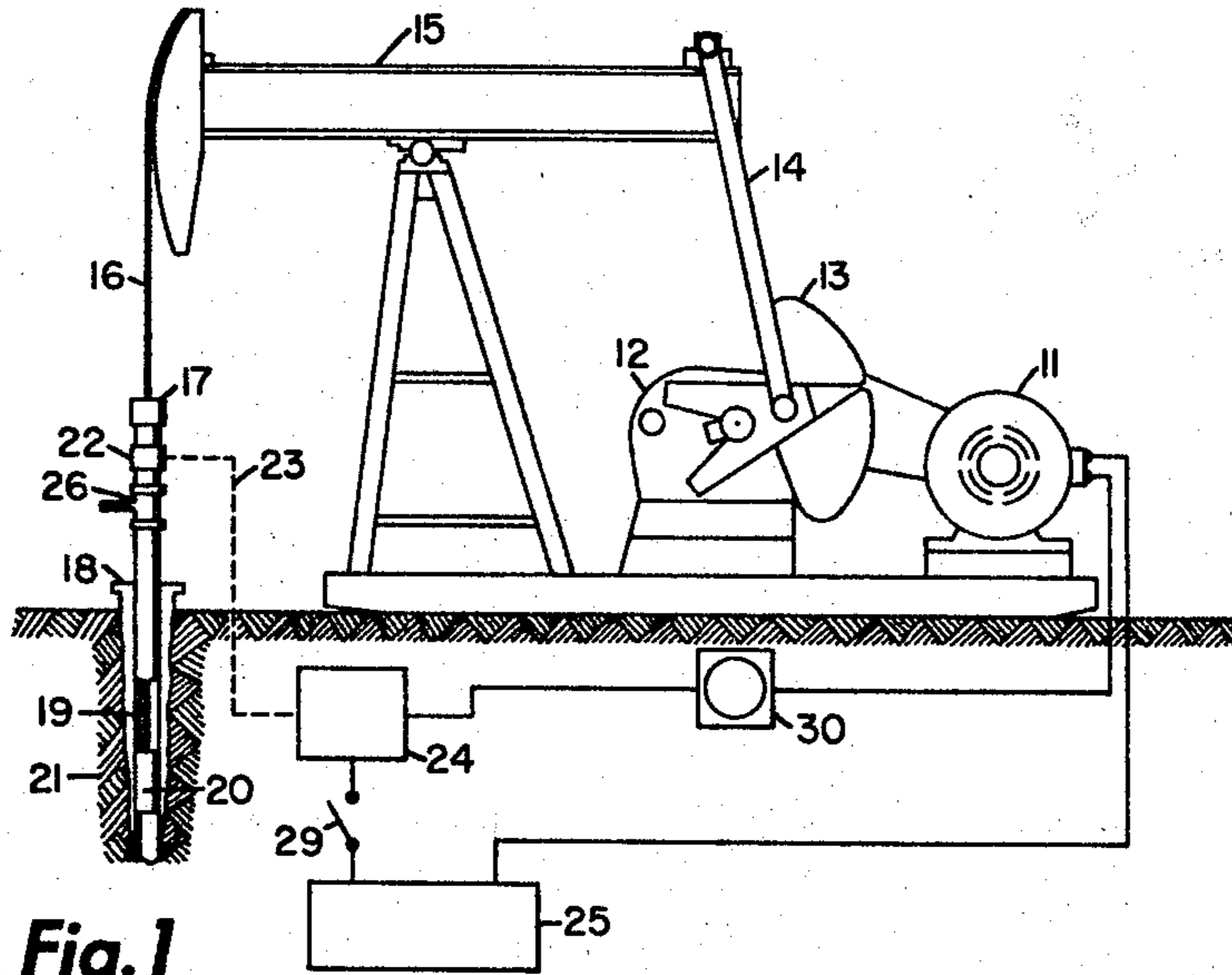


Fig. 1

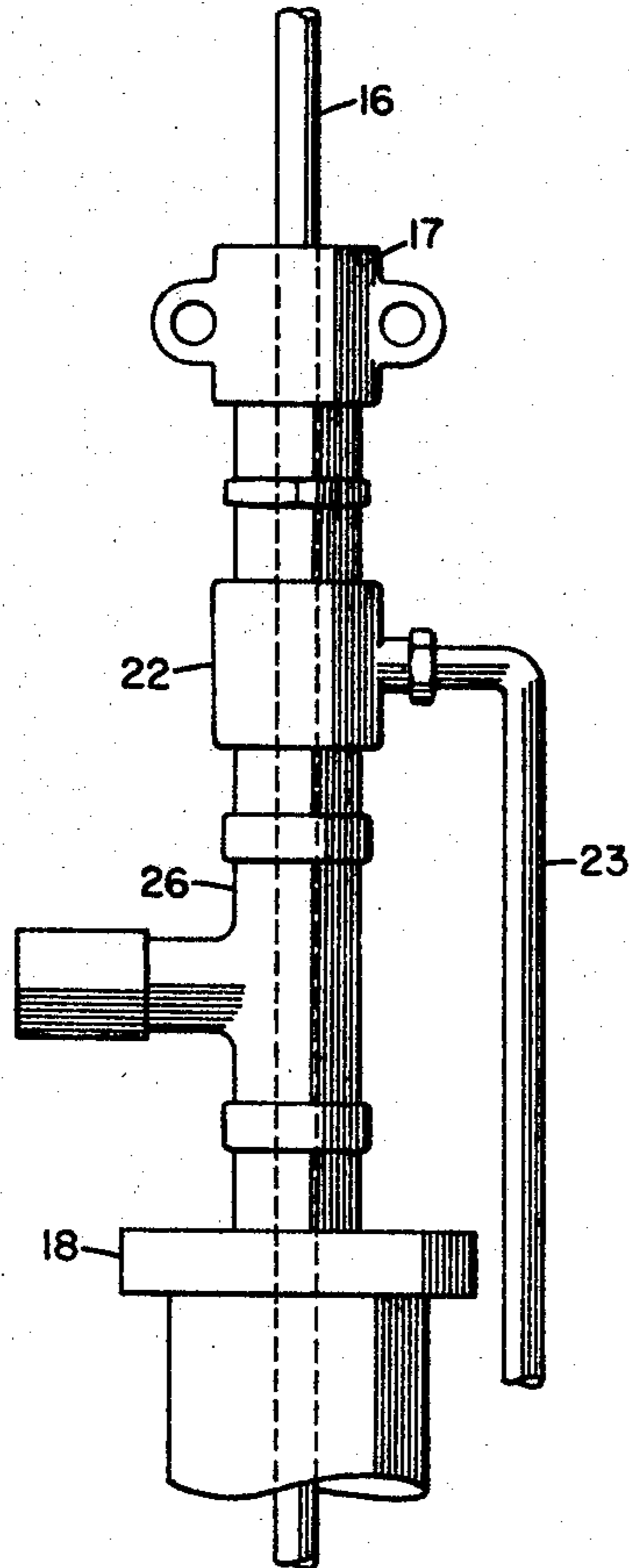


Fig. 2

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**WELL PUMPING SYSTEM AND
RELATED CONTROL**

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ABSTRACT OF THE DISCLOSURE

A control system for well pumping units having external power means connected by a polish rod to a well pump. Temperature sensing means in a stuffing box control the external power means in response to the heat generated by the polish rod.

The present invention relates to new systems for the pumping of fluids from wells and in particular relates to control systems for preventing hazards and difficulties previously experienced from overheating of polish rods connecting well pumps with drive mechanisms.

Typically, fluids are pumped from wells, e.g. oil wells, by reciprocating pumps located within the wells which are actuated by drive means usually operating through a "walking beam." The walking beam is driven through a Pitman which serves to convert the rotary motion of an electric motor into reciprocating motion for actuating the well pump.

In such installations the well pump is connected to the end of the walking beam by a polish rod (sucker rod or other elongated member) which reciprocates through a stuffing box that prevents loss of fluid from the well.

