May 12, 1942. R. W. GOFF 2,282,865

ELECTRIC SWITCH

Filed April 4, 1941

Fig. 1.

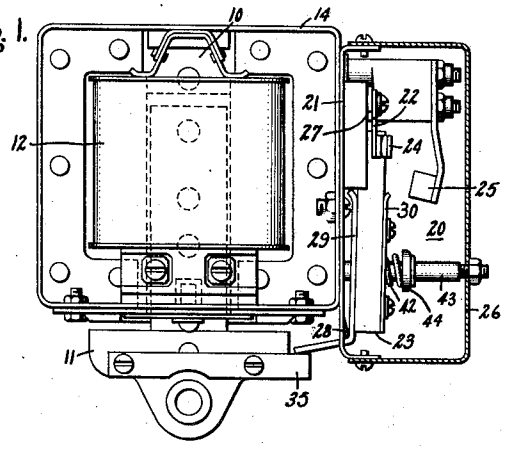


Fig. 2.

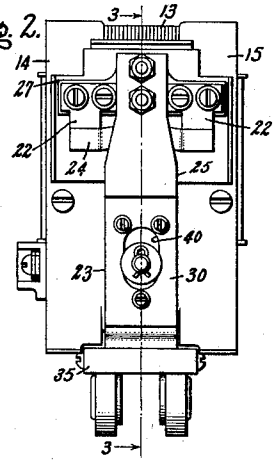


Fig. 5.

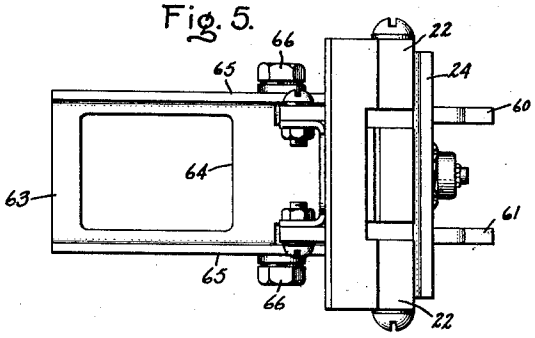


Fig. 3.

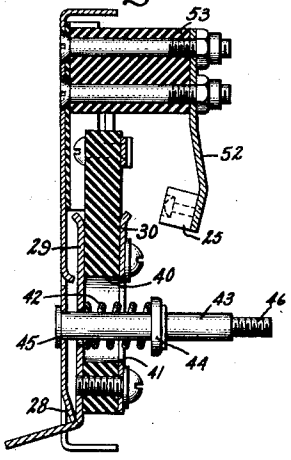


Fig. 4.

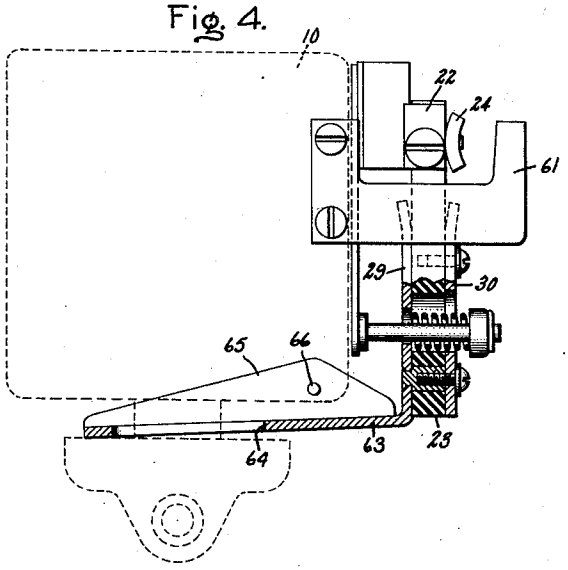


Fig. 6.

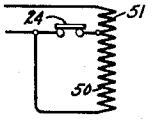
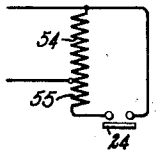


Fig. 7.



