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ARC DISCHARGE TUBE HAVING AN ELECTRODE WHICH CONTAINS A LIGHT-EMITTING METAL

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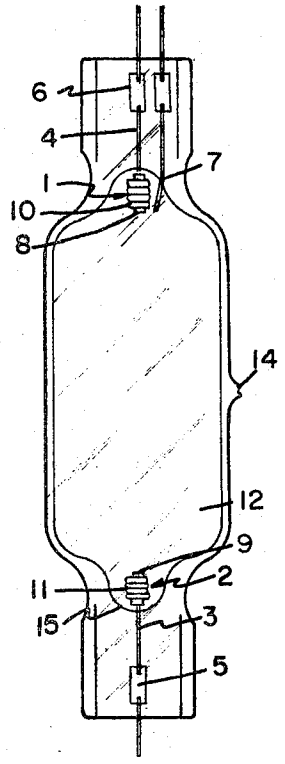


FIG. 1

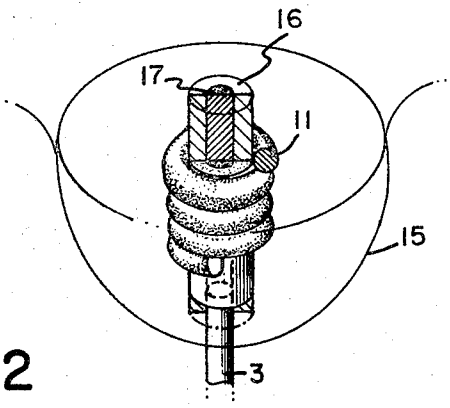


FIG. 2

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ARC DISCHARGE TUBE HAVING AN ELECTRODE WHICH CONTAINS A LIGHT-EMITTING METAL

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This invention relates to high pressure electric discharge devices and their cathodes and particularly to devices which emit colors other than the characteristic bluish hue of mercury lamps.

High pressure electric discharge devices have been known to the art. Such devices have commonly been made with a fill of mercury metal. When the devices are operated, the mercury is ionized and characteristic emission lines of mercury are emitted at 4048, 4348, 5461, 5770 and 5990 A. Basically these lines produces a bluish emission. Recently it has been discovered that if iodine and a light-producing metal are incorporated into the arc tube, a wide variety of new emission colors can be obtained. For example when thorium, scandium, vanadium and/or certain of the rare earth metals such as yttrium, lanthanum, lutetium, holmium, thulium, cerium, neodymium, praseodymium, gadolinium, terbium, dysprosium and erbium are added to the arc tube, white light can be obtained. If thallium, for example, is added to the arc tube, a brilliant green color is produced and when indium, molybdenum and gallium are included blue light is realized. Other metals which have been added to the arc tube to produce variations in colors include cadmium and sodium. For example, cadmium produces red and sodium adds yellow.

As with the advent of any new device, however, some engineering problems have developed. Foremost among these problems has been a continual rise in the operating voltage of the lamps during their life. Although the lamps may operate on reasonable voltage when orginally made, during their life the voltage tends to increase. We have now discovered that, to a degree, this increase in operating voltage can be traced to a so-called "gettering" of one of the several materials in the arc tube. When the metal is gettered or is made chemically ineffective in the arc tube, the operating voltage will change. A "consumption" of the metal causes an imbalance of the materials in the arc tube, some of which cause the operating voltage to rise and others of which cause it to decrease. For example, sodium is gettered more quickly than thorium in an arc tube containing sodium, thorium, iodine and mercury. While the ratio of sodium to thorium is shifting, the operating voltage will rise. In order to circumvent this problem, we have discovered that if the light-emitting material is dispensed or metered-out during the operation of the lamp, that the operating voltage will not increase so precipitously. By our invention, we dispense the light emitting material by using a tungsten cathode having a conventional external shape but which is hollow. A requisite quantity of light emitting metal is disposed in the hollow as a core. During the life of the lamp, the heat of the arc discharge and the chemical reaction of ionic iodides gradually causes the light-emitting metal to enter into the arc stream. When sufficient quantities of light-emitting material are included as the core, the gradual gettering of this metal will not produce a shift in the ratios.

Accordingly, the primary object of our invention is the reduction of increases in operating voltage of high pressure electric discharge devices containing mercury iodine and light-emitting metal.

