Oct. 31, 1939. E. R. PIORE 2,178,081

THIN INSULATING FILM

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FIG. 1.

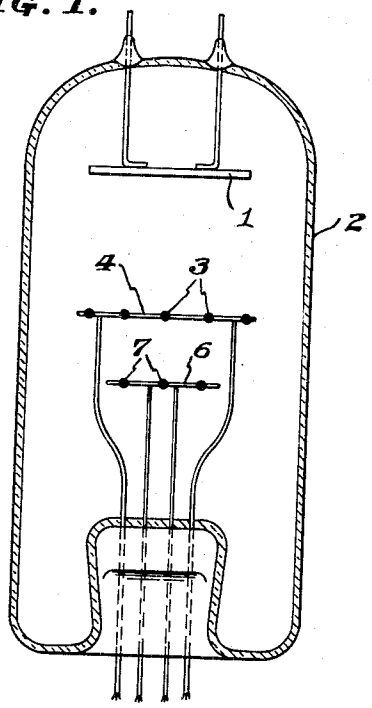


FIG. 2.

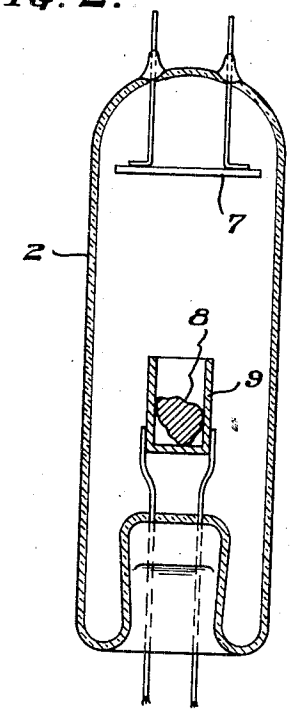


FIG. 3.

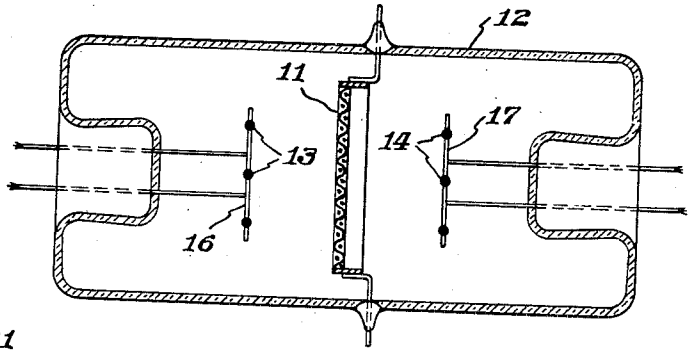
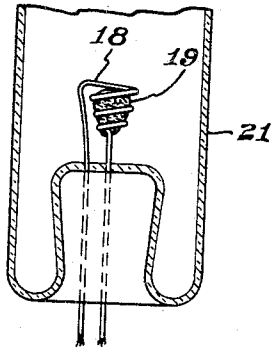


FIG. 4.



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FIG. 5.

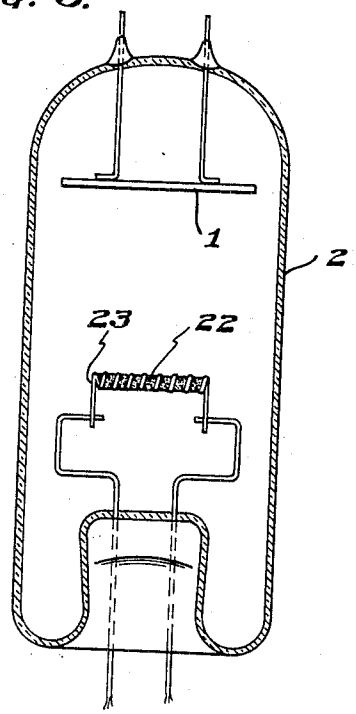


FIG. 6.

