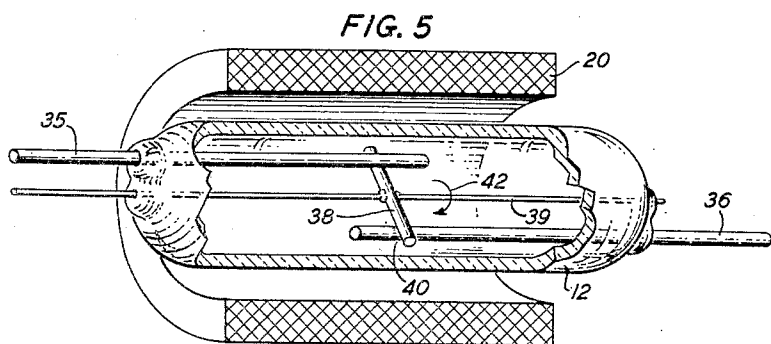
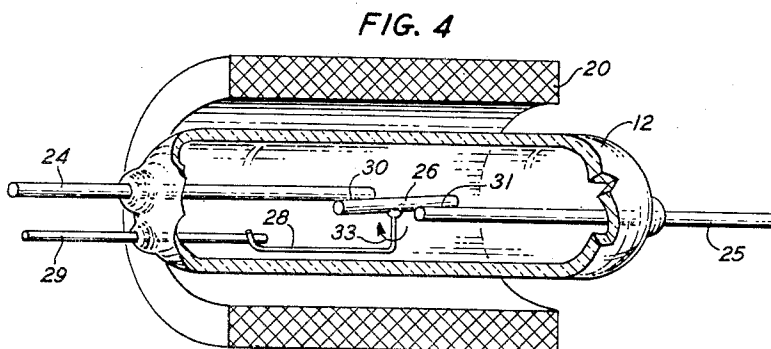
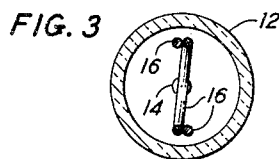
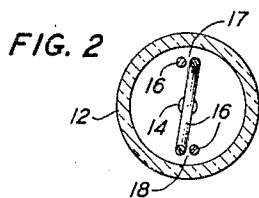
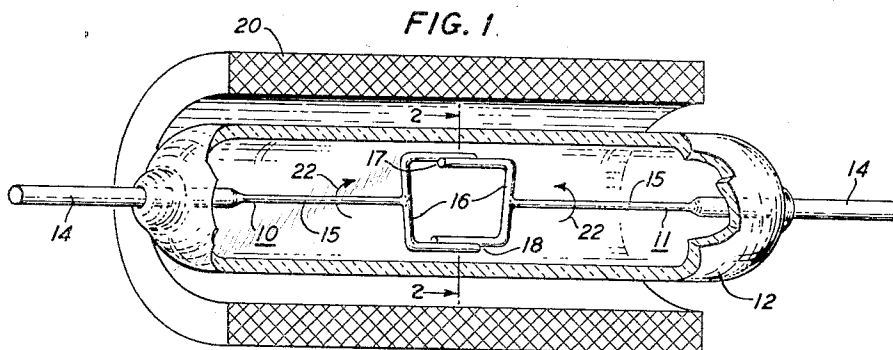


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S. T. BREWER
ELECTROMECHANICAL SWITCH

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ELECTROMECHANICAL SWITCH

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1 Claims. (Cl. 200—87)

This invention relates to electromechanical switches and more particularly to such switches having rapid operating times.

As new switching systems are developed having a large number of electronic components enabling them to operate at faster speeds than priorly attainable, the slowness of operation of the electromechanical switches or relays with which these systems must cooperate becomes a major problem. Many present switching systems utilize all metallic paths for the transmission of voice currents because of the reliability of the all metallic path, as opposed to a path including electron discharges. However, the present slow operating relays which comprise the switches of that metallic path render nugatory the possible high speeds of operation attainable by the electronic control circuits for the relays.

A general object of this invention is to provide an improved electromechanical switch.

