

Sept. 28, 1954

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2,690,519

INCANDESCENT SCREEN FOR PROJECTION TUBES

Filed Sept. 17, 1952

FIG. 1.

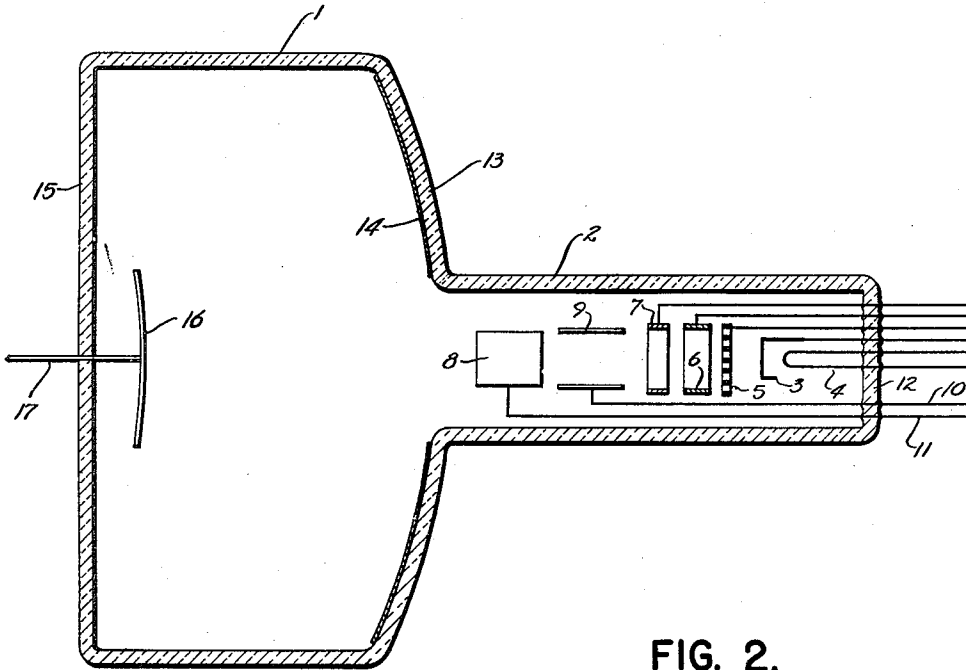


FIG. 2.

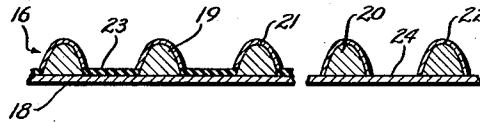
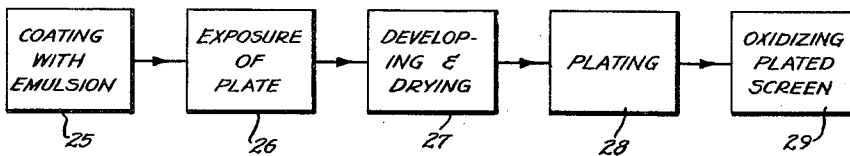


FIG. 3.



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2,690,519

INCANDESCENT SCREEN FOR PROJECTION
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Application September 17, 1952, Serial No. 310,012

3 Claims. (Cl. 313—90)

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This invention relates to improvements in television receiving tubes of the cathode ray type and more particularly to an improved screen structure for use in incandescent television projection tubes.

According to conventional practice, one of the methods heretofore employed in the manufacture of an incandescent television screen consists of impregnating a woven pile fabric with a mixture of salts, such as barium and thorium. The fabric is then burned off, in the manner of an incandescent gas mantle, leaving a screen structure of oxide particles which are incandescent when bombarded by an electron beam. Understandably, such a structure is necessarily fragile and requires delicate handling. Furthermore, this type of screen is unable properly to dissipate the heat generated therein by an intense electron bombardment. Certain arrangements have heretofore been devised to overcome this problem of fragility and heat dissipation by coating a metallic mesh with a luminescent material. This latter type, however, has not met with success as is evidenced by the lack of commercial usage of such a device.

It is well known that the bombarded surfaces of an incandescent television screen must become illuminated in a relatively short space of time and that, upon cessation of the bombardment, the extinguishment of illumination must also necessarily be rapid. This illumination and extinguishing process taking place on the screen surface is determined by the heating and cooling properties of this surface. These properties are greatly dependent upon the mass of the luminescent substance coupled with other factors, such as the dissipative or retentive properties of elements supporting the screen surface.

It is an object of the present invention to provide an improved incandescent screen for television projecting tubes of rugged structure capable of withstanding vibration without deleterious effects, and having relatively rapid illuminating and extinguishing properties.

It is another object of the present invention to provide a method of manufacture for an improved incandescent screen for television receiving tubes.

