Feb. 1, 1949. V. J. FRANCIS 2,460,738

ELECTRODE CONSTRUCTION

Filed Feb. 25, 1947

Fig. 1

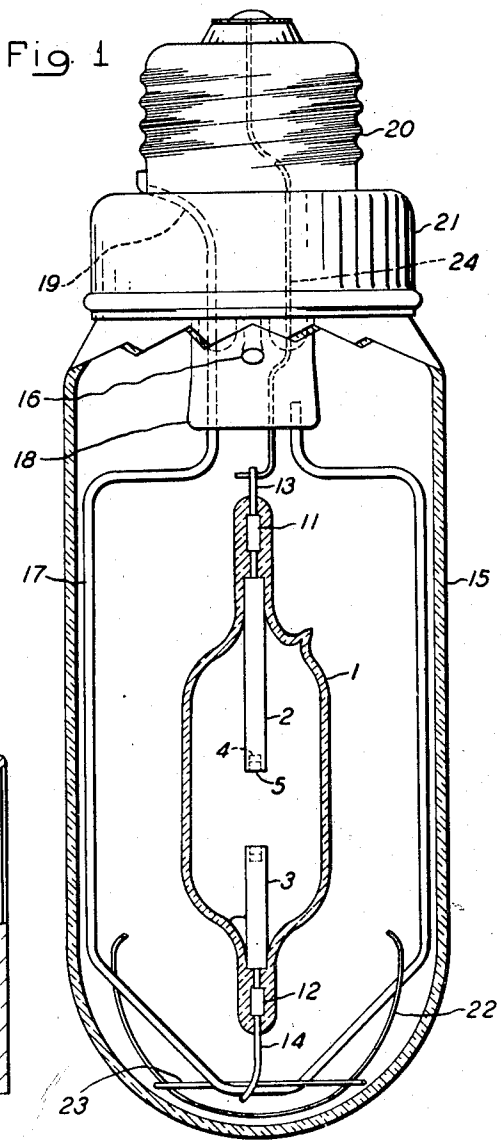


Fig. 2

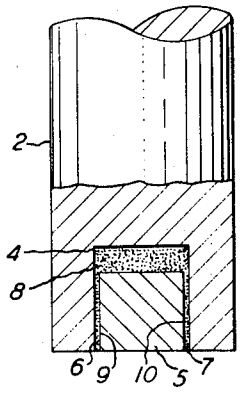
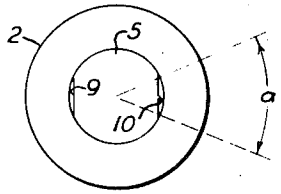


Fig. 3



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ELECTRODE CONSTRUCTION

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6 Claims. (Cl. 176—126)

1

My invention relates to electrode constructions for electric discharge devices, and more particularly to electrode constructions for high pressure mercury vapor lamps of the kind which operate at a relatively high loading, that is at a relatively high value of power in watts, as for example 100 or more watts, per cm. of arc length.

In high pressure lamps employed heretofore, it has been usual to use non-activated electrodes, that is to say electrodes which are not activated upon those surfaces on which the electric discharge terminates in normal operation, hereinafter referred to as terminal surfaces. Activating material for starting purposes is commonly located away from said surfaces. When such lamps which operate satisfactorily on direct current, are operated on alternating current, hot spots often develop and are followed by "tree growth," that is to say metal of the electrode projects into the discharge space beyond the original terminal surface. The result of this is an unduly rapid vaporization of the electrode material and deposition thereof on the walls of the envelope with consequent reduction in useful life of the lamp. It is generally not practical to activate the terminal surfaces in the usual way because the activating material is rapidly vaporized. Various arrangements have been employed heretofore in electrode construction to provide activating material to the terminal surface during operation of the discharge device or the lamp in which the electrodes were used. However, many of these arrangements have been deficient for various reasons, one of the most important of which has been the failure to supply correct amounts of the activating material throughout a reasonably long period to provide satisfactory lamp life.

It is an object of my invention to provide a new and improved electrode construction for electric discharge devices.

It is another object of my invention to provide a new and improved electrode construction for use in high pressure electric discharge devices.

Briefly stated, in accordance with my invention I provide an electrode construction particularly suitable for use in high pressure electric discharge devices, such as high pressure mercury vapor lamps, and which comprises a body member of refractory metal having at one end thereof a terminal surface in which there is a recess which contains activating material and an irregular shaped insert or plug firmly held by the walls of the recess but providing paths or spaces for the passage of activating material to the terminal or arc supporting surface of the electrode during operation of the device or lamp in which the electrode is employed.

2

This application is an improvement of the invention shown and claimed in my co-pending application Serial No. 730,806, filed concurrently herewith and assigned to the assignee of this application.

For a better understanding of my invention reference may be had to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. Fig. 1 illustrates a high pressure mercury vapor lamp including electrodes constructed in accordance with my invention; and Figs. 2 and 3 are enlarged cross-sectional and end views respectively, of an electrode constructed in accordance with my invention.

Referring now more particularly to Fig. 1, my invention is there illustrated as applied to an electric discharge device of the high pressure type, such as a high pressure mercury vapor lamp of the short-gap type comprising a quartz envelope 1 and having positioned therein a plurality or pair of electrodes 2 and 3. Electrodes 2 and 3, where the lamp is intended for operation on alternating current are of similar construction, and each includes a terminal surface at the end thereof. The distance between the electrodes 2 and 3, in this short-gap high pressure lamp, is less than the transverse inside dimension of the envelope 1 at the portion of the envelope surrounding the arc discharge path. A quantity of mercury is employed, as the ionizable medium, the quantity preferably being in an amount which is completely vaporized during normal operation of the lamp.

