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A. C. DUCATI
MAGNETIC SWITCH DEVICE
Filed Jan. 31, 1955

2,922,855

FIG. 1.

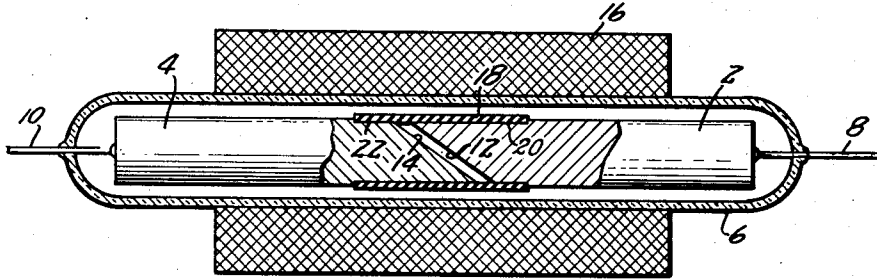


FIG. 2.

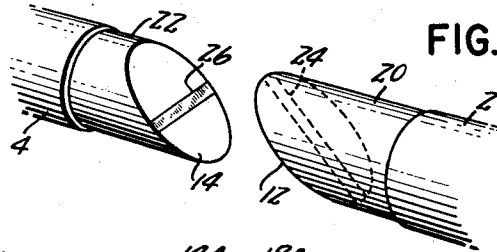


FIG. 3.

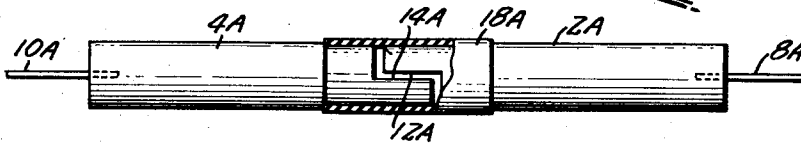


FIG. 5.

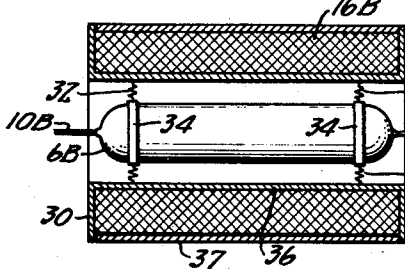


FIG. 4.

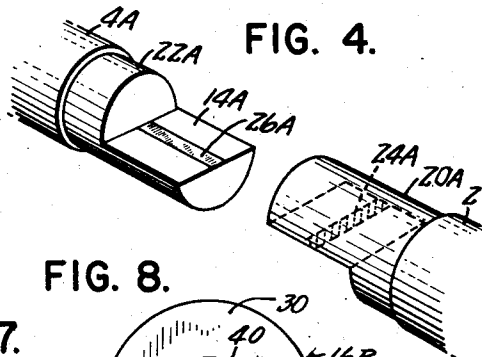


FIG. 8.

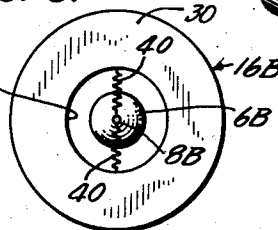


FIG. 6.

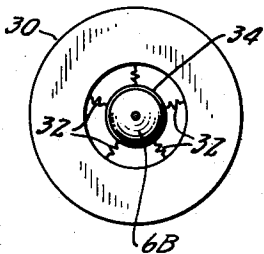
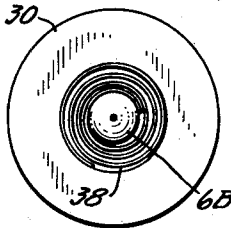


FIG. 7.



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MAGNETIC SWITCH DEVICE

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8 Claims. (Cl. 200—87)

This invention relates to magnetic switches and more particularly to switches having contact members formed of magnetizable material enclosed within a sealed glass envelope and actuated by a winding around the outside of the glass envelope.

In general, such switches have utilized blade type electrodes in overlapping relationship so that when the two blades are magnetized they are drawn together with their flat sides in contact. These flat electrodes ordinarily are housed in glass envelopes of circular cross-section so that there is substantial space within the glass envelope that is not filled with magnetic material. The present invention is directed toward a more efficient electrode construction that decreases the effective electrical force required to actuate the switch and increases its speed of response. This improved switch construction also minimizes bouncing or chattering of the contact members when the switch is energized, provides an improved arrangement of contact surfaces.

In a preferred embodiment of this invention, the contact members of the switch are circular in cross section and are provided with overlapping beveled end-surfaces. These electrodes substantially fill all of the space within a tubular glass envelope which is surrounded by the actuating coil. With this arrangement maximum magnetic material is provided within the field of the coil and efficient operation is achieved.

The various aspects and features of the invention will be in part pointed out in and in part apparent from the following description considered in conjunction with the accompanying drawings, in which:

Figure 1 is a sectional view through a switch embodying the invention;

Figure 2 is a diagrammatic illustration showing the arrangement of contact strips on the end surfaces of the contact members;

Figure 3 shows a switch having a modified electrode arrangement;

Figure 4 is a diagrammatic view showing one arrangement of contact strips on the electrode members of Figure 3;

Figure 5 is a sectional view showing a switch similar to that of Figure 1 but having shock-resistant construction;

Figure 6 is an end view of the switch shown in Figure 5;

Figure 1 shows another type of shock-resistant support; and Figure 8 shows another support.

