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Knochel et al.

[11] **3,746,907**

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[54] **END CAP CONFIGURATION FOR CERAMIC DISCHARGE LAMP**

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[73] Assignee: **Westinghouse Electric Corporation**, Pittsburgh, Pa.

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[52] **U.S. Cl.** **313/318**, 339/144

[51] **Int. Cl.** **H01j 5/52**

[58] **Field of Search** ..... 313/317, 318; 339/144 R, 144 T, 145 R, 145 D, 145 T

[56] **References Cited**

UNITED STATES PATENTS

3,497,756	2/1970	Knockel et al.	313/318 X
3,534,217	10/1970	Vause et al.	313/318
3,329,854	7/1967	Hirohide et al.	313/318
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FOREIGN PATENTS OR APPLICATIONS

1,204,624	9/1970	Great Britain	313/318
688,491	3/1953	Great Britain	339/144 R

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[57] **ABSTRACT**

In a ceramic discharge lamp including an elongated tubular ceramic body closed off at each end by electrode carrying refractory metal end caps sealed thereto, the improvement comprising a plurality of inwardly directed indentations circumferentially disposed about the skirt portion of the end cap, said indentations being constructed and arranged to lightly grip the outer surface of the tubular ceramic body and thereby facilitate a superior seal between the end cap and the tubular ceramic body.

6 Claims, 4 Drawing Figures

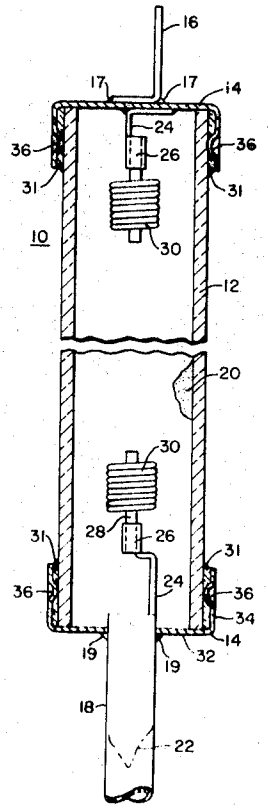
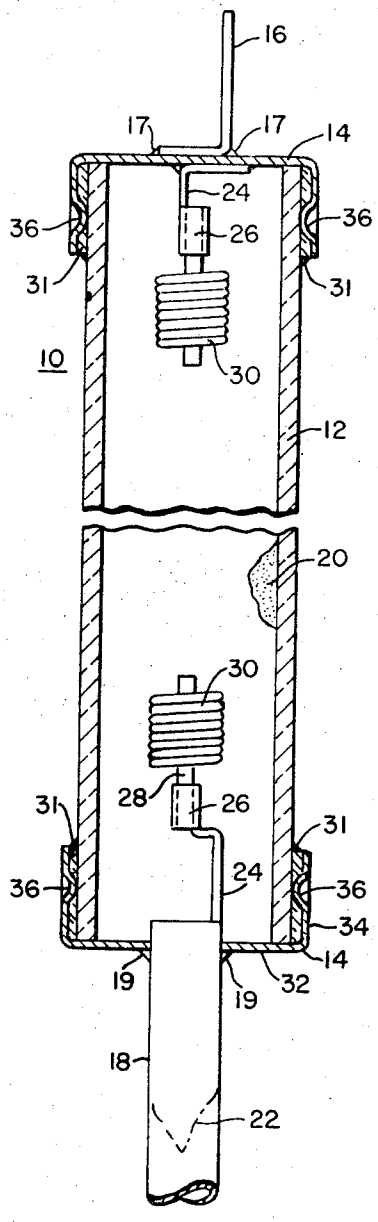


