United States Patent [19]

Freese et al.

[11] **3,900,761**

[45] **Aug. 19, 1975**

[54] **HIGH INTENSITY METAL ARC DISCHARGE LAMP**

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[22] Filed: **Nov. 30, 1973**

[21] Appl. No.: **420,671**

[52] **U.S. Cl.** **315/60**; 313/198; 315/204; 315/330

[51] **Int. Cl.** **H05b 37/00**

[58] **Field of Search** 315/60, 203, 204, 207, 315/330; 313/198, 229

[56] **References Cited**

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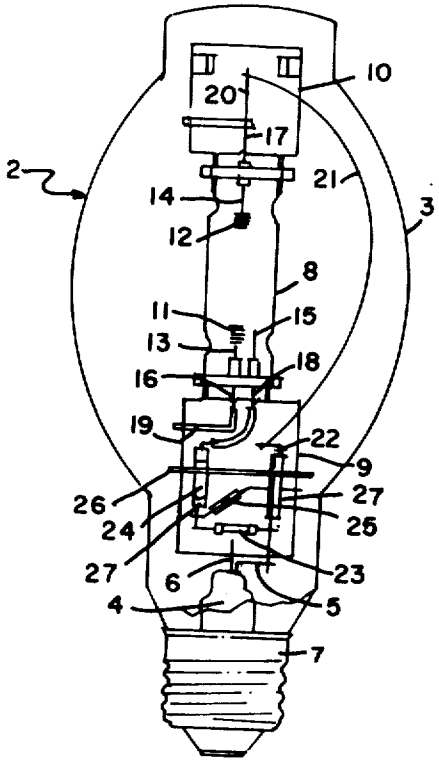
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[57] **ABSTRACT**

A metal halide lamp, having two main electrodes and a starter electrode, has a resistor and a diode connected between the starter electrode and the adjacent main electrode. A second resistor is also in the circuit between the starter electrode and its connector to an external power supply. This circuit permits the lamp to be started on high pressure mercury vapor lamp ballasts.

