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METHOD OF COATING INSULATING MATERIALS ON METAL OBJECTS

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Fig. 1

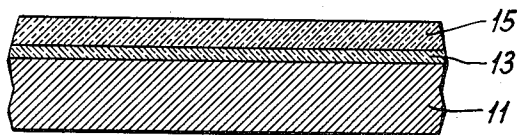


Fig. 2

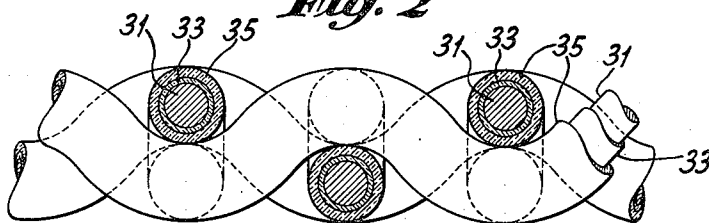
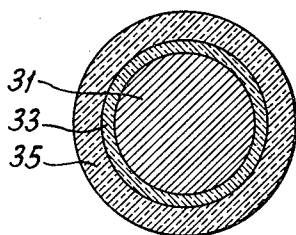


Fig. 3



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METHOD OF COATING INSULATING
MATERIALS ON METAL OBJECTS

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5 Claims. (Cl. 91-70)

The present invention relates to a method of coating insulating materials on metal surfaces.

The invention has been developed more especially in connection with the production of arrangements for transmitting television signals of the kind in which an element having a surface is provided on which an optical image may be projected, the surface being capable of acquiring an electrical charge varying from point to point in the surface in dependence on the light and shade of the optical image projected thereon, this surface being scanned by a cathode ray beam to produce signal currents which may be used for the electrical transmission of the picture to a distant location.

The electrode surfaces adapted to acquire the locally varying electric charge in accordance with the light and shade of an optical image may be produced by forming or applying particles of a metal such as silver on a non-conducting plate usually formed of mica, the silver or like particles being coated with a photo electric layer, the electron emission from which under the action of light produces the required locally varying charge. The reverse side of the supporting plate of mica from that on which the silver or like particles are supported is usually coated with or has applied to it thin film or foil of conducting metal which may serve as an electrode. Electrodes thus prepared are termed "mosaic electrodes," or "mosaics."

In preparing mosaic electrodes as described above it is essential that the mica plate shall be of uniform thickness and quality throughout, otherwise the structure of the mica plate will have an influence on the locally produced electric charges so that undesired effects will appear in the picture as reproduced at the distant location.

Attempts have been made to form supporting plates for mosaic electrodes by evaporating an insulating material onto a supporting plate. However as far as my investigations go, I have found it difficult to produce a uniform vitreous layer of insulating material on a metal supporting plate due to the fact that insulating material does not readily attach itself to the metal and tends to form globules on the plate when fused rather than to become evenly distributed over the plate.

One object of the present invention is to provide a supporting plate for a mosaic electrode for use in a television transmitter which will be uniform throughout.

A further object of the present invention is to

provide a conducting plate with an insulating surface layer of which the insulation resistance can be controlled.

According to the invention a method of forming a coating of insulating material on a metallic surface is provided comprising the step of oxidising the surface of the surface to be coated and condensing thereon after evaporation a layer of an insulating material, and then, baking the coating at a temperature in the vicinity of or above the fusing point of the insulating material.

In describing my invention in detail, reference will be made to the drawing in which Fig. 1 shows diagrammatically a section of a mosaic plate prepared in accordance with my invention, while Fig. 2 shows a modification of the embodiment of my invention shown in Fig. 1 in which a wire mesh mosaic is provided instead of a metal plate, and Fig. 3 shows on a larger scale a cross-section of one of the wires coated in accordance with my invention.

In carrying the invention into practice in connection with mosaic electrodes for television transmission it is preferred to use as the insulating material, lithium borate, which is capable of becoming vitrified after being fused. This is evaporated down in vacuo on to the metal surface to be insulated, the metal having been previously oxidised very lightly. The borate may be evaporated, for example, from spirals of a suitable metal such as tungsten or platinum or from metal crucibles of the same metals. Preferably the evaporation is discontinued when a borate film of a thickness of the order of from 10^{-4} to 10^{-3} mm. has been obtained, the coated metal surface being removed from the vacuum chamber in which the evaporation has been performed and stoved for a few seconds in an inert atmosphere at a temperature some 10° C. above the fusing point of the borate, whereby a vitreous insulating coating is formed on the metal. If the step of baking the coating of insulator is carried out in an inert atmosphere it is found that the degree of oxidation of the base metal is substantially unaffected by the baking operation.

Care must be taken to ensure that the borate film is not too thin initially, as in this case the finished surface will be covered with a large number of "dry patches" whence the borate has run away to thicken up the surrounding film. Moreover, if the borate film is too thick objectionable tendencies may appear in the evaporated film in that the said film may tend to stand away from the metal and flake off, even in vacuo, or

even if the film does not actually begin to flake during evaporation it may be wrinkled and uneven after fusion.

It is found that by oxidising the surface of the coated metal initially, the borate is enabled to wet the surface of the metal plate upon fusion and thus does not draw up into globules but remains as a uniformly disposed film. Moreover, the extent to which the oxidation of the metal surface is carried determines the electrical insulation resistance of the borate film after fusion. For example, if a copper base is used, the picture point resistance of the vitreous film can be made as low as two or three megohms. This would provide a means of forming a semi-insulating layer on a metal plate to form a base for a mosaic electrode for use in a television transmitter whereon the mosaic structure could be maintained at a given potential.

