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INDIRECTLY HEATED CATHODE

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4 Claims. (Cl. 250—27.5)

A customary embodiment of cathodes of the indirectly heated type is composed of a wire-shaped heating element which is covered with an insulating layer, or which is inserted in an insulating body, and a cathode sleeve or cover which surrounds the insulated heating member, the cathode sleeve or cover having a coating of some electron emitting substance on its outer surface. For the proper functioning of cathodes of this type it is absolutely necessary that the insulating layers or bodies have a high electric resistance at the operating temperature. The porcelain-like substances containing silicate as generally used for this purpose do not fulfill this requirement and cause a great number of disturbances during the operation of the tubes. Better results have been obtained by the use of insulating bodies or layers consisting of pure oxides such as MgO, Al_2O_3, ZrO_2 etc., and cathodes in which such material has been used were generally found to operate with good results in tubes having a heating voltage up to 20 volts.

It is the trend in recent times to operate cathodes of the indirectly heated type, with high heating voltages. The tubes to which such voltages are applied may be heated directly from the house lighting system and may be connected in series or in parallel, i. e., in the case of A. C. without an intermediate transformer and in the case of D. C. without series resistance. Tests have shown that the insulating layers consisting of known oxides are of little suitability for this purpose, since changes occur in these layers, apparently by the action of high potentials that appear during operation between the cathode sleeve and the filament (when connected in parallel also between the ends of the filament of a cathode), which in most cases after a short period cause a breakdown of the insulation and thus destroy the tube. So far the best results were obtained with aluminum-oxide as the insulating material. It is difficult however, to carry out a working treatment of this oxide due to its great hardness and its small capacity of baking together. Furthermore, its comparatively low melting point does not admit of its application in general.

Now, it has been found that certain compounds of aluminum-oxide, or mixtures thereof which act in a similar manner, show a surprisingly high dielectric strength, and furthermore, that the working treatment of such materials can be carried out in a considerably easier manner than in the case of pure oxide. These compounds are the aluminum-oxides of the spinel type, such as $MgOAl_2O_3$, $BeOAl_2O_3$, $CaOAl_2O_3$. The electric resistance at glow temperature of these compounds is in part essentially higher than that of the aluminum-oxide. Also the melting point for most of these compounds is several hundred degrees above that of the aluminum-oxide. According to the invention these materials are used for the manufacture of insulating bodies and layers for cathodes to be indirectly heated. It is to be preferred instead of using the natural compounds, which generally are in a very impure state, to produce these compounds from pure oxides through thorough mixing and burning.

The following are some of the ways of carrying out the new method according to the invention. For the purpose of covering the filaments or of lining the cathode sleeves there may be used for instance an emulsion of the powdery compounds in collodion lacquer, or similar liquids through which the parts to be covered are passed, or it may be sprayed thereon. After drying, these coverings are fastened to the carriers through burning. The powdery compounds can also be formed without difficulty into a dough together with tragacanth or similar materials, and as such they can be sprayed to form insulating bodies of various shapes. Preferably these bodies are thereafter burned at 1600°. The insulating members thus obtained possess a superior strength.

In some cases it is advisable instead of producing the pure spinel from the oxides, to use an oxide in excess. In general however, this excess should not amount to more than 20% of the amount of oxide necessary for the formation of the compound.

Furthermore, it is possible to directly use the oxide mixture without additional means for the manufacture of insulating bodies or layers. In this case the transformation of the mixture into the compound occurs during the sintering treatment of the insulating bodies or the sintering of the insulating layers respectively.

In employing for the manufacture of the insulating bodies mixtures consisting of the powdered compound and oxides not yet transformed, it is possible to affect thereby the volume of the pores and the size of the grain of the insulating members to a considerable extent. This is of importance in so far as insulating members, the pores of which having a certain volume, appear to be particularly safe against breaking down.

Finally, in place of a compound, a mixture consisting of several spinels, such as $MgOAl_2O_3$ together with $BeOAl_2O_3$ may be used for the manufacture of insulating bodies and layers.

What is claimed is:

1. An indirectly heated cathode for an electron discharge device comprising an electron emitting sleeve member having disposed therein an insulating core member consisting substantially of one or more aluminum-oxides of the spinel type.

2. An indirectly heated cathode for an electron discharge device comprising an electron emitting sleeve member having disposed therein an insulating core member consisting of the spinel $MgOAl_2O_3$.

3. An indirectly heated cathode for an electron discharge device comprising an electron emitting sleeve member having disposed therein an insulating core member consisting of the spinel $BeOAl_2O_3$.

4. An indirectly heated cathode for an electron discharge device comprising an electron emitting sleeve member having disposed therein an insulating core member consisting of the spinel $CaOAl_2O_3$.

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