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V. J. FRANCIS

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HIGH-PRESSURE METAL VAPOR ELECTRIC DISCHARGE LAMP

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Fig. 1.

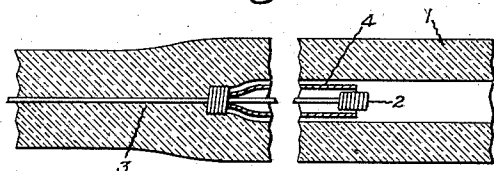
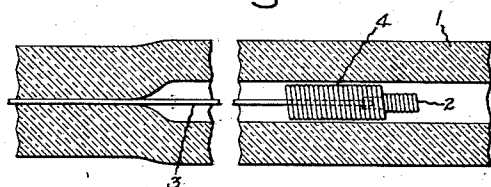


Fig. 2.



Inventor:
Victor J. Francis,
by *Harry E. Dunham*
His Attorney.

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HIGH-PRESSURE METAL VAPOR ELECTRIC
DISCHARGE LAMP

Victor James Francis, North Wembley, England

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In Great Britain September 18, 1936

4 Claims. (Cl. 176—126)

This invention relates to high-pressure mercury vapor electric discharge lamps of the type in which the inner diameter of the tubular envelope in the neighbourhood of the electrodes (and usually along its whole length) does not exceed 4 mm. High-pressure here implies that the pressure of the mercury vapor during operation greatly exceeds one atmosphere (it is usually not much less than 10 atmospheres and may exceed 100 atmospheres), whereby the inner wall of the envelope of the device is heated intensely and has to be composed of quartz or other similarly refractory material, even if it is cooled externally by water or like means. The term "mercury" does not exclude the presence of substances additional to mercury whose spectra may contribute appreciably to the light emitted.

The main advantage of lamps of this type is the great brightness of the discharge column; accordingly it is desirable in principle to make the bore of the envelope narrow. One of the factors setting a lower limit to the bore is the need for maintaining free space between the electrodes and the envelope. If the end of the electrode on which the discharge terminates touches the envelope, the lamp is apt to fail through cracking of the envelope; accordingly either the electrode must be so stout as to be inflexible and a relatively small gap left round it, and/or the gap must be relatively large so that the electrode cannot touch the envelope even if it bends or is inaccurately aligned in construction. Moreover there is sometimes a lower limit to the gap other than zero; for if a large excess of mercury is present (as is known in lamps of this type), it is apt to be held in the gap by surface tension and to serve itself as the electrode; this also leads to early failure. The object of the invention is to provide means for overcoming these difficulties.

According to the invention in a lamp of the type specified, one or preferably each of the electrodes is surrounded by a cylindrical spacing member, fitting between the electrode and the envelope, and the free end of each electrode so surrounded projects substantially from the spacing member. The gap can then be adjusted to the desirable minimum by choice of the thickness of the spacing member, regardless of the flexibility of the electrode or possible inaccuracies in alignment. The end must not, of course, project so far that these factors enter once more.

The spacing member may be a sheath of quartz; but, if the electrode proper is the usual tungsten helix surrounding a rod of alkaline earths, it may conveniently be another tungsten helix sur-

rounding the first. If there is no large excess of mercury in the tube, the electrode need project from the spacing member only so far that the discharge terminates certainly on the electrode, and not on the sheath, and that the thermal resistance of the path between the end of the electrode and the envelope is sufficient.

When the exterior of the envelope is water cooled, there may be, in known manner, considerable excess of mercury in the envelope; then other considerations enter. For the mercury will collect behind the electrode; if it covers the whole spacing member (as may be desirable, in order that the member may be cooled), the distance that the electrode projects from the mercury, rather than from the spacing member, will be the determining factor. This distance may be controlled in known manner, during the manufacture of the lamp, for example by reducing the dead space behind the electrode by progressive collapse of the tube after it has been sealed, until the desired operating characteristic is attained.

Two embodiments of the invention will now be described by way of example, with reference to Figures 1 and 2 of the accompanying drawing, each of which shows a longitudinal section of one end of a high-pressure mercury-vapor lamp; the other end is similar.

In both figures, 1 is the tubular quartz envelope of 2 mm. bore and 2 mm. wall thickness; 2 the thermionic electrode, consisting of a tungsten spiral carrying alkali earths; 3 the lead, passing through the end of the tube by which the electrode is supported; 4 is the spacing member. In both examples the envelope is cooled externally by water (not shown) and during operation there is excess of mercury behind the electrode. In manufacture this mercury is introduced before the end of the envelope is sealed, so that no side tube is required. In each case the distance of the free end of the electrode from the end of the envelope is about 15 mm.; but since the final distance is adjusted as aforesaid by collapsing the tube, it will vary from tube to tube. The distance between the free ends of the electrodes (the second of which is not shown) is about 30 mm. Both lamps dissipated about 1000 watts, when passing about 1.5 a. with about 700 volts between the electrodes.

