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[54] **HIGH-PRESSURE METAL HALIDE ELECTRIC DISCHARGE LAMP**
1 Claim, 1 Drawing Fig.

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[50] **Field of Search** 313/197, 198, 227, 229; 315/59, 60, 71–73, 101, 160, 165, 166, 168, 171, 203, 261, 264, 330, 335, 336

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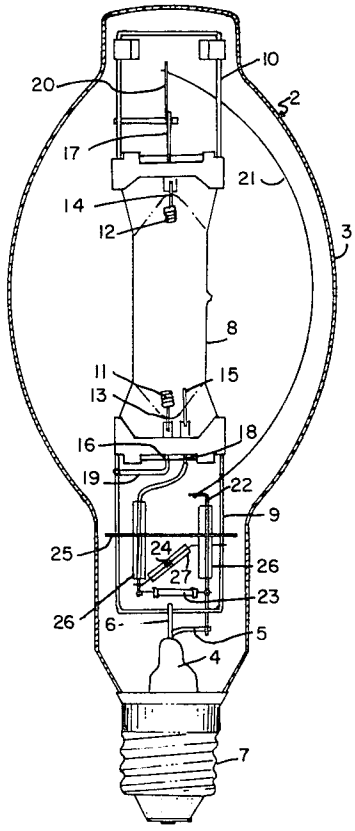
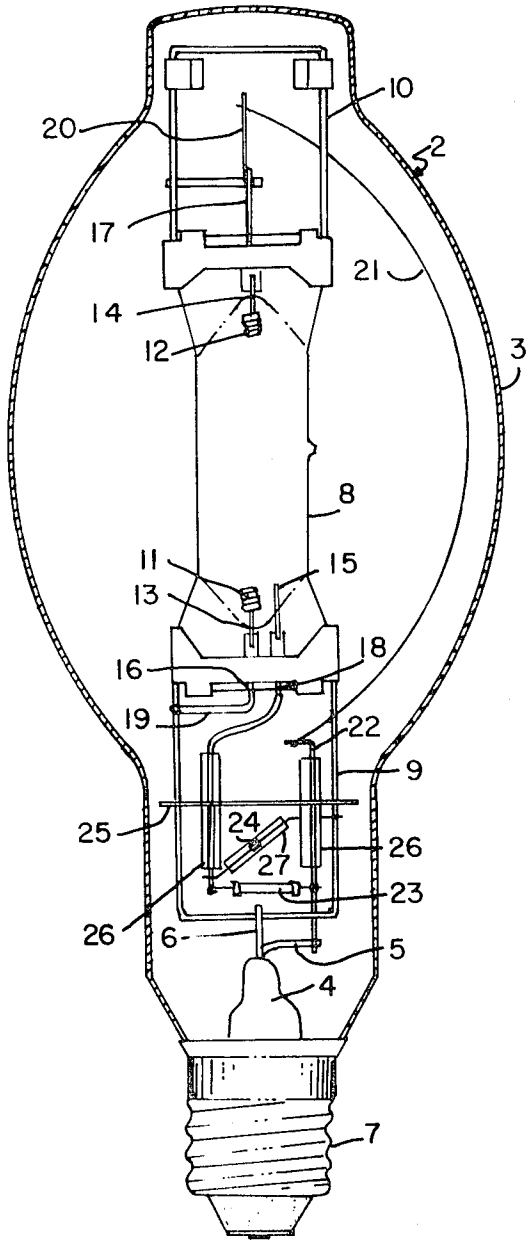
ABSTRACT: The arc tube of an arc discharge lamp has two main electrodes and a starter electrode adjacent one of them, the starter electrode being electrically connected to the adjacent electrode through a rectifying device, such as a diode, external of the arc tube. The polarity of the rectifier is such as to permit the starter electrode to attain a voltage positive with respect to the adjacent electrode but to substantially prevent a negative voltage therebetween.





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HIGH-PRESSURE METAL HALIDE ELECTRIC DISCHARGE LAMP

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of high-pressure arc discharge lamps and is especially applicable to such lamps having a metallic halide fill.

2. Description of the Prior Art

High-pressure metal halide arc discharge lamps generally comprise an elongated arc tube containing an ionizable fill and having press seals at each end of the tube. Disposed within the arc tube are two main electrodes, one at each end. The electrodes are generally supported in the press seals and are usually connected to a thin molybdenum ribbon, disposed within the press seal, the purpose of the ribbon being to prevent seal failures because of thermal expansion of the lead-in wire.

