

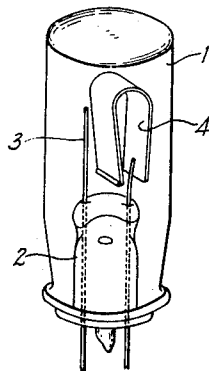
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DISCHARGE DEVICE

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DISCHARGE DEVICE

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5 Claims. (Cl. 250—27.5)

My invention relates to glow discharge devices of the type comprising closely spaced electrodes of large surface coated with alkaline earth metal, such as wire or sheet metal electrodes of iron, nickel, or aluminum. These alkaline earth metal coatings make it possible to attain low starting and operating potentials and are readily produced by the dissociation of azides, carbonates or nitrates of these metals which compounds are applied to the electrode surfaces. The alkaline earth metal coatings produced from carbonates or nitrates give particularly low starting and operating voltages, probably because they are purer than the alkaline earth metal coatings produced from azides. The greater purity of the electrode layer entails also a permanent purity of the ionizable gas with which the device is filled. Frequently, an appreciable time elapses, which may be seconds after application of the starting potential to such devices before ignition of the discharge occurs. This delay in starting is very disadvantageous in a good many applications of such devices; for instance, it is disadvantageous when the devices are used for signalling or relay purposes. In fact, such delay may make the devices useless for such purposes.

Radioactive materials are useful for minimizing the delay in starting of such glow discharge devices. I have observed, however, that when such materials are present in the form of compounds mixed with the alkaline earth metal on the electrodes of the device, the glow discharge does not appear uniformly over the coated surface of the electrodes, which is disadvantageous when the device is used as a lamp, and the starting and operating voltages of the device are increased.

An object of my invention is to provide a glow discharge device having alkaline earth metals produced from the carbonates or nitrates of these metals on the electrodes of the device together with radioactive material which device starts not later than $\frac{1}{1000}$ of a second after the application of the starting potential thereto and which retains the starting and operating voltages characteristic of such devices having no radioactive material on the electrodes thereof. Another object of my invention is to provide a method of manufacturing such devices. Further objects and advantages of my invention will appear to those skilled in the art from the following detailed description thereof.

I have discovered that the above objects are attained when the radioactive material is present in the form of metal which is finely and uniformly distributed in the coating of alkaline earth metal

on the electrodes of the device and when the radioactive metal is produced on the electrode by adding a small amount, preferably less than 0.1 per cent by weight, of a suitable compound thereof, such as radium carbonate or nitrate, to the alkaline earth metal carbonates or nitrates used for producing the alkaline earth metal layer or coating on the electrodes, which radioactive metal compound is decomposed, together with the alkaline earth metal compound, to the form of metal on the surface of the electrode.

The method of my invention makes possible a selection of the quantity of the radioactive metal with respect to the alkaline earth metal, so that the quantity most suitable for a particular use of the device may be applied to the electrodes. Thus, the application of excessive amounts of radioactive metal may be avoided and, since a relatively small quantity of atoms of the radioactive element in the finished electrode layer will suffice to prevent the delay in starting of the discharge, the cost of manufacture of discharge devices comprising radioactive materials is reduced to a minimum.

As the main material for the electrode coating I prefer an alkaline earth carbonate or nitrate, or a mixture of several such carbonates or nitrates, for instance a mixture of barium and strontium carbonates. To the main material I prefer to admix, with the help of a suitable elutriating liquid such as methyl alcohol or acetone, and with the addition of a binder such as a nitrocellulose solution, a slight amount of a corresponding compound of a radioactive element. Thus, radium carbonate may be admixed to the alkaline earth carbonate or carbonates, whereupon the suspension produced in this manner is thoroughly ground. The quantity of added radioactive compound is so measured that, in orders of magnitude, one radioactive atom is added to a million alkaline earth atoms. The mixture is then sprayed on the electrode surface or is applied to the latter by electrophoresis.

A uniform distribution of the particles of the radioactive compound within the structure of the particles of the alkaline earth metal compound or compounds is thus produced on the electrodes. The electrodes are then heated to a glowing temperature in vacuo, in the well known manner. The envelope of the device is then filled with a suitable gas, such as neon, or argon, under a pressure of about 20 to 50 mm. Hg, and the products of decomposition which have remained on the electrodes from the preceding heating are further destroyed by producing dis-

charge impulses between the electrodes. In this manner there is finally produced on the electrodes, with the release of residual gases, a layer of pure alkaline earth metals which is permeated with atoms of a radioactive element. Getter materials, such as zirconium or magnesium, may be placed in the envelope of the device for binding the last traces of gas impurities released.

