July 5, 1949. J. H. LOWNDES 2,475,331

ELECTROMAGNETICALLY OPERATED SWITCH

Filed Dec. 1, 1944

Fig. 1.

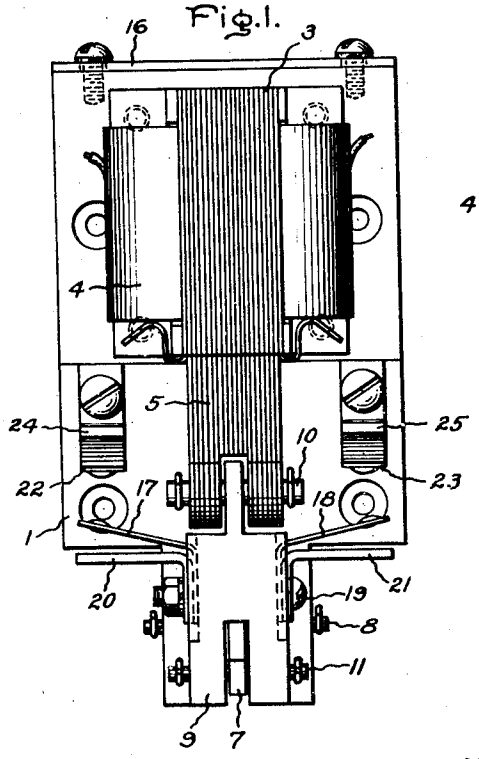


Fig. 2.

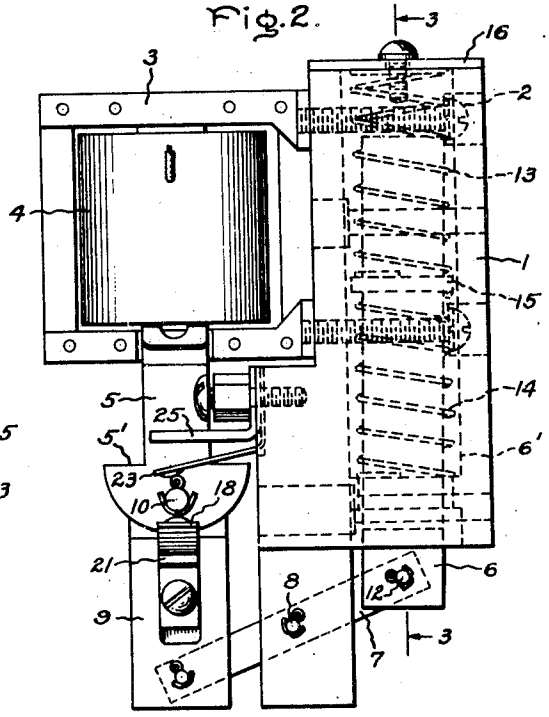


Fig. 3.

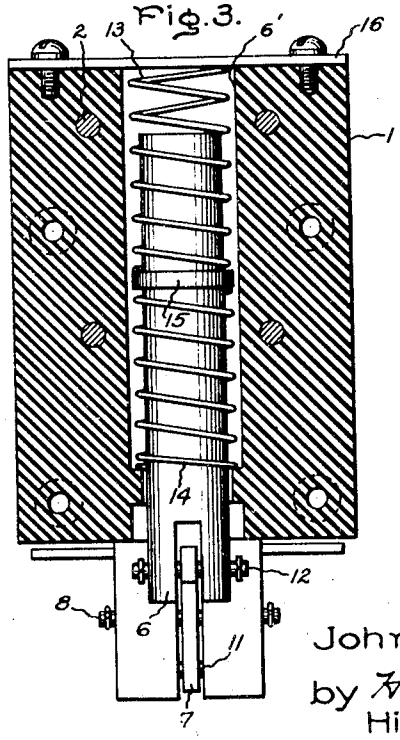
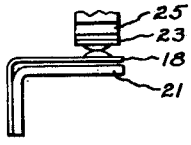


Fig. 4.



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ELECTROMAGNETICALLY OPERATED SWITCH

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Application December 1, 1944, Serial No. 566,082

5 Claims. (Cl. 200—111)

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My invention relates to electromagnetically operated switches, and has for its object a simple, reliable and inexpensive switch which is free from the effects of severe mechanical shocks.

In carrying out my invention, I counterbalance the armature by means of a weight and position the armature in its unattracted position by spring means thereby to prevent rebound of the armature and closing of the switch in the event of a shock when the switch is open. In one form of my invention, I operate the switch by means of a plunger type armature and provide a weight connected to the armature through a lever for counterbalancing the armature, together with two opposed helical springs acting on the weight for biasing the armature to its unattracted position and for positioning the armature in its unattracted position thereby to prevent the transmission of shocks from the support to the weight.

