Nov. 10, 1936. J. L. COX 2,060,610

ELECTRODE STRUCTURE FOR ELECTRIC DISCHARGE LAMPS

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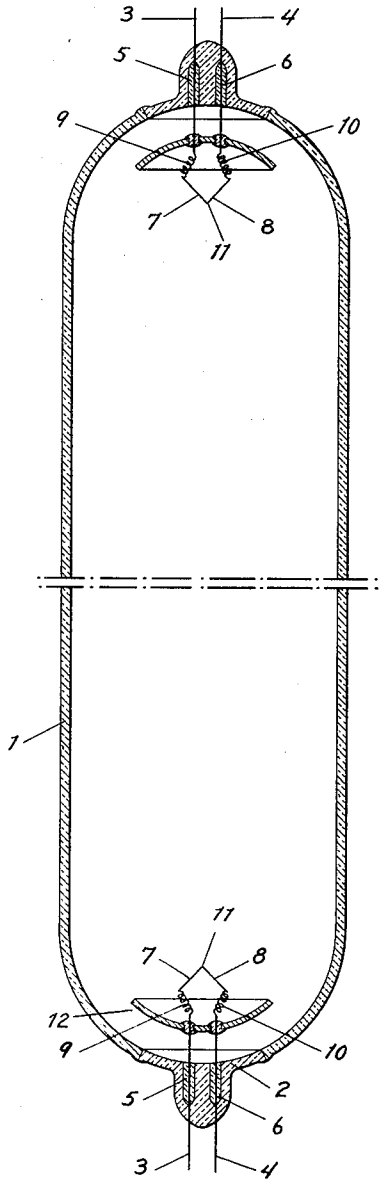


Fig. 1.

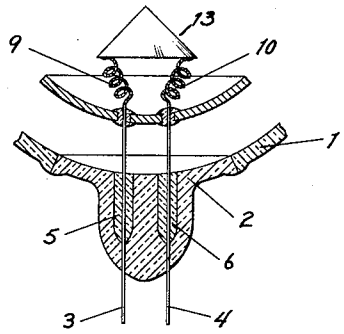


Fig. 3.

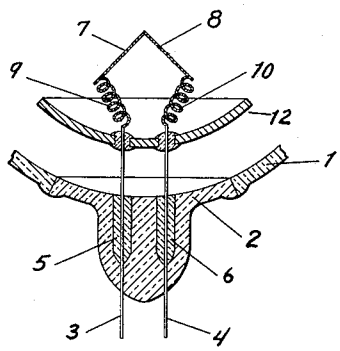


Fig. 2.

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ELECTRODE STRUCTURE FOR ELECTRIC DISCHARGE LAMPS

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10 Claims. (Cl. 176—126)

This invention relates to electric discharge lamps and with particularity to lamps wherein the main luminous source consists of an arc-like discharge through an ionizable medium.

An object of the invention is to provide an improved electrode arrangement for gas or vapor discharge lamps.

I have found that one of the causes of reduced luminous efficiency in lamps of the high pressure arc-discharge type, is the positonal instability of the arc proper. I have further found that this instability is caused to a certain extent by the turbulence and iregular flow of the convection currents in the heated gas or vapor filling. Accordingly, another object of the present invention is to provide an improved arc discharge lamp wherein the tendency of the arc to positional instability is materially reduced.

A feature of the invention relates to an electrode for gas or vapor discharge lamps whereby the discharge is localized substantially centrally of the electrode. As a result of this feature the arc column is maintained substantially straight and is not seriously subjected to disturbing convection streams within the gas or vapor filling.

A further feature relates to an electrode for vapor or gas arc-discharge lamps whereby the electric discharge from the electrode is confined to a point-like source, and the electrode and its lead-in wires are subjected to substantially equal current distribution therethrough.

A further feature relates to a wire electrode for arc-discharge lamps wherein the discharge is substantially concentrated at a central point of the wire, and the wire is so arranged as to prevent migration of the discharge over the remaining portions thereof.

Another feature relates to a filament electrode consisting of straight portions terminating in a point and joined to convoluted portions, the straight portions serving to shield the convoluted portions from a migrating discharge.

A further feature relates to an improved wire electrode for arc-discharge lamps having a point-like discharge surface and being symmetrically disposed with relation to the main arc column.

A still further feature relates to the novel organization, arrangement and relative location of parts which go to make up an efficient arc lamp of the high pressure vapor or gaseous type.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed description and appended claims.