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UNITED STATES PATENT OFFICE

2,282,865

ELECTRIC SWITCH

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Application April 4, 1941, Serial No. 386,928

6 Claims. (Cl. 200—97)

My invention relates to electric switches and particularly to cutout switches for use in connection with the operating coil of plunger type electromagnets.

In direct current plunger type electromagnets where a relatively high pick-up force is required in comparison to the magnitude of the necessary holding-in force it is known to change the operating coil connections after the plunger has completed its pick-up stroke. This may be done either by using only a portion of the operating coil across the full voltage for pick-up and thereafter connecting in series the remainder of the coil, or by using a high resistance portion of the coil to pick up the plunger and thereafter connecting a low resistance portion of the coil in parallel therewith. In either case it is necessary to provide a cutout switch preferably operated directly by the solenoid plunger.

Accordingly, it is an object of my invention to provide a simple and durable and efficient device of this character consisting of a minimum number of parts and adapted for inexpensive manufacture upon a large scale basis.

According to my invention the switch operating member of a solenoid cutout switch is made of resilient material to obtain a time delay in switch opening operation by utilizing the inertia and resilience of the contact carrying end of the switch member. The time delay thus obtained insures that the switch contacts will remain closed until the electromagnet plunger has completed its pick-up stroke. To prevent reclosing of the switch contacts due to oscillations of the resilient switch operating member after it has been actuated, I provide damping means cooperating with the free end of the switch operating member to interrupt vibrations at natural frequency due to switch actuating operation. Since devices of the character described are frequently installed upon rapidly moving parts of controlled apparatus, my damping means is also useful in preventing vibrations of the switch operating member induced by vibrations of the controlled apparatus.

My invention itself will be better understood and its objects and advantages further appreciated by referring now to the following detailed specification taken in connection with the accompanying drawing in which Fig. 1 is a side elevation of a plunger type of electromagnet having connected thereto a cutout switch embodying my invention, the cutout switch cover being shown in section; Fig. 2 is an end view of the device of Fig. 1 with the cutout switch cover removed; Fig. 3 is a sectional view of the cutout switch of Figs. 1 and 2 taken along the line 3—3 of Fig. 2 looking in the direction of the arrows; Fig. 4 is a side elevation partly in section of a modified form of cutout switch embodying my invention, the electromagnet being indicated in dotted outline; Fig. 5 is a plan view of the cutout switch of Fig. 4; and Figs. 6 and 7 are simplified circuit diagrams of connections for the electromagnet actuating coil illustrating respectively the use of normally closed and normally open cutout switch contacts.

Referring now to the drawing, and particularly to Fig 1, I have shown an electromagnet comprising a magnetic frame 10, a T-shaped movable plunger 11, and an actuating coil 12. As shown in Fig. 2, the laminated iron structure 13 of the magnetic frame 10 is riveted together between a pair of flanged end plates 14 and 15. The end plates 14 and 15 are provided with flanges on all four sides thereof to provide for convenient mounting of the solenoid to other apparatus and for convenient mounting of the cutout switch to the solenoid. The electromagnet is fully described and claimed in my copending application, Serial No. 395,077, filed May 24, 1941, and assigned to the same assignee as the instant application.

Mounted upon one side of the flanged end plates 14 and 15 is a cutout switch 20 comprising a base plate 21, a pair of fixed contacts 22 mounted upon the base plate, a pivotally mounted movable switch member 23 carrying a bridging contact 24, and a damping buffer positioned closely adjacent the actuated position of the movable switch member 23. The buffer 25 may, but preferably does not, act as a stop for determining the actuated position of the switch member. The actuated position of the switch member 23 is predetermined by separate means, as will more clearly appear hereinafter.

The base plate 21 for the cutout switch preferably consists of a metal plate having flanges at its upper and lower extremities for supporting a cover 26. Attached to the base 21 is a fixed support 27 carrying a pair of stationary contacts 22. The base plate 21 is slotted at 28 and bent inwardly to provide a pivotal support for the operating member 23.

