

July 28, 1942.

D. G. LORRAINE

2,291,245

ELECTRICAL CONTROL SWITCH

Filed Oct. 29, 1940

2 Sheets-Sheet 1

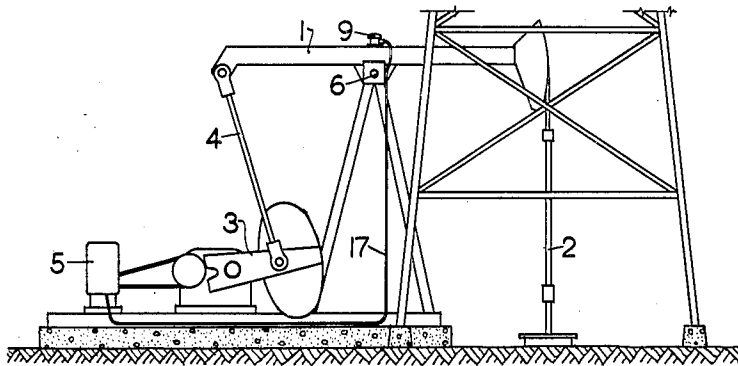


Fig. 1.

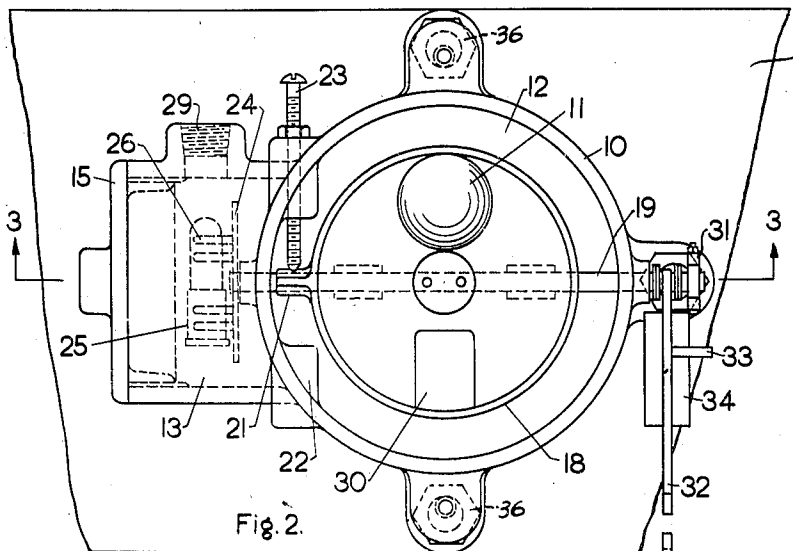


Fig. 2.

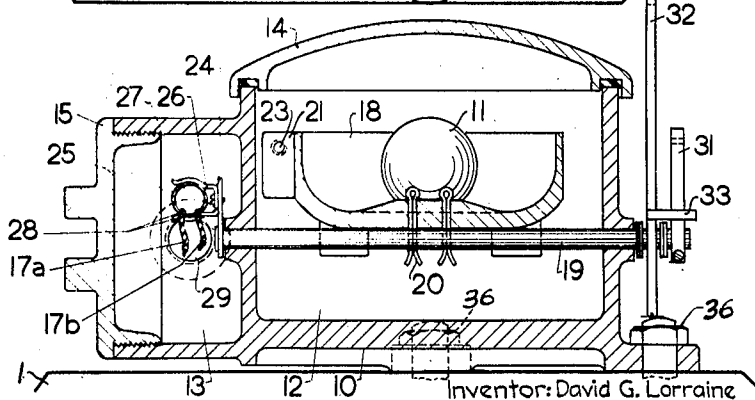


Fig. 3.