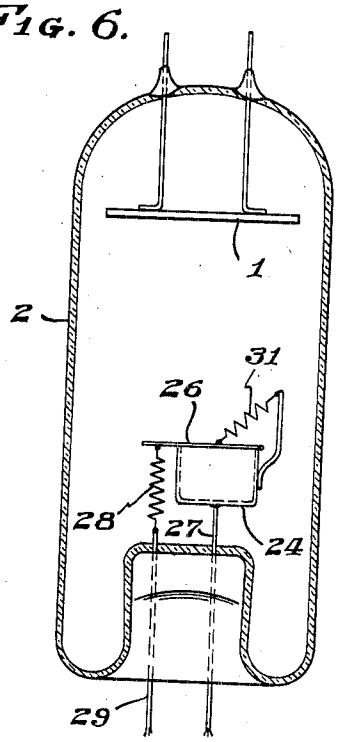
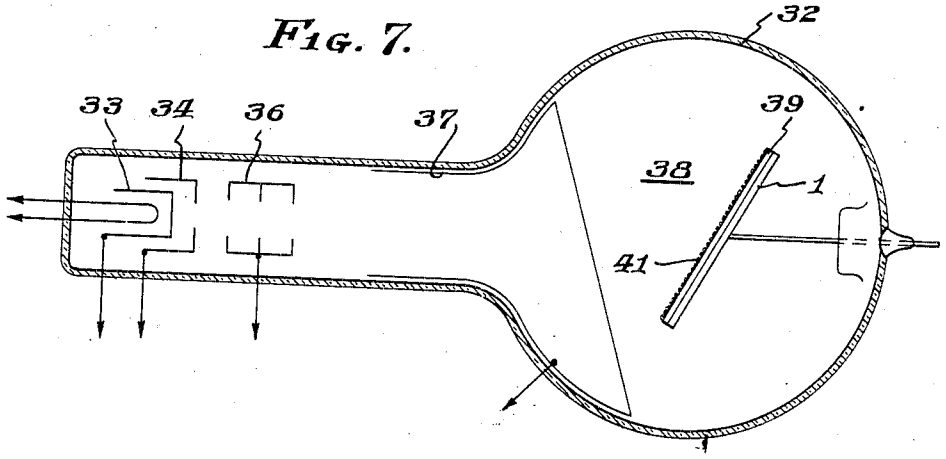


FIG. 7.



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Patented Oct. 31, 1939

2,178,081

UNITED STATES PATENT OFFICE

2,178,081

THIN INSULATING FILM

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Application February 27, 1937, Serial No. 128,057

5 Claims. (Cl. 250—153)

My invention relates broadly to a method of producing thin insulating films and specifically to cathode ray picture transmitting tubes and their method of manufacture.

It is frequently desired to obtain a thin insulating film on a metal surface such as a metal plate or screen. For example, in one form of cathode ray transmitter tube for television, a mosaic of light-sensitive elements is separated from a metal surface by a thin sheet of mica. In a television transmitter tube of another type a metallic screen is given an insulating coating of enamel or the like before the light-sensitive material is applied in the form of a paste.

It has been found that mica of the quality necessary for obtaining the desired thin insulating sheets is expensive and that considerable care must be taken in splitting the mica. In the case of providing an insulating coating on a fine mesh screen, it is difficult to obtain an insulating layer of uniform thickness and of the desired thickness. Furthermore, it appears that caesium has a tendency to combine with the enamel.

One of the objects of my invention is to provide a method of forming insulating films for photo-electric mosaic surfaces which avoids the above-mentioned difficulties.

More broadly an object of my invention is to provide an improved method of forming thin insulating films.

A further object of my invention is to provide an improved television transmitter tube of the cathode ray type and to provide an improved method of making the same.

In accordance with a preferred embodiment of my invention, I form an insulating film upon a conducting surface by evaporating either boron oxide (B_2O_3) or a metal borate upon the conducting surface.

The alkaline earth metal borates, especially calcium borate, strontium borate and barium borate have been found particularly suitable for use in producing photo-electric mosaics for cathode ray transmitter tubes. However, various other metal borates such as tungsten borate and manganese borate will be found suitable as will be explained hereinafter.

The invention will be better understood from the following description taken in connection with the accompanying drawings in which

Figures 1 to 6 are views illustrating various ways of evaporating the desired insulating material upon a conducting surface, and

Figure 7 is a view of a television transmitter tube of the cathode ray type to which my invention may be applied.

Referring to Fig. 1, I have shown a metal plate 1 supported in an evacuated envelope 2. The insulating material which is to be evaporated upon the plate 1 is held in the form of beads 3 on a platinum filament 4. By heating the filament 4 to a suitable temperature, to a red heat, for example, the material of the beads 3 may be evaporated to form a thin insulating film on the plate 1. If the plate 1 is to be employed as the "back plate" of a cathode ray tube mosaic structure for picture transmission, the tube 2 preferably includes a second metallic filament 6 which carries silver beads 7.

After the insulating film has been formed on plate 1, the filament 6 is heated and a film of silver is evaporated upon the insulating film. The plate 1 with the two layers thereon may then be removed from the envelope 2 and mounted in the envelope of a cathode ray tube where the final steps in the preparation of the mosaic are carried out.

The beads 3 may be formed on the filament 4 by mixing the desired borate, such as barium borate, with water to form a paste, placing beads of this paste on the filament and then heating the filament sufficiently to fuse the paste, thus producing fused barium borate in the specific example mentioned. This part of the process may be done in air as the platinum wire will not oxidize. The evaporation of the insulating material, however, should be done in a sufficiently good vacuum to prevent the vapor of insulating material from striking too many gas molecules on its way to the metal plate 1.

Instead of having fused borate beads on a filament I may fuse the desired metal borate or the boron oxide in air and then place a piece of the fused material 8 in a tungsten or platinum cup 9 as shown in Fig. 2. In Fig. 2, as in Fig. 1, the metal plate 1 is supported in an evacuated envelope 2. The material 8 is evaporated by heating the cup 9 by means of a coil carrying a high frequency current, this coil (not shown) being slipped over the tube 2. The method of evaporation illustrated in Fig. 2 is especially suitable when boron oxide is to be evaporated as it is preferred to fuse the boron oxide when in powder form merely by heating it in air. A piece of this fused material may then be dropped into the cup 9.