2 Claims, 3 Drawing Figures



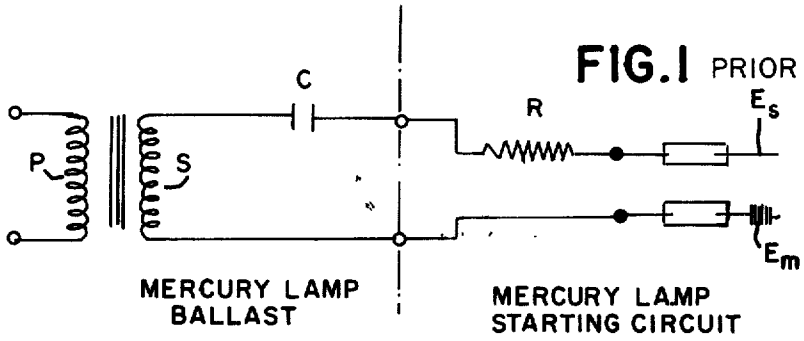


FIG.1 PRIOR ART

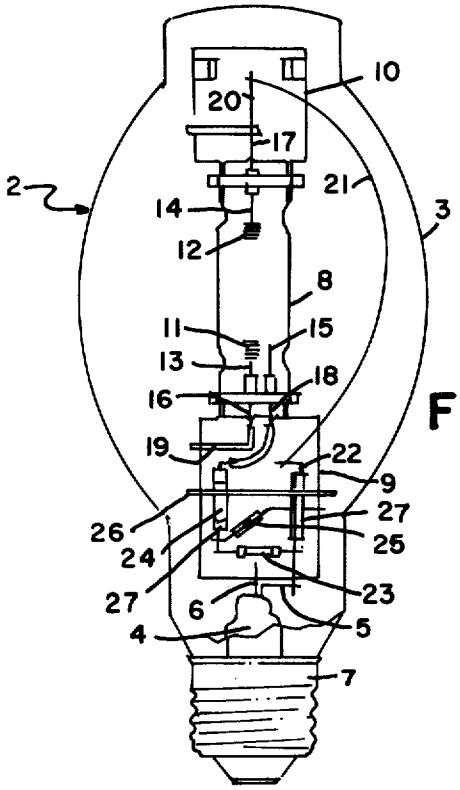
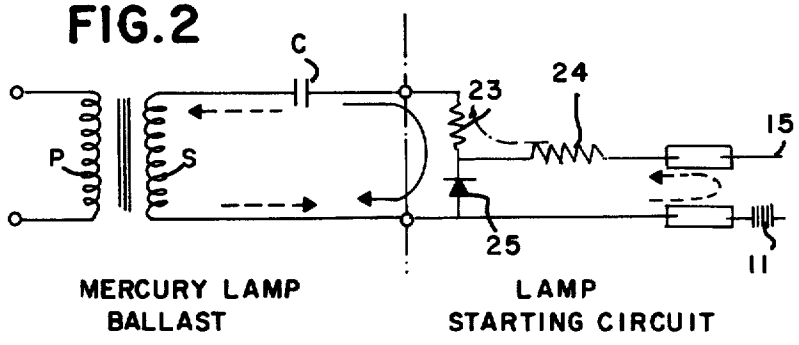


FIG.3

FIG.2



HIGH INTENSITY METAL ARC DISCHARGE LAMP

BACKGROUND OF THE INVENTION

1. Field Of The Invention

This invention relates to the field of high intensity arc discharge lamps and especially 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 to 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 is ignited, the ionizing gas decreases the resistance between the two main electrodes and if enough potential is available between the main electrodes an arc will be formed therebetween. The starter electrode normally has a resistor in series with it to limit the current flowing through the starter electrode after an arc has started.

A metal halide lamp requires a potential considerably higher than that of a high pressure mercury vapor (HPMV) lamp for reliable starting and operating and is normally operated on a metal halide type ballast designed to provide the required potential. A metal halide lamp will not start reliably on standard HPMV ballasts. For example, a typical 400 watt mercury lamp needs a peak starting voltage of 320 volts for reliable starting, while a typical 400 watt metal halide needs 540 volts for reliable starting.

In a given HPMV lamp installation, it is often desirable to replace the mercury lamps with metal halide lamps which have a much higher lumen output and better color rendition. At the present time there are two ways to accomplish this:

1. Replace the mercury ballasts in the installation with suitable metal halide ballasts.
2. Modify the circuit of the existing ballasts to increase the starting potential sufficiently to operate the metal halide lamps.

Both of these methods are expensive and time consuming.

The purpose of this invention is to provide a metal halide lamp which will start and operate reliably on a mercury lamp installation with no change or modification of the existing installation.

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 to its adjacent main electrode by a resistor and a diode. In addition, the starter electrode is electrically connected to an external lead-in wire through a second resistor in series with said above resistor.

The circuit comprising the two resistors and the diode operates to increase the output voltage of a capacitor type HPMV ballast, such as CW and CWA type mercury ballasts, which is the major type of mercury ballast in use. This voltage increase delivers a higher starting voltage between the starter electrode and its adjacent main electrode, thereby permitting metal halide lamps to be started and operated on mercury type ballasts.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic drawing of a capacitor type mercury ballast and the starting circuit of a typical mercury lamp.

FIG. 2 is a schematic drawing of the same ballast and the starting circuit of a metal halide lamp in accordance with this invention.

FIG. 3 is an elevational view of a metal halide lamp in accordance with this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIGS. 1 and 2, a capacitor type mercury lamp ballast has a primary winding P, a secondary winding S and a capacitor C. The starter circuit for a mercury lamp, shown in FIG. 1, comprises a resistor R, a main electrode E_m and a starter electrode E_s.

When normal AC power is supplied to the ballast, the normal output voltage of the ballast is applied across E_m and E_s. Although this voltage is sufficient to start mercury lamps, it is not sufficient to reliably start metal halide lamps.