The operating member 23 comprises a switch arm of rubber or other resilient material mounted between a pair of metallic supporting plates 29 and 30. The supporting plate 29 is bent transversely to provide a knife edge seat for engaging the pivot point 28 of the cutout switch base. As clearly indicated at Figs. 1 and 3, one end of the

supporting plate 29 extends through the cutout switch base plate 21 to provide a striker for engaging an actuating bar 35 mounted upon the electromagnet plunger 11. At its free end the rubber switch arm 23 carries the bridging contact 24.

As shown at Fig. 2, the rubber switch operating member 23 is apertured at 40 and the supporting plate 30 is correspondingly apertured at 41 to receive a biasing spring 42 which holds the switch operating member 23 in a normal position. As shown in the drawing the switch contacts are closed in the normal position of the switch member. The spring 42 is mounted upon a pin 43 which passes through apertures in the base 21 and the supporting plate 29 and carries at one end a stop 44 engaging one end of the biasing spring 42. The other end of the spring 42 engages the supporting plate 29 to hold the switch operating member 23 in position. The pin 43 is also provided with a head 45 engaging the switch base 21 and with a threaded portion 46 arranged to aid in mounting the switch cover 26 as shown in Fig. 1.

In operation, when the actuating coil 12 of the solenoid is energized to pick up the plunger 11 the bar 35 strikes the projecting end of the supporting plate 29 to move the switch operating member 23 to its switch opening or actuated position. The actuated position of the switch member 23 is preferably not determined by the buffer 25, but rather the projecting end of the supporting plate 29 is so positioned that the plunger 11 will move the switch member 23 only so far that it is closely adjacent the buffer 25. I, therefore, wish to have it understood that, while the switch member 23 in its actuated position may actually engage the buffer, it is sufficient and in fact preferable that the buffer 25 be only sufficiently near the actuated position of the switch member to engage the contact carrying end whenever that end begins to vibrate, thereby to interrupt violent oscillations at natural frequency.

As shown in Fig. 6, opening of the switch contacts 22 and 24 results in inserting a high resistance holding portion 50 of the actuating coil 12 in series with a low resistance pick-up portion 51 of the coil. The switch contacts, however, cannot be separated until the plunger 11 has completed its pick-up stroke due to the fact that an earlier diminution in the operating current would permit the plunger to drop out before completing its pick-up stroke. On the other hand, after the plunger has completed its stroke it no longer has any movement which may be used to open the switch contacts. For this reason the switch operating member 23 is made of rubber to introduce a time delay between the engagement of the actuating bar 35 with the switch member 23 and the opening of the switch contacts. Such time delay is introduced by the resilience of the rubber operating member 23 which permits the contact carrying end of the operating member to remain in switch closing position due to its inertia while the lower end of the operating member begins its movement under the influence of the actuating bar 35. By actual test it has been found that the contacts 22 and 24 do not separate until the plunger 11 has fully completed its pick-up stroke. After completion of the plunger pick-up the resilient operating member 23 opens the switch contacts to insert the holding portion 50 of the operating coil in series with the pick-up portion 51. It has also been found that the rubber member 23 is much better able to withstand the repeated and sudden shocks to which a switch of this type is subjected. A metallic or other rigid switch member has proven unsatisfactory.

To prevent violent oscillation of the upper end of the rubber operating member 23 at its natural frequency after the switch opening operation the buffer member 25 is positioned sufficiently close to the upper end of the operating member 23 in its switch opening position to engage the member 23 and interrupt any substantial vibration of its resilient upper end. As shown in Figs. 1 and 2 the oscillation damping buffer 25 is attached to a depending metallic arm 52 mounted upon a rubber support 53 which is attached to the cutout switch base 21.