The switch shown in Figure 1 includes two magnetizable switch electrodes 2 and 4 formed of soft iron or other easily magnetized material. These electrodes 2 and 4 in effect serve both as movable armatures and as contact members, the electric current which is to be carried by the switch passing longitudinally through these members. The electrodes 2 and 4 are circular in cross-section and are resiliently supported within a sealed glass envelope 6 by means of two Kovar metal leads 8 and 10, respectively. These Kovar leads are secured to the

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ends of the respective electrodes 2 and 4 and are sealed into the ends of the glass envelope 6 so as to support resiliently the switch electrodes within the envelope. The size of the Kovar leads 8 and 10 and the distance 5 between the ends of the respective electrodes and the end of the glass envelope 6 are selected so that the electrodes are supported within the envelope 6 with the desired resiliency and so that the adjacent ends of the two electrodes normally are maintained in spaced relationship. 10 ship.

The adjacent ends of the electrodes 2 and 4 are cut off at an angle to form beveled contact faces 12 and 14. When the two switch electrodes 2 and 4 are coaxially positioned within the envelope 6, these two faces are spaced so that there is no electrical connection between the leads 8 and 10 to the switch. However, when these two electrodes 2 and 4 are magnetized, for example by passing direct current through a winding 16 surrounding the envelope 6, the end portions of the electrodes 2 and 4 are attracted to each other and are displaced by an amount sufficient to permit the two members to make electrical contact. 15

It has been found desirable to bevel the faces at an angle of approximately 32° and to arrange the electrodes so that very small spacing exists between the end of the electrodes when they are in their rest position, so that relatively little transverse movement is required to bring the two faces of the electrodes into engagement. 25

In order to prevent vibration or accidental shock from deflecting the ends of the electrodes sufficiently to make contact with each other and also to minimize the bouncing effects when the electrical contact is made, a resilient sleeve 18 is positioned so as to extend over the end portions of each of the electrodes 2 and 4 around the contact faces 12 and 14. This sleeve preferably is formed of silicone rubber but other resilient insulating material can be used. This sleeve 18, which in this example is formed of thin-walled tubing, is positioned in recessed portions 20 and 22 of the electrodes 2 and 4, so that there is no possibility of the resilient sleeve being shifted in position. 30

When the two members 2 and 4 are magnetized by energization of the winding 16, the end portions of the electrodes 2 and 4 are permitted to deflect radially in opposite directions to complete the electrical contact between the bases 12 and 14. When the magnetizing force is removed by de-energization of the winding 16, the electrodes are returned to their previous positions in coaxial alignment by the restoring force of the two lead members 8 and 10 and also by the restoring force provided by the resilient silicone sleeve 18. 35

The contact faces 12 and 14 may be coated with suitable contact material such as silver, tungsten, platinum, or the like. To reduce further the possibility of corrosion of the electrodes as well as arcing at the contacts, the envelope 6 may be evacuated or may be filled with inert gas such as helium or the like. 40

An improved arrangement for placing the contact material on the ends of the members 2 and 4 is illustrated in Figure 2 in which a strip 24 of metal, such as silver, platinum, tungsten or the like, is placed across the beveled face 12 of the electrode 2 and another strip 26 of similar contact metal is placed across the beveled face 14 of the electrode 4 at an angle with respect to the strip of metal 24, so that the two strips of contact metal 24 and 26 in effect lie crosswise with respect to each other. These strips of metal may be positioned at an angle of 90° with respect to each other or some lesser angle, but it is preferred that the two strips are not parallel. 45

Figure 3 shows a switch similar to the one shown in Figure 1 but having a different arrangement of contact 50

faces. The parts in Figure 3 have been given the same numbers as the corresponding parts of Figure 1 followed by the suffix "A." In this example, the beveled faces are eliminated and the end portion of the electrode 4A is provided with a notch or recess provided by removing a semi-circular segment from the circular electrode to provide a contact surface 14A extending parallel with the longitudinal axis of the electrode 4A. The end portion of the other electrode 2A is provided with a similar notch or recess portion to form a contact face 12A which is parallel and normally spaced from the contact face 14A. When the winding 16A is not energized, the electrodes are in the position shown in Figure 3, and when the winding 16A is energized the two electrodes 2A and 4A are attracted, thereby bringing the faces 12A and 14A into engagement. In this example an alternative method of securing the Kovar leads 8A and 10A to the respective electrodes is illustrated. In this example, a hole is provided in the outer ends of the electrodes 2A and 4A, in which the respective Kovar leads 8A and 10A are inserted. The leads are then soldered to the respective electrodes by means of silver solder or other suitable means.

