Oct. 16, 1956 J. D. BUCHANAN ET AL 2,767,276

ELECTRIC SWITCH

Filed June 18, 1954 2 Sheets-Sheet 1

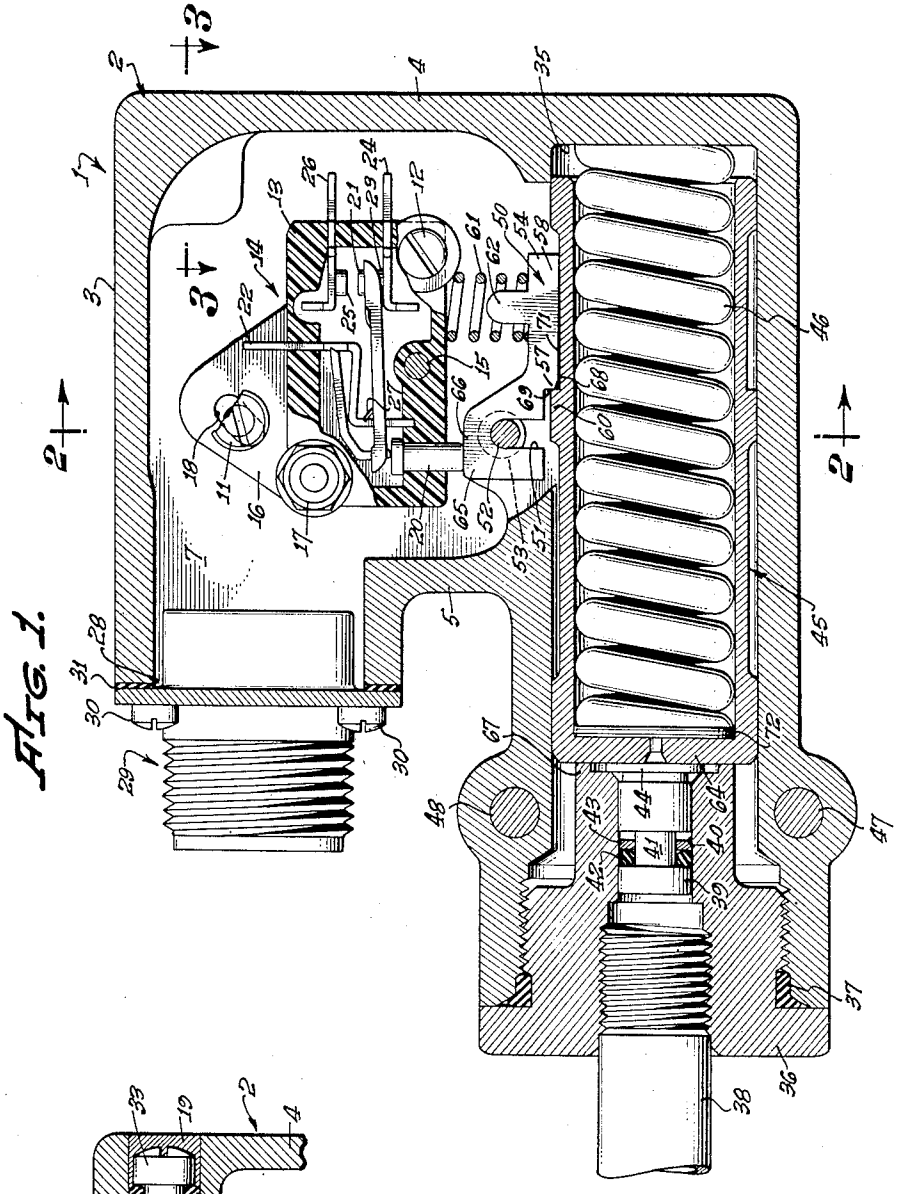


FIG. 1.

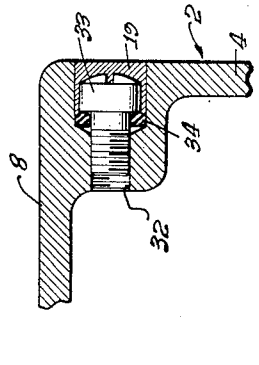


FIG. 3.

