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VACUUM SWITCH STRUCTURE USING SYLPHON AND SLOTTED DIAPHRAGM

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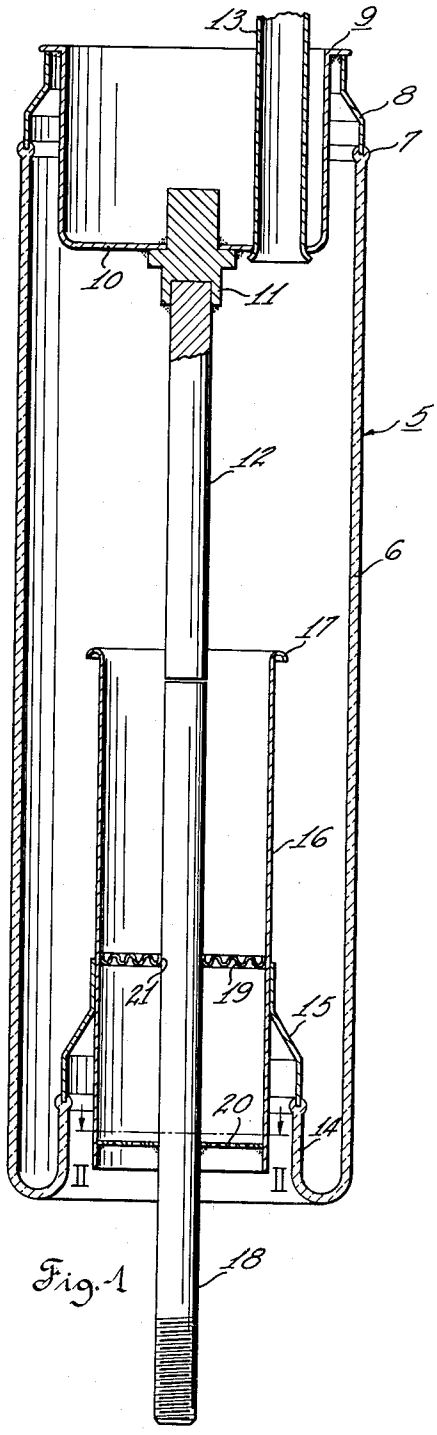


Fig. 1

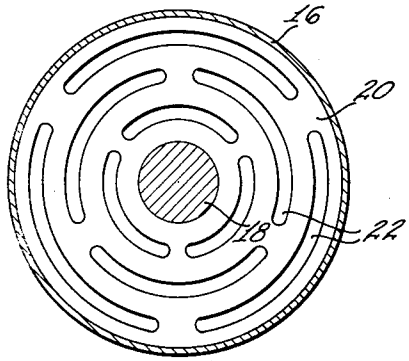


Fig. 2

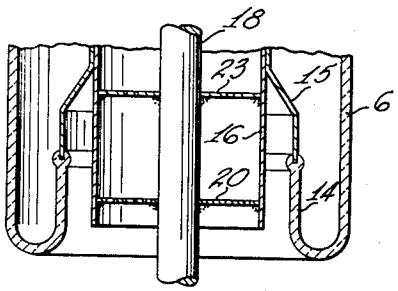


Fig. 3

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VACUUM SWITCH STRUCTURE USING SYLPHON AND SLOTTED DIAPHRAGM

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This invention relates to electric switches and more particularly to a new and improved vacuum switch employing contact controlling means for restraining axial movement and substantially eliminating lateral movement of a movable contact and for providing a fixed electrical connection between the movable contact and its cooperating terminal member, if so desired.

Heretofore vacuum switches employed a plurality of sliding members for controlling the axial and lateral movements of the movable contacts and for providing electrical connections to terminal members. These sliding members not only are costly to manufacture but make the vacuum switch highly susceptible to shock and vibration and provide only random electrical connections between the movable contacts and their cooperating terminal members.

In accordance with the invention claimed a new and improved electric switch is provided comprising in combination a vacuumized envelope, a pair of relatively movable cooperating contacts mounted within the envelope and a metallic shielding tube mounted to extend within the envelope and around at least a part of one of the contacts. The shielding tube is arranged in gas tight engagement with the envelope. A diaphragm such as a flexible disklike bellows is fixedly attached in gas tight engagement along its outer periphery to the inside surface of the shielding tube. This diaphragm is provided with an aperture extending therethrough and a movable contact of the switch is arranged to extend through the aperture with the periphery of the aperture being fixedly attached in gas tight engagement to the movable contact. Guiding means such as a disklike diaphragm is fixedly mounted within the tube and around and connected to the movable contact to prevent substantial lateral movement of the movable contact during a switch opening and closing operation.