As previously stated, the borates of various metals may be employed in place of the preferred alkaline earth metal borates. For exam-

ple, the borates of tungsten, titanium, lead, bismuth, nickel, manganese, lanthanum or copper may be used. Preferably a borate should be selected which will not become liquid until the temperature exceeds 500 degrees C., if it is to be employed as the insulating film for a television tube mosaic because a tube of this type is baked at about 500 degrees C.

The borate of any one of the above-mentioned metals may be formed by melting or fusing B_2O_3, generally known as boron oxide, with an oxide of the desired metal. See Text Book of Inorganic Chemistry by Dr. Fritz Ephraim—English edition by Thorne—2nd edition—page 765.

If my invention is applied to the production of television tube mosaics of the double-sided type, that is, mosaics of fine metal screen having "plugs" of photo-sensitive material in the screen openings, the metal screen may be given the necessary insulating coating as illustrated in Fig. 3. In this figure the metal screen, indicated at 11, is supported in an evacuated envelope 12. Borate beads 13 and 14 are located on platinum filaments 16 and 17, respectively, whereby the borate may be evaporated upon both sides of the screen 11 simultaneously to produce an insulating film on all points of the screen.

A tungsten filament may be employed in place of the more expensive platinum filament by shaping the filament as indicated at 18 in Fig. 4 to form a "basket" or "cup" into which a piece of fused borate or boron oxide 19 may be dropped. Since the envelope 21 will be evacuated during the evaporating process, the tungsten filament 18 will not become oxidized.

As shown in Fig. 5, where parts corresponding to those in Fig. 1 are indicated by like reference numerals, the borate 22 may be fused on a platinum filament 23 wound in the form of a spiral instead of being placed on a straight filament in the form of beads.

If desired, the borate or boron oxide may be fused in the evacuated envelope 2 itself as shown in Fig. 6. In this embodiment of the invention a tungsten cup 24 having a lid 26 is supported from a lead wire 27. The borate or boron oxide in powdered form may be placed in the cup 24 and then fused in a vacuum by means of a high frequency coil. The lid 26 is held closed by means of a tungsten spring 28 during the fusing process to prevent the powdered material from reaching the plate 1. After the material is fused, current is passed through the lead wire 27, the cup 24 and lid 26, and through the spring 28 and another lead wire 29 to melt the spring 28. A spring 31 then pulls the lid 26 open and the fused material may then be evaporated upon the plate 1 as described in connection with Fig. 2.

In Fig. 7 there is illustrated a television transmitter tube of the cathode ray type constructed in accordance with the present invention, the tube being of well known construction except for the mosaic. It comprises an evacuated envelope 32 having therein an indirectly heated cathode 33, a control electrode 34, a first anode 36 and a second anode 37. The envelope 32 also has therein a mosaic structure indicated generally at 38. It will be understood that an optical image of the subject to be transmitted is projected upon the front surface of the mosaic 38 and that this surface is scanned by the cathode ray to produce picture signals.

The mosaic 38 comprises the metal plate 1 and an insulating layer 39 formed as described in the foregoing specification, the thickness of the film 39 being greatly exaggerated in the drawings. The photo-sensitive globules or droplets which are insulated from the plate 1 by the borate or boron oxide film 39 are indicated at 41. These globules are formed in a well known manner by heating or baking a film of silver which has been formed on the film 39, the heating being sufficient to break the silver film into globules. The silver globules are next sensitized by admitting oxygen and oxidizing them by a glow discharge and then admitting caesium or some other alkali metal into the envelope 32 after the oxygen has been pumped out and again baking the tube.

The process of forming silver globules is described and claimed in Essig Patent No. 2,065,570. The process of oxidizing the globules is described and claimed in Essig Patent No. 2,020,305.

In the claims the expression "a material comprising B_2O_3" is intended to cover boron oxide itself as well as the various borates.

I claim as my invention:

1. A picture transmitting tube comprising a mosaic structure and means for producing an electron beam and directing it toward said mosaic structure, said mosaic structure comprising an electrically conducting surface having thereon an insulating film of a material comprising B_2O_3, and a multitude of electron emissive elements supported on said insulating film and insulated from each other.

2. The invention according to claim 1 wherein said material is a metal borate.

3. The invention according to claim 1 wherein said conducting surface is a metal plate.

4. The invention according to claim 1 wherein said conducting surface is a metal screen.

5. A picture transmitting tube comprising a mosaic structure and means for producing an electron beam and directing it toward said mosaic structure, said mosaic structure comprising an electrically conducting surface having thereon an insulating film of a compound of boron and oxygen, and a multitude of electron-emissive elements supported on said insulating film and insulated from each other.

EMANUEL R. PIORE.