According to this invention there is provided an incandescent screen for a cathode ray tube comprising a continuous conductive base having on one surface thereof a plurality of spaced islands of a rare earth metal each having relatively wide bases and substantially narrow tips, the outer surfaces of each of these islands comprising an oxide of the earth metal.

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According to this invention the screen is made by providing on one surface of a conductive plate discrete separated deposits having tips of small cross sectional areas and oxidizing the surface of said deposits. The deposits are preferably made by coating the plate with a photographic emulsion, exposing the emulsion coating to photographic radiation over isolated areas, developing the exposed areas, and plating the metal onto the plate at these exposed areas.

In accordance with a feature of the present invention, there is provided a television receiving tube having an incandescent screen adapted to convert an electron beam into visible light when scanned and to thereby provide an optical image. The screen comprises a base plate preferably of a refractory metal such as molybdenum. Upon one side of the base plate there is distributed over the entire surface, a thin layer of incandescent substance in the form of a multiplicity of metallic particles of substantially conical or nodular tip configuration mutually separated from one another and each having a coating thereon of an incandescent oxide.

The method of producing a minutely subdivided incandescent coating may consist in subjecting a base plate preferably of a refractory metal such as molybdenum, or tantalum, to a photo-engraving process of sensitizing, exposing the sensitized surfaces to light through a photographic negative of a sieve-like screen, and then a development treatment whereby to effect a surface having, in extremely fine distribution, innumerable point-like areas of exposed base plate, whereas the remainder of the surface is covered with a hardened enamel. The enamel appears as a sieve-like mesh upon the surface of the base plate, which plate is then subjected to an electroplating bath whereby to deposit in each of the exposed areas on the face of the base plate metallic collections which eventually build up into nodular or cone-shaped particles. These metallic particles consist of a rare metal, such as thorium, cerium, etc. or an alloy of these metals, the oxide of which is incandescent.

The base plate surface with its metallic formation is then subjected to an oxidation process, such as a glow discharge process in vacuo to change the surface of these metallic formations into an oxide. There now exists an incandescent surface on the face of the base plate which will incandesce when this surface is bombarded by an electron gun. These metallic formations with their oxide coating are separated from each other for rapid individual heating and cooling but are spaced closely enough so that a finely focused

electron beam will excite the surfaces of a sufficient number of these formations to provide a satisfactory visible spot thereat.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, in which

Figure 1 is an illustration of a projection-type cathode ray tube employing the incandescent screen embodied in the present invention.

Figure 2 is a fragmentary view, in cross-section, of an enlarged scale, of the incandescent screen shown in Fig. 1 and

Fig. 3 is a block diagram illustrating the steps in the method of preparing the incandescent screen.

Referring now to Figure 1 of the drawing, there is illustrated a projection type cathode ray tube having a glass envelope 1 surrounding the main or body portion of the tube and a stem portion envelope 2. The body portion 1 and the stem portion 2 may be substantially cylindrical and the space enclosed within these envelopes is evacuated. The stem 2 contains a conventional electron gun comprising a cathode 3 which is heated by a filament 4. Also included is a grid 5, a first anode 6 and a second anode 7. The deflecting apparatus therein comprises deflecting plates, such as 8 and 9. Electrical connections to these electrodes mounted in the stem portion 2 are made through conductors, such as 10 and 11, which extend externally of the tube through a press portion 12.

One end wall 13 of the glass envelope 1 is spherically shaped so that a concave surface is formed facing inwardly of the tube. The concave surface 13 within the envelope 2 is covered with a layer of light-reflecting material 14. The other end wall 15 may be suitably transparent and, although not so shown, may consist of an optical lens arrangement. A screen 16 having a surface adapted to incandesce when bombarded by a beam of electrons, is arranged upon a conductive support member 17 which is fixedly attached in the center of end wall 15. While there is shown a tube structure and electron gun elements of one conventional type, it is readily understandable that other suitable structures and elements may be substituted for these shown, for like purposes. In the type shown in the drawing, the spherical mirror 14 serves to project onto an external viewing screen the light image generated by the cathode-ray beam on screen 16, through faceplate 15. If desired, external optical means may be added to aid in forming the image on the viewing screen.

Referring now to the screen 16 contained within envelope 2, reference is made to Fig. 2 of the drawing which shows, on an enlarged scale, a cross-sectional view of the screen structure. There is shown a base plate 18, a coating of metallic particles 19 and 20, and each particle having a coating of incandescent oxide, indicated at 21 and 22. Also illustrated is a section of the base plate 18 having an enamel coating 23 and, alternatively, an uncoated section of the base plate is shown at 24.

