April 18, 1950 E. B. POWER 2,504,581

ELECTRIC DISCHARGE DEVICE

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Fig. 1

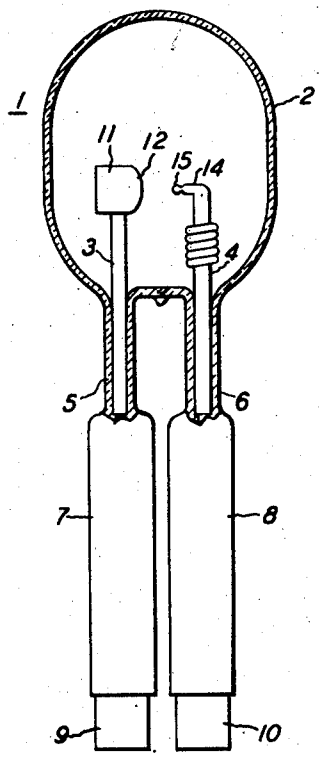
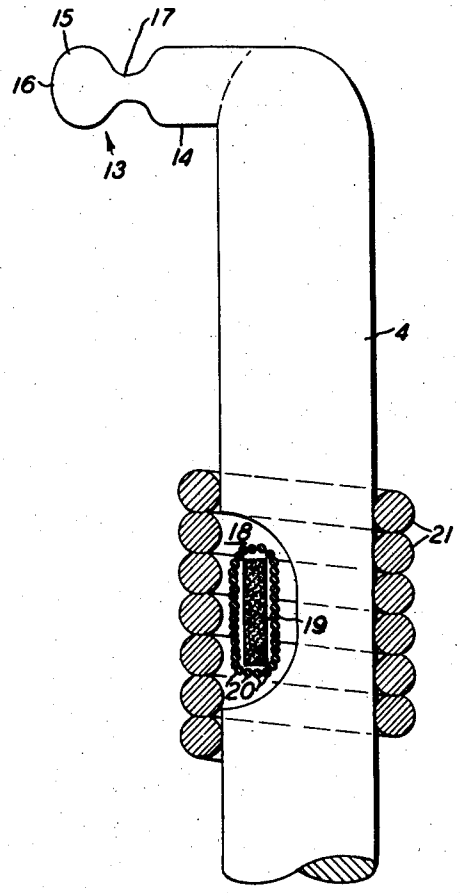


Fig. 2



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ELECTRIC DISCHARGE DEVICE

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6 Claims. (Cl. 176—122)

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My invention relates to electric discharge devices, and more particularly to high-pressure mercury vapor lamps of the high-pressure type as for example lamps in which the pressure of the mercury vapor under normal operating conditions is one atmosphere or more.

In electric discharge lamps of the high-pressure type, such as those intended for use with or in optical systems such as motion picture projectors, the prior art lamps have evidenced certain undesired operating characteristics in that the arc tends to wander from the surface of the cathode which faces the anode and which is normally intended to support the arc discharge. This disadvantage has been encountered where the lamps are operated on direct current. As a result of this wandering of the cathode spot the center of the light source consequently moves and the arc length varies. In accordance with my invention described hereinafter I provide a new and improved high-pressure mercury vapor lamp wherein the above described disadvantage is obviated.

An object of my invention is to provide a new and improved electric discharge device.

Another object of my invention is to provide a new and improved high-pressure mercury vapor lamp of the type in which the distance between arc supporting surfaces of the anode and cathode is less than the distance from either surface to the enclosing envelope.

It is a further object of my invention to provide new and improved electrode structures for high-pressure mercury vapor lamps.

Generally speaking, in accordance with my invention I provide an improved high-pressure mercury vapor electric discharge lamp wherein the arc length remains substantially constant during normal operation rendering it highly satisfactory for projection purposes. An anode and a cathode each constructed of a solid block of refractory metal are positioned on and supported by relatively heavy lead-in conductors or rods and these electrode structures are located transverse to the principal axes of the lead-in rods. For example, where the lamp is intended for vertical operation, the lead-in rods are vertical and the principal axes of the members constituting the anode and cathode are positioned horizontally. A further feature relates to the

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manner in which activating material is positioned and supplied to the arc supporting surface of the cathode, a recess being provided in the lead-in rod which supports the cathode and means is provided for supporting the activating material in this recess but which also permits egress of activating material to the arc supporting surface.

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 is a vertical view of one lamp constructed in accordance with my invention, and Fig. 2 is a much enlarged view of the cathode structure and the supporting lead-in rod which houses the activating material.

Referring now to Fig. 1 I have there illustrated my invention as applied to an electric discharge device, such as a high-pressure mercury vapor lamp 1. This lamp is of the type intended for operation in which the pressure of the mercury vapor is one atmosphere or more and is of the type furnishing a compact source of light. More specifically it may be stated that the discharge lamp is of the high-pressure type in which the arc length or the distance between arc supporting surfaces of the cooperating electrodes is less than the distance from either surface to the vitreous envelope 2.

I provide a pair of lead-in conductors or rods 3 and 4, which are preferably arranged in a vertical position and which are sealed to tubulations 5 and 6 by any suitable sealing structures 7 and 8, respectively, providing at the lower extremities thereof externally accessible contacts 9 and 10. The sealing structures 7 and 8 may be of the type disclosed and claimed in United States Patent No. 2,400,946, granted May 28, 1946 upon an application of E. H. Nelson et al., and which is assigned to the assignee of the present invention.

The lead-in rods 3 and 4 are constructed of refractory metal such as tungsten and in one embodiment of my invention comprise tungsten rods having a diameter of approximately 3 mm. On one of the lead-in rods I position an anode 11, preferably constructed of a single block of refractory metal such as tungsten, and which is arranged to have its principal axis transverse or perpendicular to the axis of the lead-in rod 3.

