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HIGH PRESSURE DISCHARGE LAMP WITH ELECTROLYSIS PREVENTING MEANS

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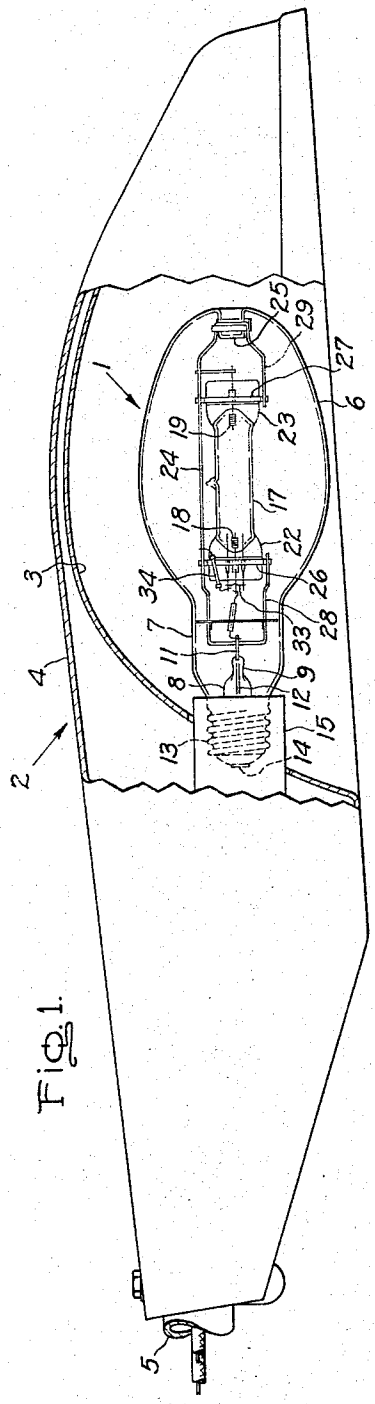


Fig. 1.

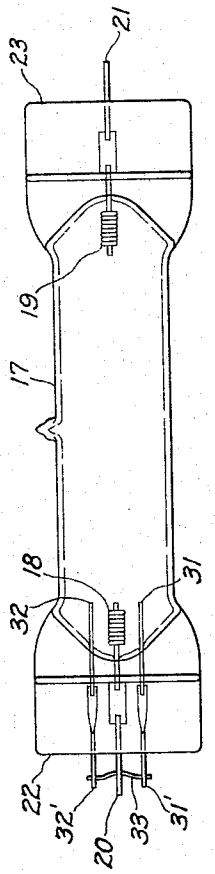


Fig. 2.

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HIGH PRESSURE DISCHARGE LAMP WITH ELECTROLYSIS PREVENTING MEANS

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This invention relates to high intensity electric discharge lamps comprising a quartz or hard glass arc tube in which an arc discharge takes place in gas or metal vapor at high pressure to produce visible light. The invention is more particularly concerned with preventing electrolysis of the quartz or glass in the vicinity of the electrode seals and especially about the auxiliary starting electrode.

The most common form of high intensity lamp at the present time is the high pressure mercury vapor lamp which generally comprises a quartz arc tube enclosed within a glass outer jacket fitted with a screw base at one end. The arc tube is provided with thermionic self-heating electrodes at opposite ends and contains a quantity of mercury along with a starting gas. Other kinds of high intensity lamps may use different gas or vapor fillings within the arc tube, for instance vaporizable metal halides such as sodium iodide and mercury. In some lamps the outer jacket is coated internally with a phosphor in order to improve the quality or the total quantity of light emitted.

A relatively high voltage is required across the main electrodes in order to initiate the arc in high pressure lamps. In order to avoid the necessity for such a high voltage, it has been the practice to provide an auxiliary starting electrode which is located adjacent the main electrode at one end of the lamp and connected through a current limiting resistor to the main electrode at the other end. The possibility of devitrification of the quartz or glass seal between starting and adjacent main electrode in high pressure metal vapor lamps is well known. It occurs when a unidirectional potential arises between the starting and the adjacent main electrode by reason of current rectification by the starting electrode. The general solution to this problem is taught in Patent 2,660,692—St. Louis et al. and consists in increasing the electron emission of the starting electrode to the point where its conductivity is substantially symmetrical on both half-cycles of the applied alternating current. Practical constructions proposed by the St. Louis patent for achieving this result include a long starting electrode extending substantially to the arc stream in front of the adjacent main electrode. An alternative construction provides a ring on the end of the auxiliary electrode which is located slightly forward of and surrounding the tip of the adjacent main electrode, and this was preferred for lamps intended for operation in any position including the horizontal, and not restricted to vertical operation.