In order to facilitate starting of the arc discharge, that is, ionizing of the gas fill, a starter electrode is generally disposed in the arc tube, adjacent one of the main electrodes. Such an electrode is used because an arc can be ignited between the starter electrode and its adjacent electrode at a much lower starting voltage than is required to ignite an arc between the two main electrodes. Once the arc has ignited, the ionizing gas decreases the resistance between the two main electrodes and an arc is formed therebetween. At this time, it became desirable to electrically remove the starter electrode from the circuit or, at least, to maintain it at the same potential as the adjacent electrode, for reasons to be presently shown.

During operation of some metal halide lamps containing alkali or alkaline earth additives, electrolysis between the starter electrode and adjacent electrode can occur at the press seal, if there is an electric potential therebetween. The electrolysis current consists mainly of alkali ion flow and thus is greater in an arc tube having a fill that includes an alkali than in one that does not. However, electrolysis can always be present, since the arc tube material, generally high silica glass or quartz, usually contains minute quantities of alkali metals.

Electrolysis occurs only when the starter electrode is negative with respect to the adjacent electrode; this electrolysis can deteriorate, to the point of failure, the molybdenum ribbon to which the starter electrode is connected. Thus, even when the lamp is energized by an AC voltage, the starter electrode can be negative with respect to the adjacent electrode 50 percent of the time, unless suitable means are employed to prevent a potential thereacross.

In the prior art, the means used to eliminate a potential therebetween was a temperature-sensitive switch, such as a U-shaped strip of bimetal, which, upon heating thereof, shorted the starter electrode lead-in wire to the adjacent electrode lead-in wire. A short period of time, say, about 30 seconds, was all that was normally required for the switch to heat up sufficiently to deflect and short the wires. As long as the wires were shorted and, thus, were at the same potential, no electrolysis could occur between the two electrodes. However electrolysis could occur during the period of time required for the switch to close.

During operation of the lamp, prolonged exposure of the switch to the heat emanating from the arc tube could cause the bimetal to take a "set" in the stressed position, with the result that the switch could require progressively longer time intervals to close. In some cases, the physical characteristics of the bimetal could be altered sufficiently to prevent closing of the switch altogether or to cause the switch to remain closed even at room temperature. In the latter case, the lamp could not normally be restarted.

It is an object of this invention to provide an arc discharge lamp having starting means which substantially eliminates lamp failures due to electrolysis.

SUMMARY OF THE INVENTION

A lamp in accordance with this invention has an arc tube having press seals at each end, an ionizable fill in the arc tube, two opposing main electrodes, a starter electrode adjacent one of the main electrodes and metal ribbon connectors in the press seals. Each electrode is electrically connected to separate ribbon connectors which, in turn, are connected to lead-in wires leading externally of the arc tube. The lamp has means to electrically connect each main electrode to opposite sides of an AC power supply.

The starter electrode is electrically connected, through a current limiting resistor, to the same side of the power supply as the opposite main electrode. In addition, the starter electrode is electrically connected to the adjacent main electrode through a rectifying device arranged so that current flow through the device is from the adjacent main electrode to the starter electrode. Thus at those times when the starter electrode is negative with respect to the adjacent main electrode, current will flow from the adjacent main electrode to the starter electrode thru the rectifying device and substantially eliminate any negative charge on the starter electrode. (It is a buildup of negative charge on the starter electrode that attracts positive sodium ions to it.) The reaction of the sodium ions with the molybdenum ribbon deteriorates the press seal. When the starter electrode is positive with respect to the adjacent main electrode, current will flow through the ionized fill gas from the starter electrode to the adjacent main electrode. The ionized fill gas forms essentially a short circuit between the starter and main electrode and the potential difference between the main electrode and starter electrode is not sufficient to cause electrolysis.

The rectifying device need function as a rectifier only during initial lamp ignition in order to permit an adequate starting voltage to be established between the starting electrode and the adjacent main electrode. Once ignition has occurred and the arc is struck between the main electrodes, the rectifying device need not function as a rectifier. However, upon lamp extinguishment, and cooling thereof, the rectifying device must function as a rectifier to permit the lamp to be reignited by the usual ballasts with such lamps.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is an elevational view of a high-pressure arc discharge lamp in accordance with this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawing an arc discharge lamp in accordance with this invention comprises an outer vitreous envelope or jacket **2** of generally tubular form having a central bulbous portion **3**. Jacket **3** is provided at its end with a sealed reentrant stem **4** through which extend relatively stiff lead-in wires **5** and **6** connected at their outer ends to the electrical contacts of the usual screw-type base **7**. Centrally disposed within jacket **2** is arc tube **8** which is supported at its lower end by metal frame **9** which, in turn, is welded to lead-in wire **6**. Attached to the upper end of arc tube **8** is metal frame **10**, part of which frictionally engages the upper tubular portion of jacket **2** and stabilizes the position of arc tube **8**.

