Nov. 21, 1950 H. L. BRADLEY 2,531,025

CUSHIONED MAGNETIC SWITCH

Filed Sept. 27, 1946

Fig. 1

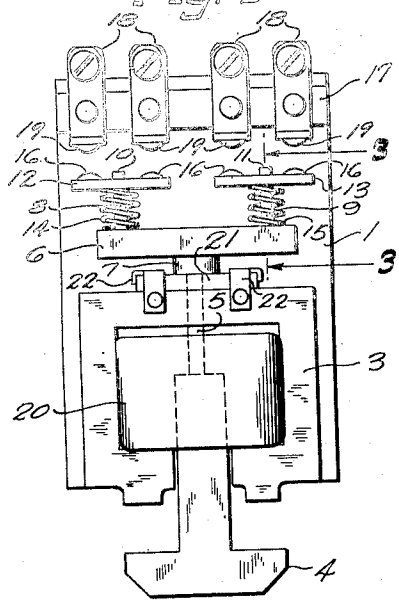
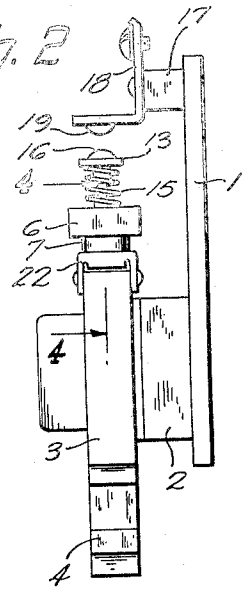


Fig. 2



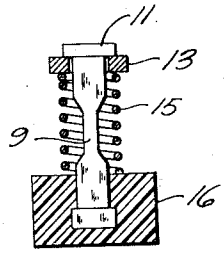
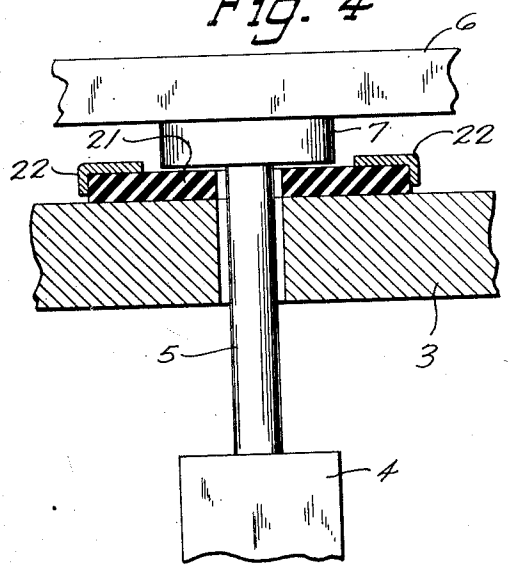


Fig. 3

Fig. 4



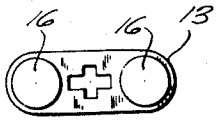


Fig. 5

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Patented Nov. 21, 1950 2,531,025

UNITED STATES PATENT OFFICE

2,531,025

CUSHIONED MAGNETIC SWITCH

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Application September 27, 1946, Serial No. 699,655

3 Claims. (Cl. 200—104)

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This invention relates to electro-magnetically actuated electric switches and it resides more specifically in an improved form of the same in which the inertia properties of resiliently backed movable contacts are related to the decelerating effect of arresting means engaged upon arrival of the switch parts in open position in such manner as to avoid destructive impact following overtravel of the movable contacts by eliminating such overtravel.

In electro-magnetically actuated switches heretofore constructed resiliently held movable contacts having a predetermined limited freedom of movement with respect to the movable parts of the switch have been commonly employed. The direction of the freedom of movement thus afforded to the movable contacts is such that upon arrival of the movable parts of the switch in open position and upon the sudden arresting of such opening movement the movable contacts tend to continue in their motion overcoming the resilient backing means. The energy thus stored in the resilient backing means is then given back to the movable contacts causing them to return rapidly and forceably against the stops which retain the same in operative position. This last named action causes impact wear and deterioration of mechanical parts constituting the contacts and the stops which limit their movement.

It is not practical to attempt to stop opening overtravel of the movable contacts by strengthening the backing springs since such increases the likelihood of faulty closure of the switch under low voltage conditions. Resilient stops at the end of opening travel have also been regarded skeptically because any rebounding of the movable switch parts at the end of the opening movement is likely to aggravate arcing and may even result in very undesirable re-arcing or reclosure.

It is the discovery of this invention, however, that the movable switch parts may be decelerated at the end of an opening movement slowly enough so that the momentum of the movable contacts will not overcome the normal preload tension of the backing springs and that such cushioning or moderated deceleration of the switch parts can be accomplished without detrimental rebound if a cushioning material having certain specific properties is properly disposed with respect to the other parts of the switch.

