United States Patent

[11] 3,619,683

[72] Inventors **Robert Frederick Weston; Kenneth Frederick Furmidge, both of London, England**

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[73] Assignee **British Lighting Industries Limited London, England**

[54] **ARC TUBES**
3 Claims, 3 Drawing Figs.

[52] U.S. Cl. 313/47, 313/184, 313/229
[51] Int. Cl. H01j 61/52
[50] Field of Search 313/25, 27, 47, 184, 229

[56] **References Cited**

UNITED STATES PATENTS

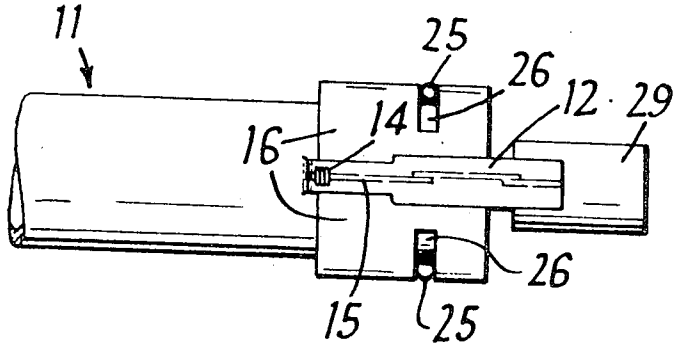
3,333,132	7/1967	Edris et al.	313/47 X
3,374,377	3/1968	Cook	313/47 X
3,407,327	10/1968	Koury et al.	313/229

FOREIGN PATENTS

740,922	10/1943	Germany	313/184

Primary Examiner—Raymond F. Hossfeld
Attorney—Laurence Burns

ABSTRACT: A high-pressure mercury vapor lamp with a fused silica pinch sealed arc tube containing metallic additions in halide form is provided with ceramic screens mounted on the pinch seals to cover parts of the envelope of the tube behind the electrodes to reduce the heat loss from these parts.



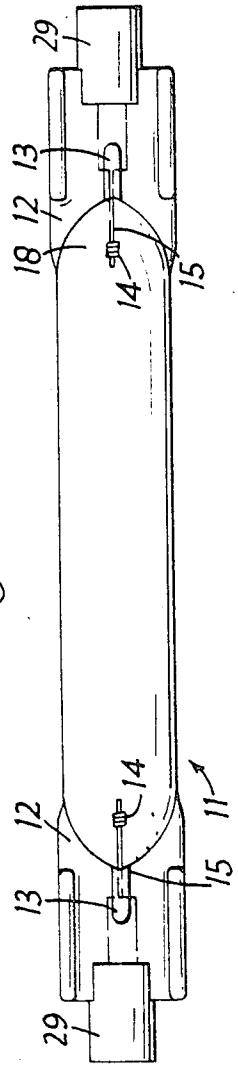


Fig. 1.

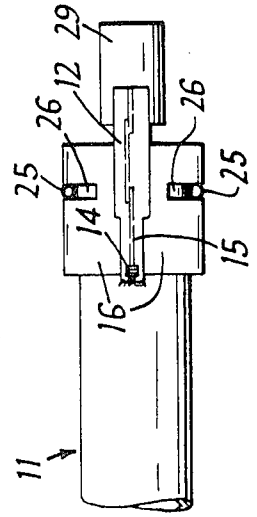


Fig. 3.

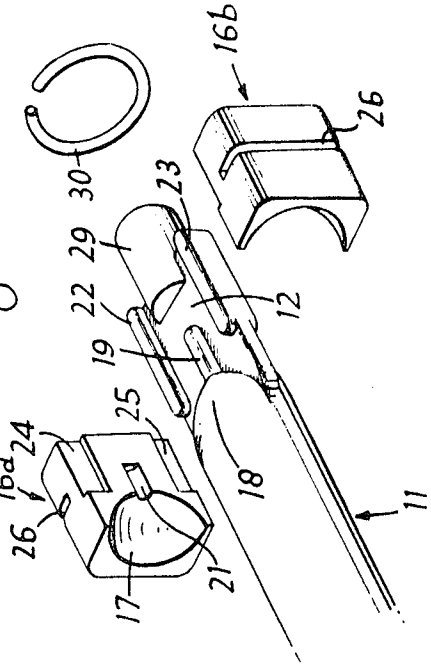


Fig. 2.

