

Oct. 17, 1944.

M. H. HALDERSON

2,360,561

CONTROL FOR OIL WELL PUMPING EQUIPMENT

Filed Dec. 30, 1940

2 Sheets-Sheet 1

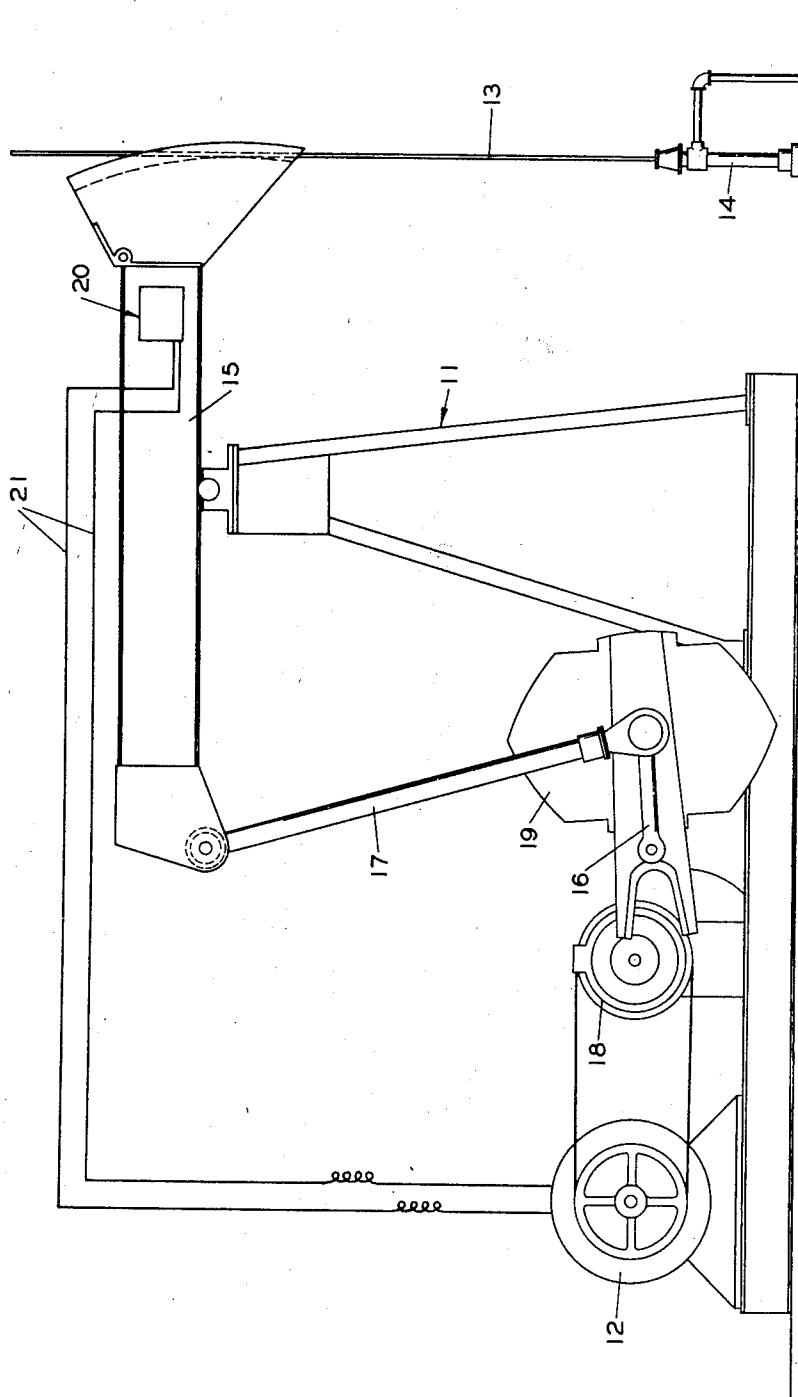


FIG. 1

INVENTOR
M. H. HALDERSON

BY

Hudson, Young, Stanley & Ginger
ATTORNEY

Oct. 17, 1944.

