Feb. 1, 1949. V. J. FRANCIS 2,460,739

ELECTRODE CONSTRUCTION

Filed Feb. 25, 1947

Fig. 1

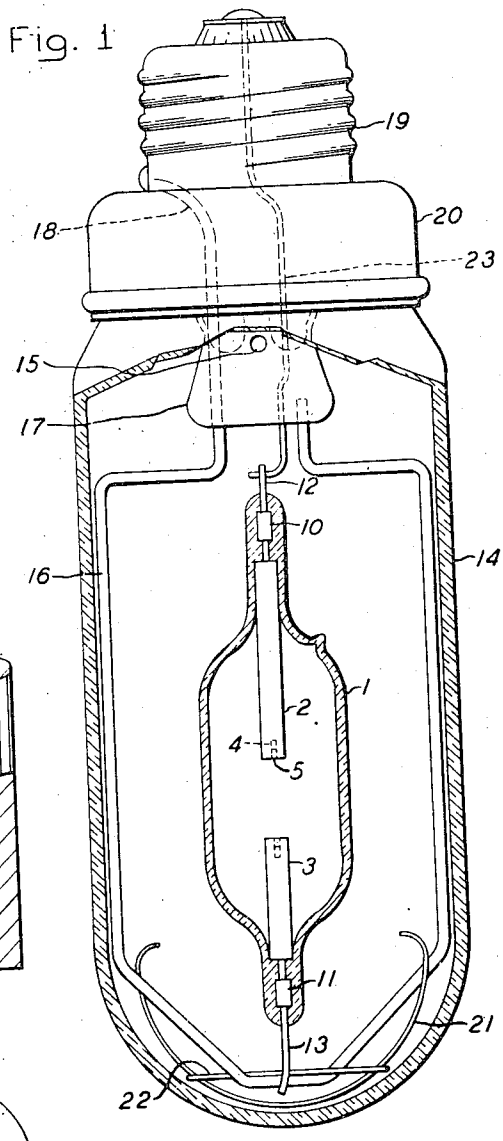


Fig. 2

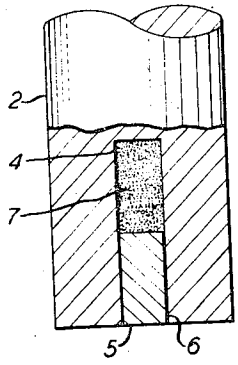


Fig. 3

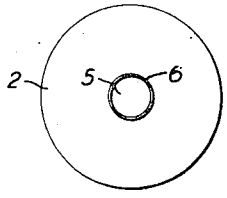


Fig. 4

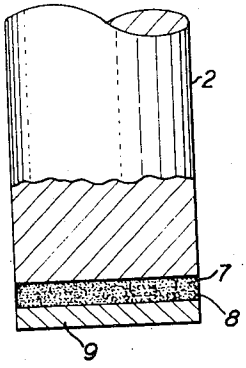
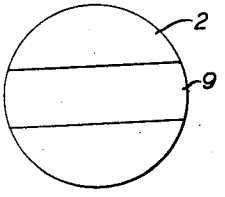


Fig. 5



Inventor:
Victor J. Francis
by John H Anderson
His Attorney.

Patented Feb. 1, 1949 2,460,739

UNITED STATES PATENT OFFICE

2,460,739

ELECTRODE CONSTRUCTION

Victor James Francis, Wembley, England, assignor to General Electric Company, a corporation of New York

Application February 25, 1947, Serial No. 730,806
In Great Britain April 17, 1946

5 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 new and improved electrode constructions 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 solid body member or rod of refractory metal having at one end thereof a terminal surface in which there is a recess which contains activating material and an insert or plug held by the walls of the recess but permitting 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. The end of the solid body member and the plug constitute thereby the stated terminal surface which is a substantial portion of the cross-sectional area of that end of the body member.

2

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; Figs. 2 and 3 are enlarged cross-sectional and end views respectively, of an electrode constructed in accordance with my invention; Figs. 4 and 5 illustrate a variation 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 piece of solid 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, which interrupts the smooth continuity of the body member end and which is preferably cylindrical in shape, is provided in or facing the terminal surface, and extends into the body part of the electrodes. Recess 4, in the case of electrodes of 4 millimeters in diameter, may be of the order of 1 millimeter in diameter and 4 millimeters in depth. A plug 5 of refractory metal, such as tungsten, is inserted in the recess and is constructed to have a shape similar to but slightly smaller than that of the recess 4 in order to provide an annular channel or space 6 which permits the passage of activating material 7 to the terminal surface from the pocket defined by the plug 5 and the bottom of the recess 4. The tungsten plug 5 may extend about 2 millimeters into the recess 4 from the terminal surface. With electrodes of larger diameter the ratio of recess diameter to electrode diameter will usually be less than ¼. If desired, the recess may extend throughout the length of the electrode.