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2 Sheets-Sheet 2

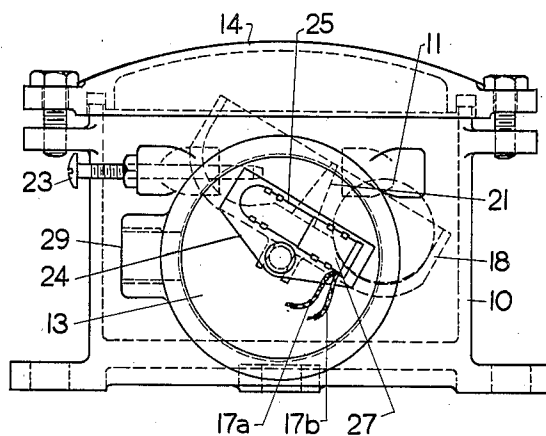


Fig. 4

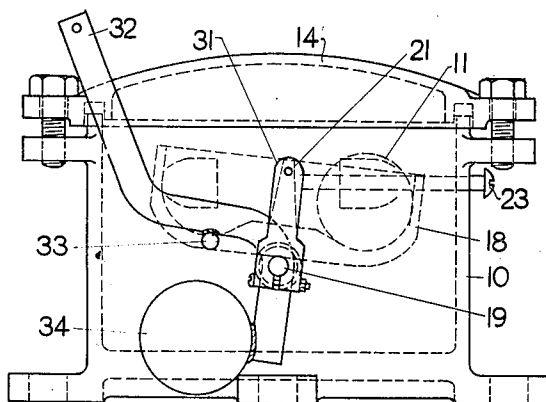


Fig. 5

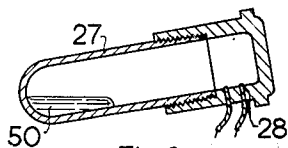


Fig. 6

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UNITED STATES PATENT OFFICE

2,291,245

ELECTRICAL CONTROL SWITCH

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Application October 29, 1940, Serial No. 363,270

5 Claims. (Cl. 200—52)

This invention relates to an electrical control switch and more particularly to an acceleration responsive device, having for its object the actuation of a controlling mechanism upon the occurrence of a predetermined acceleration.

It is, in general, an object of the invention to provide a device for retaining an operating means in inoperative position throughout normal transition of a movable element, and to shift the operating means to operative position whenever there is predetermined acceleration of the movable element, whereby a control mechanism is actuated in response to the shifting of the operating means for indicating that acceleration has occurred or preferably for arresting the movement of the accelerated element.

More particularly, it is an object of the invention to provide an acceleration responsive device for an oscillating element such as the walking beam of a deep well pump, the device being adapted for oscillation, together with the walking beam, and including an operating means which is retained in inoperative position throughout normal oscillation of the beam, but which in the event of abnormal acceleration of the beam is shifted to operative position for actuating a control which arrests oscillation of the walking beam.

The invention is thus particularly applicable as a safety device for the walking beam of a deep well pump, in that in the event of oscillation of the walking beam at excessive speed as may, for example, result from a break in the string of sucker rods which is reciprocated by the beam, a control is actuated for stopping the driving mechanism for the walking beam before excessive damage has been done.

Further objects of the invention will be readily understood from the following description of the accompanying drawings, in which:

Figure I is a side elevation of the walking beam and driving mechanism for a deep well pump, with the acceleration responsive device mounted on the walking beam.

Figure II is a plan view of a preferred embodiment of the acceleration responsive device with the actuating compartment cover removed.

Figure III is a vertical sectional view taken along the lines 3—3 of Figure II.

Figure IV is an elevation of the switch compartment end of the same embodiment with the switch compartment cover removed.

Figure V is an elevation of the other end of the same embodiment.

Figure VI is a longitudinal vertical sectional

view of a preferred form of the mercury switch detail.

The invention is particularly applicable and is therefore illustrated and described in connection with the walking beam of a deep well pump. For instance, as shown in Figure I, a walking beam 1 is adapted for oscillation about a fulcrum 6 for reciprocating a string of sucker rods 2 which extend into the well for operating the pump, the walking beam being oscillated by a usual crank 3 and pitman 4, the crank 3 being rotated by a driving mechanism which may be any suitable prime mover, indicated as an internal combustion engine 5. Preferably mounted above the fulcrum 6 on the walking beam 1 is the present acceleration responsive device, schematically represented by 9.

Referring to Figures II-V, a preferred embodiment of the present invention comprises a casing 10 divided into an actuating compartment 12 and a switch compartment 13, having weather-proof covers 14 and 15, respectively. An operating means 11 is mounted in the actuating compartment 12 and is normally retained in inoperative position but responsive to predetermined acceleration of the walking beam is shifted to operative position for actuating a suitable switch mechanism 25 in compartment 13 to close the electrical circuit 17.

