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ENCLOSED ELECTRIC ARC LAMP

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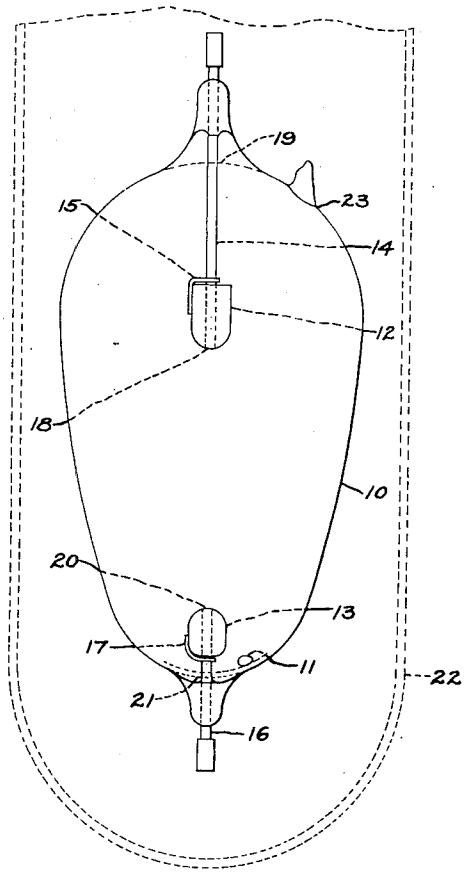

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ENCLOSED ELECTRIC ARC LAMP

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10 Claims. (Cl. 176—122)

My invention relates to electric discharge lamps generally and more particularly to high pressure metal vapor arc lamps.

One of the objects of my invention is to provide a lamp of this type in which the temperature of the envelope or bulb during operation is as nearly uniform as possible. Another object is to provide a lamp having an envelope so shaped as to permit operation of the lamp at an extremely high temperature and metal vapor pressure without danger of having the said envelope bulge out or burst. Another object is to provide such a lamp which will operate efficiently without the usual enclosing vacuum jacket.

An advantage of my lamp is that, because of the comparatively uniform temperature throughout the envelope at operation, it makes possible the operation of the lamp at temperatures rather close to the softening point of the glass used for the envelope which in turn permits the attainment of the desired high vapor pressures. In lamps having envelopes of conventional shapes, the temperature differential in different parts of the envelope is so great that when the hot portion is kept safely below the softening point of the glass envelope, the comparatively cooler portion is at too low a temperature to provide the desired high pressure because of the condensation there of the vaporizable metal.

According to my invention the envelope of the lamp is so shaped and the electrodes are mounted in such a manner that the temperature of the bulb during operation is as nearly uniform as possible, while the shape of the envelope is reasonably practical. The said envelope is of larger diameter at the top than at the bottom, the midportion of said envelope preferably increasing in diameter substantially uniformly from the bottom to the top. The said envelope is preferably somewhat oval-shaped. The electrodes are disposed in the vertical axis of said envelope so that the positive column path therebetween is in the said vertical axis, the upper electrode being preferably disposed adjacent the largest diameter of said envelope.

Further features and advantages of my invention will appear from the following description of species thereof and from the drawing.

The drawing is a vertical elevation of a high pressure metal vapor (mercury) arc lamp constructed in accordance with my invention.

Referring to the drawing, the lamp comprises a glass envelope or bulb 10 containing a readily ionizable gas, such as argon, and a vaporizable metal, preferably a globule of mercury 11. A pair of electrodes 12, 13 are disposed in the vertical and longitudinal axis of the envelope 10. The said electrodes may consist of blocks of tungsten impregnated with an electron emissive material, such as barium or strontium oxide or a mixture of such materials. The upper electrode 12 is mounted on a lead wire 14, preferably of tungsten, which extends through an axial hole in said electrode. An angular piece of wire 15, preferably a molybdenum wire, is spot welded to the said lead 14 and electrode 12 to secure the electrode on the lead. The lower electrode 13 is similarly mounted on a lead wire 16 and secured by an angular wire 17.