M. H. HALDERSON

2,360,561

CONTROL FOR OIL WELL PUMPING EQUIPMENT

Filed Dec. 30, 1940

2 Sheets-Sheet 2

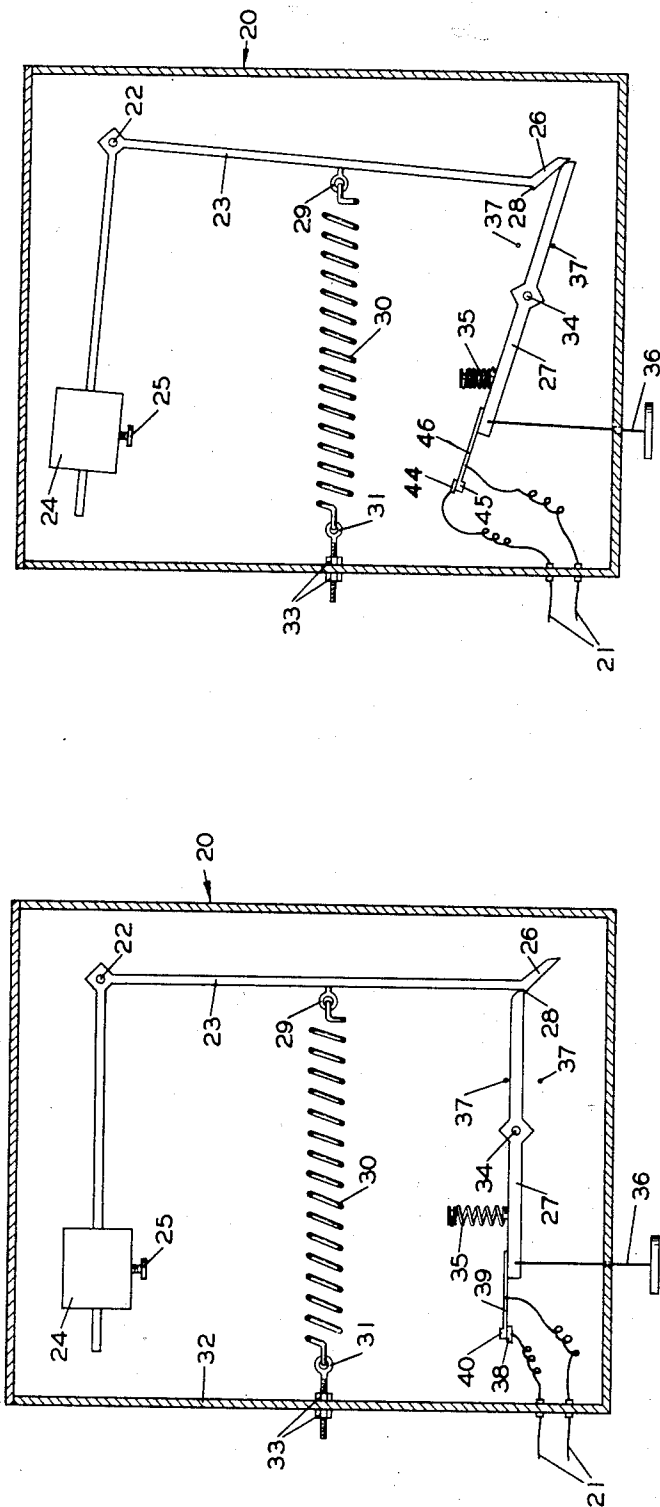


FIG. 3

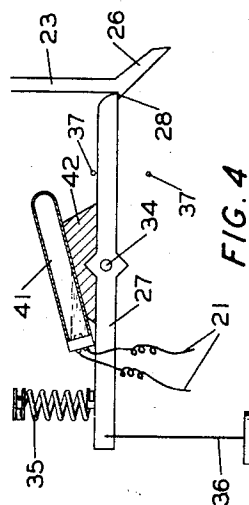


FIG. 4

FIG. 2

INVENTOR
M. H. HALDERSON

BY
Hudson, Young, Stanley & Ginger
ATTORNEY

UNITED STATES PATENT OFFICE

2,360,561

CONTROL FOR OIL WELL PUMPING
EQUIPMENTMaxwell H. Halderson, Smackover, Ark., assignor
to Phillips Petroleum Company, a corporation
of Delaware

