

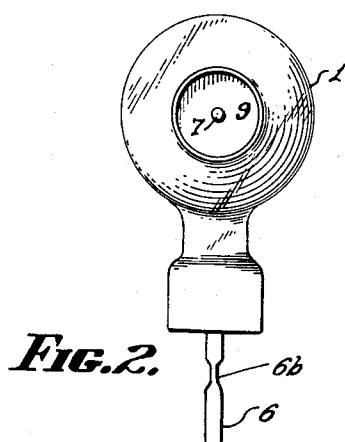
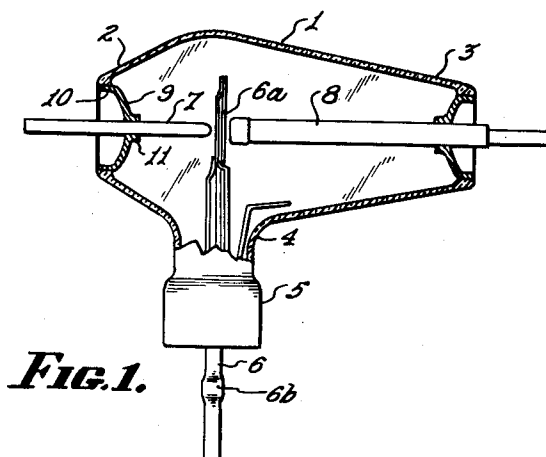
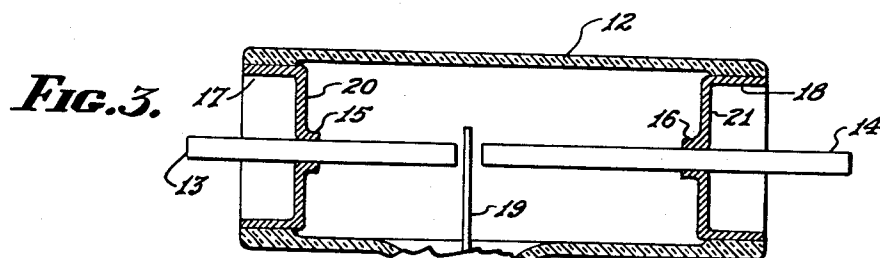
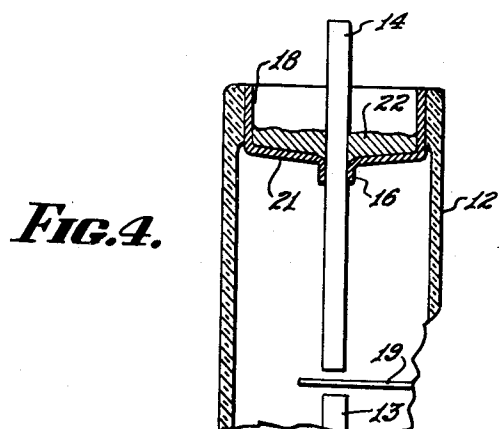
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MOUNTING FOR ELECTRODES IN GLASS VESSELS

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MOUNTING FOR ELECTRODES IN GLASS VESSELS

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In numerous uses metallic conductive members of various types (referred to herein for convenience as "electrodes") are mounted in glass vessels. Hitherto this has been accomplished by fusing the glass of the vessel directly to the metallic members, which are made of a metal or alloy e.g. Kovar, having a coefficient of expansion sufficiently similar to that of the glass to permit such mounting by fusion. Exemplary, but by no means limiting articles of this type are vacuum switches, wherein the switch elements (electrodes) are mounted in a glass vessel which is evacuated to prevent arcing or undesirable electrical discharge. Hitherto such structures have presented the serious disadvantage of limited current carrying capacity in proportion to their size, since the application of heavy currents tends to cause heating of the electrodes and disruption of the seal or of the glass envelope itself. Many such structures are employed for the switching of high frequency currents of high amperage, and the disadvantage is especially marked in such usages.

It is an object of the invention to provide means and a method whereby additional current carrying capacity can be obtained without increasing the size of the apparatus.

It is an object of the invention to provide a structure of the class set forth wherein the electrodes may attain a substantial degree of heat without affecting either the envelope or the seal.

In many envelope-enclosed electrical devices, inclusive of but not limited to electrical switches, exact adjustment of the spacial relationship of the electrodes to each other or to other apparatus is necessary, but is not always easily attained in the initial assembly of the devices. In one of its aspects, the invention has as its object the provision of means and a method whereby adjustment of the position of an electrode is made possible after sealing and without disturbing either the envelope or the seal.

These and other objects of the invention which are set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, are accomplished by that construction and arrangement of parts and in that procedure of which certain exemplary embodiments will now be described. Reference is made to the accompanying drawings wherein:

Figure 1 is a vertical sectional view of an exemplary vacuum switch embodying the invention.

Figure 2 is an end elevation thereof.

Figure 3 is a longitudinal sectional view of apparatus embodying means for adjustment after assembly.

Figure 4 is a partial longitudinal section showing the relationship of the parts after an adjustment has been effected.