J. D. BUCHANAN,
CARL E. MONNICH, SR.,
INVENTORS.

BY W. E. Beatty
ATTORNEY.

Oct. 16, 1956 J. D. BUCHANAN ET AL 2,767,276

ELECTRIC SWITCH

Filed June 18, 1954 2 Sheets-Sheet 2

FIG. 2.

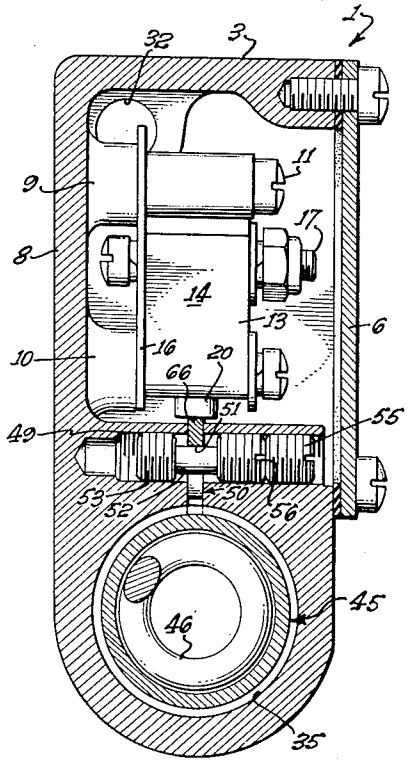


FIG. 4.

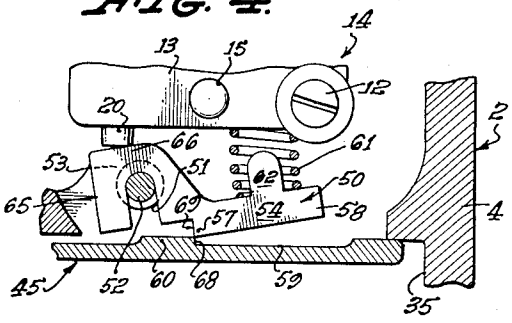


FIG. 5.

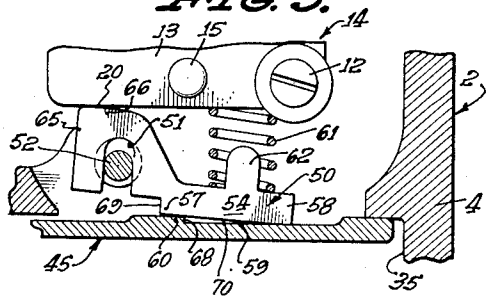


FIG. 7.

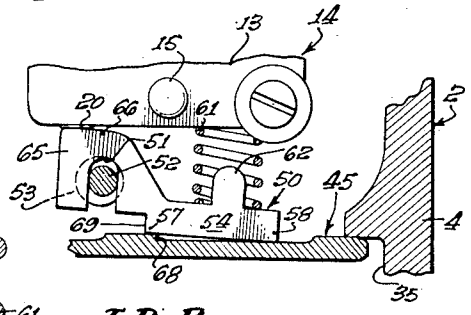
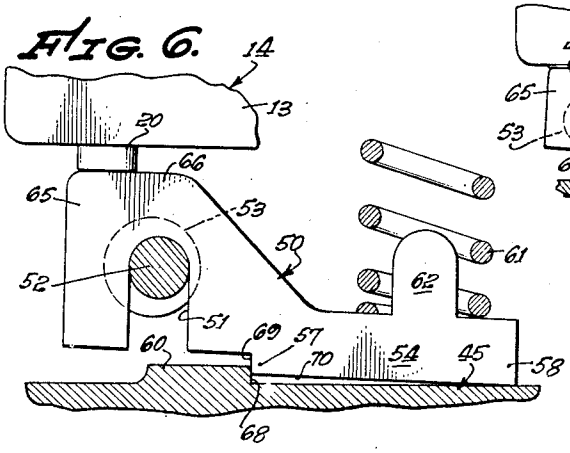


FIG. 6.