A feature of our invention is the inclusion of a light-emitting metal as a core in at least one electrode of a high pressure electric discharge device emitting-light other than characteristic blue hue of mercury lamps.

The other objects, features and advantages of our invention will become manifest to those conversant with the art upon reading the following specification when taken in conjunction with the accompanying drawings wherein specific embodiments of our invention are shown and described by way of illustrative examples.

Of these drawings:

FIGURE 1 is a plan view of an arc tube of a high pressure electric discharge device having electrodes fabricated according to our invention.

FIGURE 2 is an expanded, cross-sectional view of one end of an arc tube and the electrode.

Referring now to FIGURE 1 of the drawings, the arc tube in general is made of quartz, although other types of glass may be used such as alumina glass or Vycor, the latter being a glass of substantially pure silica. Sealed in the arc tube at opposite ends thereof are main discharge electrodes **1** and **2**. These electrodes are supported upon lead-in wires **3** and **4** which extend into the electrodes as will be described later. Each of the lead-in wires **3** and **4** are spot welded or affixed to molybdenum foil sections **5** and **6** which are press sealed in the glass. A starting probe **7** extends into the arc tube adjacent the electrode **1** and is used when the lamp is started. Each electrode comprises rod sections **8** and **9** which usually, although not necessarily, are surrounded by tungsten or molybdenum helixes **10** and **11**. A small quantity of mercury, the light emitting metal, when desired, and a source of iodine **12** is added to the arc tube through an exhaust tube **14** (only the fused residual tip of which is shown).

As shown in FIGURE 2, the rod sections extend within a well **15** formed in the press seal of the arc tube. It is disposed upon lead-in wire **3** which extends into the rod section's interior. The rod section is formed of a tube **16** which is filled with a light-emitting metal **17**. The light-emitting metal can extend downwardly through the whole length of the tube **16**, as desired. Wrapped around the outside of the rod section is the wire helix **11** as described previously. Metals utilized as light emitting sources can include those outlined previously.

In order to fabricate the rod sections we prefer to vapor deposit a shell of tungsten about the core of aforementioned light emitting metal. Frequently a large number of coatings should be applied to make the tube of tungsten sufficiently thick to withstand the temperature to which the arc is operated. Other methods of forming the cathode can include drilling a hole into a core of tungsten and filling the hole with the light-emitting material.

When the electrodes were fabricated into lamps, the voltage reading would not increase appreciably over life. Initially, the voltage reading was 109.2 v., at 180 hours it was 118.5 v. and at 468 hours it was 126 v. The operating voltage had substantially plateaued and further increases would not be marked. In lamps utilizing only conventional electrodes in which no core of light-emitting material was utilized, the operating voltage was substantially higher than that which was evidenced with the electrodes of our invention; initially, the voltage was 128 v. and at 480 hours it had risen to 158 v. Hence not only was the initial operating voltage higher than that produced with the electrodes of our invention, but moreover such increases were maintained during life.

In order to manufacture this lamp, 50 mg. of Hg, 7.5 mg. HgI_2, 1.0 mg. TlI, 19.5 mg. NaI were placed in the arc tube. An electrode having a thorium core was sealed in. In manufacturing, the arc tube filled with these ingredients baked for 7 minutes, flushed with an inert gas and flamed for 5 minutes. Afterwards it was pressurized

to 23 mm. of mercury and the exhaust tube tipped off to seal the envelope.

It is apparent that modifications and changes may be made within the spirit and scope of the instant invention. It is our intention, however, to be limited only by the scope of the appended claims.

As our invention we claim:

1. An arc tube for a high pressure electric discharge device comprising: a glass envelope sealed at either end; an electrode sealed at each end thereof; at least one of said electodes compising a tube of tungsten and a core of at least one light-emitting metal selected from the group consisting of thorium, scandium, vanadium, yttrium, praseodymium, gadolinium, terbium, dysprosium, erbium, indium, molybdenum, gallium, cadmium and sodium; said envelope containing a fill including halogen atoms and mercury.

2. The arc tube according to claim **1** wherein the core of light-emitting metal is thorium.

3. The arc tube according to claim **1** wherein the electrode has a wire helix wrapped about the tungsten tube.

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