United States Patent [19]

Cohen et al.

[11] **3,721,845**

[45] **March 20, 1973**

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

[75] Inventors: **Sheppard Cohen,** Danvers; **John J. Gutta,** Salem; **Donald A. Richardson,** Beverly, all of Mass.

[73] Assignee: **GTE Sylvania Incorporated,** Danvers, Mass.

[22] Filed: **June 28, 1972**

[21] Appl. No.: **267,097**

[52] **U.S. Cl.** **313/15,** 313/17, 315/47

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

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

[56] **References Cited**

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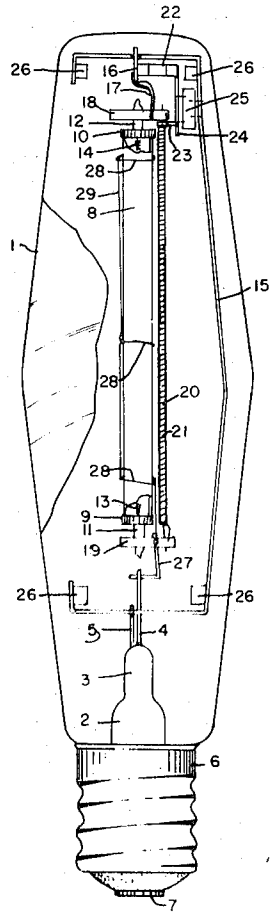
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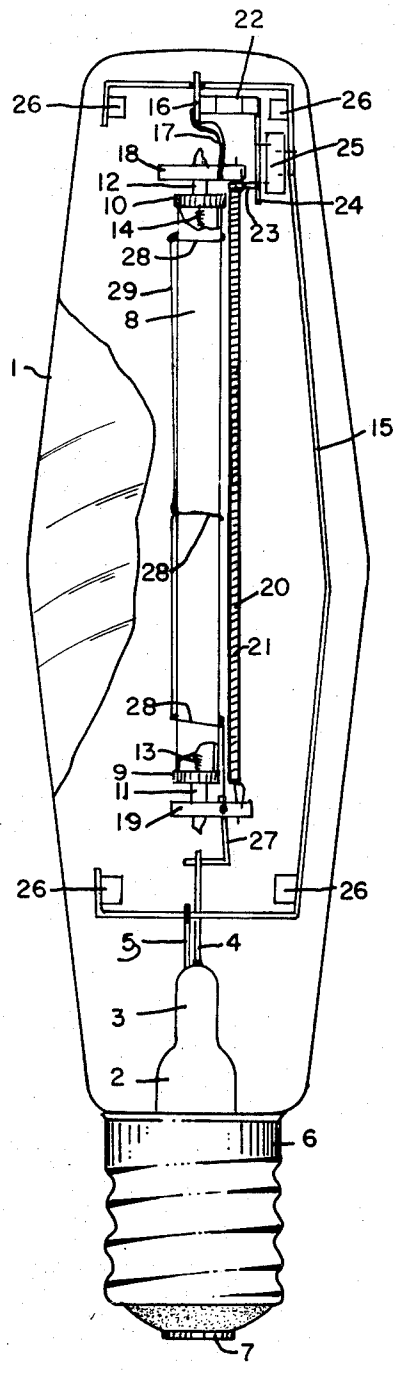
Primary Examiner—Roy Lake
Assistant Examiner—Darwin R. Hostetter
Attorney—Norman J. O'Malley et al.

[57] **ABSTRACT**

The arc tube of a sodium vapor arc discharge lamp has an external electrical heater spaced from but in heat transfer relationship therewith. The heater is made of refractory metal wire and is coiled around an insulating supporting rod. One end of the heater is connected to a wire that is wrapped around the arc tube near the end thereof that is opposite said heater end.

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 thirty to forty 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.

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 copending application Ser. No. 214,000, filed 12-30-71, entitled "Arc Discharge Tube With Surrounding Starting Coil" and assigned to the same assignee as the instant application, the invention disclosed in the instant application differs from that in said copending application.

In copending application Ser. No. 259,085 entitled "Sodium Vapor Lamp Having Improved Starting Means" by Audesse, same assignee, filed on June 2, 1972, a sodium vapor lamp having a heater adjacent the arc tube is disclosed, for the purpose of reducing the arc tube starting voltage. In the instant application, however, arc tube starting is improved to an even greater extent.

SUMMARY OF THE INVENTION

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 heater made of refractory metal wire, such as tungsten, mounted on an insulating support rod 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 220 volts for an existing 400 watt design, is in relation to the approximate 2 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.

However, we have found that the starting voltage can be reduced even more, as low as about 160 volts for said 400 watt design, by connecting one end of the heater to a wire wrapped around the arc tube proximate the electrode at the opposite end. Said wire reduces the length of the arc discharge starting gap to the distance between the electrode and the outer surface of the arc tube, in contrast to the usual gap which is the distance between electrodes.

The insulating rod is made of high temperature material, such as ceramic, because of its close proximity to the arc tube. Also, the diameter of the insulating rod 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 insulating rod 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.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE in the drawing is an elevational view, partly broken away, of a high pressure sodium vapor lamp in accordance with this invention.

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**, metal strap **17** and horizontal metal strap **18**. Support wire **15** is welded to lead-in wire **5**, support wire **16** is welded to wire **15**, strap **17** is welded to wire **16**, strap **18** is welded to strap **17** and strap **18** is con-

nected 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 established thereby between lead-in wire **4** and lower electrode **13**.

Disposed parallel to arc tube **8**, and spaced about one-sixteenth inch therefrom is a coiled coil heater **20** which is made of a length of 4 mil tungsten wire primary coiled on an 8 mil mandrel and then secondary coiled on an alumina rod **21** having a diameter of three thirty-seconds inch. The ends of rod **21** are supported by straps **18,19**. The lower end of heater **20** is electrically connected directly to strap **19**. However, in order to permit removal of heater **20** from the electrical circuit after an arc discharge has been struck between electrodes **13** and **14**, electrical connection to the upper end of heater **20** is established through a bimetallic switch **22**. For this purpose, and also for increased support of rod **21**, the upper end of heater **20** is connected to a metal strap **23** which tightly encircles rod **21** and which is connected to a vertical metal post **24**. Post **24** is insulatively supported on side wire **15** by means of glass rod **25**. One end of switch **22** makes electrical contact with post **24** and the other end of switch **22** is welded to vertical wire **16**.

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.

Wrapped around arc tube **8** are three wire loops **28**, one near each electrode and one at the center. Loops **28** are joined by a wire **29** which is connected to the lower end of heater **20** at strap **19**. This structure establishes the outer surface of the arc tube around upper electrode **14** at the same potential as the lower end of heater **20**. Thus, when a voltage is applied to the lamp, said voltage is established between upper loop **28** and electrode **14**, a short distance in comparison to the gap between electrodes **13** and **14**. As a result, lamp starting voltage is significantly reduced.

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 at the ends thereof and containing a filling including sodium, mercury and an inert gas; a heater disposed parallel to said arc tube and closely spaced therefrom said heater comprising refractory metal wire coiled around an insulating rod; a wire loop encircling said arc tube near one electrode, said loop being connected to said heater at the end opposite said one electrode; and a thermal switch disposed within said envelope and electrically connected to one end of said heater.

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

3. The lamp of claim **1** wherein said insulating rod is made of alumina.

4. The lamp of claim **1** comprising two additional wire loops, one encircling the arc tube at about its center and the other encircling the arc tube proximate the other electrode.

5. The lamp of claim **1** wherein said switch is normally closed during non-operation of the lamp and is open during lamp operation.

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