As in the previous example, the surfaces 12A and 14A may be coated with suitable switch contact material, such as silver or other metal, but preferably this metal is applied in the form of narrow strips as indicated in Figure 4. The contact strip 24A on the face 4A of the electrode 2A is positioned transversely with respect to the longitudinal axis of this electrode. However, the contact strip 26A on the other electrode is positioned parallel with the axis of the electrode so that the two contact strips 24A and 26A are perpendicular with respect to each other. However, a satisfactory arrangement is provided so long as they are positioned crosswise with respect to each other whether they be perpendicular or at some lesser angle.

Figure 5 shows a switch similar to that described above with a shock-resistant mounting. In this example, parts corresponding to those of the earlier figures are denoted by corresponding numerals followed by the suffix "B."

The glass envelope 6B is mounted axially along the central opening of a bobbin 30 of circular cross-section. The envelope 6B is resiliently suspended in the center of this bobbin opening by a number of radially-extending tension spring members 32 (see also Figure 6) which are connected at their inner ends to two spaced collars 34 fitted snugly around the glass envelope 6B. The outer ends of the spring members 32 are fastened to the inner surface of the central core 36 of the bobbin 30. The annular clearance between the envelope 6B and the inner surface of the core 36 permits substantial movement of the envelope 6B without striking the bobbin 30. The winding 16B is supported by the bobbin 30 so that in this instance the winding is spaced a substantial distance from the envelope. Around the winding is a casing 37 of magnetically permeable material, such as "Permalloy," providing a low reluctance return path for the control flux.

Figure 7 shows another mounting arrangement in which each set of tension springs 32 has been replaced by a flat spiral spring 38 having a central part clamping the envelope 6B and its outer part in compressive relationship with the inner surface of the core 36.

Figure 8 shows yet another shock-resistant support in which pairs of opposed resiliently "soft" springs are connected between the projecting ends of the Kovar leads 8 and 10 (not seen in Figure 8) and the inner surface of the central core 36 of the bobbin 30. Preferably the core 36 is of insulating material.

From the foregoing it will be seen that I have provided a switch construction well adapted to meet the ends and objectives set forth above and which is subject, without exceeding the scope of the invention, to various modifica-

tions in order to best adapt the switch for each particular use.

What is claimed is:

1. A magnetic switch device comprising a sealed envelope, two electrodes of magnetizable material, said envelope and said electrodes being cylindrical in configuration with said electrodes being in spaced end-to-end relationship and in substantial alignment with the axis of said envelope, and in axial alignment with each other, the adjacent ends of said electrodes having oppositely tapered end portions, said end portions being axially aligned and overlapping each other and having contact faces in closely spaced relationship, means resiliently mounting at least one of said electrodes in said envelope for motion of the end portion thereof toward the other end portion in a direction substantially perpendicularly to the axis of said envelope, a sleeve of resilient flexible material surrounding both of said end portions, and electromagnetic control means outside said envelope for magnetizing said electrodes, thereby to attract each other to flex said sleeve laterally and engage said contact faces.

2. A magnetic switch device as claimed in claim 1, and wherein said sleeve is of silicone rubber.

3. A magnetic switch device comprising a relatively long generally cylindrical sealed envelope, a pair of rigid generally cylindrical electrodes of magnetizable material, one in each end of said envelope, said electrodes being in spaced end-to-end relationship and in axial alignment with each other and in alignment with the axis of said envelope, the adjacent ends of said electrodes being axially aligned and having offset tip portions overlapping each other and defining contact faces in closely spaced relationship, the opposite ends of said electrodes being relatively widely spaced from each other, a pair of resilient support elements passing out through the opposite ends of said sealed envelope, each of the opposite ends of said electrodes being connected to one of said resilient support elements, said electrodes substantially filling the space within said cylindrical sealed envelope, said resilient support elements being substantially more flexible than said electrodes, and electromagnetic control means outside said envelope for magnetizing said electrodes, thereby to attract each other and engage said end portions.

4. A magnetic switch device as claimed in claim 3, and wherein said resilient support elements are flexible Kovar metal leads insulated from each other and axially aligned with each other and with said envelope and sealed into the ends of the envelope.

5. A magnetic switch device comprising a sealed envelope, two electrodes of magnetizable material, said electrodes being in spaced end-to-end relationship and having longitudinal axes substantially in alignment with each other, the adjacent ends of said electrodes being substantially in axial alignment and having portions generally tapered in opposite directions and overlapping each other and providing contact faces in closely spaced relationship, a first narrow strip of contact metal extending across one of said contact faces, a second narrow strip of contact metal extending across the other of said contact faces in a direction generally crosswise of said first strip, resilient mounting means for said electrodes enabling said tapered portions to move transversely of said axes, and electromagnetic control means for magnetizing said electrodes, thereby to attract each other and engage said contact strips.

6. A magnetic switch device as claimed in claim 5, and wherein the adjacent ends of said electrodes are recessed and said closely spaced contact surfaces extend parallel with the longitudinal axes of the electrodes.

7. A magnetic switch device as claimed in claim 5, and wherein said tapered portions have parallel beveled contact faces and said strips of contact metal extend across said beveled contact faces.

8. A magnetic switch device as claimed in claim 5, and including a sleeve of resilient flexible insulating material

surrounding the overlapping end portions of said electrodes, said sleeve flexing laterally in response to movement of said tapered end portions.

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