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(54) Electrode positioning in metal halide lamps.

(57) A low wattage metal halide discharge lamp includes an evacuated outer envelope, a domed quartz sleeve therein and an arc tube within the domed quartz sleeve with the arc tube having a pair of electrodes press sealed therethrough with each of the electrodes having a coil thereon spaced from the press seal and from the end of the electrode to provide a figure of merit (FM) substantially equal to the product of the distance from the press seal to the coil and the distance from the press seal to the end of the electrode.

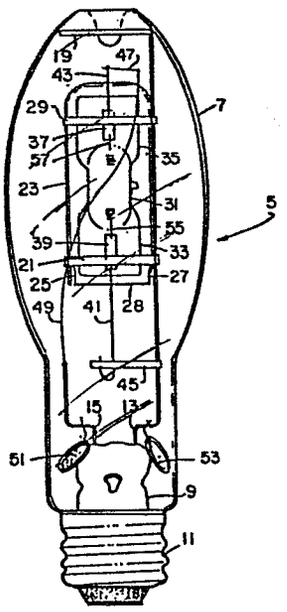

FIG. 1

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ELECTRODE POSITIONING IN METAL HALIDE LAMPS

TECHNICAL FIELD:

This invention relates to metal halide discharge lamps and more particularly to the positioning of electrodes in low power metal halide discharge lamps to enhance the efficiency of such lamps.

BACKGROUND ART:

In the present-day market place, metal halide discharge lamps are, in general, of the intermediate and high wattage variety. More specifically, the known metal halide discharge lamps which are readily available have a rating in the range of about 175 to 1500 watts. Also, it is known that these metal halide discharge lamps having the higher wattages also have the higher efficacy. Moreover, efficacy is directly related to efficiency and is conveniently defined as the total lumen output to input power and is expressed in lumens per watt.

Of the known metal halide discharge lamps employed for use for general illumination, the smallest is the 175 watt version. Such relatively small lamps, in accordance with conducted testing, appear to have an efficacy of about 80 LPW or lumens per watt, a lumen output of about 14,000 lumens and a color temperatures of about 4400 °K for a clear lamp and about 4000°K for a phosphor coated lamp.

However, it has been a common belief that metal halide discharge lamps of a size smaller than about 175 watts would be impractical due to the undesired relatively low efficacy. Also, it has been presupposed that the color temperature of about 4400°K, common to present-day lamps, would also appear on

the low wattage metal halide discharge lamp. Moreover, a color temperature of about 4400°K would be unsatisfactory for general illumination purposes since the ordinary incandescent lamp has a color temperature of about 2780°K.

OBJECTS AND SUMMARY OF THE INVENTION:

An object of the present invention is to provide a metal halide discharge lamp which overcomes the problems of the prior art. Another object of the invention is to provide an improved metal halide discharge lamp. Still another object of the invention is to provide an enhanced low wattage metal halide discharge lamp having improved efficacy. A further object of the invention is to provide an improved low wattage metal halide discharge lamp with an enhanced electrode configuration.

These and other objects, advantages and capabilities are achieved in one aspect of the invention by a low wattage metal halide discharge lamp having an evacuated outer envelope with a domed quartz sleeve positioned therein and an arc tube disposed within the domed quartz sleeve with the arc tube having a pair of spaced electrodes sealed therein with a coil on each electrode and each electrode having a figure of merit (FM) substantially equal to the product of the back space (BS) or distance from a press seal to the coil and an insertion length (IL) or distance from a press seal to the end of the electrode.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a cross-sectional view of a low wattage metal halide discharge lamp of the invention;

FIG. 2 is an enlarged sectional view of an electrode of the arc tube of FIG. 1; and

FIG. 3 is a comparison chart illustrating the efficacy and color temperature for a given figure of merit of a low wattage metal halide discharge lamp of the invention.

BEST MODE FOR CARRYING OUT THE INVENTION:

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims in conjunction with the accompanying drawings.

Referring to FIG. 1 of the drawings, a low wattage metal halide arc discharge lamp 5 includes an evacuated outer envelope 7 hermetically sealed to a glass stem member 9 and having an external base member 11 affixed thereto. A pair of electrical conductors 13 and 15 are sealed into and pass through the stem member 9 and provide access for energization of the discharge 5 by an external source (not shown).

Within the vacuum of the evacuated outer envelope 7, a support member 17 is affixed to one of the electrical conductors 13 and extends substantially parallel to the longitudinal axis of the lamp 5 and forms a circular configuration 19 near the upper portion of the envelope 7. This circular configuration 19 in conjunction with the upper portion of the envelope 7 tend to maintain the support member 17 in proper alignment and resistant to deformation caused by external shock.