Another object of this invention is to enable the attainment of a high speed of operation in a switching circuit while still utilizing an all metallic connection for information signals or frequencies through that circuit.

These and other objects are attainable in accordance with specific embodiments of this invention wherein two cooperating contact members, at least one of which is rotatable, are supported within a sealed envelope, the contact members defining a pair of gaps and being at least in part of a magnetic material. An energizing coil encompasses the sealed envelope. The rotatable contact member or members are supported by a wire so as to be stressed in torsion when the gaps are closed and thus to provide a restoring force tending to maintain the switch gaps open. On energization of the encompassing coil, a magnetic field is applied to the contact members causing the rotatable member or members to revolve through a small angle against the restoring force of the torsion stress to close the contact gaps. Upon removal of the field the torsion support restores the moving member or members to their original positions.

Because of the very low mass and low moment of inertia of the moving elements of the switch and also because of the very small angle through which the moving elements need rotate to assure positive action of the switch, very rapid speeds of operation may be attained. I have found that electromechanical switches in accordance with my invention may operate in times as short as three tenths of a millisecond, without chattering.

It is therefore a feature of this invention that the restoring force for a rotatable contact of an electromechanical switch be provided by a torsion stress introduced into the wire supporting the rotatable contact on closure of the contacts of the switch.

It is a further feature of this invention that an electromechanical switch comprise at least two magnetic contact members positioned within an enclosed envelope, at least one of the contact members being rotatable, the contact members defining a pair of normally open gaps, and the rotatable contact member or members being supported by a wire so as to be stressed in torsion on closure of the two gaps between the contact members. More specifically, it is a feature of this invention that the wire supporting the rotatable

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contact member be perpendicular to the plane of rotation of the contact member.

It is a still further feature of this invention that the gaps thus defined by the contact members be of the order of mills in the length so that the rotation of a movable contact member is very short and the restoring torsion force introduced into the supporting wire of the rotatable contact member is small, whereby very rapid operate and release times may be attained.

Further features of this invention include the structural arrangements of specific embodiments of this invention, as further described below.

These and other features of this invention may be fully understood from the following detailed description and accompanying drawing, in which:

Fig. 1 is a side view of an electromechanical switch illustrative of one specific embodiment of this invention, a portion of the enclosing envelope being broken away to reveal the internal members more clearly and the encompassing magnetic coil being shown in section;

Fig. 2 is a plan view of the switch of Fig. 1 along the line 2—2 thereof, the contact members being shown in their open position;

Fig. 3 is a plan view of the switch of Fig. 1 identical with that of Fig. 2 but the contact members being shown in their closed position; and

Figs. 4 and 5 are side views of electromechanical switches illustrative of two other specific embodiments of this invention, a portion of the enclosing envelope of each switch being broken away to reveal the internal members more clearly and the encompassing magnetic coil being shown in section.

Turning now to Fig. 1, in the specific illustrative embodiment there depicted two contact members 10 and 11 are positioned in an enclosed envelope 12, the contact members being of a magnetic material, such as Permalloy, and each having a base portion 14 extending through the envelope and to which electrical connection is made, a slender wire portion 15, and a yoke or U-shaped contact portion 16 providing the two switch gaps 17 and 18 which are in parallel both magnetically and electrically. In accordance with an aspect of this invention the slender wire portions 15 are stressed in torsion on closure of the gaps 17 and 18 to provide the restoring force for opening the switch gaps.

An energizing coil 20 encompasses the sealed envelope 12. On energization of this coil a magnetic field is provided through the contact members 10 and 11 which causes their yoke portions 16 each to revolve through a very small angle, closing the switch gaps 17 and 18. The direction of this turning of the wire portions 15 in application of the magnetic field is indicated by the arrows 22. Upon removal of this field the torsion stress in the slender wire portions 15 restore the yoke portions 16 to their original positions.