In certain specific instances it has been found that in an electro-magnetic switch otherwise capable of continued service that disabling mechanical deterioration due to rebound impact

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following overtravel of the movable contact members occurs after approximately 3 million cycles of operation. It is an object of this invention to overcome such limitations upon the life of switches of the character herein referred to. Properly applied in the specific instance referred to, the improvement of this invention has increased the life of a switch to as much as 7 million cycles of operation.

This invention is herein disclosed by reference to the accompanying drawing forming a part hereof in which there is set forth by way of illustration and not of limitation one form in which a switch may be constructed in accordance with this invention.

In the drawing:

Fig. 1 is a front view in elevation of one form of an electro-magnetic switch constructed in accordance with this invention;

Fig. 2 is a side view in elevation of the switch shown in Fig. 1;

Fig. 3 is an enlarged detail view in side elevation and in section viewed through the plane 3—3 indicated in Fig. 1;

Fig. 4 is an enlarged fragmentary front view in elevation and partly in section of the parts appearing at the plane 4—4 indicated in Fig. 2; and

Fig. 5 is an enlarged detail top plan view of one of the contact bars.

As shown in the drawing a switch may be constructed in accordance with this invention by providing an insulating mounting plate 1 to which is secured a forwardly projecting magnet bracket 2. Secured to the bracket is a stationary magnet frame 3 arranged to cooperate with a gravity returned vertically slideable armature 4. The upper part of the frame 3 is provided with an opening through which an actuating rod 5 secured to the upper end of the armature 4 projects upwardly.

Rigidly secured to the upper end of the actuating rod 5 is a transverse actuating arm 6 formed of insulating material and provided with a downwardly projecting arresting boss 7 disposed as shown. Projecting upwardly from the actuating arm 6 near each end thereof are non-circular retaining pins 8 and 9 rigidly molded in place as appears more clearly in Fig. 3. The retaining pins 8 and 9 are provided with transverse heads 10 and 11. Mounted on retaining pins 8 and 9 for vertical sliding movement but held against rotation are electrically conducting movable contact bars 12 and 13 which are urged upwardly against the heads 10 and 11 by pre-

loaded springs 14 and 15. Projecting upwardly from the surface of the contact bars 12 and 13 are contact buttons 16 composed of a metal or alloy suitable for withstanding the effects of electrical rupture.

To facilitate assembly of the contact bars 12 and 13 with their respective retaining pins 8 and 9 the bars are provided with central cross shaped openings as shown in Fig. 5. The long dimension of the cross shaped opening may be passed over the heads 10 and 11 and then the bars may be pressed down against the springs 14 and 15 to the narrow waists of the pins 8 and 9 where they may be turned 90° and released, whereupon the smaller dimension of the cross shaped opening engages the pins 8 and 9 with the heads 10 and 11 retaining the contact bars in place as shown.

Projecting forwardly from the insulating base 1 is a stationary contact support 17 composed of insulating material to which stationary contact terminals 18 are attached. The lower ends of the terminals 18 are bent forwardly and carry on their lower surfaces stationary contact buttons 19.

A coil 20 is mounted within the magnet frame 3 so as to surround the path of movement of the inner tongue of the armature 4. When the coil 20 is energized the armature 4 is forcibly raised and held in sealing engagement with the frame 3 bringing the contacts 16 into engagement with the contacts 19. In so doing the contact bars 12 and 13 retreat from the heads 10 and 11 a predetermined small amount and the springs 14 and 15 become further compressed. This relative motion between the heads 10 and 11 on the one hand and the contact carriers 12 and 13 on the other hand serves to insure proper engagement of the movable contacts 16 with the stationary contacts 19 and to establish reliable predetermined contact pressures.

When the coil 20 is deenergized the armature 4 and parts associated with it drop under the influence of gravity to the position shown in Figs. 1 and 2. Upon arrival in the open position the arresting boss 7 on the carrier arm 6 comes into contact with a cushion plate 21 held in place as shown by retaining members 22 secured to the magnet frame 3. The cushion plate 21 is formed of a relatively easily deformed material preferably having a consistent capacity to recover dimension slowly after deformation. Certain rubber compositions possess the properties desired, the same being compounded to produce an easily deformable composition but one in which substantial hysteresis in the elastic properties of the material are exhibited. Other materials such, for example, as cork, or piles of laminations of semiductile metals also exhibit the properties desired.

The properties of the cushion plate 21 are related to the momentum of the opening action, the inertia of the contact bars 12 and 13 and the preload tension of the springs 14 and 15 to bring about a sufficiently slow deceleration of the movable parts of the switch at the end of the opening movement so that the contact bars 12 and 13 will not overcome the springs 14 and 15 through their momentum.