By actual test it has been found that, while without the damping buffer 25 the oscillations of the upper end of the switch operating member 23 are sufficiently violent to cause intermittent closing of the switch contact and ultimate burning out of the pick-up portion 51 of the coil as well as rupture of the rubber armature above the supporting plates 29 and 30, the vibrations of the switch operating member 23 are almost imperceptible when the buffer is used. In addition to its function in damping oscillations due to switch opening movement of the operating member 23, the buffer 25, which preferably consists of a block of resilient material, is also useful in preventing oscillation of the switch operating member 23 due to vibrations of moving machinery upon which the cutout switch and magnet are sometimes mounted.

It will be understood, of course, that by supporting the stationary contacts in a position to be engaged by the bridging contact 24 when the operating member 23 is in its actuated position, the switch may be converted to a normally open type. The switch which I have disclosed may be so connected without any permanent structural change by merely detaching the bridging contact 24 and connecting it to the opposite face of the extending end of the rubber switch arm 23.

As shown in the circuit diagram of Fig. 7 the normally open switch mechanism may be employed to connect a plurality of portions of the actuating winding in multiple circuit relation upon operation of the plunger 11 to the attracted position. With the connection as shown in Fig. 7 only the pick-up portion 54 of the actuating winding 12 is energized initially and serves to supply the attractive force necessary to effect operation of the plunger 11 to the attracted position. Preferably the portion 54 of the actuating winding 12 is formed of a large number of turns and consequently has a relatively high resistance, while the remaining portion 55 of the winding is formed of a relatively few turns having a relatively low resistance. With the plunger 11 in the attracted position a very much reduced attractive force is sufficient to maintain the plunger picked up. Thus the switch contact 24 is arranged to connect the portion 55 of the actuating winding in parallel circuit relation with the portion 54. With the portion 55 of the actuating winding of relatively few turns and relatively low resistance, the major portion of the current in the series circuit will flow through the portion 55 while the portion 54 of the actuating winding will be energized in accordance with the voltage drop across the portion 55. In this way the effective ampere turns of the actu-

ating winding may be materially reduced with a corresponding reduction in the watts input.

At Figs. 4 and 5 I have illustrated a modified form of my invention in which the damping buffer consists of a pair of U-shaped members 60 and 61 fixedly attached to the electromagnet or cutout switch frame in position to nearly engage the bridging contact 24 in the actuated position of the switch member 23. As shown at Fig. 4 the switch operating member 23 comprises an apertured rubber arm mounted between two supporting plates in a manner generally similar to the construction shown in Fig. 3. To illustrate another means for mounting the operating member of the cutout switch the supporting plate 29 of Fig. 4 is shown bent to form a pivoted striker portion 63 apertured at 64 to receive the shank of the T-shaped plunger 11. The striker portion 63 is provided with a flange 65 at either side thereof for pivotal connection to the electromagnet frame as by pivot pins 66.

The damping buffers 60 and 61 of Figs. 4 and 5 are preferably formed of a molded insulating material in order to avoid metallic connection between the electromagnet frame and the bridging contact 24. It will be understood, of course, that if desired the U-shaped buffers 60 and 61 may be metallic and provided with insulating means at their point of contact with the bridging contact 24.

While I have described and illustrated only certain preferred embodiments of my invention, by way of example, many other modifications will occur to those skilled in the art and I, therefore, wish to have it understood that I intend in the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A delayed action electric control switch comprising a support, cooperating switch contacts, a resilient switch member having one end movably mounted upon said support and carrying at its free end one of said contacts, means for biasing said switch member to a normal position, quick-acting actuating means for moving said switch member to an actuated position spaced from said normal position, the resilience of said switch member and the inertia of its free end being sufficient to delay movement of said free end from said normal position until said actuating means has substantially completed its movement, and means mounted upon said support adjacent said actuated position of said switch member to engage and damp oscillations of said free end of said switch member after movement thereof to its actuated position.

2. A delayed action electric control switch comprising a support, a fixed contact mounted upon said support, a movable switch member of resilient material pivotally mounted at one end upon said support and carrying at its free end a movable contact for cooperation with said fixed contact, means for biasing said switch member to a normal position, electromagnetic actuating means for suddenly moving the pivoted end of said switch member to an actuated position spaced from said normal position, the resilience of said switch member and the inertia of said free end being sufficient to delay movement of said free end until said actuating means has substantially completed its movement, and stop means mounted upon said support adjacent the actuated position of said free end of said switch member intermittently to engage said free end and damp oscillations produced by its actuation.

