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Gutta et al.

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[54] **SODIUM VAPOR LAMP HAVING IMPROVED STARTING MEANS**

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[52] **U.S. Cl.** **315/47**, 313/15, 313/44, 315/46

[51] **Int. Cl.** **H01j 7/24**

[58] **Field of Search** 315/46, 47, 48; 313/15, 17, 44

[56] **References Cited**

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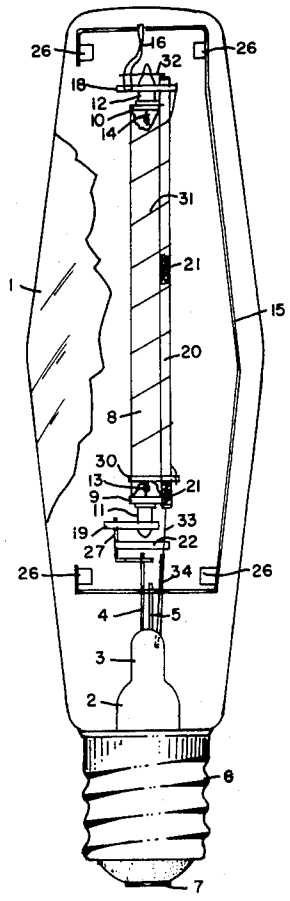
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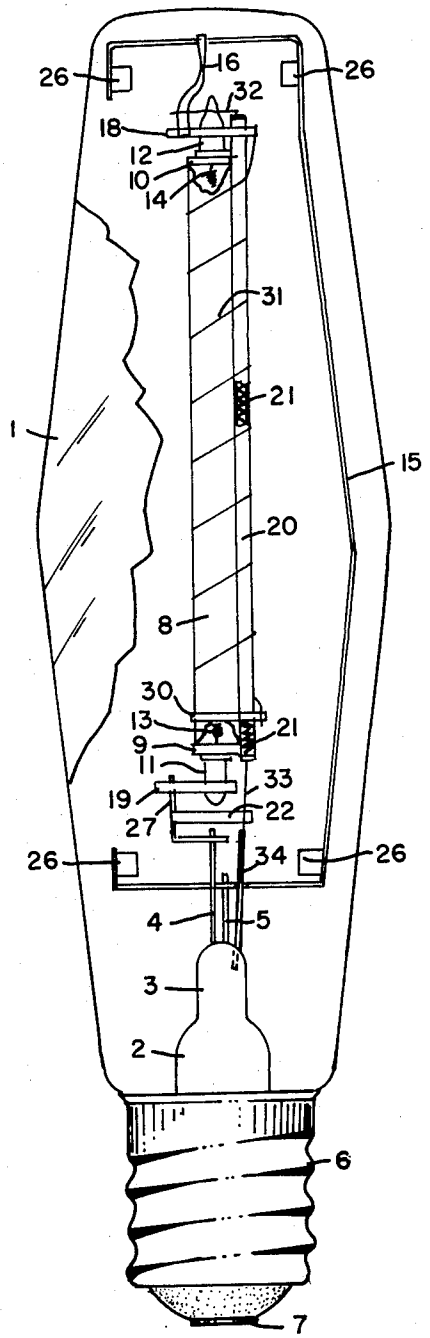
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[57] **ABSTRACT**

The arc tube of a sodium vapor arc discharge lamp has an external electrical heater in heat transfer relationship therewith. The heater comprises coiled refractory metal wire and is inserted in a ceramic sleeve that is parallel and adjacent to the arc tube.

5 Claims, 1 Drawing Figure




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SODIUM VAPOR LAMP HAVING IMPROVED STARTING MEANS

BACKGROUND OF THE INVENTION

1. Field Of The Invention

This invention relates to arc discharge lamps and, in particular, to high pressure sodium vapor lamps.

2. Description Of The Prior Art

Within the past few years, high pressure sodium vapor lamps have become commercially useful, especially for outdoor lighting applications, because of their high efficiency, generally in excess of 100 lumens per watt. The sodium operating vapor pressure in such lamps can vary from several millimeters to about 1,000 millimeters Hg.

