

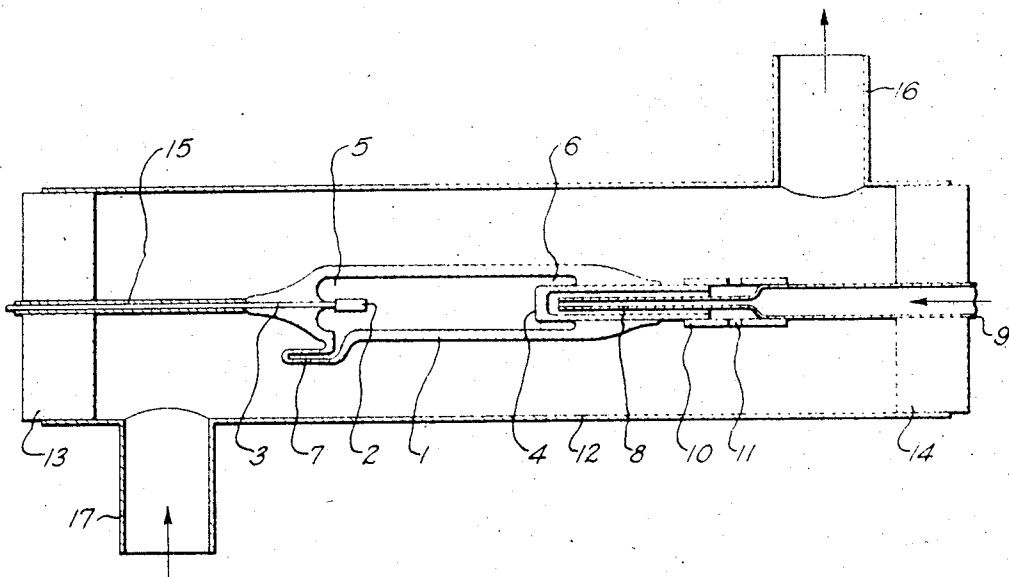
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ARTIFICIALLY COOLED HIGH-PRESSURE MERCURY-VAPOR DISCHARGE TUBE

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ARTIFICIALLY COOLED HIGH-PRESSURE
MERCURY-VAPOR DISCHARGE TUBEHendricus Johannes Lemmens and Eduard
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2 Claims. (Cl. 176—122)

Artificially cooled high-pressure mercury-vapor discharge tubes are known comprising solid electrodes extending but slightly (less than 5 mms.) from a quantity of vaporizable metal partly surrounding them. This supply of metal, constituted by mercury or amalgam, is heated by the discharge which emerges from the ends of the solid electrodes and produces the high-pressure mercury vapor necessary for the use of the tube. The distance to which the electrodes extend from the supply of metal influences the resultant value of the vapor-pressure. If this distance is reduced the heating of the supply of metal is intensified and the atmosphere of vapor acquires a higher pressure.

If such a tube is operated with direct current a larger quantity of heat is evolved at the anode than at the cathode so that the supply of metal is heated to a greater extent on the anode side than on the cathode side. If the initial distances over which the anode and the cathode extend from the vaporizable supplies of metal are identical more metal is first vaporized on the anode side than on the cathode side and in some cases a slight quantity of mercury may even be condensed on the cathode side. A state of equilibrium is set up very rapidly after the tube is put into use, the anode extending from the supply of metal surrounding it for a larger distance than the cathode. Due to this larger distance the cooling of the anode is, however, reduced and this exercises an unfavourable influence on the life of the anode and thus of the tube.

According to our prior British patent specification No. 484,143 this difficulty is met by choosing the cross-section of the part of the anode which extends from the supply of metal so that it is larger than the cross-section of the part of the cathode which extends from the supply of metal. In some cases the improvement obtained in this manner may, however, lead to other disadvantages since if the discharge tube according to the prior specification is to be rendered suitable for heavy currents, e. g. higher than 5 or 10 amp., it is necessary for the cross-section of the anode to be made very large compared with the cross-section of the cathode. Such a large increase may have the effect that the annular slot between the anode and the tube wall becomes so narrow that the vaporizable metal which is intended to surround the anode does not fill the slot at all points, with the result that the heat transmission from the anode to the tube wall is greatly hampered. A considerable increase of

the anode cross-section may also lead to a diameter of the discharge tube which is larger than the diameter desirable in view of the high vapor-pressures.

The invention has for its object to improve the discharge tube according to the prior specification in order to remove these disadvantages.

According to the invention the anode is constructed as a hollow body adapted to be traversed by a cooling medium. This cooling medium conducts away a part of the heat evolved at the anode so that it is possible to maintain its cross-section below a practical limit. The cross-section of that part of the anode which extends from the supply of metal is preferably less than 10 times the cross-section of the part of the cathode that extends from the supply of metal.