In current manufacture of high pressure mercury vapor lamps, foil inleads are used and they are pinch sealed into the ends of the quartz arc tube. The pinch-sealing process is fast and amenable to complete mechanization and has almost completely replaced the older vacuum sealing process which required much skilled hand labor. Unfortunately with pinch sealing it is very difficult to position the electrodes accurately. At the instant just prior to sealing, the electrode is supported entirely by the very thin and flexible molybdenum foil. The foils at sealing temperature do not have sufficient rigidity even to support the electrodes upright and they are straightened out only when the plastic quartz is pressed into engagement: thus positioning cannot be accurate. This has made the ring-type starting electrode preferred by the St. Louis patent for lamps intended for horizontal operation, impractical.

The object of the invention is to provide a new and

improved starting electrode arrangement for a high pressure discharge lamp which avoids the problem of seal electrolysis in horizontal operation without requiring especially accurate placement of electrodes or inleads.

The invention is based upon the observation that electrolytic seal failure in horizontally operated lamps utilizing conventional auxiliary electrodes generally occurs when the lamp is so rotated on its axis that the auxiliary electrode is lowermost. The auxiliary electrode then runs too cold to have the electron emission necessary to avoid current rectification and seal electrolysis. It is not practical to make the socket of the fixture or the base of the lamp adjustable. My invention finds an economical and convenient solution to the problem which consists in providing twin auxiliary electrodes at one end of the arc tube and located on opposite sides of the main electrode. The two auxiliary electrodes are linked together and are connected to the main electrode at the opposite end of the lamp through the starting resistor in the usual way. With this arrangement, there is always one of the auxiliary electrodes located on or above the axis of the arc tube so that it is sufficiently heated by the discharge to achieve the electron emissivity necessary for avoiding electrolysis of the seals.

For further objects and advantages and a better understanding of the invention, attention is now directed to the following description and accompanying drawing illustrating a prefered embodiment. The features believed to be novel will be more particularly pointed out in the appended claim.

In the drawing:

FIG. 1 is a side elevation, partly sectioned, of a mercury vapor lamp luminaire in which the lamp is seen horizontally mounted.

FIG. 2 is a side elevation of the arc tube of the lamp provided with twin auxiliary starting electrodes at one end in accordance with the invention.

Referring to FIG. 1 of the drawing, there is shown a high pressure mercury vapor lamp **1** horizontally mounted within a luminaire **2** comprising an inner reflector **3** within an outer casing **4** supported by a bracket **5**. The lamp comprises an outer vitreous envelope or jacket **6** of generally ovoid or ellipsoidal shape and made of soft glass, or if preferred of a hard borosilicate glass. The neck **7** of the outer envelope is closed by a re-entrant stem **8** having a press **9** through which extend stiff inlead wires **11, 12** connected into the usual screw type base **13**, one to the threaded shell and the other to the insulated center contact **14**. Base **13** of the lamp is screwed into a conventional screw type socket **15** which is a permanent part of the luminaire. In the manufacture or in the assembly of the luminaires and sockets or in the selection of lamps for the socket, no attempt is made to assure a particular orientation of the lamp when it is screwed into the socket and it would not be practical to do so.

The inner arc tube **17** is made of quartz or fused silica and is provided at opposite ends with a pair of main discharge supporting electrodes, **18** at the base end and **19** at the outer end. The electrodes are mounted on inleads **20, 21** having intermediate thin foil portions which are hermetically sealed through full diameter pinch seals **22, 23** at the ends of the arc tube. Each main electrode comprises a core portion which is a prolongation of the inner end of the inlead made of tungsten and surrounded by a double tungsten wire helix. The turns of the helix and the interstices between turns are coated or filled with an electron-emitting mixture of alkaline earth oxides. The arc tube is supported within the outer jacket by means of a harness comprising a side rod **24** which is anchored to one of the inleads through the stem at one end and engages a re-entrant dimple **25** at the domed end of the bulb. The arc tube is supported in the harness by

clamping the pinched ends between metal bands **26, 27** which extend between side rod **24** and complementary end portions **28, 29**. Electrode **18** is connected directly to one of the inleads **11, 12** while electrode **19** is connected to the other inlead through side rod **24**.

