

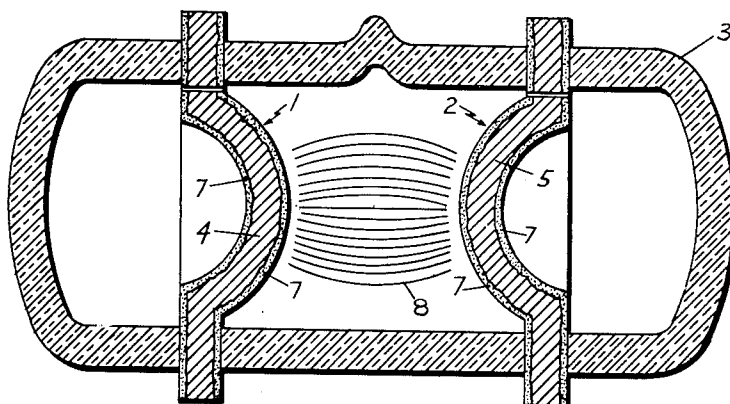
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COATED ELECTRODES FOR ELECTRON DISCHARGE DEVICES

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COATED ELECTRODES FOR ELECTRON DISCHARGE DEVICES

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2 Claims. (Cl. 148—31.5)

This invention relates to electron discharge devices, and more particularly to the electrode structure of gas or vapor-filled arc discharge tubes.

For some time it has been the practice in the art of manufacture of electron discharge devices to construct the electrodes of some metal such as tantalum. This metal is singularly well adapted for this purpose because of its high melting point, low electron emissivity, good gettering properties, and the ease with which it is degassed. However, even tantalum electrodes, when installed in arc discharge tubes of high voltage or current rating, are subject to erosion and pitting because of the intense electrical and thermal stresses set up by arc discharges.

Prior to this invention, the electrodes in arc discharge tubes have been protected by a hard refractory coating consisting of a metallic carbide mixed with some metallic binding material and applied to the electrode surface and sintered to fix it in place. This method has several disadvantages when applied to arc discharge tubes.

In the first place, the sintered coating, as heretofore applied, has a rough granular surface composed of carbide particles interspersed with particles of the metallic binder. Such a rough surface presents small sharp peaks and edges which constitute favorable points for the establishment of arc discharges. This results in repeated arcing at these preferential points rather than over the greater area of the whole electrode. These "pin point discharges" result in the generation of intense local heat and electrical stresses at these small areas which will soon cause the formulation of craters and pits and the eventual destruction of the electrode.

Another disadvantage of the sintered coating is the nonuniform character of the surface. Particles of metal and metallic carbide are interspersed, and, because the metal is softer than the carbide, it is preferentially eroded, leaving pits.

It is one of the objects of the present invention to overcome the disadvantages of the present carbide-coated tantalum electrode by the application of the coating in the form of a hard, highly polished homogeneous layer.

This and other objects of the invention will become clear from the following description of an embodiment thereof, in connection with the single figure of the accompanying drawing which is a cross-sectional view of one type of gaseous arc discharge tube.

Referring to the drawing, the arc discharge device comprises two dome-shaped electrodes, 1 and 2, hermetically sealed in glass envelope 3. Electrodes 1 and 2 comprise metallic tantalum bases 4 and 5 coated with a

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thin layer of tantalum carbide 7. Envelope 3 is filled with gas at low pressure. The arc discharge takes place between substantial areas of the convex faces of the electrodes 1 and 2, as schematically indicated by lines 8.

Carbide coating 7 is formed by packing the completely formed metallic tantalum electrode in a closed container with a suitable carbonaceous material, such as charcoal or bone meal, and fired in a furnace at a temperature preferably between eight hundred degrees and one thousand degrees centigrade for approximately one and one-half hours. The tantalum will react with the carbon forming a tightly adhering surface layer of tantalum carbide.

The thickness of the carbide coating can conveniently be varied by changing the firing time. Thus, when the electrode is fired for one and one-half hours in charcoal at one thousand degrees centigrade, the layer thickness will be approximately .005 inch. Any desired thickness may be attained by this method, but it has been found that a .003 to .005 inch layer of carbide results in a very durable electrode.

After firing, the electrode is cooled and brushed free of any adhering carbon. It is then buffed to a high polish, after which it is ready to be incorporated in an electron discharge device.

Electrodes constructed according to the teachings of this invention have many advantages. The carbide layer formed by this method is uniform and homogeneous, and follows every contour of the base metal. No bonding medium is needed as the coating is actually a part of the metal itself. Further, this method can be used to treat intricate parts that could not be conveniently coated by the previous methods. However, the most important factor is the ability of this type of coating to take a mirrorlike polish, thereby practically eliminating the problem of the pin point discharges that caused the breakdown of prior coatings.

It is to be understood that this invention is not limited to the particular details as described. Many equivalents will suggest themselves to those skilled in the art, as, for example, the use of gaseous carburizing agents. It is therefore desired that the appended claims be given a broad interpretation commensurate with the scope of the invention.

What is claimed is:

1. An electrode for a gaseous discharge device of tantalum having thereon a smooth external surface of tantalum carbide formed in situ by heating the tantalum electrode in a carbonaceous substance at 800° C. to 1,000° C. for about one and one-half hours, and subsequently substantially removing any uncombined carbon.

2. An electrode for a gaseous discharge device of tantalum having thereon a smooth external surface of tantalum carbide formed in situ by heating the tantalum electrode in a carbonaceous substance at 800° C. to 1,000° C. for a time sufficient to form a coating of tantalum carbide of the order of .003" to .005", and subsequently substantially removing any uncombined carbon.

References Cited in the file of this patent

UNITED STATES PATENTS

2,153,009	Scott	Apr. 4, 1939
2,249,672	Spanner	July 15, 1941
2,422,038	Parisot	June 10, 1947