In a metal halide lamp in accordance with this invention, the starter circuit is as shown in FIG. 2 and includes two resistors 23 and 24 and a diode 25 within the lamp. Resistors 23 and 24 and diode 25 are so arranged that, with the polarity as shown, the charge path is from the secondary winding S through capacitor C, resistor 23 and diode 25 to the secondary winding S. This path is indicated by the solid line arrow. Note, with the secondary winding polarity as shown, the diode polarity is such that it presents a low impedance to the charge current.

When the secondary winding polarity is reversed, diode 25 presents a high impedance to current flow and the discharge path is across the gap between the main electrode 11 and the starter electrode 15 through resistors 24 and 23 and capacitor C to the secondary winding S. The discharge path is indicated by the dash line arrows in FIG. 2.

When AC power is applied to the primary winding P of FIG. 2, capacitor C will charge rapidly during one half cycle and discharge very slowly during the other half cycle. As the capacitor charges, a DC voltage is developed across it and becomes superimposed on the voltage across the gap between main electrode 11 and starter electrode 15.

As capacitor C continues to charge, the peak voltage across the gap between main electrode **11** and starter electrode **15** will increase until it reaches a high enough value to ionize the fill gas between the main electrode and starter electrode. Once the gas ionizes, the impedance of the discharge path will decrease but will still be greater than that of the charge path and the capacitor will continue to charge but at a slower rate. Ionization continues until the fill gas is sufficiently ionized to permit an arc from main electrode to main electrode in the arc tube. Now the lamp is started and lamp operation is completely independent of the starting circuit.

Prior to ionization of the fill gas, resistor **23** in FIG. **2** controls the rate of charge of capacitor C; discharge, in the form of leakage, is negligible. Once the fill gas between main electrode **11** and starter electrode **15** ionizes, resistor **23** controls the charge rate while resistors **23** and **24** primarily control the discharge rate. The value of resistor **23** must be high enough to have a negligible shunting effect across the arc tube during lamp operation. This value is usually about 20K ohms for a 400 watt lamp. Resistor **24** should be approximately equal in value to resistor **23** for optimum build up of the DC voltage level. When resistors **23** and **24** are equal, the charge rate is approximately twice the discharge rate.

As shown in FIG. **3**, a metal halide 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 **2** 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 resistors **23** and **24** and diode **25** is electrically connected between frame **9** and junction of resistors **23** and **24**. In one example, diode **25** was type IN5061.

Heat shield **26** is supported on frame **9** and is disposed below the lower end of arc tube **8** so as to shield resistors **23** and **24** and diode **25** from direct head radiation from arc tube **8**.

Glass sleeves **27** electrically insulate the wires passing through heat shield **26** to prevent shorting thereto. Glass sleeve **28** envelopes diode **25** for physical protection thereof.

Arc tube **8** is provided with a filling, including mercury and a metal halide, which reaches pressures in the order of several atmospheres at normal operating 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 starting circuit portion of FIG. **3** consists of resistors **23** and **24**, diode **25**, starting electrode **15** and main electrode **11**.

Lamps made and tested according to this invention have reliably started on standard capacitor type mercury lamp ballasts.

We claim:

1. A metal halide arc discharge lamp comprising: an arc tube containing an ionizable discharge-sustaining fill including mercury and a metal halide; a first and a second main electrode disposed within the arc tube; a starter electrode disposed within the arc tube adjacent the first main electrode; and an electrical circuit within said lamp, said circuit capable of increasing the peak starting voltage applied between said first main and starter electrodes above the peak voltage applied by an external power supply during normal operation of said lamp, said circuit including a diode and two resistors, the diode and one of said resistors being in series between said first main electrode and said starter electrode, and said two resistors being in series between said starter electrode and the external lead-in wire for said starting electrode.

2. An alternating current metal halide arc discharge lamp comprising: an arc tube containing an ionizable discharge-sustaining filling including mercury and a metal halide; 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; and a voltage-increasing circuit disposed within said jacket, said circuit comprising a diode and two resistors, the diode and one of said resistors being in series between said first main electrode and said starter electrode, and said two resistors being in series between said starter electrode and the external lead-in wire for said starting electrode.

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