J. D. BUCHANAN,
CARL E. MONNICH, SR.,
INVENTORS.

BY

W. E. Beatty

ATTORNEY.

United States Patent Office 2,767,276 Patented Oct. 16, 1956

2,767,276

ELECTRIC SWITCH

J. D. Buchanan and Carl Earnest Monnich, Sr., Burbank, Calif.; said Monnich assignor to said Buchanan

Application June 18, 1954, Serial No. 437,619

8 Claims. (Cl. 200—82)

The invention relates to an electric switch and more particularly to a hydraulic pressure operated switch for operating a signal or for connecting auxiliary equipment such as a pump when the fluid pressure reaches a certain low value.

As described in co-pending application, Serial No. 286,991, filed May 9, 1952, now Patent No. 2,736,778, by one of the joint inventors herein, namely, J. D. Buchanan, for Hydraulic Pressure Operated Switch, it is explained that such a switch is useful for providing a signal light in the pilot's position in an airplane to show whether the oil pressure is high enough such as 3000 lbs. p. s. i. to operate the hydraulic motors or pistons which operate the various components of an airplane.

The above mentioned co-pending application discloses and claims a switch of the character described wherein a micro-switch is arranged at one side of a hydraulic plunger with an intervening switch operating element which is cocked against the action of a spring for sudden release by snap action into or out of operative engagement with the switch as the plunger moves in one direction or the other. The micro-switch has both front and back contacts and proper high oil pressure with an inward position of the plunger can either open or close a circuit to a signal or other device depending on how the switch is connected in the circuit. In the case of a signal when the oil pressure has a lower value such as 2700 lbs. p. s. i. the switch actuates a signal device to show the pilot that the oil pressure is below normal.

While the switch of the present invention is generally similar to the switch of the above application, the present invention is an improvement thereon in a number of respects, principally regarding ease of manufacture, reduction in the number of working parts and ease of adjustment of the micro-switch casing with respect to its operating element and also the ease of adjustment of the switch operating element in relation to both the hydraulic plunger and the micro-switch and adjustment of the snap acting connection between the plunger and the switch operating element to adjust the differential between the high and low pressure operating points of the switch, and more particularly to adjust the low operating point of the switch to different values for substantially the same or other high pressure operating values.

In the former application, the casing was provided with a bore open at its opposite ends for the hydraulic plunger and its spring, whereas the present invention provides a single dead-end bore and provides a more compact arrangement by housing the plunger spring in a spring barrel which actuates the switch operating member.

Also in the former application, the switch operating element was provided with a cam surface which acted on a fixed cam follower to raise the switch operating element for sudden release into operating engagement with the switch while another cam surface on the switch operating element escaped an abutment on the plunger, this abutment or sear element serving to cock the switch operating element against the action of a spring. The present

invention provides a further improvement in dispensing with the first mentioned cam on the switch operating element and in providing inter-engaging transverse or sear faces on the plunger and on the switch operating element for cocking the switch operating element against the action of a spring for sudden release when the sear on the switch operating element escapes its cooperating sear on the plunger, whereupon the switch operating element, as the plunger moves inwardly, comes to rest on an elevated portion of the plunger surface, to support the switch operating element in position to operate the switch to its alternate position. When the pressure drops, the switch operating element snaps back to a lower position to operate the switch to its other position. In other words, the plunger is provided with surfaces at different elevations to support the switch operating element into or out of operative engagement with the switch.

The present invention is also an improvement of the above mentioned application in another respect, namely, in the former case, when the plunger was in, due to high pressure, the switch operating member was in elevated position, the present invention being an improvement by arranging the switch operating element on a sliding pivot so that when the plunger is in, with one end of the switch operating element elevated, its other end which operates the switch, is lowered, preferably to open the switch. The ease of adjustment above mentioned is provided by mounting the micro-switch on a bracket so that it can be adjusted with respect to the switch operating element, and the latter is adjusted by arranging its pivot eccentrically on a rotatable mount such as a screw, so that the screw can be rotated to move the switch operating element transversely to the line of travel of the plunger to adjust the amount of engagement of the sears with each other to change the above mentioned differential between the high and low operating points of the switch pressure. While this eccentric adjustment also results in shifting the sear on the switch operating element lengthwise of the travel of the plunger, which is not desired, this can be compensated for by adding or removing a shim at one end of the plunger spring to adjust the tension on the plunger spring to the same value it had before such an adjustment of the pivot.