In the embodiment of Figure 1, the spacing member 4 is a thin quartz sheath extending to the end of the envelope and collapsed on to the wire with the envelope at that end. The electrode 2 is 2 mm. long and projects $\frac{1}{2}$ –1 mm. beyond the sheath; the supporting wire 3 is of

molybdenum $\frac{1}{2}$ mm. thick. The lamp contains 0.2 gm. of mercury; the volume of the dead space is adjusted as aforesaid until the lamp runs up with an initial current of some 4 a.

5 In the embodiment of Figure 2, the spacing member 1 is a tungsten helix of wire 0.2 mm. thick wound on a mandrel 1.25 mm. in diameter; its length is 5 mm. The rear turn may be distorted so as to fix the helix longitudinally.
10 The electrode 2 is $2\frac{1}{2}$ to 3 mm. long and projects $1\frac{1}{2}$ to 2 mm. from the helix; the wire 3 supporting it is of molybdenum 0.7 mm. thick. The lamp contains about 0.67 gm. of mercury; the volume of the dead space is adjusted as before.

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

1. An electric discharge device comprising spaced, flexible electrodes, an envelope into which said electrodes are sealed, a gaseous filling in said
20 envelope which during operation attains a pressure materially in excess of atmospheric and supports a discharge between said electrodes and a spacing member surrounding one of the electrodes, said spacing member being mounted between said electrode and the inner wall of said
25 envelope and out of contact with said wall and electrode at any point along the length of the electrode, said electrode extending beyond said spacing member towards another electrode, said
30 spacing member terminating at a point along the length of the electrode such that the path of vibratory movement of the exposed end of the electrode is restricted to a distance less than the inner diameter of said envelope.

35 2. An electric discharge device comprising a tubular envelope having an inner diameter of the order of 2 mm., spaced, flexible electrodes sealed into the ends of said tubular envelope, a vaporisable material in said envelope which,
40 under operating conditions, produces a vapor at a pressure materially in excess of atmospheric and a spacing member surrounding one of said electrodes, said spacing member being mounted between said electrode and the inner wall of
45 said envelope and out of contact with said wall and electrode at any point along the length of the electrode, said electrode extending beyond said spacing member on the side of the spacing member remote from the point at which said electrode is sealed into said envelope, said spacing
50 member terminating at a point along the length

of the electrode such that the path of vibratory movement of the exposed end of the electrode is restricted to a distance less than the inner diameter of said envelope.

3. An electric discharge device comprising a
5 tubular thick-walled envelope of refractory light-transmitting material having an inner diameter of the order of 2 mm., flexible, electron-emitting electrodes sealed into the ends of said envelope, a vaporisable material in said envelope in an
10 amount such that during operation a vapor pressure materially above atmospheric is produced in said envelope and a spacing member surrounding one of said electrodes, said spacing member being mounted between said electrode and the inner wall of said envelope and out of
15 contact with said wall and electrode at any point along the length of the electrode, said electrodes extending beyond the inner end of said spacing member toward the opposite electrode, said spacing member terminating at a point along the
20 length of the electrode such that the path of vibratory movement of the exposed end of the electrode is restricted to a distance less than the inner diameter of said envelope.

25 4. An electric discharge device comprising a tubular envelope of refractory light-transmitting material having an inner diameter of the order of 2 mm., flexible, electron-emitting electrodes sealed into the ends of said envelope, a vaporisable
30 material in said envelope in an amount such that during operation a vaporisable pressure materially above atmospheric is produced in said envelope, each of said electrodes comprising a helix of refractory metal mounted on the end of a current
35 lead sealed into the end of said envelope, said helices being covered with electron-emitting material and a spacing member surrounding one of said electrodes, said spacing member being mounted between said electrode and the inner
40 wall of said envelope, said spacing member being fastened to the current lead of the electrode surrounded thereby, the inner end of said helix extending beyond the end of said spacing member towards the other of said electrode, said
45 spacing member terminating at a point along the length of the electrode such that the path of vibratory movement of the exposed end of the electrode is restricted to a distance less than the inner diameter of said envelope.

VICTOR JAMES FRANCIS.