Considering the enlarged views of the electrode 2 shown in Figs. 2 and 3, the body of the electrode 2 is preferably cylindrical in shape and constructed of a refractory metal, such as tungsten, providing at the end thereof a terminal surface which supports an arc discharge during normal and intended operation. A recess 4, preferably cylindrical in shape, is provided in or facing the terminal surface, and extends into the body part of the electrodes. A plug 5 is inserted in the recess and is constructed to have a shape different from that of the recess 4 in order to provide one or more channels, or spaces 6 and 7, which permit the passage of activating material 8 to the terminal surface from the pocket defined by the plug 5 and the bottom of the recess 4.

Insert or plug 5 is preferably irregular in shape or cross-section, but it nevertheless is constructed

to provide firm engagement with the wall of the recess 4. One way in which this plug may be conveniently constructed is illustrated in Fig. 3 wherein the substantially cylindrical-shaped plug 5 is provided with flat surfaces 9 and 10 and the diametrically positioned arcuate surfaces of the insert 5 between the flat surfaces 9 and 10 tightly engage the wall of the recess 4 thereby holding the plug 5 firmly in the position illustrated. The activating material 8 is preferably one or more of the refractory materials such as thoria, zirconia, or zirconia and thoria.

The rate at which the activating material is dispensed depends, among other things, upon the dimensions of the spaces 6 and 7. One example of dimensions or proportions which may be used in carrying out my invention is that the flat surfaces 9 and 10, in the views shown in Figs. 2 and 3, subtend an angle a of about 40° to 60° at the axis of the cylindrical plug 5.

Returning now to Fig. 1, the electrodes 2 and 3 are fused and sealed to the envelope 1 by suitable seal constructions which may comprise strips 11 and 12 which are electrically connected to the body members of electrodes 2 and 3 and which are connected to lead-in wires 13 and 14 having ends thereof externally accessible.

In order to minimize temperature differences appearing over the surface of the envelope 1, I may employ an outer envelope 15 defining about the inner envelope 1 an evacuated space which serves to equalize the temperature distribution. As a means for supporting the envelope 1 and the associated electrode structure in the position shown, I employ a suitable structure wherein the outer glass envelope 15 is preferably provided with a stem tube 16 and exhaust tube through which the envelope 15 may be exhausted. The support for the lamp comprises a conductive support or frame 17, bent into a substantially U or rectangular-shaped frame having its upper ends sealed in a stem press 18. One end of the wire frame 17 is attached to an outer lead wire 19 which in turn is attached to a screw-threaded shell 20, having a skirted base 21. The other end of the supporting frame 17 terminates in the stem press 18. The lower end of the frame is braced by a substantially semicircular and resilient wire 22 located at the bottom of the outer envelope 15. Wire 22 is attached to the lower end of frame 17 by a wire member 23 which is welded at its middle to lead wire 14 and its ends to wire 22. In this manner electrical connection to electrode 3 is established through frame 17 and the lead wire 14. Electrical connection to electrode 2 is obtained by connecting conductor 24 to the lead-in wire 13.

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

1. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a body member of refractory metal having at one end thereof a terminal surface, a recess in said terminal surface, activating material in said recess, and a plug inserted in said recess and having a shape different from that of said recess and defining with the wall of said recess a space for the passage of activating material to said terminal surface.

2. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a body member of refractory metal having at one end thereof a terminal surface, a recess in said terminal surface, activating material in said recess, and a plug inserted in said recess having an irregular cross-section defining surfaces for engaging the wall of said recess and for firmly holding said plug therein, said plug defining with said wall at least one space for the passage of activating material to said terminal surface.

3. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a cylindrical body member of tungsten having at one end thereof a terminal surface, a cylindrical recess in said terminal surface, activating material in said recess, and a substantially cylindrical-shaped plug inserted in said recess and having diametrically positioned flat surfaces and diametrically positioned arcuate surfaces for firmly engaging the wall of said recess and for holding said plug therein, said flat surfaces defining, with said wall, spaces for the passage of activating material to said terminal surface.

4. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a cylindrical body member of tungsten having at one end thereof a terminal surface, a cylindrical recess in said terminal surface, activating material comprising thoria in said recess, and a substantially cylindrical-shaped plug inserted in said recess having flat surfaces and diametrically positioned arcuate surfaces for firmly engaging the wall of said recess and for holding said plug therein, said plug defining, with said wall, spaces for the passage of thoria to said terminal surface.

5. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a cylindrical body member of tungsten having at one end thereof a terminal surface, a cylindrical recess in said terminal surface, activating material comprising thoria and zirconia in said recess, and a substantially cylindrical-shaped plug inserted in said recess having flat surfaces and diametrically positioned arcuate surfaces for firmly engaging the wall of said recess and for holding said plug therein, said plug defining, with said wall, spaces for the passage of activating material to said terminal surface.

6. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a cylindrical body member of tungsten having at one end thereof a terminal surface, a cylindrical recess in said terminal surface, activating material comprising zirconia in said recess, and a substantially cylindrical-shaped plug inserted in said recess having flat surfaces and diametrically positioned arcuate surfaces for firmly engaging the wall of said recess and for holding said plug therein, said plug defining, with said wall, spaces for the passage of zirconia to said terminal surface.

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