FIG. 1



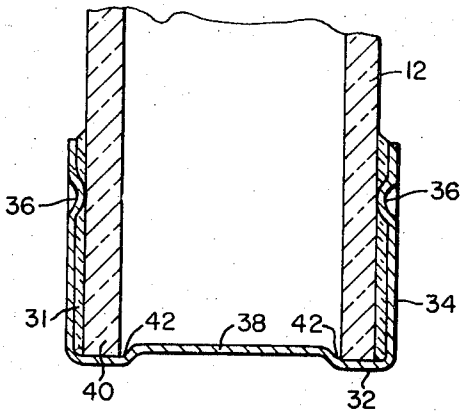
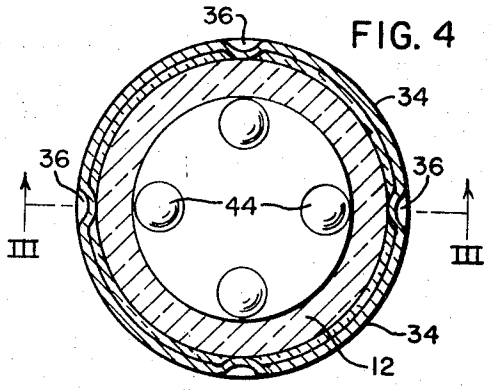


FIG. 2

FIG. 4



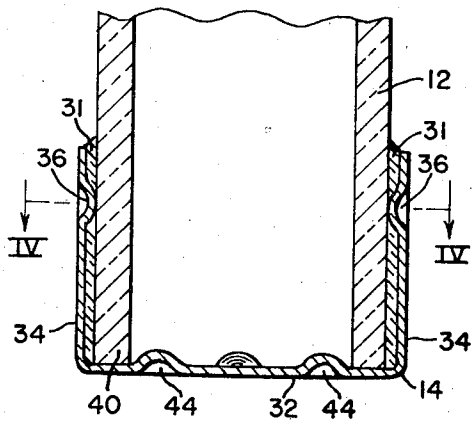


FIG. 3

END CAP CONFIGURATION FOR CERAMIC DISCHARGE LAMP

BACKGROUND OF THE INVENTION

This invention relates to ceramic discharge lamps and more particularly to an improved configuration for the refractory metal end cap of such lamp which end cap configuration produces better alignment between the end cap and the tubular ceramic body and thereby produces a better quality and more uniform seal.

The arc tube of a ceramic discharge lamp generally comprises a body member of polycrystalline alumina, closed off at its ends by cup shaped end closure members or caps. The end caps carry on their interior surfaces the discharge sustaining electrodes and include, either in the form of tubulation or strip, a lead-in conductor connected to or through the outer surface of the end cap. The end closures or end caps are generally sealed to the polycrystalline alumina member by a glassy seal, generally in the form of slightly modified calcium aluminate.

Typical construction of a ceramic discharge lamp arc tube may be found in U.S. Pat. No. 3,497,756 to W. J. Knochel et al. Examples of sealing compositions for bonding the ceramic arc tube to a refractory metal end closure in a ceramic discharge lamp may be found in U.S. Pat. No. 3,469,729 to R. B. Grekila et al. and U.S. Pat. No. 3,467,510 to W. J. Knochel et al.

Lamp failure in ceramic discharge lamps can often be traced to a leak, in the form of a crack or fracture of the sealing composition, between the arc tube and the refractory metal end cap. Many of these failures can further be traced to the fact that the wall thickness of the glass frit between the arc tube and the end cap is either too thick or too thin. Since there must necessarily be a slight difference between the outside diameter of the arc tube and the inside diameter of the skirt portion of the end cap to provide a space for the glass frit it will be apparent that if the end cap is not substantially centered on the arc tube, as for example, the ceramic body is touching one side of the cap skirt then a large glass frit wall thickness must necessarily occur on the opposite side with almost no sealing composition adjacent the point where the cap is touching the arc tube. Non-uniform seal wall thickness also renders the seal more susceptible to failure due to thermal shock during the lamp seasoning process. This is particularly true when the lamp is seasoned at higher than normal wattages in accordance with the improved seasoning concept disclosed in copending application Ser. No. 50,180 filed June 26, 1970 for a Method of Seasoning Ceramic Discharge Lamps by W. J. Knochel et al. and owned by the assignee of this invention, issued Aug. 8, 1972 as U.S. Pat. No. 3,682,525.

