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W. K. RANKIN

2,037,535

VACUUM APPARATUS

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Fig. 1.

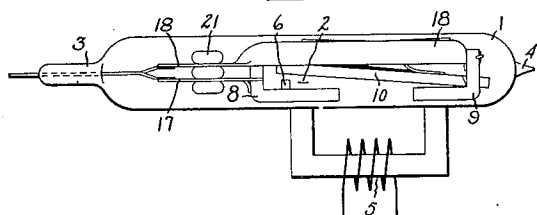


Fig. 2.

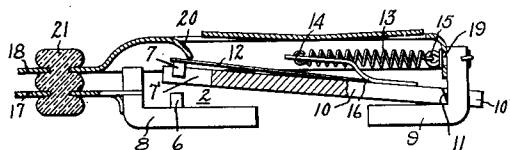


Fig. 3.

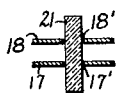
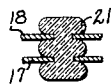


Fig. 4.



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VACUUM APPARATUS

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6 Claims. (Cl. 200—87)

My invention relates to vacuum apparatus, more particularly to vacuum switches, and has for its principal object the provision of improved vacuum switch structure.

5 My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

10 Referring to the drawing, Fig. 1 is a view of a complete vacuum switch embodying my invention; Fig. 2 is a detailed view, partly in section, of the vacuum switch structure shown in Fig. 1 removed from its enclosing switch envelope, and Figs. 3 and 4 are sectional views illustrating my improved method of mechanically interconnecting and electrically insulating electrical conductors.

20 The vacuum switch illustrated by Fig. 1 comprises an evacuated envelope 1 of suitable insulating material such as glass within which is mounted relatively movable contact structure generally indicated at 2. The electrical connections to the respective contacts are sealed through one end of the glass envelope in a well-known manner as at 3, the glass envelope in the present instance being exhausted through the opposite end as indicated at 4. The conditioning of a vacuum switch, as is well known, comprises degassing all parts within the evacuated envelope and pumping all air and gases as far as practically possible from said envelope prior to sealing the same. Operating means, as an electromagnet 5, disposed exteriorly of the switch envelope 1 is provided for effecting operation of the contact structure within said envelope in a manner hereinafter described.

40 Referring more particularly to Fig. 2 which illustrates in detail the contact structure and associated conductors which are normally disposed within the glass envelope, the relatively movable contacts 6 and 7 composed of tungsten or other suitable contact material are mounted with respect to contact supporting angle members 8 and 9 which in turn are spaced along the longitudinal axis of the envelope 1. The members 8 and 9 comprise part of the magnetic circuit of the electromagnet 5 and are preferably shaped so as to conform to the bottom wall of the switch envelope on which they are adapted to rest.

55 The member 8 has mounted thereon the fixed contact 6 which coacts with movable contact 7. The operating means for the movable contact 7 comprises an armature 10 coacting with the elec-

tromagnet 5 pivotally mounted at one end, as at 11, on the member 9 and resiliently supporting at its opposite end, as by a leaf spring 12, the movable contact 7. The armature 10 is pivotally mounted on the member 9 by means of an extension 10' which extends through a corresponding slot (not shown) in the member 9. The shoulders 10' of the armature 10 abutting the member 9 may be beveled as indicated so that the armature has substantially a knife-edge pivot with respect to the member 9.

The vacuum switch in the present case is of the type wherein the contacts are normally biased towards open circuit position, and to this end a tensioned spring 13 is secured at one end as at 14 to the armature 10 and at the opposite end as at 15 to the member 9. The armature 10 as shown is provided with a lug 16 to which the spring 13 is secured.

For the purpose of providing a magnetic path of comparatively high permeability the electromagnet 5 is positioned directly opposite the members 8 and 9 so that the gap in that part of the magnetic circuit simply corresponds to the thickness of the glass wall of envelope 1.

25 The engagement of contacts 6 and 7 takes place within a cup-shaped recess 7' formed at the free end of the armature 10. When the contacts are closed due to attraction of the armature by energization of electromagnet 5, the contact 7 engages the coacting fixed contact 6 shortly before the downward movement of the armature 10 is checked by the member 8. The continued movement of the armature 10 causes flexing of the contact supporting spring 12 so that when the electromagnet is deenergized and the armature is moved to open circuit position by spring 13 the contacts 6 and 7 remain in engagement for a brief time after which the armature 10 separates the contacts with a hammer-like blow.