Such lamps are called high pressure in order to distinguish them from low pressure sodium vapor lamps in which the sodium operating vapor pressure is in the order of a few microns. Low pressure sodium lamps have been in use for about 30 or 40 years, but, although efficient, they produce an unattractive monochromatic yellow light. The color of light from high pressure sodium lamps is considerably improved over that from low pressure sodium lamps.

High pressure sodium lamps generally comprise an alumina ceramic arc tube and an arc tube fill of sodium, mercury and an inert gas. Examples of such lamps are shown in the following U.S. Pat. Nos. 3,248,590; 3,384,798; 3,448,319; 3,453,477; 3,485,343; 3,519,406, 3,521,108; 3,558,963.

One of the problems of high pressure sodium arc discharge lamps relates to the starting thereof. Such lamps require a considerably higher starting voltage to initiate an arc discharge than do other types of arc discharge lamps, such as fluorescent, mercury or metal halide. This higher starting voltage requirement necessitates the use of a special ballast for high pressure sodium lamps.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a high pressure sodium vapor lamp having a reduced starting voltage, thereby eliminating the high voltage requirements of the ballast. Thus, a simpler more economical ballasting arrangement becomes quite practicable and, in fact, conventional mercury lamp ballasts can often be used. Although such a lamp is shown in a copending application, Ser. No. 259,085, entitled "Sodium Vapor Lamp Having Improved Starting Means" filed on June 2, 1972 by Audesse, same assignee as the instant application, this invention is an improvement thereover.

A high pressure sodium vapor lamp in accordance with this invention comprises an arc tube having electrodes at its ends and containing a fill including sodium, mercury and an inert gas. Adjacent the arc tube is a coiled refractory metal wire heater mounted inside a ceramic sleeve which is substantially parallel to the arc tube. The wattage and spacing of the heater are such that the heater will heat up the arc tube sufficiently in less than about three or four minutes to permit ignition thereof by a relatively low voltage between the electrodes. The relatively low voltage, about 200 volts for an existing 400 watt design, is in relation to the approximate two kilovolt pulse that is normally needed to initiate the arc discharge in a high pressure sodium lamp and which high voltage pulse requires a special ballast.

The sleeve is made of high temperature insulating material, such as ceramic, because of its close proximity to the arc tube which is quite hot during operation. Also, the diameter of the sleeve should be less than about 40 percent the diameter of the arc tube in order that the amount of light intercepted and blocked by the sleeve be small in relation to the total light output from the arc tube.

The tungsten heater is electrically connected to a thermal switch that opens and removes the heater from the circuit after the arc has been struck between the electrodes.

In the copending application mentioned above, a heater is wrapped around an insulating rod that is in close proximity to the arc tube. The instant invention is an improvement thereover in that heat transfer to the arc tube is more efficient, the reason being that the ceramic sleeve reradiates heat in longer wavelengths than that radiated directly by a refractory metal wire heater. Said longer wavelengths are more readily absorbed by the arc tube than are shorter wavelengths.

Also, in lamps where a metal wire is wrapped directly around an arc tube in order to reduce starting voltage even more, such as is shown in copending application entitled "Sodium Vapor Lamp Having Improved Starting Means," Ser. No. 267,097, Cohen et al., filed June 28, 1972, the disclosure of which is incorporated herein by reference, the ceramic sleeve of the instant invention eliminates the possibility of a short circuit occurring between said metal wire and the heater.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A high pressure sodium vapor lamp in accordance with this invention comprises an outer glass envelope **1** which can be of elongated ovoid shape, such as is commonly used in high pressure sodium lamps, or of bulbous shape, such as is commonly used in mercury vapor and metal halide lamps. The neck of the envelope is closed by a reentrant stem **2** having a press **3** through which extend stiff lead-in wires **4,5** connected at their outer ends to a threaded shell **6** and center contact **7** of a conventional screw base.

Disposed within envelope **1** is an alumina arc tube **8** sealed at its lower end by niobium end cap **9** and at its upper end by niobium end cap **10.** Niobium tubes **11,12** are brazed or welded to end caps **9,10** and are used to support arc tube **8** as well as to conduct current to electrodes **13,14** within the arc tube. In addition, one of the niobium tubes serves as an exhaust tube during manufacture and is used to introduce a fill including an inert gas (e.g., argon or xenon), sodium and mercury into the arc tube, after which the niobium tube is sealed, such as by a cold weld.