SUMMARY OF THE INVENTION

The novel end cap configuration of this invention provides for better alignment between the ceramic arc tube and the refractory metal end cap and thereby produces better and more uniform seals between these two principle arc tube elements. The foregoing is accomplished in accordance with the present invention by providing in a ceramic discharge lamp which includes an elongated tubular ceramic body closed off at each end by electrode carrying, refractory metal, cup-shaped, end caps sealed to the ends of the ceramic body an improved end cap configuration. The end caps each have the configuration of a circular base portion bounded by a ring-shaped skirt portion which overlaps the end portions of the ceramic body and the improved construction comprises a plurality of inwardly directed indentations or dimples circumferentially disposed about the skirt portion of the end cap, which indentations or dimples lightly grip the outer surface of the tubular ceramic body and thereby facilitate a more uniform and superior seal between the end cap and the tubular ceramic body.

BRIEF DESCRIPTION OF THE DRAWINGS

Many of the attendant advantages of the present invention will become more readily apparent and better understood as the following detailed description is considered in connection with the accompanying drawings, in which:

FIG. 1 is a sectional view of a typical arc tube for a ceramic discharge lamp employing end caps constructed in accordance with the present invention;

FIG. 2 is a sectional view of a slightly modified alternative embodiment which the end cap of this invention may take;

FIG. 3 is a section view of a still further alternative embodiment of the end cap; and

FIG. 4 is a sectional view taken along the line IV—IV of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in detail to the drawings, wherein like reference characters represent like parts throughout the several views there is illustrated in FIG. 1 a typical arc tube for a ceramic discharge lamp generally designated 10 which includes the tubular ceramic body preferably of high density sintered polycrystalline alumina or sapphire. The tubular ceramic body is sealed off at each end by refractory metal end caps 14. Current for operating the arc tube is generally supplied at one end of the arc tube by a refractory metal, preferably tantalum, lead-in conductor 16 which is secured to the outer face of the upper end cap 14 as for example by welding or brazing. Current is generally supplied to at least one of the electrodes by means of exhaust and fill tubulation 18 illustrated at the bottom end of the discharge tube of FIG. 1. The exhaust and fill tubulation 18 is secured centrally to the end cap by a titanium braze illustrated at 19 and permits the exhausting of the sealed arc tube and the subsequent filling thereof with a starting gas, such as for example argon or xenon along with a discharge sustaining filling. The discharge sustaining filling may be any of the well known mercury-metal or mercury metal halide arc sustaining fillings, such as for example an amalgam of sodium and mercury as indicated at 20. After the filling procedures the tubulation 18 is pinched off to provide a vacuum tight seal at 22 thus completing the fabrication of an operative arc tube.

In the illustrated embodiment of FIG. 1, at the non-tubulation end of the arc tube a flexible tantalum strap 24 having a pair of gripping fingers 26 thereon is welded or brazed at one end to the interior surface of the end cap with the fingers 26 at the other end securely wrapped about and welded to the leg 28 of a coiled tungsten electrode. A similar electrode mount is illustrated at the lower end of the tube where a similar tantalum strap 24 carrying fingers 26 is secured about

and welded to the leg 28 of a coiled tungsten electrode 30.

As indicated previously, the refractory metal end caps 14 are conventionally sealed to the polycrystalline alumina or sapphire body member 12 by a glassy sealing composition 31 and although many sealing compositions are suitable, the preferable sealing compositions for sealing refractory metal end closures or caps to a polycrystalline alumina tubular body member are those disclosed in U.S. Pat. No. 3,467,510 to W. J. Knochel et al. and U.S. Pat. No. 3,469,729 to R. B. Grekila et al. Typically, end caps are cup-shaped as illustrated in FIG. 1 and include a circular or planar base portion 32 bounded by a ring-shaped skirt portion 34, which overlaps and surrounds the end portions of the ceramic arc tube. Although the end cap may take many different shapes such as for example a thimble or a cup-shape with integrally formed extending tubulation, the principle of this invention applies equally to any refractory metal end closure for a ceramic discharge lamp which includes in the area of the seal, a ring shaped portion of the end cap which overlaps and surrounds the end of the polycrystalline alumina arc tube.

