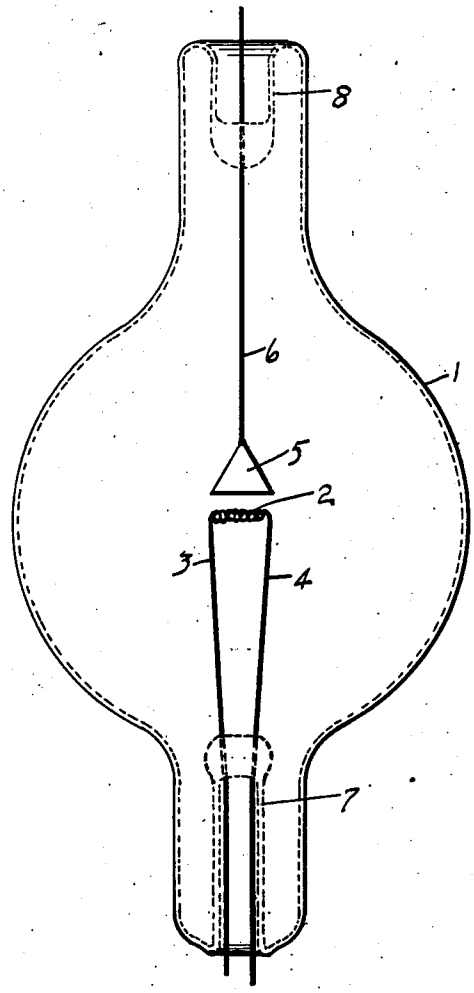
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METHOD OF CONTROLLING THE DISTRIBUTION OF ELECTRIC DISCHARGES

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METHOD OF CONTROLLING THE DISTRIBUTION OF ELECTRIC DISCHARGES.

Application filed March 22, 1921. Serial No. 454,388. 313-212

The present invention relates to electrical devices employing an electron-emitting body, and more particularly to electric arc devices having an incandescent cathode.

An object of my invention is the provision of a method for increasing the life of such devices.

My improvement will be understood and appreciated by reference to the following description of a specific example illustrative of my invention. In connection with this description, I have shown diagrammatically in the accompanying drawing, a device containing an incandescent cathode a portion of which contains a material having high electron-emitting properties.

The device comprises an envelope 1, preferably of glass, which contains a filling of any suitable gas, such as argon. A filamentary cathode 2, adapted to be heated to incandescence electrically, consists of a highly refractory material, such, for example, as tungsten. The ends of the cathode 2 are welded to leading-in conductors 3, 4 which are preferably of a refractory material. The anode 5 consists of conductive material, such as carbon, tungsten, or other refractory material. The cathode current-supply wires 3, 4 and the anode conductor 6 are sealed into stems 7 and 8, respectively in the usual manner.

In the operation of devices of this character prior to my invention, the arc between electrodes tended to concentrate on a limited portion of the cathode, thereby causing a localized electrical disintegration which resulted in a division of the cathode into two parts, by which the usefulness of the device was destroyed.

In electric arc devices, the arc tends to take the path of least resistance. If an electrode of a given material has a non-uniform temperature or is not at the same potential at all points, a point will exist on this electrode from which electrons will most copiously be given off, thereby providing a path of least resistance and resulting in the concentration of the arc at that point. This concentration of the arc still further augments the non-uniformity of temperature and results in a localized electrical disintegration of the electrode which it is desired to avoid. These conditions existed in devices similar to the one described above prior to my invention, inasmuch as the temperature of the cathode was non-uniform because of the conduction of heat from it through its leading-in conductors causing the ends of the cathode to be at a much lower temperature than its central portion, and being heated electrically, the cathode also had a potential gradient so that the potential difference was not the same quantity between the anode and all points of the cathode.

The electronic emissivity of a substance, i. e., the number of electrons emitted per unit area in unit time, depends on the nature of the substance and its temperature. As to the nature of electron emitting bodies, it is known that certain substances, when hot, emit electrons in greater numbers than other substances at the same temperature. For instance, sodium, potassium and many oxides, emit electrons at an elevated temperature more copiously than other materials, such, for example, as tungsten at the same temperature. It is also known that electrons are emitted from a given substance more copiously as the temperature is increased.

In devices employing electron-emitting bodies in which the electrons are transmitted, either through a vacuous space or through a gas, the voltage drop or loss in the arc for a given value of current is less when electrons are copiously given off from the electron-emitting body than when the electronic emissivity is lower. It is, therefore, advantageous to employ bodies which emit electrons in great numbers, other factors being satisfactory.