As heretofore explained, the purpose of the screen 16 is to incandesce when scanned by an electron beam, whereby to convert this beam into light to provide an optical image. The electron beam, not shown, will impinge upon the incan-

descent material, such as 21 and 22, exciting this material to luminesce within the visible spectrum. The efficiency of the screen 16 is enhanced by minutely subdividing the coating thereon because each elemental luminescent area, such as 21 and 22, will quickly respond to excitation to produce faster incandescence and will likewise cool faster and dispense heat more quickly through the base plate 18.

There follows a description of a method of producing the screen 16 according to the instant invention as illustrated in Fig. 3. The base plate 18 is preferably of a refractory metal, such as molybdenum, and has one face thereof treated in the manner of a photo-engraving process with coating of photo-engravers' emulsion as indicated at 25. This emulsion normally has an enamel base to which there has been added a suitable photographic sensitizer. While the enamel on the face of the base plate 18 is still in a liquid condition, the plate is placed in a heated drying chamber and subjected therein to a spinning process whereby to throw off and remove excess emulsion and at the same time to dry the emulsion remaining thereon. When the emulsion is thoroughly dried, a photographic negative of a sieve-like screen, that is, a plate which is opaque where the screen holes were, is placed over the sensitized surface of the base plate 18 and photographic light rays such as ultra-violet rays are directed therethrough to the sensitized surface as indicated at 26. It is preferred that the original screen will have apertures therein of the order of one million per square inch. It has been found that an exposure of the sensitizer plate for a time duration of twenty minutes at a distance of one foot from the light source is satisfactory.

After completing the exposure, the screen is removed from the face of the base plate 18 and the plate then developed in a suitable photoengravers developing solution. The development process will only remove the enamel coating from those portions of the plate which have not been exposed to the light source through the apertures in the screen. Thus, after development, the plate 18 will have an enamel-like coating through which there will appear, in extremely fine distribution, areas of the base plate separated from each other. The plate 18 with its apertured coating is washed and subjected to a "burn-in" process which consists of appropriate heating, such as by a gas flame, to harden the enamel coating thereon as indicated at 27. The plate 18 is then placed in an electroplating bath of thorium, cerium, barium or alloys or mixtures of these or similar rare earth metals as indicated at 28. The apertured surface of the plate is disposed towards the plating anode so that plating will be deposited only on the uncovered portion of the plate. Plating is continued and the metal deposited through the apertures gradually builds up to form a multiplicity of metallic nodules or cones.

These metallic nodules or cones will be relatively wide at their base plate in contact with base plate 27 and will gradually taper off at their free end to a sort of tip or vertex. Because of the nature of growth during the plating process the tip of the deposits will be rounded and substantially conical regardless of the shape of the exposed areas. The apertured enamel masking coating is preferably removed by a solvent or it may be left intact upon the face of the base plate 18.

The next step consists of oxidizing the surface

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of the metallic mass or cone. This may be accomplished by oxidizing in a rare oxygen atmosphere as indicated at 29. The plate may be placed in an evacuated chamber especially prepared for glow discharge. The plate may be used as the negative electrode with the conical deposits extending toward the positive electrode. Oxygen is then admitted into the chamber to a predetermined pressure and a glow discharge will be caused to occur. As the tips of the deposits are relatively sharp the discharge is concentrated at these tips and they quite soon become oxidized.

It will be understood that the tips of the nodules or cones should be sharp or as pointed as possible. These tips are coated with an oxide adapted to incandesce under the impact of an electron beam. Understandably, incandescence of a relatively sharp tip of metallic oxide will be achieved more rapidly due to lack of mass, and so also will extinguishment be effected as compared with a substantially dull or broad tip which represents a considerable metallic mass.

While the electro-deposit method is preferred in producing the screen, it will be understood that similar construction may be made by depositing the metals on the backing plate in the form of metal oxides. These may be mixed with a volatile salt or other carrier so that upon further heat treatment the deposited material will be left in a porous state. For example the volatile salt may be $(\text{NH}_4)_2\text{CO}_3$. These porous deposits will require less energy to heat to incandescence and so may provide a more efficient screen.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not

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as a limitation to the scope of my invention as set forth in the object thereof and in the accompanying claims.

What is claimed is:

1. An incandescent screen for a cathode ray tube comprising a continuous conductive base member, and a plurality of spaced deposits of rare earth metal on and in conductive contact with said member, said deposit each having substantially conical tips at their free ends, the exposed surfaces of said deposits having a covering of an oxide of said rare earth metal capable of luminescing when impacted by a beam of electrons.
2. An incandescent screen for a cathode ray tube comprising a continuous refractory metal base member, and a plurality of spaced islands of rare earth metals on said member, said islands comprising substantially conical tips at their free ends, said tips comprising an oxide of said rare earth metal which is capable of incandescing under the impact of a beam of electrons.
3. A screen according to claim 2 wherein said tips comprise a porous coating of said oxide.

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