A first strap member 21 is welded to the support member 17 and extends therefrom in a direction normal to the longitudinal axis of the support member 17. A heat conserving means such as a domed quartz sleeve 23 has a pair of oppositely disposed notches 25 and 27 on the end 28 thereof opposite to the domed

portion. These notches 25 and 27 are formed to slip over the first strap member 21 which serves to support the domed quartz sleeve 23. Also, a substantially circular-shaped strap 29 surrounds the domed quartz sleeve 23 near the domed portion thereof and is attached to the support member 17.

Within the domed quartz sleeve 23 is an arc tube 31. The arc tube 31 has a pinch seal at opposite ends thereof, 33 and 35 respectively. Metal foil members 37 and 39 are sealed into the press seals 33 and 35 and electrical conductors 41 and 43 are attached to the foil members 37 and 39 and extend outwardly from the press seals 33 and 35. A flexible support member 45 is affixed to one of the electrical conductors 41 and to the support member 17. Also, a lead 47 is affixed to the other electrical conductor 43 which passes through the domed portion of the domed quartz sleeve 23. Moreover, a flexible spring-like member 49 connects the lead 47 to the other one 15 of the pair of electrical conductors 13 and 15. A pair of getters 51 and 53 are affixed to the electrical conductors 13 and 15 and serve to provide and maintain the vacuum within the evacuated outer envelope 7 and the domed quartz sleeve 23. Moreover, a pair of electrodes 55 and 57 project into opposite ends of the arc tube 31.

Referring more specifically to the arc tube 31, it is to be noted that each of the ends thereof immediately adjacent and including the press seals 33 and 35 is coated with a white zirconium oxide paint in order to provide a wall temperature ofincreased uniformity. Also, the arc tube 31 contains a starting gas, mercury and scandium and sodium metal halides. Moreover, other metal halides are also suitable to the structure.

Referring to the enlarged sectional view of FIG. 2, the details of the electrodes 55 and 57 and the press seals 33 and 35 can be more clearly seen. Since both ends of the structure

are similar, a review of one end serves to illustrate the configuration. As can be seen, an electrode 55 is attached to a foil member 37 and this electrode 55 includes a coil 59 affixed thereto. Also, the coil 59 is positioned on the electrode 55 in a manner to provide a specific distance from the press seal 33 to the back of the coil 59 and this distance is designated the back space (BS). Also, the electrode 55 projects into the arc tube 31 for a given distance and this distance from the press seal 33 to the inner end of the electrode 55 is known as the insertion length (IL). Importantly, it has been found that the back space (BS) and the insertion length (IL) are critical parameters and the product thereof provide a design criteria which may be referred to as a figure of merit (FM). To repeat, the figure of merit (FM) is substantially equal to the product of the back space (BS) and the insertion length (IL). Accordingly, the figure of merit (FM) provides a discharge lamp design capability whereby specific design parameters are obtainable.

As to the above-described figure of merit (FM), it has been found that a back space (BS) or the distance of the back of a coil on an electrode to the press seal is preferably in the range of about 0.5 $\pm$ 0.2 mm for lamps having a figure of merit (FM) greater than about 1.0 and less than 1.5. Also, lamps employing thoriated tungsten electrodes having a diameter of about 0.017 inch and a space therebetween of about 1.4 cm are preferable for low wattage lamp configurations.

Referring more specifically to the comparison chart of FIG. 3, therein a comparison is provided for a 100 watt metal halide discharge lamp with the above-described figure of merit (FM) compared with both lamp efficacy and a color temperature. As can readily be seen, a 100 watt metal halide discharge lamp having a figure of merit (FM) greater than about 1.0 and less than about 1.5 would provide a lamp having an efficacy (LPW) in

the range of about 98% to 93% and color temperature (T_c) in the range of about 2800°K to 3200°K. Thus, it can be seen that a 100 watt metal halide discharge lamp can be designed to have a color temperature most satisfactory for general illumination. Moreover, the design also provides an efficacy much improved over prior known low wattage structures.