Application December 30, 1940, Serial No. 372,408

3 Claims. (Cl. 200—52)

This invention relates to apparatus for automatically shutting down prime movers when operating conditions become abnormal.

When the reservoir energy of a hydrocarbon oil-bearing formation is not sufficient to lift the oil from the reservoir to the surface of the ground some means of artificial lift is employed. A common type of artificial lift is the well known reciprocating bottom hole pump which is actuated by a string of sucker rods extending downwardly from the surface of the ground. A pumping unit, rig front, or the like, having an oscillatory member or walking beam is one of the devices generally used to transmit energy from a prime mover to the polished rod and reciprocating pump.

In pumping fluids by this method, fatigue stresses or corrosion weaken the string of sucker rods, causing them eventually to break. In wells producing appreciable quantities of sand or other solid materials along with the crude oil, the pumps may "sand up" and stick, causing the sucker rods to part or to become disconnected from the walking beam of the pumping unit. The parting of sucker rod strings puts abnormal stresses on the pumping unit or rig front since this surface equipment is counterbalanced to reciprocate the sucker rods at minimum peak loads. Consequently, when the sucker rods part or become disconnected from the surface equipment, this equipment is thrown out of balance, and stresses far exceeding the safe working limits result, and if operation is allowed to continue under these abnormal conditions, serious damage to the surface equipment may result.

As the oil wells usually pump a considerable length of time unattended, some means of automatically shutting down the prime mover is very desirable. There are a number of devices which attempt to accomplish this result, however, none is entirely satisfactory.

The advantages of the present invention are its direct action, its simple, compact design, its adaptation to a wide variety of operating conditions, and its faculty for quick resetting.

The primary object of my invention is to provide a device for automatically shutting down a prime mover when operating conditions become abnormal.

Another object of my invention is to provide a device that will shut down a well pumping prime mover in the event the sucker rods part.

A still further object of my invention is to provide a compact, simply-designed shut-down device that is positive in action, dependable in oper-

ation, and adaptable to a great variety of operating conditions.

Another object of my invention is to provide an automatic shut-down device which can be readily reset manually after it has once been actuated.

Other objects and advantages will be apparent to persons skilled in the art by reference to the following description and annexed drawings which pertain to preferred embodiments of my invention. While the present description of the invention is directed to its use with an oil well pumping unit, it is to be clearly understood that this is merely by way of illustration as my invention performs its intended functions in a wholly satisfactory manner when employed with various other types of equipment.

Figure 1 is an elevation view of oil well pumping equipment with the apparatus of my invention operatively connected thereto.

Figure 2 represents an elevation view of one embodiment of my invention, partly in cross section, showing the device in the set position.

Figure 3 is a portion of the device, partly in cross section, illustrating the adaptation of my invention to shutting down an internal combustion engine. This figure shows the device in tripped position.

Figure 4, which is an elevation view, represents a portion of another embodiment of my invention that may be used where an open electric arc would create a fire hazard.

Referring to Figure 1, a pumping unit, generally represented by reference numeral 11, is driven by a prime mover 12, which in this embodiment is shown as an electric motor. Polished rod 13, which is the uppermost member of a string of sucker rods, reciprocates through well head fittings 14 to actuate a common type of bottom hole pump (not shown). The polished rod is suspended in the usual manner from a walking beam 15 which is operated from a crank 16 by means of a pitman 17. A gear reduction unit 18 transmits energy from motor 12 to crank 16. Counterweights 19 are employed to balance the uneven loads to which pumping unit 11 would otherwise be subjected, and thus provide a substantially even operation of the pumping unit. An automatic shut-down device 20 is secured to the forward end of walking beam 15 and is connected to prime mover 12 by electric leads 21.