My invention is useful in connection with relays of the gaseous electric discharge type comprising a bimetallic electrode and used in the starting circuits of ultraviolet and fluorescent lamps of the positive column discharge type having electrodes which require preheating. Such relays are used to connect the lamp electrodes in series across the terminals of a current source to heat said electrodes to a discharge sustaining temperature and to break the series connection between said electrodes when they have attained such temperature. Fast starting of the discharge in relays used in such lamp circuits is highly desirable in order to minimize the time between the application of potential to the lamp circuit and the emission of light by the lamp. Uniform coverage of the glow discharge over the electrodes of the relay is likewise desirable for the same reason, since the bimetallic electrode is thus quickly heated by the glow discharge and flexes into engagement with another electrode in the relay to extinguish the discharge between the electrodes and to permit a heavy heater current to flow through the series connected electrodes of the lamp.

Relays of this type are commonly called switches in the lamp art and a species thereof is disclosed in the copending application Serial No. 400,645, filed July 1, 1941, inventor Leo R. Peters, which application is assigned to the assignee of the present application. The switch disclosed in the copending application comprises a sealed envelope containing an ionizable gaseous atmosphere and normally spaced cooperating electrodes including a stationary electrode and a bimetallic electrode constructed and arranged to make contact with the stationary electrode and thus to extinguish the discharge between said electrodes when heated by said discharge. Metals of low work function, such as the alkaline earth metals, on the switch electrodes make possible the fabrication of switches capable of starting and operating on commercial voltages of 110 and 220 volts.

In the drawing accompanying and forming part of this specification I have shown in a perspective view a switch of the type described above which comprises a sealed envelope containing an ionized gas and having a stem 2 supporting electrodes 3 and 4. Though initially separated, the electrodes engage each other to permit a heavy current to flow through the switch when the bimetallic electrode 4 is heated by a glow discharge between said electrode 4 and the stationary electrode 3. The heavy current is inter-

rupted when the electrode 4 flexes back to its original, spaced position with respect to the electrode 3 a short time after the glow discharge has been short circuited by the engagement of the electrodes. The electrodes 3 and 4 are provided with a mixture of alkaline earth metal and radium in accordance with my invention.

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

1. A gaseous electric glow discharge comprising coating electrodes severally surfaced with layers comprising pure alkaline earth metal permeated with radioactive atoms uniformly distributed therein, in proportions of the order of a minor fraction of a per cent of radioactive metal to alkaline earth metal.

2. The method of minimizing the starting time without increasing the starting and operating voltage of gaseous electric discharge devices of the glow discharge type having alkaline earth metal on the electrodes thereof which comprises the steps of first mixing material from the group consisting of the carbonates and nitrates of the alkaline earth metals with a corresponding compound of radium, applying said mixture to said electrodes and then decomposing said compounds to produce a mixture of radium and alkaline earth metal on said electrodes.

3. The method of minimizing the starting time without increasing the starting and operating voltage of gaseous electric discharge devices of the glow discharge type having alkaline earth metal on the electrodes thereof which comprises the steps of first mixing the carbonate of an alkaline earth metal with radium carbonate, applying said mixture to said electrodes and then decomposing said compounds to produce a mixture of radium and alkaline earth metal on said electrodes.

4. The method of minimizing the starting time without increasing the starting and operating voltage of gaseous electric discharge devices of the glow discharge type having alkaline earth metal on the electrodes thereof which comprises the steps of first mixing the nitrate of an alkaline earth metal with radium nitrate, applying said mixture to said electrodes and then decomposing said compounds to produce a mixture of radium and alkaline earth metal on said electrodes.

5. The method of minimizing the starting time without increasing the starting and operating voltage of gaseous electric discharge devices of the glow discharge type having alkaline earth metal on the electrodes thereof which comprises the steps of first mixing material from the group consisting of the carbonates and nitrates of the alkaline earth metals with a compound of a radioactive metal, applying said mixture to said electrodes, and then decomposing said compounds to produce a mixture of said radioactive metal and alkaline earth metal on said electrodes.

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