When the electrical circuit 17 has been closed by shifting the operating means 11 to operative position, it may indicate that excessive acceleration has occurred, e. g. by providing an electrically responsive signal device (not shown) in the electrical circuit, but as a preferred arrangement closing the electrical circuit stops the driving mechanism for the walking beam, e. g. by short circuiting the ignition system in the internal combustion engine 5 or by energizing a suitable electrically responsive cut-off (not shown) for whatever type of prime mover may be employed.

The actuating mechanism comprises a sphere 11, preferably of steel, which rests in the bottom of a tiltable cup 13. In a convenient arrangement the bottom of the cup 13 is provided with an annular groove, which forms a circular raceway for the sphere. The cup 13 is suitably mounted, such as by cotter pins 20, on a shaft 19 pivotally attached to the walls of the casing 10, one end of which shaft preferably projects through the walls to the outside and the other end extends into the switch compartment 13. The cup 13 and shaft 19 are adapted to be swung in an arc limited in one direction by a lug 21

on the cup 18 contacting the lug 22 on the casing 10 and in the other direction by the adjusting screw 23, which projects through the casing 10 to the outside. Normally, in inoperative position the cup 18 is tilted against the adjusting screw 23. In this position and during normal oscillation of the walking beam the sphere 11 is free to roll back and forth in an arc in one side of the bottom of the cup 18. In the operative half of the cup 18, that is, in the half of the cup 18 on the side of the shaft 19 adjacent the lug 22, is a well 30 adapted to receive the sphere 11 and restrain it from further rolling when abnormal oscillation causes the sphere 11 to pass over the tilting axis formed by the shaft 19 from inoperative to operative position.

On the end of the shaft 19 extending into the switch compartment 13, a switch, generally designated by 25 and preferably of the mercury type, is suitably carried, such as by means of a plate 24 riveted to the end of the shaft 19 and clips 26 on the plate 24 for holding the mercury switch 25 perpendicular to the shaft 19. The mercury switch 25 may, for example, as shown more clearly in longitudinal vertical section in Figure VI, comprise a non-conducting tube 27, for example, of glass or resin, containing a pool of mercury designated by 50 and a pair of electrical contacts 28 adapted to be electrically connected by the mercury when the tube 27 is tilted into operating position. Electrical lead wires 17a and 17b, as shown in Figure III, are connected to the contacts 28 and lead to the prime mover, as shown in Figure I, to complete the electrical circuit. The lead wires 17a and 17b may be encased in a flexible conduit (not shown) attached to a port 29 (Figure II) in the switch compartment 13.

On the other end of the shaft 19 projecting outside the casing 10 are a rigidly attached short lever 31 and a rotatably attached reset lever 32, having a pin 33 projecting from it adapted to contact the fixed lever 31. The reset lever 32 is weighted at its lower end 34 for a subsequently-described purpose.

The device of the embodiment just described is fastened by bolts 36 or the like to the walking beam immediately above the fulcrum with its oscillating shaft 19 parallel and the mercury tube 27 perpendicular to the longitudinal axis of the beam 1, as shown in Figures I-III. The cup 18 is then tilted against the adjusting screw 23 to place it in inoperative position. The screw 23 is adjusted to allow normal walking beam motion to cause the sphere 11 to roll back and forth in an arc in the bottom of the cup 18 on one side of the shaft 19, but abnormal erratic motion of the beam due to rod failure or other breakage to cause the sphere 11 to roll around to the other side of the cup 18 and to fall into the well 30. In inoperative position of the device the mercury switch 25 is positioned with its tube 27 tilted so that no electrical connection is made between the electrical contacts 28 by means of the mercury. However, when the sphere 11 rolls to the operative side of the cup and into the well 30 and thereby the cup 18 is tipped in the other direction, the rotation of the shaft 19 caused by the tipping of the cup causes the mercury switch tube 27 to be tilted into operative position for completing the electrical circuit 17 between the electrical contacts 28 and thence by the means of electrical leads 17a and 17b to the prime mover, such as the engine 5 as shown in Figure I, whereby the prime mover is stopped. By means

of the well 30 on the operative side of the cup 18 the sphere 11 is prevented from rolling back and reopening the switch.

To reset this acceleration responsive device into inoperative position, the floating reset lever 32 is thrown or turned so that its pin 33 operates the fixed lever 31 to turn the shaft 19 and the cup 18 back against the adjusting screw 23. The reset lever 32 is weighted at its lower end 34 to carry it back to its normal position after resetting the device and may be formed so that it may be operated from the ground by a cord attached to its outer end.

