Oct. 10, 1939. A. ROSE 2,175,701

METHOD OF MANUFACTURING MOSAIC ELECTRODES

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Fig. 1

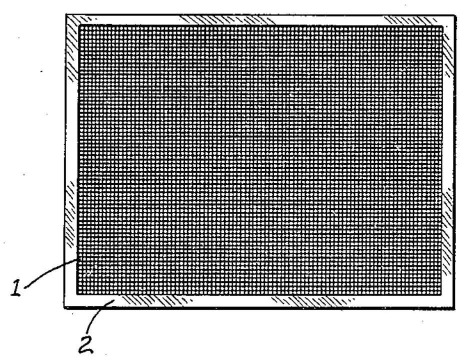


Fig. 2

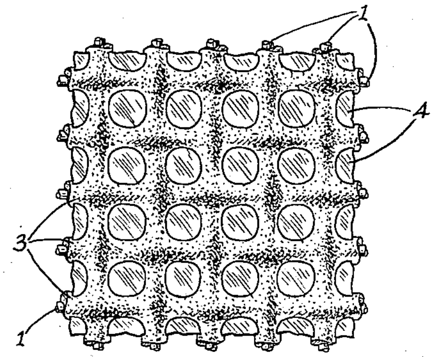
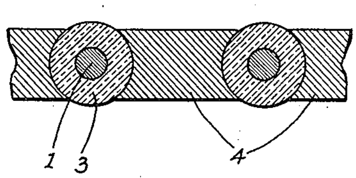


Fig. 3



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METHOD OF MANUFACTURING MOSAIC ELECTRODES

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2 Claims. (Cl. 250—27.5)

My invention relates to a method of manufacturing multi-apertured electrodes of the double-sided mosaic type, such as are used in television transmitting and receiving tubes.

Many types of television transmitting and receiving tubes, such as disclosed by W. H. Hickok in United States Patent 2,047,369 July 14, 1936, utilize a double-sided target or mosaic electrode which consists in general of a fine mesh foundation screen of electrically conducting wire coated with a vitreous enamel, the interstices of the mesh being filled with electrically conducting metal plugs which are oxidized and treated with caesium to provide surfaces high in photoelectric emission or surfaces having high secondary electron emission when bombarded by a beam of high velocity electrons.

The manufacture of such electrodes entails considerable skill and experience as it is exceedingly difficult to obtain an electrode having uniform electrical characteristics over its effective surface. It is necessary to fill the insulated interstices of the foundation screen with a metal or metal compound to form plugs which are of uniform size and are mutually insulated one from another. Any satisfactory method of manufacture should insure all of the holes being completely filled. Double-sided mosaic electrodes of this type have been made by coating the foundation screen with vitreous insulating enamel, the interstices being filled with a paste comprising finely divided metal powder or metal compound mixed with a semi-liquid binder consisting of rosin oil slightly diluted with turpentine. It has been found, however, that by such a method only about 95% of the interstices are filled and, further, that some of the filling is insecurely held within the interstices so that many of the metal plugs fall out during the subsequent steps of manufacture.

It is an object of my invention to provide an improved method of manufacturing double-sided mosaic electrodes for use in television transmitting and receiving tubes which exhibit uniform electrical characteristics over the entire effective surface.

Another object of my invention is to provide a method of manufacturing double-sided mosaic electrodes having minimum electrical leakage and high photoelectron emissivity.

These and other objects, features, and advantages of my invention will appear from the following description taken in connection with the accompanying drawing in which:

Figure 1 is a plan view of one form of a foundation member suitable for use in practicing my invention,

Figure 2 is a greatly enlarged plan view of a portion of a mosaic electrode made in accordance with my invention, and

Figure 3 is a greatly enlarged cross-section of a portion of the electrode shown in Figure 2.

Referring to Fig. 1, the foundation for the mosaic electrode preferably consists of a fine wire mesh screen 1 supported by a frame 2 which may be of metal. All of the wires are coated with an enamel or other vitreous insulating material which has high electrical resistance properties. As best shown in Fig. 2, all of the wires of the mesh are covered with the enamel 3 so that the masses of metal or plugs 4 are held in place in the screen but are thoroughly insulated from the metal of the screen by the enamel coating 3. A greatly enlarged cross-section of this structure is shown in Fig. 3.