In order that the invention may be clearly understood and readily carried to effect, it will now be described more fully with respect to the accompanying drawing, which represents, by way of example, one embodiment thereof.

The discharge tube 1 shown in the drawing and serving for the emission of rays is made of quartz and has an internal and an external diameter of 6 and 9 mms. respectively. At one of its ends the tube contains a cathode 2 of tungsten having a diameter of 1.5 mm. In some cases this cathode may be coated with oxides capable of copiously emitting electrons. The leading-in wire 3 for this cathode is sealed in the quartz tube in known manner by means of one or more transition glasses.

At the other end of the tube there is the anode 4 which is constituted by a hollow tungsten tube which is also sealed in the quartz by means of transition glasses. The external diameter of the tungsten tube is 4 mms. and the wall thickness is 0.8 mm. The bottom of the tungsten tube, which is adjacent the discharge path, has a thickness of 1.5 mm. The distance between the cathode and the anode 4 is 20 mms.

The discharge tube 1 contains an ignition gas, constituted by argon for example, and a supply of mercury surrounding the cathode and the anode respectively in such manner that these electrodes only extend from the mercury 5, 6 for a small distance (about 1 mm.). A small tube 7 arranged laterally of the tube 1 serves in manufacturing the tube to adjust the distance to which the electrodes extend from the mercury since shortening of the tube 7 results in a small quantity of mercury being urged into the discharge tube proper so that the distance over-

which the electrodes extend from the mercury is reduced.

The anode tube has arranged in it a small tube 8 which merges at one end into a tube 9 of larger diameter. This tube 9 and the end of the anode tube are engaged by a cylindrical tube 10 in which apertures 11 are formed.

The discharge tube 1 is arranged within a cylindrical glass cooling vessel 12. The ends of this cooling vessel are closed by plugs 13 and 14. The leading-in wire for the cathode is led through the plug 13 and is separated from the cooling water which is led through the cooling vessel 12 by an insulating coating 15.

When the tube is in use cooling water is passed through the tube 9 to cool the anode 4 and this water enters through the apertures 11 into the cooling vessel 12 in order to leave this vessel through the outlet tube 16. The cooling liquid for the discharge tube 1 is supplied through the tube 17 and also leaves the cooling vessel 12 through the outlet tube 16.

The tube is supplied from a source of direct current with the interposition of a series resistance, the negative terminal of said source being connected to the leading-in wire 3 for the cathode, whereas the positive terminal of the source, similarly to the cooling water, is connected to earth. The tube of the form illustrated was experimentally operated with a current of 50 amp. and an operating voltage of 100 volts so that the absorption of energy was 5 kw.

What we claim is:

1. A lighting apparatus comprising in combination, a light transmitting vessel having apertures for the passage of a cooling medium there-through, a high pressure vapor discharge lamp mounted in said vessel, said lamp comprising an elongated tubular envelope having an anode mounted at one end thereof and a cathode at the opposite end thereof, a quantity of vaporizable metal about each of said electrodes, the part of said anode projecting from said vaporizable metal being approximately 2.66 to 10 times larger in cross section than the corresponding part of said cathode, a current inlead wire for said cathode extending from said lamp through the wall of said vessel, said anode being an elongated hollow body having a closed end extending into the

space defined by said envelope and an open end protruding from said envelope, a tube extending from the exterior of said vessel to the interior of said hollow anode for providing a flow of the cooling medium to the closed end of said anode, the part of said tube in said anode having an external diameter substantially less than the internal diameter of said anode to provide an annular passage between these elements and a perforated tube physically connecting said anode and said first named tube together in said vessel, said annular passage and said perforated tube permitting the flow of the cooling medium from the interior of said anode to the interior of said vessel.

2. A lighting apparatus comprising in combination, a light transmitting vessel having apertures for the passage of a cooling medium there-through, a high pressure vapor discharge lamp mounted in said vessel, said lamp comprising an elongated tubular envelope having an anode mounted at one end thereof and a cathode at the opposite end thereof, a quantity of vaporizable metal about each of said electrodes, the part of said anode projecting from said vaporizable metal being approximately 2.66 to 10 times larger in cross section than the corresponding part of said cathode, a current inlead wire for said cathode extending from said lamp through the wall of said vessel, said anode being an elongated hollow body having a closed end extending into the space defined by said envelope and an open end protruding from said envelope, a tube extending from the exterior of said vessel to the interior of said hollow anode for providing a flow of the cooling medium to the closed end of said anode, the part of said tube in said anode having an external diameter substantially less than the internal diameter of said anode to provide an annular passage between these elements and a perforated tube physically connecting said anode and said first named tube together in said vessel, said annular passage and said perforated tube permitting the flow of the cooling medium from the interior of said anode to the interior of said vessel and being mounted adjacent the outlet for the cooling medium in said vessel.

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