Fig. 2 is a plan view along the line 2—2 of Fig. 1 showing the contact members 16 in the open or unoperated position and separated by the gaps 17 and 18. Fig. 3 shows the contact members after application of the magnetic field, when the contact members have closed the gaps. An appreciation of the small angle through which the motion occurs can be gained from the fact that the gaps 17 and 18 may advantageously be of the order of one to ten mills. The smaller gaps may be employed when the primary consideration is the rapidity of response or operation while the somewhat larger gaps may be employed where larger currents are to be broken on opening of the gaps. With a one mil spacing between the contact members, the switch operates in times of the order of three tenths of a millisecond. On removal of the magnetic field, the switch releases in times of the order of one tenth of a millisecond. The magnetic field employed may be of the same order of magnitude as presently utilized for reed contact relays, such as a field of a hundred ampere turns. The field strength will, of course, depend on the size of the contact members and supports which are in turn related to current carrying and breaking capacity. Advantageously in order to attain rapidity of operation the movable parts should have

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as small a mass and moment of inertia as in compatible with the current requirements of the switch.

Turning now to Fig. 4, in the specific illustrative embodiment of the invention there depicted two contact members 24 and 25 comprise straight wires, advantageously of Permalloy or other magnetic material, which extend through opposite ends of the envelope 12. A third or movable contact member 26 is supported between the inner ends of the two members 24 and 25 by a thin wire 28 which itself may extend through the envelope 12 or may be connected, as depicted in the drawing to another and larger wire 29 which extends through and is sealed to the envelope 12. The portion of the wire 28 secured to the rotatable contact member 26 supports member 26 at its midpoint, extends perpendicular to it, and in accordance with an aspect of this invention is stressed in torsion on rotation of contact member 26 so as to maintain open the two gaps 30 and 31 between the ends of the movable contact member 26 and the contact wires 24 and 25. Upon application of the magnetic field the gaps 30 and 31 are closed by the motion of the contact member 26 against this torsion stress, the motion being as indicated by the arrow 33. The movable contact member 26 may be only about two tenths of an inch long so that the moving element has a very low moment of inertia aiding in the rapidity of response of a switch in accordance with this embodiment of the invention. The wire 28 may be an eight mil Phosphor bronze wire, though other material wires may be employed.

In the embodiment of Fig. 5 two stationary contact wires 35 and 36 again extend through and are sealed to opposite ends of the envelope 12. In this embodiment the rotatable contact member 38 is supported perpendicular to the two stationary contact wires 35 and 36, whereas in the embodiment of Fig. 4 the rotatable contact member 26, when in the closed position, was effectively parallel to the stationary contact wires 24 and 25. The rotatable contact member 38 is supported by a thin wire 39 which may extend through one or both of the ends of the envelope 12. In accordance with an aspect of this invention wire 39 is stressed in torsion on rotation of contact member 38 so as to maintain a small gap 40 between the ends of the movable contact member 38 and the wires 35 and 36, only one of the gaps being seen in the drawing.

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On application of the magnetic field the movable member 38 moves in the direction indicated by the arrow 42 against this torsion stress in the wire 39 to close the gaps 40. When the magnetic field is removed the movable element 38 returns to its prior position and restores the gaps 40 due to this torsion stress in the wire 39.

It is apparent that in each of the embodiments depicted in Figs. 4 and 5 a potential may be applied, through the wire 29 or the wire 39, to the rotatable element itself. Furthermore as the supporting wires for these embodiments need not be part of the magnetic circuit, the material for these wires may be chosen with a view to its elastic and torsional properties alone and without consideration for its magnetic or electrical properties.

While this invention has been depicted with reference to specific embodiments in which two gaps were opened and closed simultaneously, it is to be understood that the invention is not to be considered as limited thereto. Thus the above-described arrangements are illustrative of the application of the principles of the invention and numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

An electromechanical switch comprising a pair of normally spaced U-shaped contact members defining a pair of magnetic flux gaps therebetween of the order of mils in length, said contact members being at least in part of a magnetic material, a wire supporting each of said U-shaped contact members so as to be stressed in torsion on closure of said gaps, and means for applying a magnetic field to said contact members to effect closure of said gaps by motion of both of said U-shaped contact members against the restoring forces of the torsion stress of said wires, said wires being perpendicular to the plane of rotation of said contact members.

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