Insert or plug 5 is preferably cylindrical in

shape and is constructed to provide relatively loose engagement with the wall of recess 4, thus permitting the plug 5 to remain in the position illustrated but allowing the activating material 7 to seep through the interstices established by the zone of engagement between plug 5 and the wall of the recess 4. The diameter of plug 5 is chosen relative to the diameter of the recess so that the plug 5 is maintained in the position shown, and at the same time permits the passage of the activating material to the terminal surface through the clearance space, or through the minute interstices established between the surface of the plug and the recess wall. The activating material 7 is preferably in the form of a plug or sintered mass and comprises one or more of the refractory materials such as thoria, zirconia, or zirconia and thoria.

With reference to Figs. 4 and 5, the body of the electrode 2 embodies the above-described corresponding parts of Figs. 2 and 3 except recess 4 is replaced by a recess 8 in the form of a trough or slot transverse to the longitudinal axis of electrode 2. A plug or sintered mass of activating material 7 is placed in the slot and the open end of the trough or slot is provided with a refractory metal insert such as a tungsten insert or plug 9 which lies in and constitutes part of the terminal surface thereby shielding the activating material, and thus serving to protect the activating plug from direct effects of the arc discharge.

In either of the above-described variations, activating material for starting purposes may be provided away from the terminal surfaces in addition to that inset into the end of the electrode.

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 10 and 11 which are electrically connected to the body members of electrodes 2 and 3 and which are connected to lead-in wires 12 and 13 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 14 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 14 is preferably provided with a stem tube 15 and exhaust tube through which the envelope 14 may be exhausted. The support for the lamp comprises a conductive support or frame 16, bent into a substantially U or rectangular-shaped frame having its upper ends sealed in a stem press 17. One end of the wire frame 16 is attached to an outer lead wire 18 which in turn is attached to a screw-threaded shell 19, having a skirted base 20. The other end of the supporting frame 13 terminates in the stem press 17. The lower end of the frame is braced by a substantially semicircular and resilient wire 21 located at the bottom of the outer envelope 14. Wire 21 is attached to the lower end of frame 16 by a wire member 22 which is welded at its middle to lead wire 13 and its ends to wire 21. In this manner electrical connection to electrode 3 is established and to electrode 2 is obtained by connecting conductor 23 to the lead-in wire 12.

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 cylindrical body member of tungsten having at one end thereof a terminal surface, a recess transverse to the longitudinal axis of said member in said terminal surface, activating material in said recess, and a bar-shaped plug inserted in said recess for protecting said material from direct effect of the arc discharge and permitting activating material to pass to the terminal surface.

2. 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 trough transverse to the longitudinal axis of said member in said terminal surface, activating material comprising thoria and zirconia in the form of a plug in said trough, and a bar-shaped plug inserted in said trough for protecting said material from direct effect of the arc discharge.

3. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a rod member of refractory metal, one end of said rod having a recess, activating material in said recess, and a plug in said recess, said end and plug defining a terminal surface constituting a substantial portion of the cross-sectional area of said end.

4. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a solid cylindrical body member of tungsten, one end of said body member having a cylindrical recess, activating material in said recess, and a cylindrically-shaped plug in said recess for protecting said material from the direct effect of the arc discharge and permitting activating material to pass to the terminal surface, said end and plug defining said terminal surface constituting a substantial portion of the cross-sectional area of said end.

5. In an electrode structure for an electric discharge device of the high pressure type, the combination comprising a solid cylindrical body member of tungsten, one end of said member having a cylindrical recess therein, activating material in said recess consisting of a plug of zirconia, and a cylindrically-shaped plug extending substantially into said recess for protecting said material from direct effect of the arc discharge, said end and the last-mentioned plug defining a terminal surface constituting a substantial portion of the cross-sectional area of said end.

VICTOR JAMES FRANCIS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,932,078	Knowles	Oct. 24, 1933
2,008,066	Ende	July 16, 1935
2,177,690	Davies	Oct. 31, 1939