May 26, 1942. J. E. LAKE 2,284,437

SNAP SWITCH

Filed March 20, 1941

Fig. 1.

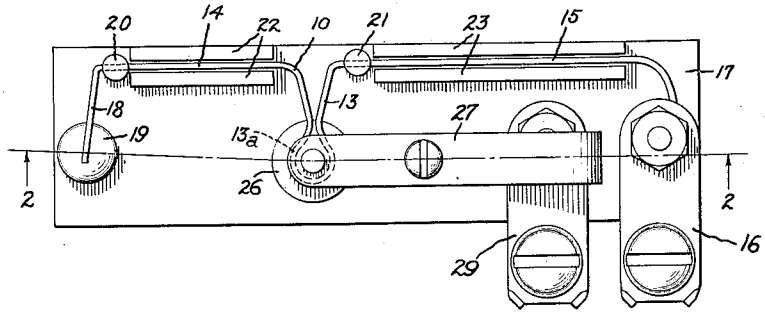


Fig. 2.

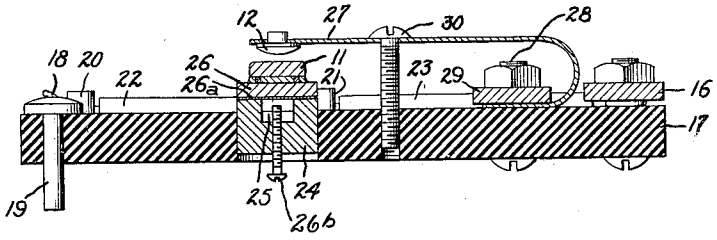
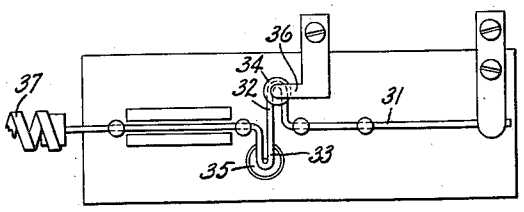


Fig. 3.



Inventor:
John E. Lake,
by Harry E. Dunham
His Attorney.

Patented May 26, 1942 2,284,437

UNITED STATES PATENT OFFICE

2,284,437

SNAP SWITCH

John E. Lake, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application March 20, 1941, Serial No. 384,228

4 Claims. (Cl. 200—67)

My invention relates to snap switches, more particularly to snap switches, such as limit switches, used in the control of electrical equipment, and has for its object a simple, reliable and inexpensive snapping mechanism.

In carrying out my invention in one form I utilize a spring torsion shaft or rod for operating the movable contact and provide a permanent magnet for holding the movable contact in a predetermined position until the spring shaft has been twisted sufficiently to release the contact from the magnet whereupon it is snapped to another position by the spring shaft.

For a more complete understanding of my invention, reference should be had to the accompanying drawing, Fig. 1 of which is a plan view of a snap switch embodying my invention; Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1 and looking in the direction of the arrows; while Fig. 3 is a plan view of a modified form of my invention.

Referring to the drawing, in one form of my invention I provide a torsionally resilient wire 10, forming a torsion shaft or rod, which when rotated operates the movable contact 11 with respect to the stationary contact 12. This rod 10 is provided with an intermediate loop portion forming a laterally extending arm 13 to which is secured the movable contact 11. Also, the wire is provided with a straight portion or section 14 forming a torsion spring operating member and with an equal or longer straight portion or section 15 serving to form a balanced support for the arm 13 and also as an electric conductor from the movable contact 11 to a terminal 16 secured to the insulating support 17. The other end of the wire is provided with an operating arm 18, the end of which can be forced upward, as seen in Fig. 2, with respect to the support 17 by means of a plunger 19 thereby to twist the straight section 14.

As shown, two posts 20 and 21 are provided on the support 17 at points adjacent the arms 18 and 13 respectively. These posts are provided with small apertures through which the straight sections of the wire extend loosely whereby the posts form bearings for the straight sections 14 and 15. Also, the straight lengths 14 and 15 are additionally supported against lateral movement by pairs of bars 22 and 23, constituting spaced raised portions on the base 17, between which the straight portions lie loosely. These raised portions furthermore provide protection for the wire against mechanical damage from engagement with other objects. In other words, they form shields for the wire.