A lamp of the particular proportions illustrated in the drawing has been constructed and operated successfully in a 400 watt capacity size, operating at 70 volts and 6.35 amperes. The envelope 10 in this case was filled with argon gas at a pressure of 8 mm. and contained .033 cc. of mercury. As shown, the upper electrode 12 is substantially at the center of curvature of the spherical upper end of the envelope 11, that is, it is adjacent the largest diameter of said envelope. The lower electrode 13 in this particular case is below the center of curvature of the smaller spherical lower end of said envelope. The said upper and lower spherical portions of the bulb are joined by a slightly curved intermediate portion which increases in diameter substantially uniformly from the lower to the upper end between the electrodes. The active or arc-sustaining end or surface 18 of the upper electrode 12 is approximately three times as far from the upper end 19 of the envelope 10 as the active end or surface 20 of the lower electrode 13 is from the lower end 21 of said envelope. The distance from the said surface or end 18 of electrode 12 to the side wall of the envelope 10 opposite thereto is approximately fifty per cent greater than the distance from the surface or end 20 of electrode 13 to the side wall opposite thereto, that is, the diameter of the envelope 10 adjacent the end 18 of electrode 12 is approximately fifty per cent greater than the diameter of said envelope adjacent the end 20 of electrode 13.

During operation of a lamp of the proportions described above in a surrounding globe 22, the temperature of the envelope at various points was measured and the results were approximately as follows: at the lower end, 405° C.; midway between the electrodes, about 470 to 480° C.; at the elevation indicated by the marker 23, 490° C.; and at the top, 470° C. Thus, the difference between the highest and lowest temperatures was about

85° C.,—that is, the maximum temperature of the envelope was less than twenty per cent greater than the minimum temperature. The operating pressure of the lamp was approximately two atmospheres. It is important in a lamp operating at a pressure in excess of about one atmosphere that the temperature is either the same at all points between the electrodes or that it increases uniformly from the lower to the upper electrode, that is, there must not be a dip in the temperature gradient between the electrodes because the arc would in that case bow out toward the cooler region. When a lamp is made with a plain cylindrical envelope large enough in diameter so that the top is not overheated, the temperature at the bottom is so much lower that the desired mercury pressure cannot be reached due to condensation of the mercury at the bottom.

It will be understood by those skilled in the art that the actual ratios of small bottom diameter to large top diameter of the envelope will vary with changes in arc length, operating pressure, electrode size and shape, total watts, etc. For a lamp operating in the open, that is, without the enclosing globe 22, the bottom diameter is preferably smaller than that of the envelope illustrated in the drawing, more nearly resembling a "top" than an oval, because of the cooling effect of the air passing upward along said envelope.

The electrodes in the lamp may also be of the indirectly heated or directly heated type. However, they are solid electrodes as distinguished from electrodes of metallic liquid such as mercury.

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

1. A high pressure metal vapor arc lamp adapted to have its longitudinal axis vertically disposed and comprising an envelope containing a quantity of vaporizable metal, upper and lower electrodes in said envelope disposed in said longitudinal axis, the upper electrode being located at a substantially greater distance from the top of said envelope than the lower electrode is from the bottom of said envelope, the diameter of said envelope adjacent said upper electrode being greater than the diameter of said envelope adjacent said lower electrode, and the portion of said envelope between said electrodes increasing substantially uniformly in diameter from the bottom to the top.

2. A high pressure metal vapor arc lamp adapted to have its longitudinal axis vertically disposed and comprising an envelope containing a quantity of vaporizable metal, upper and lower electrodes in said envelope disposed in said longitudinal axis, the distance from the arc sustaining surface of the upper electrode to the upper end of said envelope being at least twice the distance from the arc sustaining surface of the lower electrode to the lower end of said envelope, the diameter of said envelope adjacent said upper electrode being greater than the diameter of said envelope adjacent said lower electrode, and the portion of said envelope between said electrodes increasing substantially uniformly in diameter from the bottom to the top.

3. A high pressure metal vapor arc lamp adapted to have its longitudinal axis vertically disposed and comprising an envelope containing a quantity of vaporizable metal, upper and lower electrodes in said envelope disposed in said longitudinal axis, the distance from the arc sustaining surface of the upper electrode to the upper end of said envelope being approximately three times the distance from the arc sustaining surface of the lower electrode to the lower end of said envelope, the diameter of said envelope adjacent said upper electrode being greater than the diameter of said envelope adjacent said lower electrode, and the portion of said envelope between said electrodes increasing substantially uniformly in diameter from the bottom to the top.