In accordance with my invention I plug an insulated multi-apertured foundation member with a paste composed of finely divided metal powder or readily-reducible metal compound and a binder which is solid at room temperatures, melts to a thin liquid at temperatures somewhat above 40° C., and volatilizes at temperatures such that it may be quickly removed at temperatures below the sintering point of the metal powder. A preferred way of practicing my method includes heating both the material and the insulated foundation to a temperature around the melting point of the binder, and applying the heated material to the heated insulated foundation to completely fill the apertures or interstices with the material. The insulated foundation is cleaned of any excess material and the assembly is placed in a furnace to volatilize the binder and A. R. sinter the powder to form the individually insulated metal plugs of the assembly.

The foundation may consist of a perforated metal sheet, but is preferably a closely woven wire mesh screen, and when such a screen is designed for use in television transmitting and receiving tubes, it is desirable to provide a screen having 150–200 or more wires per linear inch if the tube is to be suitable for reproducing a television image in good detail.

The choice of metal from which the foundation screen is made is usually dictated by the availability of suitable insulating enamels. I prefer to use nickel wire screen which I have found to possess certain advantages when coated with a vitreous enamel in which the percentages of alkali and of silica are considerably high and the percentage of boric anhydrid is lower than in the usual enamels. Such an enamel is described by John L. Gallup in his co-pending application Serial No. 115,192 filed September 10, 1936. This enamel is particularly advantageous because it is a poor solvent of metals, has high electrical resistance and has a thermal coefficient of expansion similar to that of nickel at the temperatures attained during manufacture and use. The nickel mesh screen 1 is rolled and treated with acid to increase the area of the holes or interstices as described by Hickok in his patent referred to above. Prior to enameling the nickel mesh I find it particularly advantageous to clean the nickel thoroughly, then oxidize it slightly by heating in air until it assumes a greenish color, probably due to a film of nickel monoxide, NiO. I then spray the mesh with the enamel ground to a particle size under two microns and held in suspension in either water or alcohol. The sprayed screen is then fired in a furnace at about 900° C. in air for a period of 1 to 2 minutes to fuse the enamel into a smooth glassy coating which completely covers all of the metal surface and adheres firmly to it. I prefer to build the enamel coating up to a thickness of approximately 3 mils on the surface of the electrode and to a thickness of ½ to 1 mil on the walls of the holes or interstices in the electrode by applying the enamel in several thin coats and firing the screen after each coat is applied. I find in this way that well-insulated screen electrodes highly suitable for the production of mosaic electrodoes for television transmitting or receiving tubes can be made with such a wire mesh screen.

Following the formation of the insulating coating on the electrode and in accordance with my invention, I fill the interstices thereof with finely divided metal powder, such as silver, or a readily-reducible metal compound such as silver oxide, which is mixed with a binder such as paraffine, preferably paraffine having a melting point of around 50° C. The mixture may be made by melting a small quantity of paraffine and adding to it sufficient metal powder to produce a semi-fluid mass. The insulated foundation member is then heated to approximately the melting point of the binder, which in the example described is approximately 50° C., and the mixture applied by brushing it into the interstices with a camels hair brush. The interstices, however, may be filled in another way which I have found equally advantageous, which comprises coating the foundation member with a layer or film of a binder such as paraffine which is solid at room temperatures, supporting the foundation member on a smooth surface such as glass, heating the foundation to the melting point of the binder, sprinkling the powdered metal uniformly over the surface of the foundation member, and working the metal powder into intimate contact with the binder and into the interstices of the foundation by brushing the assembly with a camels hair brush. The foundation is cleaned of any excess binder and metal powder by maintaining it at a still lower temperature, approximately 35° C. in case the particular binder described is used, and gently rubbing it with a cloth. I have, however, found that the cleaning operation may be performed to advantage by sprinkling additional metal powder over the surface of the foundation and the filled interstices, after the foundation has cooled and the binder has solidified, and then rubbing the foundation with a cloth to remove the excess material. By the use of the latter cleaning method I have found that better separation of the metal plugs filling the interstices is obtained as the additional metal powder serves as an abrader to clean off any excess of the mixture deposited on the foundation between the interstices.