40 The electrical connections to the contacts comprise a pair of conductor strips 17 and 18 electrically connected to the contact supporting members 8 and 9, respectively. The strips 17 and 18 which are suitably connected to the lead-in conductors extending through the seal 3 are rigidly interconnected and spaced by insulating structure 21 hereinafter described. The conductor strip 17 is shown as rigidly connected with respect to the contact 6, whereas the conductor strip 18 which is suitably secured as at 19 to the upper portion of the angle member 9 is electrically connected to the contact 7 through the armature 10 and leaf spring 12. The member 9 is electrically connected to the armature through

spring 13 and lug 16 and also at the knife-edge support.

At a point opposite the movable contact the conductor strip 18 has formed at its lower surface a downwardly turned portion 20 serving as a stop or limit member for the movable contact 7. The conductor strip 18 which extends substantially parallel to and throughout the length of the armature may be slit as indicated to minimize eddy currents and is formed to present a curved surface to the envelope 1 as in the case of the members 8 and 9.

The problem of properly insulating electrical apparatus within a highly evacuated envelope, as in vacuum switches, requires that the insulating material be of such character that it can be readily degassed and maintained in the degassed condition within a high vacuum. Glass is found suitable for this purpose and the use of glass for the insulating envelopes or casings of vacuum apparatus is well known. Aside from the lead-in conductor seal of the glass envelope, difficulty has been encountered in rigidly interconnecting a pair of spaced electrical conductors and at the same time electrically insulating the same with respect to each other.

For the purpose of so mechanically joining and electrically insulating a pair of conductor strips, I provide a unitary glass structure comprising a glass rivet which is set so as rigidly to maintain the conductor strips in spaced relation and insulate the same with respect to each other.

Referring more particularly to Figs. 3 and 4, there are illustrated steps in the formation of the aforesaid structure. In Fig. 3 the conductor strips 17 and 18 are shown as provided with aligned apertures 17' and 18', respectively, into which a heated glass rivet 21 is inserted.

It will, of course, be understood that any similar insulating material having characteristics desirable for the present purpose may be used and that the term "glass" as used herein is intended to comprehend such material. The glass rivet is preferably heated prior to insertion through the apertures 17' and 18' although the method is not limited in this respect.

While the glass rivet is still hot and in plastic condition, it is compressed at the opposite ends thereof so as to be set in the manner indicated by Fig. 4. It will be noted that the excess glass is squeezed transversely so as to encompass the edges of both of the conductor strips at opposite sides thereof. When the glass rivet cools the conductor strips are rigidly interconnected and spaced by a unitary structure having desirable insulating properties and which may be readily degassed and prepared for high vacuum service.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A vacuum switch comprising an evacuated

glass envelope, a pair of contact supporting members positioned within said envelope and spaced along the longitudinal axis thereof, a pair of conductors electrically connected to said members respectively, an armature pivotally mounted on one of said supporting members, a contact resiliently mounted on said armature for coacting with a stationary contact mounted on the other of said supporting members, a spring for biasing said armature and movable contact towards open circuit position, one of said conductors serving to limit the contact opening movement of said armature, means sealing the connections to said conductors through one end of said envelope, and an electromagnet exteriorly of said envelope for actuating said armature.

2. A vacuum switch comprising an evacuated glass envelope, a pair of conducting angle members mounted within and spaced along the longitudinal axis of said envelope, an armature pivotally mounted at one end on one of said members, a resiliently mounted contact supported at the opposite end of said armature, a coacting fixed contact mounted on the other of said members, a spring secured at one end to said armature and at its other end to the first-named member biasing said armature and movable contact towards open circuit position, a pair of conductor strips having connections thereto sealed through one end of said envelope, a glass rivet interconnecting said strips and set so as rigidly to space and insulate the same, and an electromagnet disposed exteriorly of said envelope for actuating said armature.

3. In vacuum apparatus including an evacuated envelope and a pair of conductor strips having aligned apertures mounted within said envelope, means for spacing and insulating said conductor strips with respect to each other, comprising a glass rivet extending through said apertures and set so as rigidly to interconnect and space said conductor strips.

4. An insulating and spacing structure for a pair of electrical conductor strips having aligned apertures comprising a glass rivet extending through and set with respect to said strips so as rigidly to space and interconnect the same.

5. The method of rigidly spacing and electrically insulating a pair of conductor strips with respect to each other which comprises forming aligned apertures in said strips, maintaining said strips in spaced relation, and compressing a heated glass rivet extending through said aligned apertures so as mechanically to unite said conductor strips and form a rigid and unitary glass spacing structure therebetween.

6. In the art of fabricating vacuum apparatus including an evacuated envelope and a pair of conducting strips mounted therein, the method of rigidly spacing and insulating said conductor strips which comprises forming aligned apertures in said strips, maintaining said strips in spaced relation, positioning a heated glass rivet within said aligned apertures and setting said rivet so as permanently to unite said strips.

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