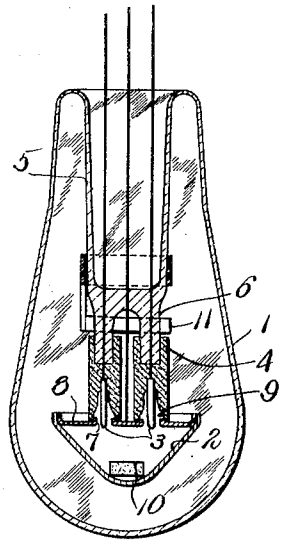
Oct. 15, 1929. C. G. SMITH 1,731,945

ELECTRIC DISCHARGE DEVICE

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ELECTRIC DISCHARGE DEVICE

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This invention relates to rectifiers of the glow discharge type wherein rectification is secured chiefly by the difference in area of the cathode and anode. The subject-matter described hereinafter contemplates a process of coating one or more electrodes with a substance designed to reduce losses in the rectifier. Now, since the coating, when initially heated to the forming temperature, spreads as a liquid, it is preferable that the electrode contour defines a dish-like surface. By reason of this, the invention has particular adaptation to the type of unilateral conductors exemplified in the applications of Smith Serial No. 526,095, now Patent 1,617,179 of February 8, 1927, Jenks Serial No. 725,867 and Bush Serial No. 22,988.

The primary object of my invention is to reduce the voltage loss in a glow rectifier. Another object is to provide a device that operates in an efficient manner and may be manufactured economically by the improved process.

The particular embodiment of the invention shown in the figure, comprises a tube 1 which may be formed of glass, a hollow cathode 2, preferably made of nickel, anodes 3 and insulating thimbles 4 preferably of lavite. The glass tube 1 has reentrant stem 5 provided with two tubular projections 6 that extend into recesses in the thimbles, the latter being slipped over the projections and held in position by cathode 2. The anodes 3 are alined with and held in place by the thimbles, passing through openings concentric with projections 6 and the openings 7 in the cathode. The latter is preferably formed in two parts, the lower part as shown, comprising a conical-shaped member; the upper portion consists of cover 8 fitting over the open end of the cone, openings 7 being provided in this element. The peripheries of the openings 7 are preferably bent inwardly to fit into the recesses 9 and spaced from the anode surfaces a distance having magnitude of the order or less than the mean free path of the electrons present. At the point where the anodes enter the thimble material, there is an insulating space also of magnitude having an order equal to or less than the mean free path of electrons; the thimbles serve to prevent the passage of space current between either anode and the outer surface of the cathode. The ionic activity is thus confined to the space enclosed by the cone, i. e. the region adjacent to the inner surface of the latter since the cone shaped electrode substantially totally encloses the remaining electrodes, and this enclosure is more effectively obtained with the cooperation of the insulators 4 and the entire cathode as a whole. The cylindrical members or thimbles 4 contain circular recesses 9 adjacent to the opening 7 to prevent or reduce to a negligible factor the tendency of current to flow between cathode and either anode along the surface of insulation. Now I propose to reduce the voltage drop between electrodes by coating in the manner described hereinafter the inner surface of the cathode with alkali metal. One of the effects of the alkali metal is to intensify the ionic activity confined within the hollow cathode.

The process consists essentially in placing a small amount of metallic lithium 10 inside the hollow cathode during the process of manufacture. The rectifier is sealed onto the pumping system in the inverted position as shown, so that the piece of lithium rests in a portion of the hollow, remote from the anodes. The tube is heated in a furnace to about 310° C. during the pumping process for twenty minutes, more or less. Inasmuch as lithium melts at 186° C. and boils at about 1400° C. the heating process melts the lithium but does not drive it out as a vapor. The inserted material is preferably in small amount so as not to drop upon the anodes if at any time when it is molten, the rectifier should be inverted. Lithium, being a very light metal and having relatively high surface tension when molten, sticks tenaciously to the cathode surface in the form of a film or coat. As a gas purifier, a getter of potassium should preferably be employed, capsule 11 being fired in the usual manner, e. g. by induced currents, after the tube is evacuated. If desired, a monatomic gas of the helium group at a pressure of about 15 m. m. Hg may be ad-

mitted to the envelope after pumping. When the tube is operated, certain impurities that are knocked off from the cathode and the lithium coat can be readily taken up by the getter. Rectifiers made by this process have a relatively low loss in both starting and operating potential, these however, depend to some extent upon the geometrical construction and arrangement of electrodes.

While I have described my process in connection with a particular type of rectifier the invention is applicable to thermionic devices in general requiring an alkali-coated electrode and in which the latter takes on a partially closed form, e. g. a cone, semi-closed cylinder and the like; the limitation of shape is not necessary but preferable, to prevent the flow of molten lithium from the extreme edges of the electrode to be coated. It is apparent that a practical degree of success in procuring the coat may be had from a substantially flat electrode.

I claim:

1. A gaseous discharge device comprising an envelope, a plurality of electrodes spaced therein, one of said electrodes being hollow, the remaining electrodes presented to the interior of said hollow electrode, all of said electrodes forming an isolated chamber, and a quantity of lithium within said chamber.

2. A gaseous discharge device comprising an envelope, a plurality of electrodes spaced therein, one of said electrodes being a hollow cathode, at least one anode presented to the interior of said hollow cathode, insulation surrounding said anode, said insulation and electrodes forming an isolated chamber and a quantity of lithium within said chamber.

Signed by me at Cambridge, Massachusetts, this 10th day of January, 1927.

CHARLES G. SMITH.