In order to obtain a snap action, I provide a suitable releasably holding force for the movable contact 11. This force, as shown, is provided by means of a small disc-shaped permanent magnet 24 made of a material having relatively great magnetic retentivity and having a high coercive force. Preferably, I use an alloy consisting of aluminum, nickel, copper and iron, such as described and claimed in Patent 1,947,274, issued on February 13, 1934, to William E. Ruder, and Patent 2,027,997, issued on January 14, 1936, to Tokushichi Mishima. For example, I may use an alloy consisting of 12 per cent aluminum, 25 per cent nickel and 5 per cent copper by weight, the balance being mainly iron.

This disc-shaped magnet is magnetized with both north and south poles on its upper side, as seen in Fig. 2, these poles being separated by a groove 25 in the upper face of the magnet. A disc-shaped armature 26 is provided for the magnet, this armature being made of a magnetic material such as soft iron. On its lower side, as seen in Fig. 2, the armature has secured to it a thin layer 26*a* of non-magnetic material such as copper which forms in effect an air gap between the armature and the magnet when in its fully attracted position, as seen in Fig. 2, thereby to provide for a predetermined holding force on the armature and prevent sticking of the armature which might occur if no air gap were provided. The air gap also can be made adjustable by means of a screw 26*b* projecting through a hole in the magnet. This screw, by adjusting the air gap, adjusts the force action on the armature.

As shown, the magnet 24 is inserted in an aperture provided for it in the support 17 in a position to be directly under the end of the wire looped arm 13. For example, the magnet may be forced tightly in the aperture so as to be held on the support 17 by friction. The support preferably is made of a suitable moulded compound such as a phenolic condensation product.

The end of the arm 13 is secured to the upper side of the armature 26, as seen in Fig. 2, the movable contact 11 being secured on top of the arm 13. In order to facilitate the securing of the arm 13 to the armature, the wire at the end of the arm is formed into a substantially circular form somewhat smaller than the contact 11. This circular portion of the arm 13 is indicated in dotted outline 13*a* in Fig. 1. This portion is secured between the armature and the movable

contact 11 by welding or brazing the three parts together.

As seen in Fig. 1, the arm 13 extends toward the armature 26 along a line extending diametrically through the armature or, in other words, the two wires of the arm 13 are on opposite sides of such a line. Consequently, the armature is balanced on the arm 13 so that there is very little torsional force exerted by the armature on the arm 13. Consequently, the right and left-hand edges of the armature, as seen in Fig. 2, are maintained at substantially equal distances from the magnet when the armature is in its unattracted position.

Preferably, the stationary contact 12 is mounted on one end of spring arm 27, the other end of the arm 27 being secured by a bolt 28 to the support 17, and also by the bolt to the terminal 29 whereby the arm 27 forms an electrical connection between the contact 12 and the terminal 29. By means of a screw 30, the end of the arm 27 can be adjusted to vary the position of the contact 12.

In the operation of the device, the armature 26 is normally held in its attracted position, as seen in Fig. 2, with the contacts separated. To move the contact 11 into engagement with the contact 12, the pin or plunger 19 is pressed upward whereby the end of the arm 18 is moved upward and a torsional force or twist applied to the straight length 14. The arm 18 bends somewhat but the main distortion of the wire occurs in the twisting of the length 14. Finally, when the pin 19 has been pressed up far enough to apply a force to the armature sufficient to move it away from the magnet, the armature is snapped to its unattracted position and the contact 11 is thereby snapped into engagement with the contact 12. Also, in moving the armature to the unattracted position the arm 13 moves upward whereby a torsion or twist is applied to the length 15 which produces a small force tending to return the armature to its unattracted position. Preferably, the spring arm 27 is of such strength that it yields somewhat, allowing the stationary contact 12 to move upward a short distance by the force applied by the rod 10. This provides for a wiping action between the contacts.