Referring to Figure 2, a pivot pin 22 is provided on shut-down device 20 and serves as a fulcrum for an L-shaped lever 23 which has a substantially horizontal arm whereupon a slid-

able weight 24 is mounted and secured thereto by means of a screw 25. The substantially vertical arm of lever 23 is preferably provided with a foot 26 on its lower end. This foot is notched at 28 and is so designed that it cooperates with one end of a contact lever 27 to maintain it in one predetermined position when the pumping system as a whole is operating in a normal manner and to maintain it in a second predetermined position when device 20 has been actuated to shut-down the prime mover under abnormal operating conditions. The vertical arm of lever 23 carries an eye 29, preferably midway between pivot 22 and notch 28. A coil spring 30 connects at one end to eye 29 and at the other end to an eyebolt 31 which is fastened to a housing or case 32, which encloses the device, by nuts 33. The tension in spring 30 may be adjusted by changing the positions of nuts 33 on eyebolt 31.

A second pivot pin 34 serves as a fulcrum for lever 27. A spring 35, preferably in tension, insures within desired limits, the turning of lever 27 about its pivot 34. A latch member 36, operable from the exterior of case 32, is attached to the left end of lever 27 so that the attendant may readily set my device initially, or reset the same after a shut-down by merely pulling downwardly on this latch, thereby eliminating the necessity of opening the case to set or reset the device. The movement of the right or tripping end of lever 27 is limited by stops 37 provided in case 32. The switch mechanism of this device consists of conductors or leads 21, one of which is connected to a stationary contact point 38, the other to a conductor member 39 which has a contact point 40 on one end and which is secured at the other end to lever 27. In this embodiment wherein the pumping unit 11 is driven by an electric motor 12, leads 21 are part of the power circuit to the electric motor. Therefore, point 40 contacts point 38 to complete the electric circuit. Thus, the pumping unit will operate only when the device 20 is in the set position.

Turning next to Figure 3, it is obvious that the instant invention is also adapted to shutting down an internal combustion engine by connecting leads 21 to the engine's magneto and by keeping fixed contact point 44 and movable contact point 45 of conductor member 46 separated while the pumping unit is operating. Thus, when the device 20 is actuated, point 45 contacts point 44 to short circuit the magneto and thereby shut down the prime mover.

In operation, returning to Figure 2, device 20 is secured to the walking beam of pumping unit 11, preferably as near the polished rod 13 as possible. The tension in spring 30 is adjusted to compensate for the ordinary irregularities of pumping conditions. Thus, only the abnormal conditions of the pumping cycle will cause the device 20 to be actuated and to shut down prime mover 12. By changing the distance between weight 24 and pivot 22, further sensitivity of the device may be obtained. Having adjusted the device to properly operate under the usual well-pumping conditions, pumping unit 11 is placed in operation and the device oscillates with walking beam 15, but remains in the set position until the sucker rods part or some other abnormal condition arises whereby the acceleration of device 20 becomes abnormal. When the sucker rods part, the rod end of the walking beam 15 is accelerated upwardly at a rate which exceeds that of normal pumping conditions. The device 20

is accelerated with the walking beam, but the weight 24, due to its inertia, lags behind the rest of the device. Hence, the weight causes lever 23 to turn about pivot pin 22 in a counter-clockwise direction, thus moving foot 26 sufficiently to the right to allow the tripping end of lever 27 to become disengaged from lever 23 at notch 28. Spring 35 exerts an upward force on the left or resetting end of lever 27 and tends to rotate the lever clockwise about pivot 34. Thus, when the tripping end of lever 27 disengages notch 28, the electric motor is shut down because conductor member 39 with contact point 40 is rotated away from stationary contact 38, breaking the electric circuit. After lever 23 has rotated about pivot 22, and lever 27 about pivot 34, spring 30 pulls lever 23 back to a position, as illustrated in Figure 3. The design of foot 26 allows cooperation with the upper edge of the tripping end of lever 27 in such a manner that contact points 38 and 40 will remain separated until device 20 is manually reset by a downward pull on resetting means 36. The proper design of the tripping end of lever 27 and foot 26 also facilitates the resetting of the device.