Briefly, in the practice of the invention, the electrodes to be sealed into the glass envelope are provided with intermediate cup-shaped members having a central portion for attachment to the electrode, an external rim or flange for sealing to the glass of the envelope, and a web-like portion connecting the two. The electrode

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proper is thus isolated from the seal by the extent of the web-like connecting portion. This portion, depending both on its thickness and its area, reduces the transmission of heat from the electrode to the seal by cutting down the effective heat conductivity while radiating a substantial portion of the heat to the surrounding atmosphere. Moreover, in high frequency devices, the current density is reduced through the seal, owing to the increased effective seal diameter, and because of the "skin effect."

In this way structures may be made in which the envelope and the seals are not adversely affected in spite of a high electrode temperature. In some such structures which have been made, continuous operation at high amperages and high frequencies such as to cause the electrodes themselves to attain a red heat, has not been found destructive of the envelope or seal.

A specific example of a device embodying the invention is illustrated in Figures 1 and 2. This is in the form of a vacuum switch comprising a glass body 1 having opposite end portions 2 and 3 for receiving electrodes or poles. The body has a laterally extending neck 4 to which a conventional thimble 5 is fused. This thimble has the conventional end diaphragm to which a switch operating electrode 6 is attached in the usual fashion. This electrode extends upwardly so that its end lies between the opposed end of electrodes 7 and 8. The particular switch illustrated is a single pole double throw switch. The element 6 is mechanically movable so that a contact 6a at its end can be brought against either the electrode 7 or the electrode 8. The structure of the electrode 6 may be that described and claimed in the copending application of Albert E. Gerth and George F. Embshoff entitled Switch Structure, Serial No. 609,627, filed September 13, 1956, now Patent No. 2,854,550, issued September 30, 1958, but this is not a limitation on the invention.

In the specific embodiment the electrodes 7 and 8, instead of being sealed directly to the glass of the envelope are first joined to flat or cup-shaped members hereinafter for convenience called flares. These flares have disc-like body portions 9 and external rims 10. They are made of a metal suitable for sealing to glass and are conveniently formed by stamping or spinning sheet metal. The electrodes are to be joined axially to central portions of the disc-like parts, which may be done directly. It is not necessary in all instances that the electrodes extend through the flares. In such structures, connection may be made to the disc-like part of the flare outside the envelope by means of a clip.

In some instances electrical contact elements may be joined directly to the disc-like parts inside the envelope; and the term "electrode" is used herein in a sense broad enough to include this. Where the electrodes are to extend through the disc-like parts, these are at least perforated centrally; but it is preferred to make them with small central necks as illustrated at 11 in Figure 1. The electrode may be assembled to the flare by being passed through the perforation or neck, and the flare and electrode are then sealed together in a gas-tight fashion. This may be done by soldering or brazing but is more conveniently and positively accomplished by hydrogen-brazing with the use of copper as the joining metal.

The provision of the small neck 11 helps to keep the electrode rigid against tilting with respect to the disc; and rigidity of the electrode with respect to the rim 10 can be attained by forming the disc-like part dome shaped or conical.

It will be understood that the opposed end portions 2 and 3 of the glass envelope are made of such size initially as will permit the insertion of the combined electrodes 7 and 8 and their flare members in the posi-

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tions shown in Figure 1. These positions may be established by suitable jigs, and the whole assembly placed in a lathe or other device by means of which the assembly may be rotated slowly while the fusion-sealing is being carried on. It is only necessary under these circumstances, by means of a suitable burner or flame, to melt the edges of the glass envelope at the end portions 2 and 3 against the rims 10 of the flare elements. Broad, effective and gas-tight seals may be readily accomplished in this fashion. It may be noted that it will be usual in structures of this class to evacuate the envelope through the electrode 6 which is initially in the form of a hollow tube and is connected to a suitable vacuum pump. When the desired vacuum has been attained, the tube is pinched as at 6b and is welded, brazed or soldered shut in a gas-tight fashion. The structures herein described are not limited to electrical apparatus embodying evacuated envelopes, but are equally applicable to structures having gas-filled envelopes, e.g. switches operating in an atmosphere of sulfur hexafluoride.

A principal advantage of the structure hereinabove described is that the electrodes may become quite highly heated during the operation of the switch without transmitting so much heat to the fusion-seals as to impair or destroy them, so that the current carrying capacity of the switch is very materially increased. The transmission of heat from the electrode at the center of a flare to the rim at the edge thereof will be governed in part by the thickness of the metal of the disc-portion of the flare and in part by the area of the disc-like portion or the linear distance of the electrode from the rim. These may be varied in different applications to obtain different effects. But the transmission of heat from the electrode to the seal is also diminished by the radiation of heat from the disc part to the external atmosphere, or to an immersion coolant, as will now be clear. These factors may be varied in the practice of the invention.

Figures 3 and 4 are illustrative of a form of the invention which permits adjustment of parts in the final structure. The glass envelope is indicated at 12. Electrodes 13 and 14 are shown as brazed centrally to necks 15 and 16 on flare members which have external rims 17 and 18 to which the glass envelope is sealed, as has already been described. If the structure is a single pole double throw switch, as also described above, the electrode 19 may be employed intermediate the others.