In the arrangement shown, in order to keep the contacts in engagement, the pin 19 must be held in a raised position. To separate the contacts the pin is released whereupon the armature is snapped by the magnet to its attracted position and the contacts are separated with a snap action. Preferably, the spring arm 27 is adjusted by the screw 30 to a position such that if the pin 19 is moved slowly downward from its contact closed position, the stationary contact 12, by reason of the straightening of the spring arm 27, will follow the movable contact maintaining the contacts in engagement with each other until the force of the wire 10 is overcome by the force of the magnet on the armature. The armature is then snapped quickly to its attracted position and the contacts are separated with a snap action.

In Fig. 3 I have shown the torsion wire 31 bent into two oppositely disposed loops lying in the same plane whereby two arms 32 and 33 are formed. The arm 32 carries the movable contact 34 while the arm 33 carries the armature 35 cooperating with a permanent magnet just below the armature. In this form the movable contact is mounted on top of the arm as viewed in Fig. 3 so that it is held normally when the armature 35 is in its attracted position in engagement with a stationary contact 36 positioned just above the movable contact. Also, I have shown a helical bimetallic thermostat 34 connected to the operating end of the wire 31 so as to twist the wire and operate the snap switch in response to changes in temperature.

While the wire 10 is illustrated as having a circular cross section of uniform diameter throughout its length, it will be understood that I define the term "wire" to include any torsionally resilient member regardless of the shape of its cross section.

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. A snap switch comprising a support, a torsionally resilient wire having two straight portions joined by a bent portion forming a switch arm, bearing means securing said portions to said support for rotation on said support, a movable contact carried by said arm, an armature carried by said arm, a permanent magnet on said support opposite said armature for biasing said armature and movable contact toward said support to a predetermined position with a force sufficient to produce twisting of said wire, a stationary contact, a spring arm mounting said stationary contact in position to be engaged by said movable contact when said movable contact and said armature are moved away from said magnet, a pair of terminals on said support, electrical connections between one of said terminals and one end of said wire and between the other of said terminals and said spring arm, operating means for turning the other end of said wire thereby to twist the adjacent straight portion of said wire and pull said armature away from said magnet whereby said movable contact is snapped into engagement with said stationary contact and the other one of said straight portions is twisted to apply a force to return the arm to said predetermined position when said other end of said wire is released.

2. A snap switch comprising a support, a torsionally resilient wire, a switch arm secured to said wire intermediate the length of said wire and extending laterally with respect to said wire, bearing means securing said wire to said support for rotation on said support, means securing one end of said wire to said support against turning movement, a movable contact carried by said switch arm, yieldable snap action means biasing said switch arm to a predetermined position, operating means for twisting the other end of said wire thereby to snap said switch arm to another position whereby the portion of said wire adjacent said secured end is twisted and applies an opposing force tending to return said switch arm to said predetermined position, and a stationary contact on said support in position to be engaged by said movable contact.

3. A snap switch comprising a support, a torsionally resilient wire having two aligned straight portions joined by a loop portion forming a switch arm, bearing means securing said straight portions to said support for rotation on said support, means securing one end of said wire to

said support against turning movement, a movable contact carried by said switch arm, a magnet on said support for biasing said switch arm to a predetermined position, and operating means for twisting the other end of said wire thereby to twist the adjacent straight portion of said wire and snap said switch arm to another position, and said other straight portion of said wire being twisted by said movement of said switch arm thereby to apply an opposing force tending to return said switch arm to said predetermined position, and a stationary contact on said support in position to be engaged by said movable contact.

4. A snap switch comprising a support, a torsionally resilient wire having two aligned straight portions joined by a bent portion forming a switch arm, bearing means securing said straight portions to said support for rotation on said support, a terminal on said support, an electrical connection between one end of said wire and said terminal whereby said wire may be connected in an electric circuit and said end is secured against turning movement, a movable contact carried by said arm, an armature carried by said arm, a permanent magnet on said support for biasing said armature and movable contact to a predetermined position, a stationary contact mounted on said support, and operating means for twisting the other end of said wire thereby to twist the adjacent straight portion of said wire and pull said armature away from said magnet and snap said movable contact into engagement with said stationary contact whereby the other straight portion of said wire is twisted by said movement of said switch arm to apply an opposing force tending to return said switch arm to its original position.

JOHN E. LAKE.