If the device is adapted to shutting down the prime mover of the internal combustion type, it is necessary to place contact point 44 above contact 45 so that the two points are separated while the device is in a set position. When the device is actuated, point 45 moves upwardly as lever 27 rotates clockwise about its pivot and engages stationary contact 44, closing a circuit between the device and the magneto of the internal combustion engine, grounding the magneto and thus shutting down the prime mover. If the internal combustion engine utilizes a storage battery, a high tension coil, and a distributor, rather than a magneto to obtain the electric spark for igniting the explosive mixture in the cylinder of the engine, the leads from the battery may be wired through the device 20 and the contact points 44 and 45 arranged in the manner disclosed for shutting down an electric motor, as illustrated in Figure 2.

Another embodiment of part of my invention, illustrated in Figure 4, may be used where the atmosphere contains sufficient gas to be explosive and where an open electric arc would create a fire hazard. An enclosed switch 41, preferably of the Mercoid type, is secured to lever 27 by a suitable mounting 42 so that after device 20 is actuated, the electric circuit is broken or made, as desired, depending upon the type of prime mover used for powering the pumping unit.

The operation of this embodiment is identical to that of other embodiments heretofore described. In this instance, however, the electric switching takes place within tube 41 which utilizes a fluid electric conductor, such as mercury, to make and break contact between leads 21.

From the foregoing, it is believed that the operation and advantages of the apparatus for practicing my instant invention will be readily comprehended by persons skilled in the art. It is to be clearly understood, however, that various changes in the apparatus herewith shown and described may be resorted to without departing from the spirit of the invention, as defined by the appended claims.

I claim:

1. In a device of the character described adapted to be carried by a walking beam, the combination comprising a housing, a member pivotally

supported within the housing and including a plurality of arms, a switch, means within the housing for operating the switch, said means engaging one arm of the pivotally supported member to maintain the switch and the member in a predetermined fixed position under normal operating conditions of the walking beam, means including a weight on another arm of the pivotally supported member for disengaging said means from the first mentioned arm under abnormal operating conditions of the walking beam to thereby operate the switch, and means operable from the exterior of the housing for effecting engagement between the first mentioned means and the pivotally supported member.

2. In a device of the character described adapted to be carried by a walking beam, the combination comprising a housing, a member pivotally supported within the housing and including a plurality of arms, a switch, a second member pivotally supported within the housing for operating the switch, said second member engaging one arm of the first member to maintain the switch and the first member in a predetermined fixed position under normal operating conditions of the walking beam, means including a weight on another arm of the first member for disengaging

the pivotally supported members under abnormal operating conditions of the walking beam to thereby operate the switch, and means operable from the exterior of the housing for effecting engagement between the pivotally supported members.

3. In a device of the character described adapted to be carried by a walking beam, the combination comprising a housing, a member pivotally supported within the housing and including a plurality of arms, a spring for urging the member in a predetermined direction, a switch, a second member pivotally supported within the housing for operating the switch, a spring for urging the second member in a predetermined direction, said second member engaging one arm of the first member against the action of the springs to maintain the switch in a predetermined position under normal operating conditions of the walking beam, means including a weight on another arm of the first member for disengaging the pivotally supported members under abnormal operating conditions of the walking beam, and means operable from the exterior of the housing for effecting engagement between the pivotally supported members.

MAXWELL H. HALDERSON.