June 8, 1937. H. E. ROWE 2,083,402

ELECTRODE MOUNTING FOR POOL TYPE DISCHARGE DEVICES

Filed Oct. 25, 1935

Fig. 1.

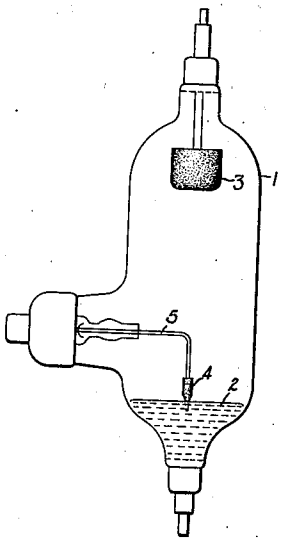


Fig. 2.

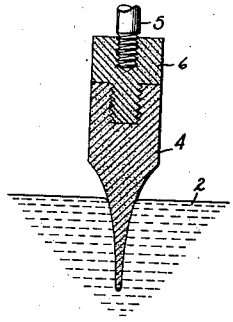
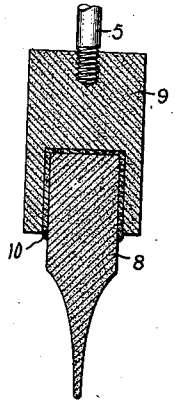


Fig. 3.



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ELECTRODE MOUNTING FOR POOL-TYPE DISCHARGE DEVICES

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Application October 25, 1935, Serial No. 46,701

5 Claims. (Cl. 250—27.5)

My invention comprises an improved electrode mounting for pool-type discharge devices.

In the operation of pool-type discharge tubes, it has been found advantageous to employ a semi-conducting starting electrode, partially immersed in the cathode pool, to initiate a discharge between the main electrodes. Due to the essentially non-metallic nature of the electrode materials most satisfactorily employed for this purpose, considerable difficulty has been experienced in developing a suitable mounting for the electrode piece.

It is an object of the present invention to provide a mounting adapted to insure a permanent electrical connection between the electrode piece and the current lead-in conductor for the same.

It is a further object of my invention to provide an inexpensive mounting for the starting electrode which will be mechanically durable and immune to the disintegrating influence of the severe temperature variations which occur under the conditions of operation of a pool-type tube. For attaining these ends I provide a graphite coupling member in close fitting engagement with both the electrode member and the lead-in conductor.

Further objects and advantages of my invention will be apparent from a consideration of the following specification taken in connection with the accompanying drawing.

In the drawing Fig. 1 represents diagrammatically a discharge device of a type with which the improved electrode mounting of my invention may conveniently be used; Fig. 2 shows in section one embodiment of my invention; and Fig. 3 illustrates a possible modification thereof.

Referring to the three-electrode discharge device shown in Fig. 1, the mercury pool cathode **2** and the anode **3** enclosed by the sealed envelope **1** are adapted to cooperate in conducting an electric discharge through the tube. It will be understood that the cathode and anode are to be externally connected in series relation with a load circuit and a suitable source of potential (not shown). In order to initiate a discharge between the main electrodes during the period in which the anode **3** is electrically positive with respect to the cathode **2**, an immersion starting electrode **4** is provided having a tip thereof projecting below the surface of the mercury. This is also intended to be externally connected through a metallic conductor **5** to a regulatable source of exciting potential adapted to cause passage of current from the starter into the mercury pool at a predetermined time with respect to the variations of the main electrode voltage. If the electrode **4** comprises a body of semi-conducting material of proper surface characteristics and having a specific resistivity at least 100 times that of mercury, it has been found that a starting current generally less than 10 amperes will suffice to cause a main discharge to take place.

In Fig. 2 I have illustrated in detail, a mounting constructed in accordance with my invention for mechanically supporting the electrode **4** and for maintaining the same in electrically conductive relation with the lead-in conductor **5**. The starting electrode itself typically consists of a short solid rod of carbonaceous semi-conducting substance such as a mixture of graphite and clay, or a carbide of silicon, tungsten or boron, or suitable combinations of such materials either with each other or with an insulating diluent. Though such a shape is not essential, I prefer to form the electrode piece as a smooth cylinder having a tapered portion in the shape of a concave-conical surface of revolution projecting into the mercury. The feature of a downwardly convergent electrode is claimed broadly in my copending application, Serial No. 64,653, filed April 16, 1936, and more particularly with respect to a concave configuration in application, Serial No. 20,964, filed May 11, 1935, in the name of J. M. Cage.