While there has been shown and described what is at present the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

CLAIMS:

1. A low wattage metal halide discharge lamp comprising:
an evacuated outer envelope;
a domed quartz sleeve located within said evacuated outer envelope; and
an arc tube disposed within said domed quartz sleeve, said arc tube having a fill gas therein and a pair of spaced electrodes press sealed therethrough with each of said electrodes having a coil thereon spaced from said press seal and from the end of said electrode within said arc tube and each of said electrodes having a figure of merit (FM)substantially equal to the product of the back space (BS) and the insertion length (IL) where
BS = distance from press seal to coil
IL = distance from press seal to end of electrode

2. The low wattage metal halide discharge lamp of Claim 1 wherein the operational voltage of said lamp is about 100 volts.

3. The low wattage metal halide discharge lamp of Claim 1 wherein said figure of merit (FM) is greater than about 1.0 and less than about 1.5 and said lamp has a color temperature in the range of about 2800 to 3200°K.

4. The low wattage metal halide discharge lamp of Claim 1 wherein said figure of merit (FM) is greater than about 1.0 and less than about 1.5 and said lamp has an efficacy in the range of about 93 to 98 lumens per watt.

5. The low wattage metal halide discharge lamp of Claim 1 wherein said arc tube fill consists of a starting gas, mercury and scandium and sodium metal halides.

6. The low wattage metal halide discharge lamp of Claim 1 wherein said electrodes are thoriated tungsten rods having a diameter of about 0.017 inch, are spaced from one another by about 1.4 cm and the lamp operating voltage is about 100 volts.

7. The low wattage metal halide discharge lamp of Claim 1 wherein said back space (BS) is in the range of about 0.5 $\pm$ 0.2 mm.

8. The low wattage metal halide discharge lamp of Claim 1 wherein said figure of merit (FM) is greater than 1.0 and less than 1.5 and said operational voltage is about 100 volts.

9. In a low wattage metal halide discharge lamp having an evacuated outer envelope with a domed quartz sleeve located therein and an arc tube positioned within said domed quartz sleeve, the improvement wherein said arc tube includes a fill gas therein and a pair of spaced electrodes press sealed therethrough with each of said electrodes having a coil thereon spaced from said press seal and from the end of said electrode within said arc tube, each of said electrodes having a figure of merit (FM) substantially equal to the product of the back space (BS) and the insertion length (IL) where

BS = distance from press seal to coil

IL = distance from press seal to end of electrode

10. The improvement of Claim 9 wherein said figure of merit is greater than about 1.0 and less than about 1.5.

11. The improvement of Claim 9 wherein said back space (BS) is in the range of about 0.5 $\pm$ 0.2 mm.

12. The improvement of Claim 9 wherein said arc tube includes a starting gas, mercury, and scandium and sodium halides.

13. The improvement of claim 9 wherein said discharge lamp is operational at about 100 volts, said fuse tube has a figure of merit (FM) greater than 1.0 and less than 1.5, said electrodes are thoriated tungsten having a diameter of about 0.17 inch and said electrodes are spaced from one another by about 1.4 cm.

14. The improvement of Claim 9 wherein said electrodes have a figure of merit greater than 1.0 and less than about 1.5 and said lamp has a color temperature in the range of about 2800 to 3200°K.

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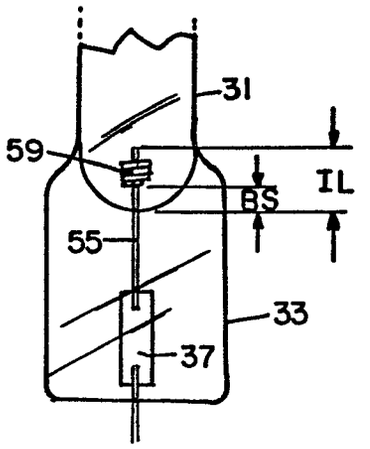