The invention also provides an improved piston with ring seal and packing to prevent leakage which seals against leakage at the high pressure employed whereas the frictional load or hysteresis is low whereby the switch operates within close limits.

For further details of the invention reference may be made to the drawings wherein Fig. 1 is a sectional view of an electric switch according to the present invention.

Fig. 2 is a sectional view on line 2—2 of Fig. 1 looking in the direction of the arrows.

Fig. 3 is a partial sectional view on line 3—3 of Fig. 1.

Figs. 4 and 5 are sectional views corresponding to Fig. 1, with parts broken away, showing the plunger and switch operating element in different operating positions.

Fig. 6 is a view corresponding to Fig. 1 with parts broken away showing the eccentric adjusted to a raised position, with the plunger in an outer position.

Fig. 7 is a view corresponding to Fig. 6, with the same eccentric adjustment as Fig. 6 and showing the switch operating member in its alternate position with the plunger in an inner position.

Referring in detail to the drawings, the switch 1 comprises a casing 2 having side walls 3, 4 and 5 and a removable cover 6, which define a switch chamber 7. Chamber 7 has a back wall 8 having bosses 9 and 10 for bolts 11 and 12 which pass through the casing 13 of a well known micro-switch 14 whereas switch 14 has casing members held together by a rivet 15 and this switch is mounted on a base plate 16 by means of a bolt

17. Plate 16 has an arcuate slot 18 concentric with bolt 12 so that by loosening these bolts, the plate 16 can be swung about the axis of bolt 12 to adjust the position of the switch casing 13. Switch 14 has a switch operating element or button 20 which in the position shown connects the spring contact 21, in circuit with the terminal 22, to the contact 23 connected to terminal 24, while in its alternate position when the button 20 is pushed in, contact 21 engages the alternate contact 25 connected to terminal 26. As the button 20 is operated, the leaf spring 27 snaps the contact 21 to one position or the other, the switch 14 itself being well known and forming no part of the present invention.

One side of switch chamber 7 has an opening 28 closed by an electrical receptacle 29 held in position by screws like 30. The receptacle 29 is fluid tight and has a seal 31. In fact, the whole interior of the casing 2 is fluid tight and the air is exhausted through an opening 32, see Fig. 3, and the casing is then filled with an inert gas such as nitrogen, whereupon the opening 32 is sealed with the screw 33 having a seal in the form of an O-ring 34 and a sealing compound 19 such as varnish.

The electrical receptacle 29 is connected to some or all of the terminals 22, 24, 26 as desired, by means of wires not shown in the switch chamber 7.

The switch chamber 7 opens into a dead end cylinder 35 closed at its right hand end as seen in Fig. 1 and open at its left hand end through which is fitted an end cap 36. Cap 36 has a seal 37 and an inlet 38 for the fluid pressure such as hydraulic oil. The inlet 38 communicates with a double piston 39 which slides in a cylinder 40. The intermediate portion of the piston 39 is of reduced diameter as shown at 41 and provided with a seal such as ring seal 42 and oil resisting sealing rings 43. The inner end of piston 39 has an enlarged thin head 44 larger than the cylinder 40 which prevents the piston 39 from falling out when the cap 36 is removed and piston 39 inserted in the inner end of cylinder 40, as well as fitting against the outer end 64 of the hollow plunger 45 to transmit the force of piston 39 to the plunger 45. The inward movement of piston 39 due to fluid pressure in inlet 38 is opposed by spring 46. While various sizes of the switch parts and springs of various strengths may be used, by way of example, Fig. 1 shows in double scale one form of invention which has been constructed and used, the plunger spring 46 having a force of 400 lbs. per inch.