I also provide cooperating silver tipped flexible spring contact arms which maintain engagement with each other in the event of rebound of the armature and oscillate together without separation in the event of shock, together with rigid support means for limiting the oscillatory movement of the spring contacts.

For a more complete understanding of my invention, reference should be had to the accompanying drawing, Fig. 1 of which is a front elevation view of an electromagnetically operated switch embodying my invention; Fig. 2 is a side elevation view of the device shown in Fig. 1; Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2 looking in the direction of the arrows, while Fig. 4 is a fragmentary view showing the switch in closed circuit position.

In one form of my invention, I provide a supporting block 1 made of electrically insulating material on which is mounted by suitable screws 2 a magnet 3 provided with an operating coil 4 and a vertical movable plunger armature 5.

For the purpose of counterbalancing the plunger armature, I provide a cylindrical weight 6 which is positioned loosely in a bore 6' in the insulating support 1 in parallel relation with the armature 5. The weight 6 is mechanically connected to the armature through a lever 7 having an intermediate stationary pivot 8 mounted on a projection on the lower end of the support 1. The connection of the lever 7 to the armature 5 is made through an intermediate contact supporting member 9 made of electrically insulating material having its upper end secured by a pivot 10 to the lower end of the armature. A pivot 11 is provided on the lower end of the support

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9 to which is secured one end of the lever 7, its opposite end being secured to the weight 6 by a pivot 12. Since the pivot 8 is substantially midway between the pivots 11 and 12, the weight 6 has substantially the same weight as the weight of the armature 5, the support 9 and the contacts carried on it.

Helical springs 13 and 14 are provided for biasing the weight 6 to an uppermost position, as shown in the drawing, in which position the armature 5 is in its lowermost unattracted position. The two springs act in opposition to each other and surround the weight 6, their adjacent end bearing on a flange or collar 15 on the weight at substantially its middle.

The spring 14 has its lower end resting on a flange at the lower end of the bore 7 and serves to bias the weight and armature to their unattracted positions, as shown. The spring 13 serves as a back stop spring to render the weight shockproof. When the weight is in its unattracted position shown, the two springs apply substantial pressures in opposite directions to the flange 15, these pressures or forces being equal with the weight in the position shown so that the weight and armature are brought to rest in that position. In this upper position of the weight, its upper end is substantially spaced from the top cross member 16 extending over the bore 7 into engagement with which the upper end of the spring 13 rests. In other words, the two springs definitely position the weight in its upper position, as shown, while at the same time they support or position both the armature and the weight free from any rigid part of the base or support 1. When the coil 4 is energized the armature moves upward until its head 5' engages the lower end of the core 3 and the weight is correspondingly moved downward, the spring 14 being compressed.

The free or floating mounting of the weight is of particular importance when the weight and armature are in their unattracted positions, as shown. It will be observed that a downwardly directed shock applied to the support 1 is absorbed by the spring 13, and therefore does not cause downward movement of the weight by reason of the rebound or billiard ball effect which would be present if the upper end of the weight were biased upward solidly against a portion of the support 1, forming a stop, such as the plate 16. For the same reason, the armature 5 is not affected by severe shocks when in its unattracted position shown because the armature, through its connection with the weight by means of the lever 7, has the same float-free support through the

springs 13 and 14 as the weight itself. Moreover, because of the fact that the armature is counterbalanced by the weight, shocks transmitted from the support 1 through the pivot 8 to the lever 7 do not produce movement of the armature relative to the magnet core 3. For the purpose of maintaining the switch contacts in engagement when the armature is in its attracted position in the event that the armature rebounds from the magnet core 3 from the effect of a shock I provide both stationary and movable contacts in the form of flexible spring arms or strips provided with silver contacts on their ends. The movable contacts are spring strips 17 and 18 (Fig. 1) which are clamped by a bolt 19 to opposing sides of the movable support 9 and have upper end portions bent outward away from the support so as to extend nearly at 90° angles with the support and the direction of movement of the armature. Also clamped to the support 9 by the bolt 19 on each side over the strips 17 and 18 are stiff rigid support members 20 and 21 which extend outward from the support 9 in 90 degree relation therewith. It will be observed that the strips 17 and 18 have a substantial angular spacing with respect to the members 20 and 21 so that the strips can bend downward by the amount of this spacing angle.

The purpose of the rigid supports 20 and 21 is to prevent such a wide angular movement of the strips 17 and 18 as would separate them from the similar stationary contact strips 22 and 23 which are mounted on the support 1 and extend substantially at right angles to the direction of movement of the armature. When the armature 5 is in its raised attracted position, the ends of the spring arms 17, 22 and 18, 23 engage each other to close electric circuits between them. The point of engagement between each pair of spring contact arms occurs when the armature is an appreciable distance from its attracted position so that the spring arms are bent by the final movement of the armature in closely spaced substantially parallel relation with their respective rigid supports as shown in Fig. 4.

