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CAPILLARY CERAMIC DISCHARGE LAMP WITH CLOSURE MEANS THEREFOR

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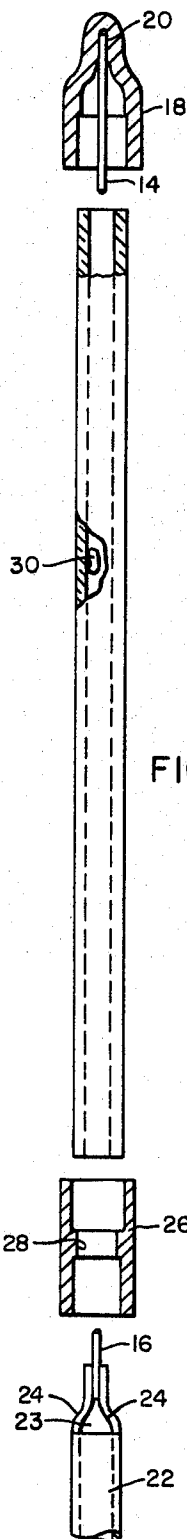


FIG. 2

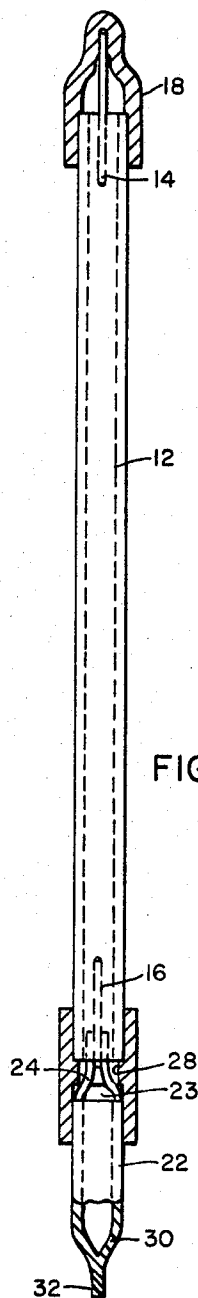


FIG. 1

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CAPILLARY CERAMIC DISCHARGE LAMP WITH CLOSURE MEANS THEREFOR

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4 Claims

ABSTRACT OF THE DISCLOSURE

The discharge lamp includes a capillary type polycrystalline alumina body having an internal diameter of not more than $\frac{1}{16}$ of an inch. One end of the polycrystalline alumina arc tube is sealed by a niobium cap carrying a tungsten wire electrode. The sealed closure at the other end of said lamp includes a niobium sleeve which receives at its one end the other end of the arc tube and at its other end tantalum tubulation carrying a second tungsten wire electrode.

BACKGROUND OF THE INVENTION

This invention relates generally to ceramic discharge devices and more particularly to a discharge device having a polycrystalline alumina body enclosing a capillary type discharge.

Ceramic arc lamps principally of polycrystalline alumina have heretofore been constructed of polycrystalline alumina cylinders of $\frac{1}{4}$ inch internal diameter and greater. Such lamps when filled with sodium, mercury and a rare gas have had luminous efficiencies greater than 100 lumens per watt at power loadings of from 400 to 600 watts. For optical equipment, lamps of small physical size and high surface luminance are preferred. Lamps of comparable luminous efficiency but with much lower wattage are also desirable for interior lighting applications. A capillary discharge lamp will have inherent advantages of higher pressures and higher temperature cold spots in addition to the ability to operate at lower power ratings. One difficulty in constructing a capillary type ceramic discharge device is the design of suitable end closure members which provide a vacuum tight seal with the extremely small diameter ceramic arc tube.

SUMMARY OF THE INVENTION

Among the objects of the present invention is the provision of a narrow bore polycrystalline alumina arc lamp which provides good luminous efficiencies at reasonable power loadings, is physically small, and may be efficiently and permanently vacuum sealed at its ends.

The foregoing and other objects are accomplished in accordance with the present invention by employing an elongated ceramic tube having a narrow passage centrally therethrough, said tube is sealed at one end by a refractory metal cap carrying a refractory metal electrode secured internally thereof which extends axially within the arc tube bore. The other end of the ceramic arc tube is sealed by means of a refractory metal sleeve, one end of which extends and is sealed about the end of said arc tube and which has refractory metal exhaust tubulation carrying a second refractory metal electrode sealed within its other end, with said second refractory metal electrode also extending axially within the bore of said arc tube.

BRIEF DESCRIPTION OF THE DRAWING

The above recited objects, and others, as well as many of the attendant advantages of the present invention will become more readily apparent and better understood as

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the following detailed description is considered in connection with the accompanying drawing in which:

FIGURE 1 is a side elevation view illustrating the arc discharge lamp of the present invention with the end closure members in section; and

FIGURE 2 is an exploded side elevation view of the arc discharge lamp of the present invention partially in section.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to the drawing, wherein like reference characters represent like parts throughout the several views, there is shown in FIG. 1 an assembled ceramic discharge device constructed in accordance with the present invention. The ceramic discharge lamp includes a capillary type tube 12 of polycrystalline alumina having an outside diameter of $\frac{1}{8}$ of an inch and an internal diameter of $\frac{1}{16}$ of an inch and which is approximately 3 inches in length. A discharge within the lamp is supported by a pair of oppositely disposed, spaced, electrodes 14 and 16 which consist of tungsten wires with 90 degree cone tips having a diameter of approximately 0.020 inch. These electrodes are adequate for the relatively small currents encountered in the capillary lamp.

