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CATHODE FOR THERMIONIC DEVICES

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This invention relates to electron-emitting filaments or cathodes, as are commonly employed in audions, vacuum tubes, and thermionic devices, and particularly to those in which the emission results from an emissive surface formed by the application of a coating to a base or core.

It has for an object the provision of a filameint or cathode emission surface which will render the completed member thermionically active at comparatively low temperatures and with a high degree of durability and uniformity or constancy of acitivity.

Another object is the provision of a filament or cathode coating of the oxide type which will both readily adhere to a metallic core, as platinum for example, and possess a high degree of activity with a long life.

Briefly these objects are accomplished by providing the electrode or core with a coating containing a compound preferably the oxide, of barium and a compound also preferebly the oxide of zirconium. Such a coating may be either in the form of a mixture of the desired oxides in suitable proportions or as superposed coatings of the individual oxides.

A more thorough understanding of the invention will be had from the description to follow.

The general form of device to which my invention is particularly well adapted is commonly known as a thermionic or vacuum tube and comprises three current conducting members, a filament or cathode and input and output electrodes, sealed in vacuum. In the choice of a filament, certain salient features are usually desired, namely high emissivity or activity, low temperature operation, and long life, the latter term being used to denote uniform or constant operating conditions over a long period of time. These ends are accomplished in one manner by providing a heating element or core with a suitable coating which serves as the electron emitting surface and it is to such a surface that my invention relates.

I have found that a satisfactory coating or electron emitting surface is produced by the joint use of a highly active material, as barium oxide, and a compound of zirconium preferably the oxide. With the use of such a combination of materials, a film may be formed on a filament or cathode which possesses not only a suitably high electron emitting activity but also uniformity or constancy of action over a long period of use when employed as the heated cathode of a vaccum tube or thermionic device.

My new combination of materials may be applied to the desired surface in various ways but a process which I have found satisfactory comprises successively coating the heating element or core, such as platinum or a platinum-iridium alloy, with solutions or layers containing the barium compound and with others containing the zirconium compound, and baking the product after each coating has been applied. In this manner, there is formed a completed filament comprising a core having a number of superposed layers of electron emissive material, the individual layers adhering well to each other and to the core. The two solutions to be applied are preferably formed of the same concentration, so that the desired proportion between the barium and zirconium may be readily obtained by suitably proportioning the number of coatings of each.

The particular solvent or flux employed to form a coating solution may be one of several substances but one which I have found to give good results is a molten wax. With such a flux, the core is passed through separate baths of molten wax in which have been incorporated the two metallic oxides in powder form. In this manner, the desired materials may be uniformly distributed over the core surface as a thin film and the wax or flux removed in the baking operation, which is preferably carried out at approximately 1000° C.

The proportions of barium and zirconium may be widely varied to meet the requirements of a large range of operating conditions, but I have found that particularly satisfactory results are obtained by maintaining the ratio of barium as an oxide to zirconium also as an oxide between the ratios of 3 to 1 and 5 to 1 by weight. When the

metals are applied in the form of some compound other than the oxide the ratio limits will be changed in accordance with the relative molecular weights of the materials. When the coating comprises superposed layers of the oxides, the proper proportions may be obtained by employing solutions of equal concentrations in oxide and making the ratio between the number of applications of barium containing solutions and that of zirconium containing solutions correspond to the desired ratio of barium oxide to zirconium oxide.

In accordance with the provisions of the patent statutes the principle of the invention has been described, and exemplified by combinations of materials which in practice have proved to be satisfactory embodiments thereof, but it is desired to have it understood that the examples given are merely illustrative, and that the invention may be carried out in other ways.

The invention having been described, what is claimed as new and desired to be secured by Letters Patent is as follows:—

1. An electron emissive cathode for thermionic devices having a vacuum of the higher order comprising a metallic electrode having a multiple coating consisting of superposed layers containing barium oxide and zirconium oxide, the ratio of the former to that of the latter being maintained substantially between the ratios of three to one and five to one by weight, to afford good adherence to said electrode with a degree of thermionic activity comparable to the activity of barium oxide and a constancy of activity with protracted use of the cathode.

2. An electron emissive filament for use in a comparatively high vacuum for the development of space current comprising a core containing platinum as the essential element thereof, and an electron emissive coating on said core containing as essential elements thereof barium oxide and zirconium oxide, the ratio of the former to that of the latter being maintained substantially between the ratios of 3 to 1 and 5 to 1 by weight, to afford strong adherence to said core with a decree of thermionic activity comparable to the activity of barium oxide and a constancy of activity with protracted use of the filament.

This specification signed and witnessed this tenth day of May, 1926.

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