Arc tube **8** is made of quartz, a high-silica glass, although other types of glass having comparable or higher softening temperatures, such as alumina glass, may be used. Sealed in arc tube **8**, at the opposite ends thereof, are main discharge electrodes **11** and **12** which are supported on lead-in wires **13** and **14** respectively. Each main electrode comprises a core portion which may be a prolongation of wires **13** and **14** and may be prepared of a suitable electrode metal such as tungsten or molybdenum. The prolongations of wires **13** and **14** can be surrounded by tungsten or molybdenum wire helixes.

An auxiliary starting electrode **15**, generally prepared of tungsten, is provided at the lower end of arc tube **8** adjacent main electrode **11** and comprises an inwardly projecting end of another lead-in wire.

The ends of the lead-in wires are welded to molybdenum ribbon connectors which are completely embedded within the press seal ends of arc tube **8**. Relatively short molybdenum wires **16**, **17** and **18** are welded to the ends of the molybdenum ribbon connectors and serve to convey current to electrodes **11**, **12** and **15** respectively.

Wire **16** is electrically connected through metal frame **9** to lead-in wire **6** by means of nickel strip **19** connected between wire **16** and frame **9**.

Wire **17** is electrically connected to lead-in wire **5** by means of wires **20**, **21** and **22** connected in series. Wire **20** is welded directly to wire **17** and wire **21** is a long thin wire extending from the upper portion of jacket **3** to the lower portion thereof.

Wire **18** is electrically connected to lead-in wire **5** through resistor **23**. Resistor **23** has a value of 40,000 ohms and serves to limit the current to starter electrode **15** during normal starting of the lamp.

Diode **24** is electrically connected between frame **9** and the electrode end of resistor **23**, thereby directly electrically connecting electrode **11** to electrode **15**. Diode **24** is connected so that the flow of current therethrough is from electrode **11** to electrode **15**, when a potential thereacross exists.

Heat shield **25** is supported on frame **9** and is disposed below the lower end of arc tube **8** so as to shield resistor **22** and diode **24** from direct heat radiation from arc tube **8**.

Glass sleeves **26** electrically insulate the wires passing through heat shield **25** to prevent shorting thereto. Glass sleeve **27** envelopes diode **24** for physical protection thereof.

Arc tube **8** is provided with a filling of mercury which reaches pressures in the order of one-half to several atmospheres during normal lamp operation at temperatures of about 450° to 800° C. The filling also includes an ionizable gas, argon, for example, at an approximate fill pressure of 25 Torr. The filling also includes a halogen, except fluorine, and is preferably added in the form of a iodide of a suitable metal, such as sodium iodide.

In operation, an AC voltage is applied to lead-in wires **5** and **6**. Because diode **24** is a rectifier at the normal ambient temperature of the lamp, the diode conducts on one-half cycle of the voltage and resists current flow on the other half cycle. As connected in the lamp, diode **24** conducts when the positive half cycle of voltage is applied to main electrode **11**, thus placing starter electrode **15** at substantially the same voltage as main electrode **11**.

However, when the negative half cycle of voltage is applied to main electrode **11**, diode **24** acts as a high resistance, thereby permitting the voltage to be impressed between main electrode **11** and starter electrode **15**, the latter being positive. It is during half cycles of this polarity that ionization of the arc tube fill gas occurs with resultant ignition of the lamp.

After the lamp has become operative, the diode may partially or totally lose its rectifying capability as the lamp approaches its normal operating temperature. But upon lamp extinguishment, and cooling thereof, the diode must function as a rectifier in order to permit the lamp to be restarted.

I claim:

1. An alternating current metal halide electric discharge lamp comprising: an arc tube containing an ionizable, discharge-sustaining filling; a sealed glass jacket enveloping the arc tube but spaced therefrom; a first and a second main electrode disposed within the arc tube at opposite ends thereof; a starter electrode disposed within the arc tube adjacent the first main electrode; a current-limiting resistance electrically connected between the starter electrode and the second main electrode; and a silicon diode disposed between the arc tube and the jacket and electrically connected between the starter electrode and the first main electrode so that the direction of current flow therethrough is from the first main electrode to the starter electrode, the diode being sufficiently heat resistant at the normal operating temperature of the lamp to retain its rectification property after the lamp has cooled to its normal ambient temperature.

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