My invention resides in providing an electrode of such a nature that an arc will tend to be uniformly distributed over it, resulting in a gradual and uniform disintegration of the cathode, thereby giving it a longer life.

In practicing my invention, I have obtained the desired result by applying to the end turns of the helical cathode 2 and to the adjacent ends of its leads 3 and 4, which are relatively cool, another substance capable of greater electronic emissivity than the substance of which the cathode is primarily composed. The effect of this added substance is to increase electronic emission at the relatively cool parts of the cathode, thus decreasing the electrode reluctance at

these points, thereby equalizing the arc drop between the anode and various points of the cathode and tending to spread the arc uniformly over the cathode. A variety of substances may be used for this purpose but it has been found that certain oxides, such as those of strontium, calcium and barium, are well adapted to this purpose.

I have used a mixture consisting of one part by weight of thorium oxide to 9 parts of metallic tungsten powder applied with a suitable binder, such as sodium silicate, and permanently fixed on the cathode and leads by being fused thereon by means of an electric arc. The tungsten powder is used as a mixture with the thorium oxide to assist in permanently incorporating the oxide into the cathode.

In a cathode treated as above described the electronic emissivity of the ends of the cathode leading-in conductors and the cooler parts of the filament is so materially increased, due to the reduction of the thorium oxide to thorium metal, that it becomes comparable with that of the hotter medial or inner section of the filament, thereby resulting in a uniform distribution of the arc, by which a more durable cathode and, therefore, a device of longer life is secured.

What is claimed is:

1. In an electron-discharge device, having an electrode with medial and end portions, means for prolonging the life of said device which consists in an additional material of higher electron-emissivity than said medial portion applied adjacent the end portions only of the electrode to prevent localized disintegration of said electrode.

2. In an electron-discharge device, an electrode comprising a coil of refractory metal, the end turns only of which have applied thereto an additional material of higher electron-emissivity than said refractory metal.

3. In an electron-discharge device, an electrode comprising, as a discharge part, a main body of refractory material containing adjacent the ends of the discharge part only a substance of higher electron-emissivity than said material.

4. In an electron-discharge device, an electrode heated to a non-uniform temperature during operation, but of composite material of different electron emissivities, so as to have a substantially uniform electron flow therefrom.

5. In an electron-discharge device, an electron-emitting electrode comprising a composite body of materials of different electron emissivities, heated to a non-uniform temperature, during operation, said lower temperature portion having the higher electron emission so that a substantially uniform electron flow is obtained from the electrode.

6. In an electron discharge device, an electron-emitting cathode, part of which is relatively hot and another part relatively cool during operation, the cooled part only being coated with a material of higher electron-emissivity than the remainder thereof, whereby a substantially uniform electron flow is secured therefrom.

7. An electron-emitting cathode consisting of a coil of tungsten having medial and end turns, the end turns only of which are coated with a substance of higher electron-emissivity than tungsten.

8. An electron-discharge device comprising a sealed envelope containing an inert gas, a comparatively cool anode and a cooperating coiled incandescent cathode therein having medial and end turns, the axis of the cathode being approximately parallel to the adjacent face of the anode and the end turns only of the cathode being treated to increase their electron-emissivity, whereby concentration of the discharge on the central turns of said cathode is prevented.

9. An electron-discharge device comprising a sealed envelope containing an inert gas, an anode operable below the temperature at which appreciable electron-emission occurs and an incandescible cathode consisting largely of refractory metal containing an additional material of higher electron-emissivity only on the end turns thereof.

10. An electron-discharge device comprising a sealed envelope containing an inert gas, a relatively cool anode and an incandescent cathode consisting largely of tungsten coated only on the end portions thereof with a material of higher electron-emissivity than tungsten, whereby concentration of the discharge on the central portion of said cathode is avoided.

11. The method of making an electrode which will cause an electron discharge to be more uniformly distributed over it, which consists in coating only the end portions of the electrode with a substance of higher electron-emissivity than the body thereof.

12. The method of securing a more uniformly distributed discharge between an anode and a cooperating coiled incandescent cathode in an electron-discharge device, which consists in applying to the end turns only of said cathode, a substance of higher electron-emissivity than the base material of said cathode.

In testimony whereof, I have hereunto subscribed my name this seventeenth day of February 1921.

ERTLE LESLIE HARRINGTON.