It will be observed from the drawing that the contacts engage each other when the armature has moved upward somewhat less than one-half of its total upward movement to its attracted position. Thereafter during the completion of the upward movement of the armature the contacts are in engagement and the spring contact arms bend to provide for the movement of the armature. Therefore the contacts are in engagement during a substantial portion of the armature movement, actually as shown during over one-half of the total movement of the armature. Moreover, the armature 5 has a large amount of movement relative to the length of the coil. As shown, the armature movement is over one-half of the length of the coil.

The spring arms 17, 18, 22 and 23 are arranged to flex back and forth in unison while maintaining their engagement with each other upon the occurrence of a shock applied to the support 1 when the armature is in its attracted position. Therefore, a shock tending to move the arms 17 and 18 downward relative to the support 1, such as an upwardly directed shock, does not open the circuits between the pairs of contacts because the spring contact arms 22 and 23 are similarly affected by the shock and follow the arms 17 and 18. The stops 20 and 21 and the similar stops 24 and 25 for the arms 22 and 23 serve as backstops and limit the oscillatory movements of the

spring arms to amplitudes over which the contact between them is not broken. Moreover, this double flexible contact arm or strip arrangement assures engagement between the contacts even though the armature is thrown a short distance downward from its attracted position by billiard ball rebound effect from a downwardly directed shock.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any 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. An electromagnetically operated switch comprising a stationary magnet core, a coil on said core, an armature movable to an attracted position in engagement with said magnet core, a support for said magnet core, a first spring contact arm on said support extending substantially at right angles with the direction of movement of said armature, a second spring contact arm on said armature extending substantially at right angles with the direction of movement of said armature arranged to engage said first contact arm before said armature reaches its attracted position after which said contact arms yield during the final movement of said armature whereby said contacts maintain an electrical engagement with each other in the event that said armature rebounds from said magnet core during a shock while said coil is energized, a plunger weight mounted for endwise movement in a direction substantially parallel with the movement of said armature, a lever connecting said weight to said armature, a flange abutment on said weight intermediate its length, and two helical springs surrounding said weight having adjacent ends seated on said flange and applying opposing forces to said weight thereby to bias said weight and said armature to predetermined unattracted positions in spaced relation with said support so that said armature is free from the rebound effect of shocks applied to said support.

2. An electromagnetically operated switch comprising a stationary magnet core, a coil on said core, an armature movable to an attracted position in engagement with said magnet core, a support for said magnet core, a first spring contact arm on said support extending substantially at right angles with the direction of movement of said armature, a second spring contact arm on said armature extending substantially at right angles with the direction of movement of said armature arranged to engage said first contact arm before said armature reaches its attracted position after which said contact arms yield during the final movement of said armature whereby said contacts maintain an electrical engagement with each other in the event that said armature rebounds from said magnet core during a shock while said coil is energized, a weight mounted for movement in a direction substantially parallel with the movement of said armature, a lever connecting said weight to said armature, and two springs applying opposing forces to said weight thereby to bias said weight and said armature to predetermined unattracted positions in spaced relation with said support so that said armature is free when in its unattracted position from the rebound effect of shocks applied to said support.

3. An electromagnet comprising a support, a

lever pivotally mounted intermediate its ends on said support, an armature pivotally mounted at one end of said lever for movement between attracted and unattracted positions, a weight pivotally mounted at the other end of said lever for movement in a direction parallel with said armature, and two springs seated on said support and arranged to apply opposing forces to said weight thereby to bias said weight and said armature to predetermined unattracted positions in spaced relation wtih said support whereby said armature and said weight are free from the rebound effects of shocks applied to said support.

4. An electromagnet comprising a support, a plunger armature mounted for endwise movement between attracted and unattracted positions, a plunger weight mounted for endwise movement in a direction parallel with said armature, a lever pivotally mounted intermediate its ends on said support and having opposite ends, a flange abutment on said weight intermediate its length, and two helical springs surrounding said weight having adjacent ends seated on said flange and opposite ends seated on said support and arranged to apply opposing forces to said weight thereby to bias said weight and said armature to predetermined unattracted positions in spaced

relation with said support so as to be free from the effects of shocks applied to said support.

5. An electromagnet comprising a support, an armature and a counterbalancing weight mounted in substantially balanced relation on said support for movement in substantially parallel spaced relation and two springs seated on said support and arranged to apply opposing forces to said weight thereby to bias said weight and said armature to predetermined unattracted positions in spaced relation with said support so that said armature and said weight are free from the rebound effects of shocks applied to said support.

JOHN H. LOWNDES.

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Certificate of Correction

Patent No. 2,475,331 July 5, 1949

JOHN H. LOWNDES

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 5, line 11, for "wtih" read *with*; line 20, after "ends" (second occurrence) insert *connected to said armature and weight*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of December, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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