4. A high pressure metal vapor arc lamp adapted to have its longitudinal axis vertically disposed and comprising an envelope containing a quantity of vaporizable metal, upper and lower electrodes in said envelope disposed in said longitudinal axis, the distance from the arc sustaining surface of the upper electrode to the upper end of said envelope being at least twice the distance from the arc sustaining surface of the lower electrode to the lower end of said envelope, the diameter of said envelope adjacent said arc sustaining surface of said upper electrode being at least twenty-five per cent greater than the diameter of said envelope adjacent said arc sustaining surface of said lower electrode, and the portion of said envelope between said electrodes increasing substantially uniformly in diameter from the bottom to the top.

5. A high pressure metal vapor arc lamp adapted to have its longitudinal axis vertically disposed and comprising an envelope containing a quantity of vaporizable metal, upper and lower electrodes in said envelope disposed in said longitudinal axis, the distance from the arc sustaining surface of the upper electrode to the upper end of said envelope being at least twice the distance from the arc sustaining surface of the lower electrode to the lower end of said envelope, the diameter of said envelope adjacent said arc sustaining surface of said upper electrode being approximately fifty per cent greater than the diameter of said envelope adjacent said arc sustaining surface of said lower electrode, and the portion of said envelope between said electrodes increasing substantially uniformly in diameter from the bottom to the top.

6. A high pressure metal vapor arc lamp comprising a substantially oval-shaped envelope and adapted to have its longitudinal axis vertically disposed with the larger end of said envelope uppermost, said envelope containing a quantity of vaporizable metal, upper and lower electrodes in said envelope disposed in said longitudinal axis, the upper electrode being disposed substantially adjacent the largest diameter of said envelope and the lower electrode being disposed substantially adjacent the lower end of said envelope.

7. A high pressure metal vapor arc lamp comprising a substantially oval-shaped envelope and adapted to have its longitudinal axis vertically disposed with the larger end of said envelope uppermost, said envelope containing a quantity of vaporizable metal, the upper and lower end portions of said envelope being substantially spherical, upper and lower electrodes in said envelope disposed in said vertical axis, the upper electrode being disposed substantially at the center of curvature of the upper end portion of said envelope and the lower electrode being disposed below the center of curvature of the lower end portion of said envelope.

8. A high pressure metal vapor arc lamp adapted to be mounted with its longitudinal axis vertically disposed and to operate at a pressure in excess of one atmosphere and comprising a vitreous envelope containing a quantity of readily vaporizable metal, upper and lower solid elec-

trodes in said envelope in said longitudinal axis, the upper electrode being located at a substantially greater distance from the top of said envelope than the lower electrode is from the bottom of said envelope, and the diameter of said envelope adjacent said upper electrode being substantially greater than the diameter of said envelope adjacent said lower electrode.

9. A high pressure metal vapor arc lamp adapted to be mounted with its longitudinal axis vertically disposed and to operate at a pressure in excess of one atmosphere and comprising a vitreous envelope containing a quantity of readily vaporizable metal, and upper and lower solid electrodes disposed in said longitudinal axis, said envelope being of substantially uniformly increasing diameter from a point adjacent said lower electrode to a point adjacent said upper electrode so that the temperature gradient along the wall of said envelope between said electrodes during operation of the lamp is substantially uniform.

10. A high pressure metal vapor arc lamp adapted to be mounted with its longitudinal axis vertically disposed and to operate at a pressure in excess of one atmosphere and comprising a vitreous envelope containing a quantity of readily vaporizable metal, and upper and lower solid electrodes disposed in said longitudinal axis, the diameter of said envelope opposite the upper electrode being greater than the diameter of said envelope opposite the lower electrode, and said envelope between said electrodes being of substantially uniformly increasing diameter from said lower electrode to said upper electrode so that the maximum temperature therein during operation of the lamp is not more than approximately twenty per cent greater than the minimum temperature.

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