ROBERT FREDERICK WESTON
KENNETH FREDERICK FURMIDGE
INVENTORS

BY Owen F. Meegan
ATTORNEY

ARC TUBES

This invention relates to pinch sealed arc tubes.

A problem with pinch seal tubes is that the area of arc tube wall behind the electrode tip receives less heating by radiation and convection from the arc discharge than the remainder of the arc tube wall. This electrode back space is also cooled to some extent by the conduction of heat through the pinch seal and the subsequent loss of heat externally by radiation and convection.

The actual temperature of the cool region behind the electrodes will, in the case of some halide inclusions, determine the contribution these halides make to the light output of the lamp.

Halide inclusions may operate under superheated or saturated conditions dependent on design requirement. For superheated halide operation a minimum arc tube wall temperature is required while for saturated vapor operation the actual vapor pressure will be a function of the temperature of the coolest spot on the arc tube. The total loading of any arc tube in watts per square cm of the arc tube surface will determine the temperature of the hottest and coolest regions of a given arc tube in a given environment.

It may be found, especially when the arc tube is operated in a gaseous atmosphere or air, that the arc tube wattage input that gives rise to acceptably high cool spot temperatures overheats the hot regions of the arc tube and thereby restricts effective lamp life. Particularly when it is desired to operate a high-pressure mercury lamp with pinch seal construction and halide inclusions in air, it is difficult to secure a reasonable contribution to lamp light output from many metal halide inclusions without severe restrictions of effective lamp life.

Attempts have been made to boost cool spot temperature by coating the ends of arc tubes behind the electrodes and part of the pinch seal with materials such as silver, platinum and gold. These materials, if suitably applied, can reduce heat loss by radiation but they are limited in operating temperature and do not materially reduce cooling by convection. Refractory oxide materials, such as aluminum oxide, titanium dioxide etc., have also been used to reduce radiation cooling but these materials although not limited in operating temperature, are extremely difficult to apply as a durable coating and generally require an adhesive. The use of an adhesive again introduces temperature limitations in order to avoid chemical reaction with the quartz of the arc tube.

According to the present invention there is provided an arc tube having an end portion sealed by a pinch seal to a lead assembly which supports an electrode arranged within the tube and a shield of ceramic material or the like surrounding the end of the tube and mounted on the pinch seal, whereby heat loss from the end portion of the tube is reduced.

Advantageously, a clearance may be provided between the end of the tube and the ceramic shield to prevent chemical reaction between the tube and the shield. The end of the tube may be rounded.

In a preferred embodiment, an arc tube has two pinch sealed ends each of which is provided with a ceramic heat shield in the manner of the invention. Each shield comprises two parts each mounted on one face of the seal and covering a portion of the tube and the pinch seal, but not the edges of the seal. The two parts may be held in position by a spring clip.

An embodiment of the invention will now be described by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a plan of an arc tube sealed at either end by a pinch seal,

FIG. 2 is an exploded perspective view of an end portion of the tube shown in FIG. 1 and a ceramic shield and a retaining spring ring, and

FIG. 3 is a side elevation of the end portion of the tube shown in FIG. 2 showing the ceramic shield mounted on the tube.

The fused quartz arc tube **11** shown in the drawings in sealed at both ends by pinch seals **12** which form hermetic seals with the refractory metal foil parts of lead assemblies **13**. Two electrodes **14** are supported by the lead assemblies **13** to which electrical connection is made by wires **15**.

A ceramic shield **16** is shown in FIG. **2** and **3** and comprises two portions **16***a* and **16***b* mounted on opposite faces of the pinch seal **12**. A similar ceramic shield is provided on the other pinch seal, but only the shield **16** is described here. The portion **16***a* covers one face of the pinch seal **12** and is formed with a recess **17** corresponding to and slightly larger than the rounded end portion **18** of the tube **11**. The clearance between the shield and the tube eliminates the possibility of a chemical reaction between the quartz of the tube and the ceramic screen. Projecting portion **19**, **22** and **23** of the seal **12** cooperate with an indent **21** and recessed portions **24** and **25** respectively of the shield **16***a* when the shield is mounted on the seal to locate the shield in the correct position.