In most wells which require pumping, the pump must have a daily capacity greater than the amount of fluids which enter the well from the surrounding formations. Under such circumstances the pump will lose fluid by "sucking the well dry" unless the pump is shut down for some portion of each day. This shut-down is most frequently conventionally accomplished by the use of timing clocks which are set to permit the pump to operate for a certain number of hours out of each day. Such clocks give only an approximate correlation between the amount of fluids available for pumping and the length of time the pump operates. Other known techniques include the use of liquid sensing devices on the outlet of the well which determine when the pump has lost its prime of liquid and then actuate a timer which restarts the pump after a preset interval. (See for example, U.S. 2,550,093 to Smith.) These latter devices are relatively expensive and because moving parts of the flow indicating devices are exposed to the corrosive fluids coming from the well, such devices are subject to failure.

The present invention exposes no moving parts to the fluids and in fact, need not contact the corrosive well fluids in any manner. In addition, the present invention permits automatic proportioning of the pumping interval to the fluids available for pumping with low cost, highly dependable control means which, in preferred embodiments, involve no moving parts whatsoever.

The polish rod in most conventional wells is cooled and often is lubricated by the liquid being pumped from the well. If this cooling or lubrication stops, the polish rod will begin to increase in temperature due to the friction between the polish rod and the packing. The present invention utilizes this increase in temperature of the polish rod to actuate a temperature sensing device, which in turn, causes discontinuance of the reciprocating action of the polish rod and therefore of the pump. By utilizing a conventional adjustable range thermostatic switch, the delay between the discontinuance and the resumption of pumping may be easily varied.

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FIGURE 1 is an illustration of a preferred embodiment of the present invention.

FIGURE 2 is a detail of the embodiment of FIGURE 1 showing the location of the temperature sensing device near the stuffing box.

In FIGURE 1 an electric motor 11 is connected through speed reduction means 12, crank 13 and Pitman 14 to one end of the walking beam 15. The other end of the walking beam 15 is connected to a polish rod 16 which passes through a stuffing box 17 and extends downward through the casing head 18 and the well-bore 19 to connect with pump 20 located below the static fluid level in the well drilled into fluid bearing formation 21. A temperature actuated variable range switch which opens when exposed to a temperature above a preset value (for example about 150° F.) and closes when exposed to a temperature below a second preset value (for example about 90° F.) is inserted into the stuffing box at a point just below the packing, and is connected by wire 23 to actuate relay 24 which in turn controls the flow of electricity from the power supply 25 to the motor 11. An interval recorder 30 may be inserted in the power line to record the times of operation of the pumping unit.

FIGURE 2 shows the polish rod 16, the stuffing box 17, the temperature sensing element 22, and its connecting wire 23, together with the pumping T 26, and casing head 18, all of conventional design.

To commence operation, manual switch 29 is closed. Because the polish rod is at approximately ambient temperature, relay 4 will be closed permitting electricity from the power source 25 to energize motor 11. Power is transmitted from motor 11 through reduction box 12, crank 13, Pitman 14 and walking beam 15 to cause reciprocal motion of polish rod 16, which in turn, fires pump 20 located in the well-bore. Fluids flow from pumping T 26 (shown in FIGURE 2) and continue to flow until the well has been pumped dry. While the pump is pumping liquid the polish rod 16 is lubricated and cooled by contact with the liquid on the downstroke. Thus, the friction between the polish rod 16 and stuffing box 17 is reduced to a minimum. This cooling and lubrication stops when the well has been pumped dry and the polish rod then begins to overheat. When the temperature of the polish rod has increased to about 140° F. thermostatic switch 22 opens, opening relay 24 and shutting off power to motor 11 which stops the reciprocal motion of the polish rod. That portion of the polish rod which is located near thermostatic switch 22 cools slowly. When its temperature has dropped to about 90° F., thermostatic switch 22 closes, closing relay 24 and again actuating motor 11 and restarting the pumping action. By properly selecting the lower temperature setting of thermostatic switch 22, at which pumping is resumed, the pumping interval of the unit may be controlled so that a proper balance is maintained between the rate of seepage of oil into the well-bore and the hourly capacity of the pump. In any case, overheating of the polish rod and damage to stuffing boxes with the resulting leakage which frequently occurs in conventional systems, can be completely avoided with the present invention while still withdrawing all of the oil which seeps into the well-bore.