In view of the essentially non-metallic character of the semi-conducting material employed in the manufacture of the starting electrode, it is extremely difficult to make a direct jointure to the lead-in conductor because of the difference in their expansion characteristics. This, coupled with the fact that with an imperfect joint the somewhat discontinuous nature of the electrode surface favors destructive arcing between it and the metallic mounting, frequently causes such mounting to fail after a brief period of use.

In accordance with my invention I overcome these difficulties by using an intermediate coupling member consisting of a graphite block **6** fitted into mechanically tight relation both with the electrode **4** and with the lead-in conductor **5**. In making this assembly a portion of the graphite is threaded and screwed into a corespondingly tapped hole in the unfired starter material. The assembly is then fired in a hydrogen or vacuum furnace at about 1,000° C., thus causing the starter material to shrink snugly on to the graphite. The end of the lead **5**, which may be of iron or other conducting materials, may then be screwed into the graphite block.

Due to the fact that the coefficients of expan-

sion of the electrode material and the graphite are similar, the joint between them will not be loosened by the alternate heating and cooling to which they are subjected. Furthermore, no metal is present in the mounting which will amalgamate with mercury or evaporate under the temperature conditions existing in the tube. An aditional feature of considerable importance lies in the fact that the mounting 6, which during the starting period frequently serves as an anode for a temporary discharge to the mercury surface, runs comparatively cool because of the high coefficient of thermal emissivity of the graphite. In this way the lead-in conductor 5 is protected from excessive temperatures which might cause it to melt or become distorted.

In Fig. 3 I have illustrated an alternative modification of which my invention is capable. In this embodiment a starter 8 is fitted tightly into a recess in a graphite block 9. A definite and permanent bond between these two parts may be assured by the use of a suitable cementing material, placed as designated by the numeral 10. This may consist, for example, of a mixture of iron and carbon whose proportions are selected to place the combination near the so-called "eutectic" point of iron. Since this implies that the iron shall have a carbon content of about 4.3%, calculated to give it the lowest possible melting point (about 1140° C.), the absorption of any further carbon from either the electrode or the mounting block will necessarily raise the melting point of the bonding substance. For this reason, after the electrode assembly is fired at a high temperature, the only additional effect of the heating occurring during the use of the tube will be to produce an increasingly heat-resistant bond between the cementing material and the carbonaceous structure of the mounting 9 and the electrode 8.

While I have illustrated my invention in connection with a particular electrode form, it will of course be understood that I do not wish to be limited thereto since many modifications of this element are possible, and I contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

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

1. An electrode mounting for pool-type discharge devices comprising a carbonaceous electrode member, a graphite coupling member in engaging relation with said electrode piece, and a bonding substance interposed between said members, said substance comprising a mixture of iron and carbon in proportions near the eutectic point of iron.

2. In a discharge device, a liquid metal cathode, a short solid rod of semi-conducting material in permanent contact with the surface of said cathode, a block of graphite in tight-fitting engagement with the upper end of said rod, and a metallic lead-in conductor having one end thereof secured to said graphite block.

3. In a pool-type discharge device, a mercury pool cathode, a tapered cylindrical rod of semi-conducting carbonaceous material in permanent contact with the surface of said pool, a block of graphite in tight-fitting engagement with the upper end of said rod and a rigid metallic lead-in conductor having one end thereof secured to said graphite block for supporting the same in proximity to the mercury surface.

4. In a pool-type discharge device, a mercury pool cathode, a short solid rod of semi-conducting material containing a carbide of the group of elements consisting of boron, silicon and tungsten in permanent contact with the surface of the pool, a block of graphite in tight-fitting engagement with the upper end of said rod and a rigid metallic lead-in conductor having one end thereof secured to said graphite block for supporting the same in proximity to the mercury surface.

5. In a pool-type discharge device, a mercury pool cathode, a semi-conducting immersion electrode comprising a short solid rod of carbonaceous material in permanent contact with the surface of said pool, a block of graphite having a recess therein to receive one end of said rod, and a heat-resistant bonding material securing said one end in said recess, said material comprising a mixture of iron and carbon.

HOBART E. ROWE.