The disc portion 20 or 21 of the flares is in this instance made uni-planar initially, and thin enough so that it can be displaced to some extent by mechanical force exerted on the electrode attached to it. The electrodes are sealed to the flare members and the rims of the flare members in turn sealed to the glass envelope, all as has hereinabove been set forth. After such assembly and cooling, it is now possible to effect mechanical adjustment. For example, let it be supposed, as illustrated in Figure 4, that a slight lateral adjustment of the electrode 14 is desired. To effect this, the assembly may be held in a suitable holder and a mechanical tilting force applied to the electrode 14 to bring its inner end to the desired adjusted position. The disc portion 21 of the flare member will bend or warp slightly due to this mechanical adjustment, although the bending will normally be resilient in character. When the desired adjusted position has been attained, it becomes necessary to fix the disc portion in adjusted position. This may be accomplished in various ways, as by introducing molten soldering or brazing material 22 against the face of the disc-like portion, so that it will contact and cover the disc portion, becoming united therewith. This is accomplished while the adjusted position of the elements is maintained; and during this maintenance, the soldering or brazing material is permitted to solidify. If the amount so introduced is sufficient to provide a rigid body, the bent condition of

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the disc portion and hence the adjustment of the parts will thereafter be maintained.

In the case of a longitudinal adjustment, this is accomplished by moving the electrode in or out with consequent bowing of the disc portion. Final rigidity is attained in the manner described. Combined lateral and longitudinal adjustments can, of course, be made.

Another mode of securing rigidity in the bowed disc portion is to insert a washer-like member over the electrode 14 so as to bring it against the disc portion and then braze or solder it to the disc portion. The washer member may be suitably shaped; but it is not necessary that it be shaped exactly to the bowed configuration of the disc portion, because the brazing metal will fill interstices therebetween, and when solidified, enable the washer-like element to impart suitable rigidity to the disc portion.

The invention as described is not limited to electric switches, but is generally applicable to structures in which electrodes are sealed in glass envelopes of various sizes and shapes including glass envelopes for arc discharge devices. Thus, the shape and configuration of the envelope is not a limitation on the invention. Where the term "glass" is used herein, it is intended to embrace any suitable envelope material capable of being heat sealed to metallic elements such as those taught herein. The invention is not limited to specific metals either for the electrodes or for the flare elements. The flare elements may be made of the well known alloy Kovar, or of non-transforming stainless steel, or of any other metal capable of uniting with the envelope substance by heat sealing and having a coefficient of expansion not so far removed from that of the envelope substance as to disrupt the seal upon the occurrence of fluctuations in temperature.

Modifications may be made in the invention without departing from the spirit of it. The invention having been described in certain exemplary embodiments, what is claimed as new and desired to be secured by Letters Patent is:

1. In a vacuum electric switch comprising a glass vessel and a stationary electrode to be sealed therein, an integral flare member of metal having a disc portion to which said electrode is united, and a rim, a tubular portion of said vessel being sealed to said rim substantially throughout the length of said rim, said disc portion having a neck substantially centrally located therein through which said electrode passes and to which said electrode is joined in a gas-tight fashion, said disc portion having sufficient rigidity to provide against movement of said electrode under unilateral gas pressure, as when said envelope is evacuated, said disc portion being sufficiently thin and of sufficient area to minimize heat transfer from said electrode to said rim and to have substantial heat radiating characteristics, said disc portion being initially flexible so as to permit adjustment of the position of the said electrode and, after said adjustment, being rendered sufficiently rigid to withstand unilateral gas pressure and external distorting forces by a layer of additional solidified substance joined thereto substantially throughout the area of the disc portion.

2. In a vacuum electrical switch, a glass envelope comprising a tubular body having opposite open ends, a hollow neck portion integral with said body and extending at an angle thereto, a pair of stationary electrodes extending inwardly through the open ends of said body, the inner ends of said electrodes approaching each other within said body, and a metal flare interposed between each of said electrodes and the adjacent open end of said body, said metal flare having a central disc portion with an outwardly extending rim and an inwardly extending neck, the said electrodes being respectively attached to said necks in a gas-tight fashion, the end portions of said body being fused to the said rims substantially throughout the length of said rims, a metal thimble element fused

to said neck and having a disc portion extending across it, a third electrode extending centrally through said disc portion and sealed thereto in a gas-tight fashion, the said electrode having a portion extending within said envelope in such position as to lie between the respective ends of said first mentioned electrodes, a portion extending outwardly beyond the disc of said thimble, the disc of said thimble having sufficient flexibility to permit a rocking motion of said last mentioned electrode when the outwardly projecting portion thereof is moved with respect to said envelope, the disc portions of said first mentioned flares having sufficient rigidity to maintain the positions of said first mentioned electrodes against movement under unilateral gas pressure, as in evacuating said envelope, but being sufficiently thin and having sufficient area to minimize heat transfer from each said electrode to said envelope and to have substantial heat radiating characteristics, the disc portions of said flares being initially sufficiently flexible to permit adjustment of said first mentioned electrodes, but being rigidified after said adjustment.

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ment by a solidified substance joined thereto substantially throughout the area of the said disc portions.

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