While the invention will be described herein as embodied in one specific lamp structure, it will be understood that this is done merely for purposes of explanation and not by way of limitation. In the drawing,

Fig. 1 illustrates in diagrammatic form a lamp embodying features of the invention.

Fig. 2 is an enlarged detailed view of one of the electrodes of Fig. 1.

Fig. 3 shows a modification of the electrode of Figs. 1 and 2.

Referring more particularly to Fig. 1 there is shown a lamp of the general type disclosed in detail in application Serial No. 758,405, filed December 20, 1934. This lamp comprises a main enclosing envelope 1 preferably of refractory transparent tubing such as glass combustion tubing. Each end of the envelope is closed by a glass cap 2 into which is sealed the electrode lead-in and support wires 3 and 4, it being understood that the support wires are preferably beaded with relatively soft glass beads 5, 6. Each of the caps 2 forms with the associated end of the envelope 1 a substantially hemispherical electrode chamber in which is mounted an electrode designated generally by the numeral 8. As shown in detail in Fig. 2 this electrode consists preferably of a wire formed with two straight portions 7, 8, joining each other in V formation, and with two zigzag or convoluted portions 9, 10, to increase the effective electron emission area of the electrode. The wire forming this electrode is preferably of a refractory material such as tungsten, molybdenum or the like and if desired this wire may have wound helically therearound a finer tungsten or molybdenum wire as described in said application Serial No. 758,405. The free ends of the convoluted sections 9 and 10 are fastened as by welding or in any other suitable manner to the lead-in and support wires 3 and 4. It will be understood of course that if desired the wires 3 and 4 may be integral extensions of the convoluted sections 9 and 10 thus eliminating the necessity of welded joints.

In accordance with the present invention the convoluted sections 9 and 10 converge towards each other so as to be entirely within the angle subtended by the straight sections 7 and 8. I have found that with this arrangement the straight sections 7 and 8 shield and prevent a migrating discharge over the convoluted sections 9 and 10. Preferably the wire electrode is so mounted that the point 11 is located on the longitudinal axis of the envelope 1, so that when the arc is struck this arc has its lower end confined to the said pointed portion 11. Preferably the

electrode including the sections 7, 8, 9 and 10 is provided with any well-known form of electron-emissive coating such as an oxide or mixture of oxides of the alkaline earths. On the other hand, the said electrode may consist of a wire having incorporated therein a material which becomes electronically emissive when raised to a suitable temperature. The electrode at the opposite end of the envelope 1 may, although not necessarily, be similar to the electrode above described, or may consist of any ordinary type of electrode. However, when the lamp is to be used on alternating current it is preferable to make both electrodes alike so as to insure that the arc which strikes between the electrodes 4 is confined as closely as possible to the longitudinal axis of the envelope 1. If desired, a shield 12 may be positioned between each electrode and the associated end-cap 2 to protect the latter as pointed out in detail in application Serial No. 23,992. I have found that with the electrode arrangement above described the discharge is confined substantially entirely to the pointed portion 11 of the electrode and a migrating discharge between the turns of the sections 9 and 10 is avoided because these latter sections are effectively shielded by being enclosed by the straight sections 7 and 8. Thus in the usual electrode structure having a coiled wire, each turn of the wire is directly exposed to the arc-discharge and it is necessary for practical purposes to situate the support or lead-in wires outside of the boundary of the filament turns so that the lead-in wires also are exposed to the discharge.

In another known type of electrode the wire is coiled and has a straight portion bent back through the convoluted portion. With this latter type of electrode when the discharge strikes the uppermost end of the electrode, the current divides flowing partly through the straight section and partly through the convoluted section. However, because of the difference in resistance or impedance between these two sections, one lead-in wire must carry a greater amount of current than the other lead-in wire with the result that one lead-in wire is overloaded and in many cases this overloading causes a break-down of the seal. Entirely apart from this disadvantage is the fact that since the convolutions are exposed to the direct line of action of the discharge, this discharge migrates from one turn to another in random fashion. In other words, the base of the discharge moves sporadically from point to point over the surface of the electrode. This movement of the base of the discharge produces a positional instability in the main arc proper and also contributes to the turbulence of the heated gases and vapors within the envelope. The combined results of these effects is that the main arc departs materially from the longitudinal axis of the envelope and bows outwardly in irregular formations towards the wall of the enclosing envelope. This wiggling or bowing of the main arc materially reduces the luminous efficiency thereof and furthermore the bowing outwardly of the main arc may in some cases raise the wall of the enclosing envelope to a destructive temperature.