Anode 11 is provided with an arc supporting surface 12 preferably arcuate in shape. In one form the anode 11 may have a substantially semispherical shape with the convex arc supporting surface 12 facing the cathode structure described immediately hereinafter.

The details of the cathode structure may be more fully appreciated by referring to the much enlarged view thereof shown in Fig. 2. The cathode structure 13 is preferably constructed of a single cylindrical piece or block of refractory metal, such as tungsten, and is provided with a base part 14 which is joined to or welded to the lead-in rod 4. At one extremity of the cathode 13 I provide a bulbous part 15 affording an arc supporting surface 16 to face the arc supporting surface 12 of anode 11, and which is connected to base part 14 by a contracted or neck section 17 to limit or minimize the flow of heat from the bulbous part 15 to the other parts of the electrode structure or assembly, thereby serving to maintain the temperature of the cathode during normal operation at or above a predetermined value, whereas the anode 11 is substantially more massive than the cathode 13 so that it effectively dissipates the excessive heat thereat during operation. The contracted section 17 may be formed by a grinding operation and the bulbous part 15 need not be symmetrical and may have a slightly flattened appearance as shown in Fig. 2 of the drawing.

In order to supply activating material to the cathode I provide a recess 18 in the supporting rod 4 for the cathode, and which may be formed by grinding away a section of the rod 4. Within the recess 18 I position activating material 19 which may comprise a composite body of oxides of the alkaline earth metals, or mixtures thereof, and which may be held in a compact form by means of a winding of tungsten wire 20 which by virtue of the small spacing between the turns thereof permits egress of activating material through a second spiral or winding of tungsten wire 21 which retains the activating material 19 in the recess 18.

In one form of lamp constructed in accordance with my invention the spacing between the arc supporting surfaces 12 and 16 is preferably within the range of 5 to 10 mm. and the vertical and horizontal dimensions of the bulbous part 15 are respectively 1½ mm. and 1 mm. for an arc discharge path of 6 mm. The cathode 13 is formed of a 1.5 mm. tungsten rod joined to the associated 3 mm. tungsten rod 4 by arc welding. The length of the cathode structure 13 to the point where it is joined to the rod 4 may be approximately 3.5 mm., and the contracted or neck part 17 may be 0.5 mm. in diameter having a length of from 0.75 to 1 mm.

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

1. In an electric discharge device of the type employing an ionizable medium and for operation on direct current, the combination comprising an envelope and a pair of electrodes positioned therein and having arc supporting surfaces thereof spaced a distance less than the distance from either surface to the envelope, one of said electrodes serving as an anode and constructed of a block of refractory metal substantially more massive than the other electrode and having its principal axis transverse to and supported by a lead-in conductor, and the said other electrode having a part thereof transverse to and of smaller cross sectional area than its supporting lead-in conductor and having a bulbous part serving as a cathode and connected to a base part by a contracted section to limit the flow of heat to the associated lead-in conductor.

2. In an electric discharge lamp of the high-pressure type for direct current operation, the combination comprising an envelope and including an anode and a cathode, said anode comprising a block of refractory metal substantially more massive than the cathode and having a convex arc supporting surface and said cathode comprising a similar body of refractory metal provided with a bulbous part having an arc supporting surface and connected to a base part by a contracted section having a smaller cross-sectional area than said base part for limiting the flow of heat from the bulbous part.

3. In an electric discharge lamp of the high-pressure mercury vapor type for direct current operation, the combination comprising an envelope, a pair of vertical lead-in rods, and an anode and cathode each constructed of a solid block of refractory metal, said anode being substantially more massive than said cathode and of substantially cylindrical shape provided with a convex face for supporting an arc discharge, and said cathode having a base part and a bulbous arc supporting part connected to the base part by a contracted section for limiting the flow of heat to the base part, the lead-in rod supporting said anode being of smaller cross-sectional area than said anode and the lead-in rod supporting said cathode being of larger diameter than said base part.

4. In an electric discharge lamp of the high pressure mercury vapor type for direct current operation, the combination comprising an envelope, a pair of vertical lead-in rods, and a horizontally positioned anode and cathode supported respectively by said rods and each constructed of a solid block of tungsten, said anode being substantially more massive than said cathode and of substantially cylindrical shape having a convex arc supporting surface and said cathode having a bulbous part serving as an arc supporting surface and connected to a base part by a contracted section for maintaining the temperature of the bulbous part at or above a predetermined value during operation of the lamp, the lead-in rod supporting said anode being of smaller cross-sectional area than said anode and the lead-in rod supporting said cathode being of larger diameter than said base part.

5. In an electric discharge device of the type employing an ionizable medium and for direct current operation, the combination comprising an envelope, a pair of lead-in rods of refractory metal, and an anode and cathode supported by said rods, said anode being substantially more massive than said cathode, said cathode comprising a body of refractory metal provided with a bulbous part having an arc supporting surface and connected to a base part by a contracted section for limiting the flow of heat from the bulbous part, a recess in the lead-in rod supporting said cathode, activating material in said recess, and means for supporting said activating material in said recess.

6. An electric discharge lamp of the high pressure mercury vapor type for direct current operation comprising a sealed envelope, a pair of stout lead-in rods extending into said envelope from one end thereof in substantially parallel relationship, an anode and a cathode of solid refractory metal supported respectively by said rods and

extending transversely thereof toward each other, said anode being substantially more massive than said cathode, the end of said cathode nearer said anode being separated from the remainder of the cathode by a neck portion of materially reduced cross-sectional area to maintain the said end of the cathode, during operation, at a higher temperature than in the absence of the said neck portion and thereby prevent wandering of the arc from the surface of the cathode which faces said anode.

ERNEST BENJAMIN POWER.

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