It will be understood that the mass of the movable parts of the switch including not only the movable contacts and their carrier but also the armature 4 and the actuating rod 5 as well as the length of the accelerating path during opening must be taken into account as factors determining the momentum of the opening action.

When sufficiently slow deceleration of the movable parts is ensured the mechanical life of the contact bars 12 and 13 and of the heads 10 and 11 is very substantially increased. On the other hand, in the absence of a cushion plate 21 in a structure which permits the rigid material of the actuating arm 6 or boss 7 to come into contact with the metallic frame 3 of the magnet a very rapid deceleration of the movable parts of the switch occurs at the end of the opening movement sufficient to cause a very substantial overtravel on the part of the contact carriers 12 and 13. When these parts ultimately return into contact with the heads 10 and 11 impact occurs sufficient under repetition to distort and deform the parts at the point of impact. It has been found that deterioration due to this cause becomes a limiting factor in the life of the switch under certain load conditions but by the imposition of a cushion plate 21 having certain specific properties the service life of the switch can be more than doubled.

While an electro-magnetically actuated switch arranged to be opened under the action of gravity is above shown and described, spring biased switches capable of operation in any position may, of course, be constructed in well known manner and the advantages of this invention may be obtained in such structures by arranging for a dead cushion stop for the parts upon their arrival in open position. It is obvious also that the dead cushion stop may be carried by the movable parts of the switch, the same being located so as to strike a stationary part at the end of the opening movement. Consistent also with this invention is the use of arc enclosing or diverting means such as are commonly employed as well as means for shielding the springs 8 and 9 against the action of the arc.

I claim:

1. The combination with an electro-magnetically actuated switch having a magnet including a stationary frame and a movable armature, means adapted to urge said magnet to open position, a contact actuator associated with said armature to be moved thereby, movable contacts carried by said actuator, retaining means mounted on said actuator supporting said contacts and adapted to retain the same with limited freedom of movement with respect to said actuator, preloaded resilient means interposed between said actuator and said movable contacts adapted to urge the same toward the limiting position imposed by said retaining means, said movable contacts being free of all restraint other than that imposed by said retaining means and said preloaded resilient means, and stationary contacts positioned to be engaged by said movable contacts adapted to cause said movable contacts to deflect said resilient means when said armature is in closed position; of a dead cushioning means associated with the frame and armature of said magnet, and a cushion engaging means positioned to engage said dead cushioned means when said armature arrives at open position, said dead cushioning means being adapted to be sufficiently deflected by the momentum of said armature and associated parts movable therewith at the end of their opening movement so as to decelerate the same at a rate insufficient to cause said movable contacts to overtravel against the tension of said resilient means without causing substantial rebound of said armature.

2. In a switch biased to open position having

a movable contact actuator having an open and closed position, movable contacts carried by said actuator, retaining means mounted on said actuator supporting said movable contacts and adapted to retain the same with limited freedom of movement with respect to said actuator, preloaded resilient means interposed between said actuator and said movable contacts adapted to urge the same toward the limiting position imposed by said retaining means, said movable contacts being free of all restraint other than that imposed by said retaining means and said preloaded resilient means, stationary contacts positioned to be engaged by said movable contacts and to deflect said resilient means when said actuator is in closed position, and dead cushioning means associated with said actuator adapted to stop said actuator upon arrival in open position and adapted to be sufficiently deflected by the momentum of said actuator and associated movable parts at the end of their opening movement so as to decelerate the same at a rate insufficient to cause said movable contacts to overtravel against the tension of said resilient means without causing substantial rebound of said actuator.

3. The combination with an electro-magnetically actuated switch having a magnet including a stationary frame and a movable armature movable between open and closed positions, of a contact actuator associated with said armature to be moved thereby, a movable contact guiding member attached to said actuator, a movable contact slidingly received on said guiding member movable inwardly and outwardly with respect thereto in a direction parallel to the direction of movement of said actuator, a stop secured to said guiding member cooperatively engaging said movable contact to limit the outward movement of said movable contact, a spring interposed between said movable contact and said actuator adapted to urge said movable contact against said stop, a stationary contact positioned to be engaged by said movable contact when said armature is in closed position, said movable contact being free of all restraint imposed by means other than said spring and said stop when said armature is in open position, and a dead cushioning stop means position to arrest movement of said armature when it arrives in open position, said dead cushioning stop means being adapted to be sufficiently deflected by the momentum of said armature at the end of its opening movement so as to decelerate the same at a rate insufficient to cause said movable contact to overcome said spring and to rebound against the stop carried by said guiding member.

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