The shield **16***a* covers the rounded end portion of the tube but only extends over a part of the length of the pinch seal terminating at a position opposite the center of the lead assembly **13**. The edges of the seal are also uncovered. This allows cooling of the pinch seal and reduces the risk of oxidizing the lead wires at the places where they leave the pinch seal. The shield **16***b* is similar to the shield **16***a* and will not be described separately.

The shield **16** is formed of a ceramic material. There are numerous suitable ceramic materials commercially marketed in various parts of the world and the choice of material for the shield is very wide. A material as follows:

99%	$al_2 0_3$	(aluminum oxide)
0.7%	SiO_2	(silicon oxide)
0.3%	trace impurities of Na_2O, Mg 0, Ca O, $Fe_2 0_3$ etc.	

manufactured in so-called "bubbled" or porous form with a thermal conductivity of some 6 B.t.u./hour/ft.²/inch/20 /inch/°F., has been found eminently suitable. The majority component of aluminum oxide may be replaced with zirconium oxide Zr $0_{2,}$, ₂magnesium oxide MgO, when the thermal conductivity may be modified by as much as minus 50 percent and plus 200 percent with little or no effect on the operation of the lamp. Which material is used depends mainly on availability and cost, which can be very low.

The shield **16***a* and **16***b* is held in position by a spring ring **30** located in a circumferential groove **26** and made of a material capable of retaining its resilience at the operating temperatures of the arc tube. Such materials are well known within the thermionic valve, cathode-ray tube and lamp manufacturing Industries. In England a material known as "Duranickel" and marketed by Henry Wiggin is suitable. Alternatively a spring clip made of tungsten has been found satisfactory, but is relatively expensive and susceptable to a small amount of oxidation. The end of the pinch seal **12** is provided with a cap **29** which protects the wire **15** and within which is provided a terminal for the tube.

The arc tube **11** is filled with the appropriate quantities of mercury, argon, thorium, scandium, iodine and sodium iodide. The mercury quantity largely controls the voltage of the arc discharge some 40 mg. being required for a voltage of 500. The argon gas is required to assist in the striking of the discharge, some 20 to 25 mm. pressure being required. Thorium is primarily required to facilitate electrode emission but some does combine with iodine to form an iodide and thereby contributes a little to the light output of the lamp. The scandium combines largely with the iodine and together with the sodium and mercury is largely responsible for the generation of the light output of the lamp. The quantity of thorium required is approximately 1 mg. with 1 mg. of scandium, 3.0 mg. of iodine and 20 mg. of sodium iodide.

When such a lamp is operated in free air without end protection against heat loss, 750 watts arc tube dissipation

produces some 40,000 to 50,000 lumens of light mainly from the highspressure spectrum of mercury with some contribution from thorium, scandium and sodium. The color appearance is best described as blue white and color rendition is poor. The use of metallized or refractory oxide end coatings in order to conserve heat loss can be shown to raise the light output to some 60,000 lumens with corresponding improvement in color. These coatings do not however have the required life performance and can damage the quartz of the arc tube or lose their effectiveness in a few hundred hours operation. The use of ceramic end shields on the arc tube has raised the total lumen output to over 70,000 lumens with a depreciation of some 10 percent through a life in excess of 4,000 hours. The color appearance is effectively changed by the use of the ceramic shields from blue-white to warm-white and the color rendition may be described as excellent.

We claim:

1. A sealed vapor-filled arc tube, having end portions, comprising:

pinch seals, having parallel edges, sealing each end portion of said arc tube;

lead assemblies sealed through said pinch seals;

arc-sustaining electrodes in said arc tube, and electrodes being supported in said arc tube by said lead assemblies;

ceramic shields disposed about and spaced from said end portions and supported from and held in contact with said pinch seals, said parallel edges of said pinch seals being substantially uncovered by said ceramic shields, each ceramic shield comprising two separate ceramic pieces mounted opposite each other,

whereby heat loss from the end portions of said arc tube during operation is reduced and cooling of the pinch seals occurs through the uncovered parallel edges thereof.

2. The arc tube of claim 1 wherein a resilient holding means for holding said two separate ceramic pieces in position.

3. The arc tube of claim 1 containing metallic additions in halide form.

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