The casing 2 is provided with apertures for mounting bolts 47, 48, to mount the switch 1 on a panel or the like. The inner end of cap 36 has a flat circular rim 67 which serves as a stop for the outer end 64 of the plunger 45, the inward movement of plunger 45 being limited by the wall 4 of casing 2.

The switch chamber 7 opens into the cylinder 35 so that the plunger 45 can operate a hammer or switch operating member 50 which operates the switch button 20. The member 50 has an open elongated slot 51 which rotatably and slidingly fits on an eccentric 52 to support the member 50 for pivotal movement about the axis of eccentric 52 and also for transverse movement toward and away from the switch button 20. Eccentric 52 as shown in Fig. 2 may comprise the intermediate portion of a screw 53 which fits in a threaded bore 49 being held in adjusted position by a lock screw 55. The position of eccentric 52 can be adjusted by removing the lock screw 55 and by applying a screw driver to the kerf 56 in the head of screw 53. Figs. 1, 2, 4 and 5 all show eccentric 52 in the same position of adjustment, namely with the eccentric in its closest position to the plunger 45, that is with its center on a vertical through the center of screw 53 as seen in Figs. 1, 4 and 5. The reason for the adjustability of eccentric 52 will be explained later.

The switch operating member 50 has an arm 54 at one side of its pivot formed by the eccentric 52, and an arm 65 at the other side of that pivot. Arm 65 has an eccentric surface 66 in position to engage and operate the button 20 when the arm 54 is supported at its outer end 57 by the higher level or land 60 of the plunger 45 as shown in Fig. 5, the inner end 58 of arm 54 at this time riding on the elongated plunger surface 59 of lower level. The arm 54 is urged into supporting relation with the plunger 45 by means of a spring 61 which centers a lug 62 on the arm 54, and bears against the underside of the switch casing 13. Between the high and low levels 59 and 60 of the plunger 45 is a transverse surface 68, that is it extends transversely to the line of travel of plunger 45. The levels 59 and 60 and surface 68 thus form an inwardly facing shoulder acting as an escapement catch or sear which slidingly fits on, catches and at times releases an outwardly facing transverse surface 69 at the outer end 57 of the arm 54 of the switch operating member 50. The switch operating arm 54 on its underside has an elongated surface 70 which is shorter than the lower level 59 and is adapted to rest on the plunger with the inner end 58 of arm 54 on the lower level 59 while the outer end 57 of that arm is resting on the high level or land 60, with the arm 65 and its surface 66 in elevated position operating the switch button 20 to one of its positions. At other times, the switch operating arm 54 is adapted to rest on the lower level 59, as shown in Fig. 1, without being tilted up at its outer end, the arm 65 at this time being in a retracted position so that the switch button 20 is now extended to its alternate position. The switch operating member 50 is shifted from one of these positions as shown in Fig. 5 to the other position as shown in Fig. 1, as the plunger 45 moves in and out, as follows.

When the plunger 45 is in an outer position as shown in Fig. 1, the arm 54 is on the lower level 59, not supported by the higher level 60. At this time, the eccentric 52 has such a position in relation to the arm 54 that the arm 54 does not lie exactly flat on the lower level surface 59 but instead is tilted up at its outer end by a very slight angle as shown at 71 in Fig. 1. As the fluid pressure in inlet 38 reaches a certain value sufficient to overcome spring 46, the plunger 45 moves inwardly and its face 68 exerts a thrust on the face 69, causing the member 50 to rotate counter clockwise, or cock against the action of spring 61 as shown in Fig. 4, the switch button 20 being unaffected by this cocking movement. A slight additional inward movement of plunger 45 beyond the position shown in Fig. 4, causes the surface 69 to escape the plunger surface 68 at a unique plunger position to bring the parts to the position shown in Fig. 5 as previously described, with switch button 20 actuated to its alternate position. For higher values of the inlet pressure, the plunger 45 can move inwardly beyond the position shown in Fig. 5 without affecting the operation of the switch, until the wall 4 acts as a stop to limit the plunger movement.