The electrode 14 is mounted in one end of the arc tube 12 by means of a niobium end cap 18. The niobium end cap is constructed from a short piece of niobium tubing which is bored to a depth of $\frac{1}{8}$ of an inch at one end to receive the end of the arc tube in a snug fit. The other end of the small piece of niobium tubing forming end cap 18 is placed about the electrode 14 and flattened therearound while the electrode is held in a suitable jig to assure alignment and the end TIG welded as at 20 to secure the electrode within the end cap 18.

The finished end cap 18 is internally coated in the bored out portion with a suitable sealing composition for example, any one of the ceramic sealing compositions disclosed in copending application Ser. No. 562,016, filed June 30, 1966 for "Sealing Compositions," by R. B. Grekila, Shih-Ming Ho, W. J. Knochel and F. C. M. Lin, and owned by the present assignee. One end of the polycrystalline alumina tube is inserted as a tight slide fit into the coated bore in end cap 18 and sealed thereto by heating in the manner described in said copending application.

At the other end of the ceramic arc tube the tungsten electrode 16 is held by a refractory metal exhaust and fill tubulation 22 which, in this instance, consists of $\frac{1}{8}$ inch O.D. tantalum tubing cut so that two fingers 24 remain to grip the centrally located tungsten electrode 16 which is secured thereto by spot welding. A small refractory metal sleeve 26, preferably of niobium, is bored at each end to accept the polycrystalline alumina tube and the tantalum tube respectively. An annular reduced diameter portion 28 located centrally thereof provides shoulders which serve as stops to limit the penetration of the tubulation into the sleeve and the depth to which the ceramic tube enters the sleeve. The shoulders of reduced diameter portion 28 thus control the position of the electrode within ceramic tube 12 while the finger configuration employed for mounting the electrode 16 provides for the maintenance of continuing communication between the interior of the ceramic tube 12 and the interior of the exhaust tubulation 22 through openings or passages 23 on each side of the fingers 24. As shown in FIG. 1 the tantalum tubulation is sealed to the niobium sleeve by TIG welding and the niobium sleeve 26 is secured in hermetic sealing relationship to the end of the arc tube 12 by means of the sealing composition disclosed in the above-identified copending application.

A lamp constructed in accordance with the foregoing

may be filled through the tantalum tubulation before pinch-off with an amalgam 30 of 10% sodium and 90% mercury which when vaporized is sufficient to give a mercury partial pressure of about five atmospheres. In addition approximately 30 torr of argon is added as a starting gas. An arc tube constructed and filled as described when pinched-off to form a hermetic seal as indicated at 32 and mounted in an outer envelope in the conventional manner produces a lamp with a luminous efficiency of approximately 100 lumens per watt at an initial loading of from 175 to 200 watts. A lamp so constructed also will provide good color rendition at optimum reservoir temperatures.

Of course, the particular lamp fill employed is for purposes of illustration since there is obviously a number of alternative discharge sustaining fillings which can be employed in a lamp constructed in accordance with the present invention dependent upon the ultimate intended use of the lamp. For example, it is well known that by changing the discharge sustaining filling the luminous intensity as well as its color rendition can be selectively effected in accordance with known practices.

It will be apparent that the lamp of the present invention provides an extremely small, high intensity, light source. Additionally, metal vapors at higher pressures may be employed due to increased temperatures at the coldest spot within the envelope. The associated reduction in thickness of colder absorbing gases along the tube walls further results in reduced line reversal. Furthermore, the lamp construction of the present invention overcomes the many problems encountered when it is attempted to employ existing sealing and electrode mounting techniques to capillary lamps occasioned by the tubulation internal diameter being as large as, or larger than the internal diameter of the arc tube.

Since numerous changes may be made in the above-described device and different embodiments of the invention may be made without departing from the spirit thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

We claim as our invention:

1. A capillary discharge device comprising:

(a) an elongated polycrystalline alumina tube having a narrow central bore enclosing a discharge sustaining filling;

(b) a refractory metal cap having a first refractory

metal electrode secured internally therein, said cap being sealed to one end of said tube with said electrode extending axially into said bore;

(c) a refractory metal sleeve, one end of said refractory metal sleeve extending about and sealed to the other end of said tube; and

(d) refractory metal exhaust and fill tubulation having a pair of fingers extending from one end thereof and carrying thereon a second refractory metal electrode, said tubulation being hermetically tipped off at the other end and said one end sealed within the other end of said sleeve with said second electrode extending axially within said bore, said refractory metal sleeve including a reduced diameter central bore, said centrally disposed reduced bore providing a pair of oppositely disposed shoulders for limiting the penetration of said tube and said tubulation into said sleeve.

2. A capillary discharge device according to claim 1 wherein said narrow central bore has a diameter of less than $\frac{1}{16}$ of an inch and said electrodes consist of tungsten wire of substantially smaller diameter.

3. A discharge device according to claim 1 wherein said discharge sustaining filling consists essentially of an amalgam of 10% sodium and 90% mercury adequate to give a mercury partial pressure of approximately 5 atmospheres to produce approximately 100 lumens per watt at a power loading of between 175 and 200 watts.

4. A capillary discharge device according to claim 1 wherein said fingers further provide a passage for the atmosphere within said ceramic tube to communicate with the atmosphere in said tubulation.

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