In accordance with the present invention, a plurality of dimples or depressions as indicated at 36, are formed in the skirt portion or side wall of the end cap, there depressions are formed, and extend inwardly, so that their innermost extent approximates the external diameter of the ceramic tube. Although any number of such depressions can be formed in the side wall or skirt portion of the end cap it is preferred, in accordance with this invention, that a minimum of three and preferably four such depressions, substantially equidistantly spaced one from the other (FIG. 4), be employed.

The depressions 36 perform multi-fold functions. The depressions or dimples 36 serve to center the end cap with respect to the arc tube body thereby providing a substantially uniform space between the normal interior surface of the end cap skirt and the arc tube around the full circumferential extent thereof. Additionally, the dimples or depressions 36 serve to secure the end cap with respect to the arc tube during sealing and hence eliminates the need for using heavy molybdenum weights which previously had to be placed on the arc tube assembly during the extensive heat treating and sealing operation. A still further unexpected feature of the end cap configuration of this invention is that the uniform space provided between the arc tube and the skirt portions of the end cap facilitate the application of the sealing frit between the parts and provides for a more uniform application whether that application be done by hand or by automatic equipment.

The embodiment of FIG. 2 is quite similar to the FIG. 1 embodiment but includes in addition a dished out portion 38 in the center of the planar or circular end portion 32 of the end cap. In this embodiment, even superior alignment is afforded in that the upper edges 40 of the arc tube body 12 are seated in an annular ring or depression 42 in the end or base portion 32 of the end cap adjacent the side walls or skirt portions 34.

The embodiment of FIG. 3 is also quite similar to the embodiments of FIGS. 1 and 2 with the exception that the dished out portion 38 in the embodiment of FIG. 2 is replaced by a plurality of dimples or indentations 44 which serve the same function as the dished out portion 38 of FIG. 2, in that they aid in centering the arc tube body 12 with respect to the end cap 14 by aligning the end 40 of the arc tube between the side wall or skirt portion 34 and the indentations or dimples 44.

As will be apparent from the foregoing, the dimpled or indented end cap construction for a ceramic arc tube of this invention, facilitates the application of the sealing frit between the two parts, insures a uniform seal thickness between the two parts, and significantly reduces the number of lamp failures due to improper seal thickness. Furthermore, because of the more uniform expansion characteristics afforded by this design, it permits the metal-ceramic seal area to withstand higher thermal shocks due to the more uniform wall thickness of the frit.

What is claimed is:

1. In a ceramic discharge lamp including an elongated tubular ceramic body closed off at each end by electrode carrying refractory metal end caps, which end caps are cup-shaped each having the configuration of a circular base portion bounded by a ring-shaped skirt portion which overlaps the end portions of the ceramic body and is sealed thereto, the improvement comprising: a plurality of inwardly directed indentations circumferentially disposed about the skirt portion of the end cap, said indentations being constructed and arranged to lightly grip the outer surface of the tubular ceramic body and thereby facilitate a superior seal between the end cap of the tubular ceramic body.

2. The improved end cap configuration for a ceramic discharge lamp according to claim 1 wherein said circular base portion includes a plurality of inwardly directed indentations which serve to define a receptacle for the ends of the arc tube on the inner surface of the end cap.

3. The improved end cap construction according to claim 1 wherein the number of said inwardly directed indentations is four.

4. In a ceramic discharge lamp including an elongated tubular ceramic body closed off at each end by an electrode carrying cup-shaped refractory metal end cap sealed to said ceramic body, with said cup-shaped end cap including a planar base portion bounded by a ring shaped side wall which overlaps the end portions of the ceramic body, the improved end cap configuration which comprises: a plurality of inwardly directed substantially equidistantly spaced dimples circumferentially disposed about the side walls of the end cap, with the circumference defined by the internal extent of said dimples approximating the circumference of the outer surface of the arc tube thereby accurately spacing the remainder of the side wall a uniform distance from the outer surface of the tubular body member.

5. The improved end cap construction according to claim 1 wherein the number of said inwardly directed dimples circumferentially disposed about the side wall of the end cap is four.

6. The improved cap configuration for a ceramic discharge lamp according to claim 4 wherein said planar base portion includes a plurality of inwardly directed indentations which serve to define a receptacle for the ends of the arc tube on the inner surface of the end cap.

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