In accordance with the invention, two auxiliary electrodes **31, 32** of refractory wire are provided at one end of the arc tube and located on opposite sides of the main electrode at that end. As shown in FIG. 2, the auxiliary electrodes are located at the base end of the arc tube on either side of main electrode **18**. Suitably the auxiliary electrodes may consist of tungsten wires forming the electrodes proper and projecting into the arc chamber. These wires are welded to the foliated ends of molybdenum inlead wires **31', 32'** which are embedded in the quartz pinch and make the hermetic seal. Desirably the auxiliary starter electrodes should project into the arc tube approximately coextensively with the main electrode; in the illustrated embodiment they are about even with the tip of the main electrode **18**. The lateral spacing of the auxiliary electrodes from the main electrode should be the least possible consistent with the requirement that sparking should be avoided and actual contact must never take place. Since in pinch sealing the accuracy of location and orientation of the foils within the pinch and the electrodes which are attached thereto is never too great, this imposes practical limits on the proximity of auxiliary electrodes to main electrode to which the arc tube must be designed. In practice for the usual sizes of mercury vapor lamps, a design spacing of 2.5 millimeters between the edge of the helix on main electrode **18** and the projecting portions of auxiliary electrodes **31, 32** has been found to result in a range of spacing from 1.5 to 3.5 millimeters in actual manufacture. This spacing is satisfactory for the purposes of the invention and avoids the frequent rejects produced when too stringent tolerance is attempted.

The two auxiliary electrodes **31, 32** are electrically connected together through a tie-wire **33**, and thence connected to the opposite main electrode **19** through the usual current limiting resistor **34**, for instance a 40,000 ohm resistor in the case of 700 and 1000 watt lamps. By providing two starting electrodes at the same end on opposite sides of the main electrode, there is always one starting electrode located above the adjacent main electrode or at least level with it, that is in the same horizontal plane.

When a single starting electrode is provided in a horizontally operated lamp, lamp orientation from screwing into the socket may result in the starting electrode being located below the main electrode. Due to convection effects in high pressure lamps, especially in lamps using heavy metal vapors such as mercury, upward bowing of the arc may cause the starting electrode to run too cool. As a result, the electron emission of the starting electrode falls off rapidly and its effectiveness as a cathode is greatly reduced while its effectiveness as an anode is not appreciably altered. The result is a tendency for a direct current component of voltage to develop between

the starting electrode and the adjacent main electrode, which causes electrolysis to occur in the quartz between their respective inleads at the high temperature of operation. The provision of two starting electrodes in accordance with the invention avoids the foregoing possibility by insuring that at least one of the auxiliary electrodes is always hot enough to provide the requisite electron emission. Actual life tests conducted on mercury vapor lamps provided with twin auxiliary starting electrodes at one end as described, and operated horizontally with random orientation, have shown that the invention eliminates electrolysis and auxiliary electrode seal failure as a cause of premature lamp failure.

While the invention has been most useful to date in conjunction with high pressure mercury vapor lamps and has been so illustrated and described, it may be used with other types of electric discharge lamps where a similar problem of excessive cooling of the auxiliary electrode may occur depending upon the orientation of the lamp. The specific embodiment which has been illustrated and described in detail is intended as exemplary and the scope of the invention is to be determined by the appended claim:

What I claim as new and desire to secure by Letters Patent of the United States is:

A discharge lamp comprising a vitreous outer jacket enclosing a quartz arc tube, said arc tube having a pair of main thermionic activated electrodes sealed therein at opposite ends, an ionizable filling within said arc tube including mercury and subject to convection effects during horizontal operation of said lamp, said main electrodes being provided with external connections through seals at opposite ends of said arc tube, and a pair of auxiliary tungsten wire starting electrodes located adjacent one of said main electrodes and extending approximately coextensive therewith on either side and provided with external connections through seals generally side-by-side with that of said adjacent main electrode, said auxiliary electrodes being connected together and joined to the main electrode at the opposite end of the arc tube through a current limiting resistor, whereby one of said electrodes is always located on or above the level of the horizontal plane through the adjacent main electrode irrespectively of the orientation of said lamp, said one electrode being sufficiently heated by the discharge to achieve at all times electron emission adequate to prevent electrolysis in the quartz in the vicinity of the seals.

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