The differential between the high and low pressure operating points of the switch depends on the travel of plunger 45 from the position shown in Fig. 1 to the position just beyond the position shown in Fig. 4 as illustrated in Fig. 5. In other words, it is substantially the overlap of the surface 70 at the end 57 of the operating member 50 with the higher level surface 60. This differential may be adjusted to smaller values by adjusting the eccentric 52 to elevate the axis about which the operating member pivots and to position the operating member 50 so that in its lowermost position, its transverse face 69 only partially overlaps the plunger transverse surface 68. This is shown in Fig. 6 wherein the eccentric 52 is illustrated as having been rotated counterclockwise 90°, with the result that in its lowest position, the face 69 only overlaps about one-half of the plunger surface 68. In this case, the plunger 45 moves inwardly a lesser distance than before in order to raise the member 60 to the point where its surface 69 will escape the plunger surface 68 and hence the differential

between the high and low pressure operating points of the switch is less than it was before. Fig. 7 illustrates the same eccentric adjustment as in Fig. 6 and shows that after escapement, the overlap of the under surface **70** of member **50** with the higher level plunger surface **60** is about one-half the amount that it was before. Other values of this differential may be obtained by adjusting the eccentric **52** to other positions. The adjustment of eccentric **52** may necessitate readjustment of the position of button **20** with respect to arm **65** so that button **20** will be in its idle position when arm **65** of operating member **50** is in its lowest position as shown in Fig. 6. This adjustment is readily accomplished by adjusting the base plate **16** of the switch as previously described.

When the eccentric **52** is moved from the position shown in Fig. 1 to elevate the pivot axis of member **50** and change the differential as previously described, this adjustment also shifts member **50** lengthwise of plunger **45** and changes slightly the high and low pressures at which member **50** operates. In cases where this is undesirable, this can be compensated for by adding one or more shims as illustrated at **72** in Fig. 1, between the outer end of spring **46** and the head or end **64** of the plunger. The high pressure at which the switch operates can thus be kept at the same value as it had before the adjustment of eccentric **52** if desired. In some cases this compensation can be accomplished by rotating eccentric **52** through an angle 180° from the position shown. Due to the special requirements for this particular switch device, it is not possible to have anything project beyond the wall **4** of the casing, and hence the means for adjusting the tension of spring **46** has been illustrated as one or more shims **72**, although other means for adjusting the tension of spring **46** may be employed in other situations.

Various other modifications may be made in the invention without departing from the spirit of the following claims.

We claim:

1. A switch device comprising a switch having an operating element, a switch operating member therefor, means supporting said switch operating member for movement to one position to actuate said switch to one position or to another position to actuate said switch to an alternate position, a reciprocating hydraulic plunger having surfaces at different levels for supporting said switch operating member in one or the other of its said positions, spring means urging said switch operating member in supporting engagement with said plunger, said plunger having an inwardly facing shoulder acting as an escapement catch, and said operating member having a coacting outwardly facing transverse surface for cocking said operating member against the action of said spring means when said plunger moves inwardly, said operating member having a switch operating arm which is ineffective to operate said switch element during said cocking, said transverse surface escaping said shoulder on further inward movement of said plunger to a unique position with said switch operating member supported on a higher one of said levels in position to operate said switch element to an alternate position.

2. A switch device according to claim 1, said means supporting said switch operating member comprising a screw having an eccentric bearing and said switch operating member having an elongated bearing surface therefor for pivotal movement of said switch operating member for engagement and disengagement of said transverse surfaces as well as movement of said switch operating member toward and away from said switch operating element, said eccentric bearing comprising means for adjusting the transverse position of said switch operating member and its transverse surface with respect to said shoulder of said plunger.

3. An electric switch comprising a casing having a hollow hydraulic plunger having a piston, a spring in said plunger opposing said piston, a micro-switch in said casing at one side of said plunger, said micro-switch having an operating element having alternate operating positions, a switch operating member between said switch operating element and said plunger and having portions in operative relation to each thereof, means on said casing movably supporting said operating member, spring means maintaining said switch operating member in supporting relation on said plunger when said plunger is in or out, and means for actuating said switch operating element to one or the other of its said positions with a snap action, said actuating means comprising coacting escapement shoulders on said plunger and on said switch operating member for extending or retracting said switch operating member against the action of said spring means on escapement of said shoulders.