3. A delayed action electric control switch comprising a support, a fixed contact mounted upon said support, a movable switch member comprising a switch arm of resilient material mounted between and extending beyond a pair of rigid supporting plates, means for pivotally mounting one of said plates upon said support, a movable contact mounted upon the extending end of said switch arm, spring means for biasing said switch member to a normal position, magnetically movable actuating means for moving said supporting plates suddenly to an actuated position spaced from said normal position, the resilience of said extending end of said switch arm and its inertia being such that said movable contact remains in said normal position until said actuating means has substantially completed its movement, and a buffer mounted upon said support closely adjacent and spaced from the free end of said resilient switch arm when said switch arm is in its actuated position thereby to engage said arm and damp oscillation thereof.

4. In a delayed action cutout switch for controlling the actuating coil of a plunger type electromagnet, the combination with said plunger of a support, a fixed contact mounted upon said support, a movable switch member comprising a rubber switch arm supported between and extending at one end beyond a pair of rigid supporting plates, a movable contact mounted upon the extending end of said switch arm for cooperation with said fixed contact, means including one of said supporting plates for pivotally mounting said movable switch member at its other end upon said support, a spring for biasing said movable switch member to a normal position, actuating means connected to said plunger for engaging at least one of said supporting plates thereby to move said plates suddenly to an actuated position spaced from said normal position, the resilience of said rubber switch arm and the inertia of its extending end being sufficient to delay movement of said movable contact until said plunger has substantially completed its actuating stroke, and a damping buffer connected to said support and positioned in closely spaced relation to the extending end of said rubber switch arm in its actuated position thereby to engage said arm and to damp oscillations thereof.

5. In a delayed action cutout switch for controlling the actuating coil of a plunger type electromagnet, the combination with said plunger of a support, a fixed contact mounted upon said support, a movable switch member comprising a flexible arm supported between and extending at one end beyond a pair of rigid supporting plates, a movable contact mounted upon the extending end of said arm for cooperation with said fixed contact, one of said supporting plates being bent transversely and extending through an aperture in said support to provide a pivot seat at the other end of said switch member and a striker bar for operating said switch member, knife edge means associated with said support for pivotally mounting said movable switch member upon said pivot seat, spring means engaging said support and said switch member for biasing said switch member to a normal position, actuating means connected to said plunger for engaging said striker bar upon energization of said electromagnet thereby to move said switch member from said normal position to an actuated position

spaced from said normal position, the resilience of said switch arm and the inertia of its extending end being sufficient to delay movement of said movable contact until said plunger has substantially completed its stroke, and a damping buffer of resilient material connected to said support and positioned in closely spaced relation to the extending end of said flexible switch arm in the actuated position of said switch member thereby to engage said arm and damp oscillations thereof.

6. In a delayed action cutout switch for controlling the actuating coil of a plunger type electromagnet, the combination with said plunger of a support, a fixed contact mounted upon said support, a movable switch member comprising a flexible arm supported between and extending at one end beyond a pair of rigid supporting plates, a movable contact mounted upon the extending end of said flexible arm for cooperation with said fixed contact, one of said supporting plates being bent transversely to provide a striker member for moving said switch member, flange means associated with said striker member for pivotally mounting said movable switch member upon said support, spring means engaging said support and said movable switch member for biasing said switch member to a normal position, means associated with said plunger for engaging said striker member to move said movable switch member to an actuated position spaced from said normal position, the resilience of said flexible switch arm and the inertia of its extending end being sufficient to delay the movement of said movable contact until said plunger has substantially completed its stroke, and a rigid buffer member having a leg positioned in closely spaced relation to said bridging contact in the actuating position of said switch member thereby to engage said contact and to damp oscillations of said switch arm.

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