FIG. 2

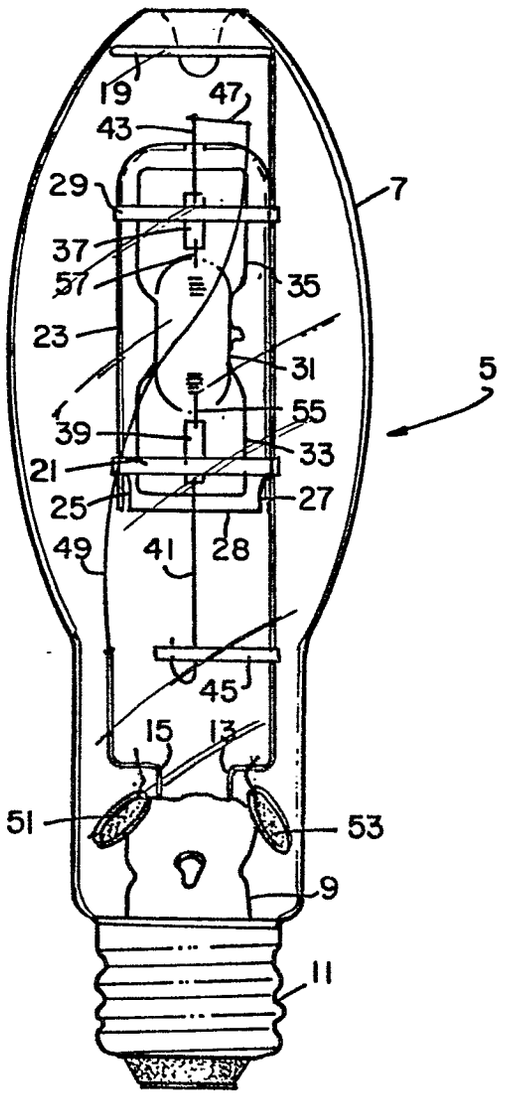

FIG. 1

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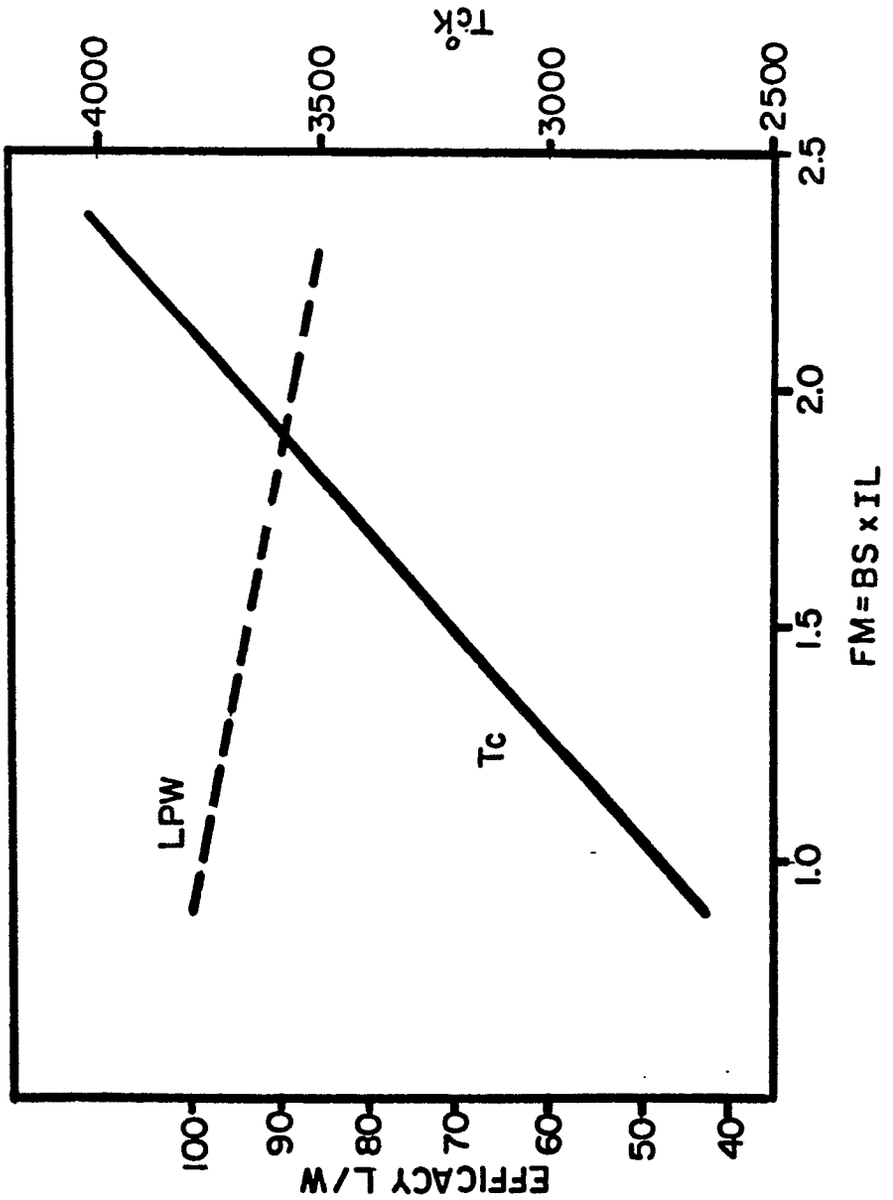

FIG.3