Arc tube **8** is supported within envelope **1** by a structure consisting of side support wire **15,** vertical support wire **16** and horizontal metal strap **18.** Support wire **15** is welded to lead-in wire **5,** support wire **16** is welded to wire **15,** strap **18** is welded to wire **16** and strap **18** is connected to upper niobium tube **12.** Electrical connection between lead-in wire **5** and upper electrode **14** is established by said structure.

The lower end of arc tube **8** is supported by metal strap **19** which is connected between niobium tube **11** and support wire **27,** with support wire **27** being welded to lead-in wire **4.** Electrical connection is also estab-

lished thereby between lead-in wire 4 and lower electrode 13.

Disposed parallel to arc tube 8, and adjacent thereto, is a ceramic (for example, alumina) sleeve 20 containing a coiled coil tungsten heater 21 therein. Sleeve 20 is supported on arc tube 8 by metal strap 30 encircling both. Additional support is provided by refractory metal wire 31 encircling both for several turns extending most of the length of arc tube 8. The upper end of wire 31 is connected to strap 18 and the lower end is connected to strap 30, which is proximate lower electrode 13. Thus wire 31 aids in lowering starting voltage for the reason stated in Ser. No. 267,097 mentioned above.

The upper end of heater 21 is directly connected to vertical support wire 16 by connecting wire 32, thereby placing the upper end of heater 21 at the same potential as upper electrode 14.

However, in order to permit removal of heater 21 from the electrical circuit after an arc discharge has been struck between electrodes 13 and 14, electrical connection to the lower end of heater 21 is established through a bimetallic switch 22. One end of switch 22 is fixedly attached to support wire 27 and the other end of switch 22 makes electrical contact, at room temperature, to connecting wire 33 one end of which is connected to the lower end of heater 21 and the other end of which is connected to a support rod 34 rigidly mounted in press 3.

Attached to the upper and lower ends of side wire 15 are spring fingers 26 which press against the interior wall of envelope 1 and provide increased support for the arc tube.

In operation the lamp was used in a fixture for a mercury vapor lamp which utilized a reactor ballast, the output voltage of which was 216 volts. At this voltage, heater 21 drew only 80 watts. Within 3 minutes an arc was struck between electrodes 13 and 14 as a result of the 216 volts thereacross. Shortly thereafter, switch 22 reached its energization temperature and opened, thereby removing heater 21 from the circuit.

The lamp also started at lower voltage but required somewhat longer time. For example, at 180 volts, with heater 21 drawing 55 watts, the lamp started in six minutes. The lower starting voltage obtained was 140 volts.

In this example arc tube 8 and sleeve 20 were 4½ inches long and had diameters of 0.350 and 0.125 inches, respectively. Heater 21 extended inside sleeve 20 (the inside diameter of which was 0.062 inch) for almost its entire length and comprised a coiled coil the primary and secondary ratios of which were low enough to prevent sagging during vertical operation.

The amount of light lost as a result of interception by sleeve 20 was less than 5 percent of the total light emitted by arc tube 8. In order that this amount of lost light be kept less than about 5 percent of the total, the diameter of sleeve 20 should be less than about 40 percent of the diameter of arc tube 8.

We claim:

1. A high pressure sodium vapor lamp comprising: a glass envelope; an alumina arc tube disposed within said envelope and having electrodes sealed therein and containing a filling including sodium, mercury and an inert gas; a ceramic sleeve disposed parallel to and adjacent to said arc tube; a coiled wire heater disposed within said ceramic sleeve; a wire electrically connected to one end of said heater, encircling both the heater and the arc tube, and extending to about the opposite electrode; and a thermal switch disposed within said envelope and electrically connected to one end of said heater, said switch opening after ignition of said arc tube and disconnecting said heater.

2. The lamp of claim 1 wherein said heater comprises a coiled coil.

3. The lamp of claim 1 wherein said ceramic sleeve is made of alumina.

4. The lamp of claim 1 wherein the diameter of said ceramic sleeve is less than about 40 percent of the diameter of said arc tube.

5. The lamp of claim 1 wherein said switch is closed at room temperature and open at normal lamp operation.

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