Following the cleaning operation the electrode is fired or baked by placing it in a furnace which is preferably at about 400° to 600° C., to volatilize the paraffine binder, which occurs at a temperature below the sintering point of the silver powder. The baking is continued for ½ to 1 hour at 400° to 600° C. to sinter the silver powder and thereby form the metal plugs. The sintering of the silver powder provides a mosaic electrode wherein the plugs are electrically conducting and firmly held in the foundation so that the assembly will withstand normal mechanical shock during use without the metal plugs falling out of the interstices.

Mosaic electrodes made in accordance with my invention are particularly suitable for use in television transmitting and receiving tubes and may be sealed into the tube and photo-electrically photosensitized by oxidizing the silver plugs and treating the oxidized surface with caesium in the usual way. One method of photosensitizing the surface, which has proven satisfactory, is that disclosed by Sanford F. Essig in United States Patent 2,065,570 December 29, 1936.

My new method of manufacturing mosaic electrodes facilitates the assembly process in that the plugs are easily formed from the metal and binder which solidifies at room temperatures and are firmly held within the interstices prior to sintering. In addition, the use of a low melting point binder which is solid at room temperatures facilitates the formation of metallic plugs of uniform thickness in an insulated screen foundation. Further, in addition, the use of my invention provides a mosaic electrode wherein the interstices are completely filled, there being little likelihood of the plugs falling out of the interstices during subsequent operations in the manufacture of the electrode and during use. While I do not wish to be limited to any particular theory to explain why the plugs are more firmly held in the interstices or apertures of the foundation, I believe that the use of a low melting point binder allows the powdered material to flow into intimate contact with the coating of insulation so that when this material is sintered to form the metal plugs the material will not shrink away from the insulated walls of the foundation. Thus the low melting point binder, when applied either prior to the application of the metal powder at which time the apertures are filled with the binder or when applied directly with the powdered material, causes the material to flow into the interstices or apertures and become lodged very closely to the coating of insulation. This flowing of the binder or binder with the powdered material into the apertures may be due to capillary forces but the final result is a mosaic electrode in which the particles are firmly held and will not become dislodged during subsequent handling or use.

While I have described one modification of my invention utilizing a metal powder such as silver, and a low melting point binder which is solid at room temperatures, such as paraffine, it is evident that the invention is susceptible to other modifications utilizing metals other than silver and normally solid binders other than paraffine. I therefore desire to be limited only to the extent necessitated by the prior art and by the appended claims.

I claim:

1. The process of fabricating mosaic electrodes from a wire mesh screen which comprises coating the exposed surface of said screen with an electrically insulating substance, filling the interstices of the screen with a mixture of paraffine and powdered material which when fired sinters and becomes electrically conducting while maintaining the screen at a temperature approximating the melting point of the paraffine to form individually separated plugs in the interstices of the screen, cooling the screen to solidify the paraffine, applying a quantity of the powdered material to each side of the prepared screen, mechanically working the powdered material into the plugs to remove the excess of the binder from the exposed surface of the insulated screen, and firing the electrode to volatilize the binder and sinter the powdered material.

2. The process of fabricating mosaic electrodes from a metallic apertured foundation member which comprises coating the exposed surface of said member with an electrically insulating substance, coating the insulated surface and filling the apertures of said foundation member with a film of low melting point binder, heating the foundation member to a temperature approximating the melting point of the binder, applying to the film of binder a powdered material which when fired sinters and becomes electrically conducting, mechanically working the powdered material into the apertures and into the binder in the apertures to form individually separated plugs in the apertures of the foundation member, cooling the screen to solidify the binder, applying an additional quantity of the powdered material to the surface of the prepared foundation member, mechanically working the additional powdered material into the plugs to remove the excess binder from the exposed surface of the insulated foundation, and firing the electrode to volatilize the binder and sinter the powdered material.

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