4. A switch device comprising a plunger, a switch having an operating element at one side of said plunger, a pivotal support, a switch operating member having a cam arm having a slide bearing on said support for pivotal movement thereon and for lateral movement of said cam arm into and out of engagement with said switch operating element, said operating member having another arm having an end and an intermediate portion having an outwardly facing transverse surface, a spring urging said other arm towards said plunger, said plunger having an inwardly facing shoulder acting as an escapement catch, said plunger having an outer idle position wherein said shoulder is removed from the transverse path of said other arm and with said spring urging said end of said other arm into supporting relation with said plunger and urging said cam arm to idle position out of operating engagement with said operating element and with said shoulder facing said transverse surface, said plunger having an intermediate range of inward movement with its said shoulder engaging said transverse surface and cocking said operating member against the action of said spring by pivotally moving said operating member while said cam arm remains out of operating engagement with said operating element, said plunger having a further inward position with said transverse surface escaped from and said intermediate arm portion laterally resting on said shoulder and with said end of said other arm engaging said plunger and with said cam arm laterally displaced into operating relation with said operating element.

5. A switch device according to claim 4, said plunger being hollow and having a hydraulic piston, and a spring in said plunger opposing said piston.

6. A switch device according to claim 4, said plunger being hollow and having a hydraulic piston, a spring in said plunger opposing said piston, said pivotal support comprising means for adjusting the overlap of said transverse surface with said shoulder when said plunger is in said idle position to adjust the differential between the high and low pressure operating positions of said switch, and means for supplying fluid pressure to operate said plunger.

7. A switch device comprising a casing having a plunger, a switch having an operating element at one side of said plunger, an eccentric on said casing, a switch operating member having a transverse slot slidably and pivotally fitting said eccentric, said operating member having one portion extending into or out of operating engagement with said operating element on transverse movement of said one portion towards or away from said operating element respectively, a spring urging said operating member towards said plunger, said operating member having pivotal cocking movement on said eccentric against the action of said spring with said one portion out of operating engagement with said operating element, cooperating sears on said plunger and on said operating member for producing said cocking movement and subsequent release of said operating member on inward movement of said plunger, said plunger sear hav-

ing a land supporting said one portion in operating engagement with said switch element on said release when said plunger sear escapes said other sear on inward movement of said plunger, and means to adjust said eccentric to adjust the overlap of said sears.

8. A switch device comprising a casing having a plunger, a switch having an operating element at one side of said plunger, a pivot on said casing, a switch operating member having a transverse slot slidably and pivotally fitting said pivot, said operating member having one portion extending into or out of operating engagement with said operating element on transverse movement of said one portion towards or away from said operating element respectively, a spring urging said operating member toward said plunger, said operating member having pivotal cocking movement on said pivot against the action of said spring with said one portion out of operating engagement with said operating element, cooperating sears on said plunger and on said operating member for producing said cocking movement and subsequent release of said operating member on inward movement of said

plunger, said plunger sear having a land supporting said one portion in operating engagement with said switch element on said release when said plunger sear escapes said other sear on inward movement of said plunger.

References Cited in the file of this patent

UNITED STATES PATENTS

2,073,141	Chaney	Mar. 9, 1937
2,485,074	Stevenson	Oct. 18, 1946
2,492,261	Bordelon	Dec. 27, 1949
2,504,381	Bordelon	Apr. 18, 1950
2,507,065	Trautman	May 9, 1950
2,511,271	Kaminky et al.	June 13, 1950
2,529,688	Grupp	Nov. 14, 1950
2,533,559	Chipman	Dec. 12, 1950
2,579,172	Bordelon	Dec. 18, 1951
2,666,829	Burkhard et al.	Jan. 19, 1954
2,732,450	Stevenson	Jan. 24, 1956
2,736,778	Buchanan	Feb. 28, 1956