With an electrode of the character described above, it is possible to confine the base of the arc substantially to the pointed portions 11 and because of the shielding effect of the sections 7 and 8 on the sections 9, 10, the discharge is prevented from migrating from turn to turn of these latter sections. As a result therefore, the arc is maintained substantially steady along the longitudinal axis of the envelope 1 and the bowing or wiggling of the arc is reduced to a minimum thus increasing the luminous efficiency of the lamp. It will be understood of course that the drawing so far as dimensions go, is entirely schematic and preferably the electrodes are designed in size so that substantially point-like discharge sources are produced, which sources are located substantially on the longitudinal axis of the envelope.

Instead of employing a wire for the electrode, the pointed portion may be replaced by a conical member such as the member 13 shown in Fig. 3. In this embodiment, either the entire outer surface of member 13 as well as wires 9 and 10 may be coated with electron-emissive material, or if desired only the pointed portion of member 13 may be so coated. While the drawing shows a pair of leads for each electrode, this is done in order to enable current to be passed through the electrodes for the purpose of driving out the gas therefrom during the evacuation of the lamp. Preferably however, when the lamp is in use the paired leads are connected together by a suitable strap exteriorly of the envelope 1, so that when the lamp is in operation the electrodes are rendered emissive by the discharge current passing through the lamp. The above described arrangements therefore provide a symmetrical disposition of the electrodes with relation to the main arc stream and the arc is localized substantially at the pointed portions 11.

While specific materials have been mentioned herein, it will be understood that various changes and modifications may be made herein without departing from the spirit and scope of the invention.

What is claimed is:

1. An arc-discharge lamp comprising an enclosing envelope having a filling of an ionizable medium, a pair of electrodes mounted in spaced opposing relation within said envelope to sustain an arc therebetween, both said electrodes being in the form of a V-shaped wire terminating in an inwardly offset convoluted portion having the points thereof faced towards each other and situated on the axis of the envelope for the purpose of centering the arc.

2. In an arc-discharge lamp, the combination of an enclosing envelope of refractory transparent tubing, and caps of softer glass closing off the ends of said envelope, lead-in wires sealed through said end caps, electrodes supported on said wires, one of said electrodes comprising a refractory wire having a V-shaped portion mounted with the point of the V facing the other electrode, and a shield in back of each electrode for controlling the convection currents within the lamp envelope.

3. In an arc-discharge lamp the combination of an electron-emitting cathode comprising a wire having a portion of its length formed to a point and another portion of its length convoluted and offset with respect to the pointed portion, support wires for said cathode, said support wires and said convoluted portion being substantially entirely within the angle subtended by the pointed portion.

4. An electrode for electric discharge lamps, having a pointed central portion and end portions joined to the diverging ends of the pointed portion, said end portions converging towards each other and disposed entirely within the angle subtended by the pointed portion for the purpose of shielding the end portions from a migrating discharge.

5. A cathode for electric discharge lamps comprising a refractory conductive member having a V-shaped central section terminating in convoluted sections offset from the V-shaped section so that the convoluted sections are substantially entirely within the angle subtended by the V-shaped section.

6. A cathode for electric discharge lamps comprising a convoluted wire, and a V-shaped wire connected in series with the convoluted wire the convoluted wire being offset with respect to the V-shaped wire, so that the said V-shaped wire shields the turns of the convoluted wire from a migrating discharge.

7. A cathode for an arc-discharge lamp comprising a hollow refractory pointed metal member, a coating of electron-emissive material on said member, and a filamentary member joined to said hollow member but offset with respect to the pointed metal member so as to be substantially completely shielded thereby.

8. An arc-discharge lamp comprising an enclosing envelope having a filling of an ionizable medium, a pair of electrodes mounted in spaced opposing relation within said envelope to sustain an arc therebetween, one of said electrodes being in the form of a refractory wire having its middle portion bent to a V with the point of the V situated substantially on the longitudinal axis of the enclosing envelope, and the end portions of the filament being disposed inwardly towards said longitudinal axis.

9. An arc-discharge lamp comprising an enclosing envelope having a filling of an ionizable medium, a pair of electrodes mounted in spaced opposing relation within said envelope to sustain an arc therebetween, one of said electrodes being in the form of a wire having a V-shaped central section and coiled end sections the coiled end sections being inwardly offset and situated within the V-section to be shielded thereby.

10. An arc-discharge lamp comprising a pair of electrodes one of the electrodes being an electron emitting cathode comprising a wire having a portion of its length bent to a V-shape and another portion of its length convoluted and offset with respect to the V-shaped portion, both the V-shaped portion and the convoluted portion being continuous throughout their length, the ends of the wire being strapped together.

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