The elevation of pump 20 controls the amount of back pressures exerted by the fluid column in the well-bore and this elevation can be adjusted in conjunction with the temperature set on the temperature sensing element 22 so as to optimize production from any given well.

In place of thermostatic switch 22 and relay 24 there can be utilized a single thermostatic switch with the main power line running directly into a thermostatic switch positioned so as to sense the temperature of the polish rod 16. This eliminates relay 24. Alternatively, a thermistor

or other temperature sensing element may be mounted to sense the temperature of the polish rod and transmit a signal which either actuates a relay or a silicon controlled rectifier or other electronic circuitry so as to interrupt the current to motor 11. Still another alternate is for the temperature sensing system to modulate the speed of a variable speed motor, as for example, by conventional silicon controlled rectifier circuitry which is actuated by a temperature sensing thermistor sensing the temperature of the polish rod. The reciprocal motion of the polish rod can thus be merely slowed rather than completely stopped.

In place of the electric motor discussed above, gasoline or steam or other conventional power means having suitable control means to permit them to be slowed or stopped in response to the signal from the temperature sensing element, can be utilized.

The circuitry can contain conventional means for compensating for ambient temperatures so that the cut-off and cut-in points are automatically raised in hot weather and lowered in cold weather, and the temperature sensing device can be insulated from radiant heat.

In addition to the oil wells mentioned above, the present invention can be utilized on water wells, salt brine wells and other air producing wells.

If desired, the minimum interval between discontinuance and resumption of pumping may be controlled by inserting a time delay device into the circuitry or by the use of conventional clock mechanisms which can be included in the recorder 30.

The word polish rod, as used herein, should be understood to include any elongated member which extends through a stuffing box and connects a pump within the well with an external power source. The term stuffing box should be understood to mean any sort of gland or seal in friction contact with the polish rod. The temperature sensing device may of course, be located on the polish rod, or near the stuffing box, or may be in a roller which presses against the polish rod, or in any other position which permits the sensing of temperature increases in the polish rod.

Various other variations and modifications to the present invention will be apparent to those skilled in the art upon a reading of the specification and all such obvious variations and modifications are to be taken as included within the scope of the claims appended hereto.

What is claimed is:

1. A control system for well pumping units having external power means connected by a polish rod to a well pump, said polish rod reciprocating through a stuffing box located between said power means and said well pump when said pumping unit is in operation; said system comprising in combination polish rod control means for slowing or discontinuing the reciprocating motion of said polish rod, temperature sensing means operably positioned to sense the temperature of said polish rod, said

temperature sensing means being connected so as to actuate said polish rod control means to discontinue motion of said polish rod when the temperature of said polish rod exceeds a preset maximum wherein the polish rod is wet by the fluid being pumped and wherein loss of fluid from the pump increases the friction between said polish rod and said stuffing box and wherein the polish rod control means is reactuated so as to resume reciprocal motion of the polish rod when the temperature sensed by said temperature sensing means falls below a preset temperature level.

2. A well pumping system comprising in combination (a) an internal well pump located in communication with the bottom of said well, (b) power means for actuating said internal well pump, (c) polish rod means for connecting said power means to said internal well pump, said polish rod reciprocating under normal operation of said well pumping system, (d) stuffing box means for forming a seal around said polish rod to prevent loss of fluid from said well, (e) temperature sensing means responsive to overheating of said polish rod, (f) polish rod control means for slowing or discontinuing the motion of said polish rod in response to a signal from said temperature sensing means indicative of overheating of said polish rod wherein the polish rod is wet by the fluid being pumped and wherein loss of fluid from the pump increases the friction between said polish rod and said stuffing box and wherein the polish rod control means is reactuated so as to resume reciprocal motion of the polish rod when the temperature sensed by said temperature sensing means falls below a preset temperature level.

3. The system of claim 1 wherein the well is an oil well.

4. The system of claim 2 wherein the well is an oil well.

5. The system of claim 1 wherein the well is an oil well and the temperature sensing means is located in contact with said polish rod.

6. The system of claim 2 wherein the well is an oil well and the temperature sensing means is located in contact with said polish rod.

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