It is, therefore, one object of this invention to provide a new and improved electric switch.

Another object of this invention is to provide a vacuum switch in which a movable contact is restrained in its axial movement and prevented from substantial lateral movement.

A further object of this invention is to provide a new and improved vacuum switch in which relatively stationary contact guiding means are arranged within the switch but outside of the vacuumized envelope.

A still further object of this invention is to provide a new and improved nonsliding guiding means which may form a fixed electrical connection between a movable contact and its terminal connection and which restrains axial movement and substantially prevents lateral movement of the movable contact.

Objects and advantages other than those set forth will be apparent from the following description when read in connection with the accompanying drawing, in which:

FIG. 1 is an elevational view in axial section of a vacuum switch embodying the invention;

FIG. 2 is a partial sectional view of the vacuum switch illustrated in FIG. 1 taken along the line II—II; and

FIG. 3 is a partial elevational view partly in axial section of a modification of the structure illustrated in FIG. 1.

Referring more particularly to the drawing by characters of reference, FIG. 1 illustrates an electric switch 5 comprising a cylindrical envelope 6 which may be formed, for example, of a suitable vitreous material. One end of envelope 6 is provided with an annular rim 7 to which is fixedly secured in gas tight connection thereto one end of a ring or flange 8. A re-entrant metallic cup 9 is sealed throughout its edge to the other end of flange 8 in the manner shown in FIG. 1.

Base 10 of cup 9 supports a contact mounting or bushing 11 which is sealed in fluid tight engagement therewith and to which is secured one end of a fixed contact 12. Contact 12 is arranged to extend along the longitudinal axis of envelope 6 and is substantially rigidly supported so as to restrict longitudinal or lateral movement thereof. Cup 9 may support a tubular venting passage 13 through which envelope 6 is evacuated and sealed off in the usual way.

The opposite end of envelope 6 is provided with an integral re-entrant portion 14 to which is sealed in fluid tight engagement one end of an inwardly extending collar 15. The other end of collar 15 is of reduced diameter and is sealed circumferentially in gas tight engagement to a tubular contact enveloping vapor shield 16. Shield 16 extends coaxially within envelope 6 with its inner end portion 17 terminating beyond the free or contact engaging end of stationary contact 12. A second contact 18 suitably attached to and movable by a contact actuating mechanism (not shown) extends into shield 16 and envelope 6 coaxially therewith and terminates adjacent the contact engaging surface of contact 12. The relatively movable arcing contacts 12 and 18 may be made of any suitable material such as tungsten or tungsten alloys. Shield 16 may be formed of any suitable metal as, for example, copper.

Contact 18 is movable longitudinally a limited predetermined distance to make and break electric connection with contact 12 while being restrained from lateral displacement. To accomplish this contact 18 is supported within shield 16 by a diaphragm or annular disk like bellows 19. Bellows 19 is provided with an aperture 21 extending through the center thereof through which the movable contact 18 projects. In order to maintain a vacuum condition within envelope 6 bellows 19 is joined along its outer periphery by a gas tight seal to the inner wall of shield 16 and along the periphery of its aperture 21 in gas tight engagement with contact 18. Due to its convoluted shape bellows 19 deflects allowing restricted longitudinal movement of contact 18. Bellows 19 to retain a vacuum in envelope 6 should be of a suitable nonporous material such as, for example, bronze.

Since normal atmospheric pressure tends to expand the bellows into envelope 6, the atmospheric pressure may be utilized to hold the contacts together in a normally circuit closed position and to speedily close the gap between them upon release of means arranged externally to releasably hold movable contact 18 in circuit open position. The required range of movement of the movable contact is relatively very small. For example, the contacts need be separated only about 3/16 of an inch to interrupt satisfactorily an alternating current power circuit fault of 1000 amperes at a potential of 15,000 volts.

