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CATHODE FOR ELECTRON DISCHARGE DEVICES AND METHOD OF MAKING THE SAME

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2 Claims. (Cl. 250—27.5)

This invention relates to thermionic filaments or cathodes for use in electron discharge devices, valves or the like.

The object of the invention is to provide such a cathode or filament which has good emission and long life.

According to one feature of the invention a filament or cathode is manufactured so that it has an active surface which comprises one or more alkaline earth metals and one or more metallic oxides.

According to another feature the alkaline earth or rare earth metals, and one or more metallic oxides, form the active surface of the cathode and are alloyed together. Preferably said surface comprises metallic barium and barium oxide.

Other features of the invention will be disclosed in the following description with reference to a preferred method or process of producing the cathode or filament of the present invention.

In thermionic filaments of the oxide type the thermionic activity is attributed by some to the alkaline earth oxide and by others to a supposed film of alkaline earth metal. I have conducted experiments which lead to the hypothesis that there exists a complex of barium metal and barium oxide which has a much higher activity than either constituent alone, and the same is probably true of the other alkaline earth metals and of the rare earth metals. The present invention is believed to provide a cathode having an active surface comprising a high percentage of this complex. Thermionic filaments made in accordance with the invention have been found to have good emissivity which is stable over a considerable period and are believed to be an improvement over any existing filaments of this type.

In order to obtain a cathode according to the invention the following procedure may be followed—

A core or filament is provided with a coating of oxide, which may for instance be barium oxide or strontium oxide or a mixture. The envelope containing the filament and other electrodes is then evacuated and during the evacuation a carefully determined amount of alkaline earth or rare earth metal is applied or added to the filament. This is more easily performed and controlled by passing an ionizing current through low pressure vapour of alkaline earth or rare earth metals, the resulting ions being carried to the cathode by a potential gradient. The

following method is preferably employed to effect the introduction of the barium source into the envelope. A mixture of barium oxide, barium peroxide, and metallic aluminum is heated, whereupon at a certain temperature (depending principally upon proportions) a reaction takes place with the formation of metallic barium and aluminum oxide. Barium may be readily distilled from the mixture. The application to the thermionic device may take place at any stage, that is to say either before or after the performance of the thermit reaction, or after the distillation of the barium. Measures are desirable to prevent oxidation or hydrating of the source while it is being applied, for preference, to the plate of the valve. Saturated hydrocarbons carefully dried over sodium have proved suitable as protection, but any other form may be used, such as another metal. It is convenient to provide a small pocket in the plate (anode) of the valve which may contain the barium source and in order to control the egress of the barium vapour therefrom a covering plate may be used to provide only a restricted outlet from said pocket. Any other means of reducing the vapour pressure of the barium may be used instead of the above.

During the operation of the device, the space current from the cathode tends, by an electrolytic effect, to establish a concentration of oxide at the cathode surface, with a corresponding concentration of alkaline earth or rare earth metal at the core; counteracting this is the normal diffusion effect tending to annul all concentration gradients. The relative concentration of oxide at the surface is also increased by the evaporation of the metals which generally have a higher vapour pressure than the oxides. For these reasons the addition of alkaline earth or rare earth metals is carried further than is required by the proportion of the complex by a certain amount which is determined by the conditions under which the cathode is to run. In certain cases it is necessary to add a further excess to allow for absorption of the metals by the core, while in some cases it is actually preferably to make the metal alloy with the core, which then serves as a reservoir from which the evaporation loss is made good.

What is claimed is:

1. The process of manufacturing cathodes for electron discharge devices which comprises providing the surface of the cathode core with a thermionically active earth metal oxide, evacuating said device, depositing on said oxide dur-

ing evacuation a pure thermionically active earth metal, and causing a space current from said cathode to form an earth metal-earth metal oxide complex on said core, an excess of said pure earth metal being supplied to alloy with said core whereby the latter serves as a reservoir of earth metal for said metal-metal oxide complex.

2. The process of manufacturing a cathode for electron discharge devices which comprises producing a coating of alkaline earth oxides on the cathode core, preparing a reaction mixture of

barium oxide, barium peroxide and aluminum, heating said mixture to reaction temperature to produce a product of metallic barium and aluminum oxide, heating said product in the presence of said cathode to distill the metallic barium therefrom, passing an ionizing current through the vapor of said distilled barium whereby the barium is drawn to the oxide surface of said cathode, and thereafter heating said cathode to intermix said barium with the oxides at the surface of said cathode.

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