In carrying the invention into practice it also has been found that other conditions being favourable, the most uniform film is formed when the borate just fuses. If the furnace in which the coated object is stoved is too hot the increased mobility of the film causes it to wrinkle. After evaporation the borate film, though insulating, is loose, powdery and easily fractured. The film may be toughened by baking it in air to just below its fusion point, though in this case the insulating film is porous to evaporated metals whereas the vitreous film obtained by stoving the plate at a temperature just above the fusing point of the insulating material is not porous. It will be appreciated that in some circumstances it may be desirable to have the film of insulating material porous. Where a coated metal plate prepared according to the invention is to be used in a television transmitter as described above, lithium borate is preferred as the insulating material because of its low secondary emission when bombarded by electrons and also because it does not poison caesium-silver oxide surfaces, or rob such surfaces of too much caesium.

The invention enables a mosaic to be provided for use in a television transmitter using a simple and clean process which results in a mosaic which itself allows the production of a picture with a clean back-ground. Moreover, with a process according to the invention an insulator can be applied uniformly to very small metal objects such as very thin wires of copper and to intricate structures such as grids of fine metal wire which for instance, may be used in electron multipliers or like devices. It is also possible with the method of the invention to obtain thinner films of insulating material than by ordinary enamelling processes. Moreover, photo electric surfaces (especially of the mosaic type) formed on an insulating surface arranged on a metal back plate in accordance with the invention may be readily constructed with a good useful sensitivity due to the fact that the insulation resistance of the insulating support can be so readily controlled, and hence the photo electric current may be saturated.

It is found that a sheet of insulating material coated or applied on a conducting base according to the invention is extremely flexible. Thus sheet metal coated by the method of the invention can be bent sharply to curves of radius less than a quarter of an inch and straightened again without fracturing the insulating coating.

Thus flat sheets of material of such low strength that they can be deformed without crushing the insulating layer, may be insulated

by the method of the invention and afterwards pressed or otherwise formed into a required shape. This provides a convenient way of forming a metal member with an insulating surface in the case where the shape of the member is such that its surface would normally be difficult to insulate. Also, according to the invention, wires may be coated in long lengths and be bent into shape as required.

Further, according to the invention, an insulating coating may be obtained which is perfectly stable and hard at high temperatures, for example up to at least 625° C. in vacuo, or up to about 800° C. in air. Such a surface can therefore be used in cases where, for example, considerations of space, required the use of small wire to pass a relatively large electric current, for example in an internally arranged focussing coil in an electron discharge device such as a picture intensifier. In such a case wire of small gauge coated with an insulating layer by the method of the invention could be used and a large amount of heating could be tolerated without risk of damaging the insulation. The invention also might be, with advantage, applied to the construction of electrical inductances or resistances which are required to operate with a relatively high load current.

Where it is desired to provide a thin flexible plate for the mosaic, the structure has the form shown in Fig. 1 in which the metal plate 11 has interposed between it and the insulating material 15 an oxidized layer of metal 13. In some instances a wire mesh is used to prepare a double sided mosaic as shown in Figs. 2 and 3 in which the wire 31 is oxidized to provide the layer of oxidized material 33 upon which is then deposited, as described above, the insulating material 35. Such mosaics are well known in the art as is typified by that shown in U. S. Patent No. 2,045,984 to Flory.

I claim:

1. The method of producing an insulating layer on an oxidizable metal base, the steps of oxidizing a surface of the metal base, vaporizing a fusible inorganic insulating material having relatively low secondary emission under electronic bombardment, condensing the vaporized material upon the oxidized surface, fusing the condensed material in an inert atmosphere at a temperature immediately above the fusing temperature of the insulating material, and subsequently cooling the metal base to provide an extremely flexible coating of insulating material upon the metal base.

2. In preparing a mosaic electrode having a metal base, the steps of oxidizing a surface of the metal base, vaporizing a fusible inorganic insulating material having relatively low secondary emission under electronic bombardment, condensing a thin layer of the vaporized material upon the oxidized surface, fusing the condensed material in an inert atmosphere at a temperature immediately above the fusing temperature of the insulating material, and subsequently cooling the metal base to provide an extremely flexible coating of insulating material upon the metal base.

3. In preparing a mosaic electrode having a metal base, the steps of oxidizing a surface of the metal base, vaporizing a fusible inorganic insulating material having relatively low secondary emission under electronic bombardment, condensing a layer having a thickness lying between 10^{-4} and 10^{-3} mm. of the vaporized material upon

the oxidized surface, fusing the condensed material in an inert atmosphere at a temperature immediately above the fusing temperature of the insulating material, and subsequently cooling the metal base to provide an extremely flexible coating of insulating material upon the metal base.

4. In preparing a mosaic electrode having a metal base, the steps of oxidizing a surface of the metal base, vaporizing lithium borate, condensing the vaporized lithium borate upon the oxidized surface to provide a thin layer thereon, fusing the layer of lithium borate in an inert atmosphere at a temperature substantially ten degrees centigrade above the fusing point of lithium borate and subsequently cooling the metal

base to provide an extremely flexible coating of lithium borate upon the metal base.

5. In preparing a mosaic electrode having a metal base, the steps of oxidizing a surface of the metal base, vaporizing lithium borate, condensing the vaporized lithium borate upon the oxidized surface to provide a layer having a thickness lying between 10^{-4} and 10^{-3} mm. thereon, fusing the layer of lithium borate in an inert atmosphere at a temperature substantially 10 degrees centigrade above the fusing point of lithium borate and subsequently cooling the metal base to provide an extremely flexible coating of lithium borate upon the metal base.

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