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Improved sintered electrode design for high-pressure arc-discharge illuminating lamps

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The service time of arc discharge illuminating lamps depends on stability of emission properties of their electrodes which produce electrons necessary to maintain the discharge. Arc-discharge lamp electrodes consist of a tungsten rod and a cylinder-shaped sintered body of tungsten and activator powder mixture fixed on it. Existence of sharp edges between the sintered body lateral surface and bases may results in localization of the cathode spot on one of them and in increased vaporization of the activator from segments close to the edge, causing an electrode service time reduction. But influence of cathode spot location on the temperature distribution over the sintered body surface was not investigated earlier. In this work, the temperature in the center of the cathode spot as a function of its position has been theoretically studied.

To increase heat removal from the sintered body surface section connecting with the discharge and to decrease vaporization of the activator from it, rounding of the edges between the sintered body lateral surface and bases has been proposed. The temperature of the sintered body surface in the center of the spot localized on the sintered body edge just slightly exceeds the temperature in the center of the spot localized on a smooth section of its surface when the radius r_c of the edge rounding is at least five times more than the radius r_s of the spot, i.e. under $5r_0 \leqslant r_c$. On the other hand, the decrease of the sintered body volume due to edge rounding should not exceed 10% of its initial value, which takes place if $r_c \leqslant \sqrt{rL/8}$, where r and L are the sintered body radius and length. Electrodes with rounded sintered body edges have been manufactured and tested in standard lamps. It has been found that their service time is higher by 15% as compared to that for the electrodes without rounding.

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