In order to substantially prohibit lateral movement of the movable contact 18, a slotted diaphragm 20 is fixedly secured within and to shield 16 and encircles and is fixedly secured to the movable contact 18 outside of the vacuumized part of envelope 6. FIG. 2 illustrates a plan view of diaphragm 20 showing in cross section contact 18. Slots 22 in diaphragm 20 reduce its mass and increase its flexibility as well as equalize the atmospheric pressure on both sides thereof.

In accordance with the invention claimed diaphragm **20** and bellows **19** control the axial and lateral movement of the movable arcing contact **18**. Both the bellows **19** and diaphragm **20** are flexible enough to allow the movable contact to travel axially the predetermined distance required to open and close the electric circuit. Slots **22** in diaphragm **20** render it flexible without destroying the rigidity necessary to prevent lateral movement of contact **18** during axial movement thereof.

FIG. 3 illustrates a modification of the structure shown in FIG. 1 wherein a second diaphragm **23**, similar in size and shape to diaphragm **20** and secured to tube **16** and contact **18** in the same manner, is used as a further aid to support contact **18**. The combination of diaphragm **23** with bellows **19** and diaphragm **20** restricts axial movement of contact **18** and substantially prevents all lateral movement thereof.

Although only two embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

What is claimed is:

1. An electric switch comprising in combination an envelope at least a part of which is vacuumized, a pair of relatively movable arcing contacts both mounted to extend within the vacuumized part of said envelope, one of said contacts being movable through said envelope, a tube mounted entirely within said envelope and arranged to extend within the vacuumized part of said envelope, said tube being in gas tight engagement with said envelope, a disklike bellows fixedly attached in gas tight engagement along its outer periphery to the inside surface of said tube, said bellows being arranged within said tube between the ends thereof and being provided with an aperture extending therethrough, said movable contact being arranged to extend through said aperture, said bellows being fixedly attached in gas tight engagement along the periphery of said aperture to said movable contact, and means comprising a diaphragm mounted within said tube and around said movable contact and fixedly attached to said tube and said movable contact for providing together with said bellows limited lateral movement of said movable contact, said diaphragm being provided with a plurality of apertures for providing atmospheric pressure adjacent said bellows.

2. An electric switch comprising in combination an envelope at least a part of which is vacuumized, a pair of relatively movable arcing contacts both mounted to extend within the vacuumized part of said envelope, one of said contacts being movable through said envelope, a metallic tube mounted entirely within said envelope and arranged to extend within the vacuumized part of said

envelope, said tube being in gas tight engagement with said envelope, a disklike bellows fixedly attached in gas tight engagement along its outer periphery to the inside surface of said tube, said bellows being provided with an aperture extending therethrough, said movable contact being arranged to extend through said aperture, said bellows being fixedly attached in gas tight engagement along the periphery of said aperture to said movable contact, and means comprising a conductive diaphragm mounted within said tube and around said movable contact and fixedly attached to said tube and said movable contact for providing a relatively fixed electrical connection between said movable contact and said tube and together with said bellows limited lateral movement of said movable contact, said diaphragm being provided with a plurality of apertures for providing atmospheric pressure adjacent said bellows.

3. An electric switch comprising in combination an envelope at least a part of which is vacuumized, a pair of relatively movable arcing contacts both mounted to extend within the vacuumized part of said envelope, one of said contacts being movable through said envelope, a tube mounted entirely within said envelope and arranged to extend within the vacuumized part of said envelope, said tube being in gas tight engagement with said envelope, a bellows fixedly attached in gas tight engagement along its outer periphery to the inside surface of said tube, said bellows being arranged within said tube between the ends thereof and being provided with an aperture extending therethrough, said movable contact being arranged to extend through said aperture, said bellows being fixedly attached in gas tight engagement along the periphery of said aperture to said movable contact, and means comprising a pair of spaced apertured diaphragms mounted within said tube and around said movable contact and fixedly attached to said tube and said movable contact for providing together with said bellows limited lateral movement of said movable contact, the apertures of at least one of said diaphragms providing atmospheric pressure adjacent said bellows.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,993,970 July 25, 1961

Samuel T. Yanagisawa

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 4, after "being" insert -- arranged within said tube between the ends thereof and being --.

Signed and sealed this 5th day of December 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

USCOMM-DC

UNITED STATES PATENT OFFICE

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