I claim as my invention:

1. In a device responsive to a predetermined acceleration of an oscillating member, a cup member, supporting means rotatably attaching said cup member to said oscillating member, the axis of the rotation of said cup member being parallel to the oscillation plane, stop means limiting the tilting of said cup member to either side of a vertical plane passing through said axis to a predetermined arc, a free rolling relatively heavy sphere within said cup, means for tilting said cup member to one side of said vertical plane, whereby the free rolling action of said sphere is limited during normal oscillation periods to a portion within the cup member to one side of said vertical plane, said sphere being responsive to an abnormal acceleration of the oscillating member to pass to the portion of said cup member on the other side of said vertical plane, whereby said cup member is tilted in the other direction, and normally open electrical switch means adapted to be closed in response to the tilting of said cup member into said second direction.

2. In a device responsive to a predetermined acceleration of an oscillating member, a shaft rotatably secured to said member in a plane parallel to the oscillation plane of said member, a cup member attached to said shaft and rotatable therewith in a plane at right angles to the oscillation plane, stop means limiting the tilting of said cup member to either side of a vertical plane passing through said shaft to a predetermined arc, a free rolling relatively heavy sphere within said cup, means for tilting said cup to one side of said vertical plane, whereby the free rolling action of said sphere is limited during normal oscillation periods to a portion within the cup member to one side of said vertical plane, said sphere being responsive to an abnormal acceleration of the oscillating member to pass to the portion of said cup member on the other side of said vertical plane, whereby said cup member is tilted in the other direction, and normally open electrical switch means adapted to be closed in response to the tilting of said cup member into said second direction.

3. In an acceleration responsive device, a casing adapted for oscillation, a switch compartment and an actuating compartment in said casing, a shaft extending from said switch compartment through said actuating compartment, a cup carried by said shaft in the actuating compartment and adapted for tilting motion in a limited arc with said shaft, means for adjusting the limits of said arc, a sphere normally resting in said cup on one side of the shaft and normally maintaining the cup tilted in one direction, the sphere being adapted to roll to the other side of the cup and to cause the cup to tilt in the other direction to operative position in response to predetermined acceleration of the casing, and a

mercury switch carried by the end of the shaft in the switch compartment and normally in inoperative position, said switch comprising a pair of contacts being in series in an electrical control circuit whereby tilting of the cup to operative position and rotation of the shaft thereby causes the contacts in the mercury switch to be bridged.

4. In combination, a walking beam for a deep well pump, a driving mechanism for oscillating the walking beam, a casing adapted for oscillation with the walking beam, a rotatable shaft in said casing parallel to the longitudinal axis of the walking beam, a cup fastened to said shaft and adapted for tilting motion in a limited arc with the shaft, means for adjusting the limits of said arc, a sphere normally resting in said cup on one side of the shaft and normally maintaining the cup tilted in one direction, the sphere being adapted to roll to the other side of the cup and to cause the cup to tilt in the other direction to operative position in response to predetermined acceleration of the casing and walking beam, a pair of spaced electrical contacts insulated from and carried by said shaft, means comprising a mobile metallic body for electrically connecting the contacts when said cup is tilted into operative position, said pair of contacts being in series in an electrical circuit which controls the driving mechanism for the walking beam, where-

by electrical connection of said contacts closes the electrical circuit and stops the driving mechanism.

5. In an acceleration responsive device, a casing adapted for oscillation, a switch compartment and an actuating compartment in said casing, a shaft extending from said switch compartment through said actuating compartment, a cup carried by said shaft in the actuating compartment and adapted for tilting motion in a limited arc with said shaft, means for adjusting the limits of said arc, a sphere normally resting in said cup on one side of the shaft and normally maintaining the cup tilted in one direction, the sphere being adapted to roll to the other side of the cup and to cause the cup to tilt in the other direction to operative position in response to predetermined acceleration of the casing, a depression in said cup adapted to maintain the sphere on the operative side of the cup after said sphere has rolled to said operative side and said cup has tilted to operative position, a mercury switch carried by the end of the shaft in the switch compartment and normally in inoperative position, said switch comprising a pair of contacts being in series in an electrical control circuit whereby tilting of the cup to operative position and rotation of the shaft thereby causes the contacts in the mercury switch to be bridged.

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