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CATHODE RAY TUBE

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Fig. 1

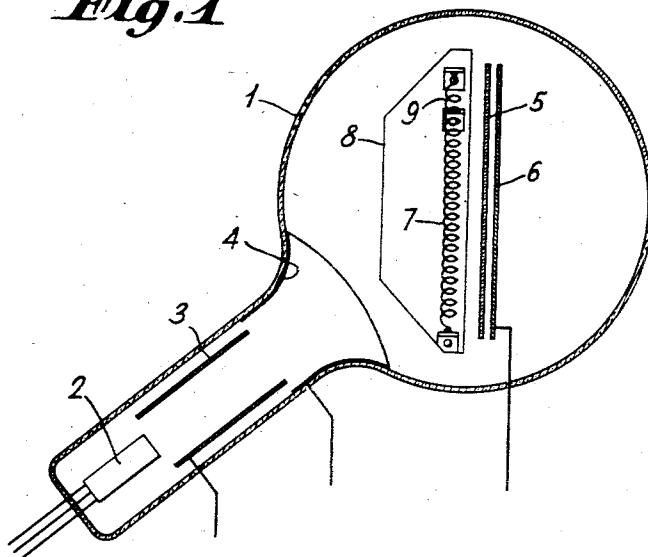
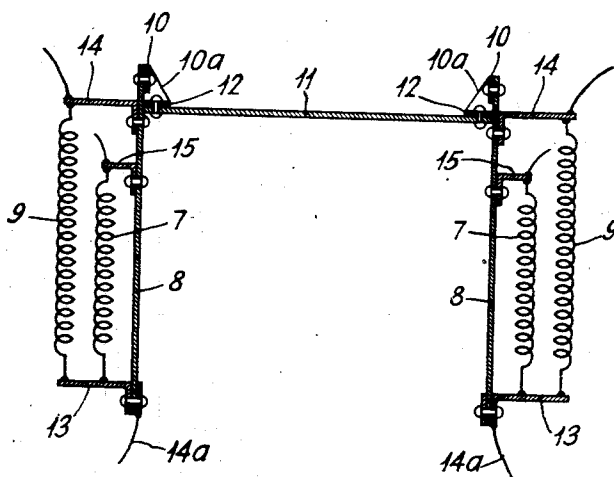


Fig. 2



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CATHODE RAY TUBE

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9 Claims. (Cl. 250—27.5)

This invention relates to cathode ray tubes employing photo-electric mosaic screens.

Cathode ray tubes of this kind are employed in television systems, an image of the object for transmission being projected upon the mosaic screen which is scanned by a cathode ray to produce picture signals for transmission.

In the manufacture of such tubes a support such as a plate of mica or other suitable material is mounted within the tube, such mica plate having a layer of silver provided thereon which is subsequently heated to such a temperature that the layer of silver aggregates into minute globules. Associated with the mica sheet is a conductive signal plate which, in conjunction with the silver globules, forms a multiplicity of small condensers. The aggregated silver layer is subsequently photo-sensitised so that on the projection of an image on to the mosaic screen so formed, the minute condensers acquire electrostatic charges according to the photo-electrons emitted in dependence on the light and dark portions of the image, these minute condensers being restored to a datum potential on scanning the screen with the cathode ray.

The silver surface which is applied to the mica is usually formed thereon prior to assembling the mica support in the tube.

In the specification of British Patent No. 458,586, it has been suggested to apply a thin layer of metal over substantially the whole of the surface of the mosaic screen on which the photo-electric mosaic elements are formed. Such a method serves to improve the insulation between the photo-electric elements of a mosaic screen and additionally the photo-sensitivity of the mosaic screen is improved without increasing the amount of secondary emission obtained when the screen is bombarded with an electron beam.

The quantity of silver or other suitable metal which is deposited on the mosaic screen has to be regulated very carefully, since, if too little metal is deposited, no effect on the insulation is obtained, while if too much silver is deposited, the insulation is decreased, since the metal in such circumstances provides a conductive path between the elements. With a tube having an incorrect amount of deposited silver or other suitable metal, pictures reproduced from signals obtained from such a tube exhibit a marked lack of detail and sharpness.

It is one of the objects of the present invention to provide an improved construction of cathode ray tube with a view to facilitating manufacture of the mosaic screen or to facilitate applica-

tion of the metal layer to the mosaic screen as referred to above.

A further object of the present invention is to provide an improved method of producing a cathode ray tube employing a photo-sensitive mosaic screen in which the amount of silver or other suitable metal which is deposited on the screen for the purpose above-mentioned can be correctly determined.

According to one feature of the invention, a cathode ray tube is provided having within the envelope one or more sources of silver or other suitable metal such as tantalum, molybdenum, iron, tungsten, platinum, nickel, copper or gold is so disposed in relation to the mosaic screen or a support on which said screen is formed and capable of being heated so that the silver or other metal can be evaporated on to the screen or the said support during manufacture of the tube or subsequently during the life thereof.

According to another feature, the invention comprises a method of producing cathode ray tubes employing photo-electric mosaic screens in an evacuated envelope and in which a thin layer of silver or other suitable metal is adapted to be deposited over substantially the whole of that surface of the screen on which the elements are formed, comprising the step of determining, after evacuation and sealing of the envelope, the correct amount of metal to be deposited by projecting an image on to the screen, scanning the screen to produce picture signals, reproducing picture signals and causing the metal to be deposited on to the screen during production of the picture signals, and until the reproduced picture acquires the required degree of sharpness. After the correct amount of metal is deposited, the tube may be subsequently heated at a temperature of the order of 100 degs. to 200 degs. C., and in cases where silver is employed as the metal, satisfactory results are obtained at temperatures between 170 degs. and 180 degs. C.

The present invention, therefore, provides a cathode ray tube in which the initial deposit of silver or other suitable metal can be applied to the mica or other support for the screen while the latter is mounted in position in the tube and also provides a construction of tube in which a deposit of silver or other metal can be applied to the photo-sensitised elements while the tube is in operation for the above mentioned purpose.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawing in which:

Fig. 1 illustrates diagrammatically a cathode ray tube constructed in accordance with the invention and suitable for carrying into effect the method hereinbefore referred to, and

Fig. 2 is a front elevation of the support employed for the metal sources shown in Fig. 1.

As shown in Fig. 1, the reference numeral 1 indicates the envelope of the tube which is provided with a bulbous portion and a tubular portion in which a cathode ray gun of known form is provided. In Fig. 1 only the cathode 2 and the first and second anodes 3 and 4 of the cathode gun are shown. A support 5 of mica or other suitable material is mounted in the tube and associated therewith is a conductive signal plate 6, a lead from which is brought to the exterior of the tube for connection to an amplifier whereby the picture signals obtained on scanning the mosaic screen which is formed on the mica support 5 can be amplified prior to transmission. The surface of the mica support 5 opposite to the surface adjacent to the signal plate 6 is provided with a layer of metal, preferably silver.

In accordance with one feature of the invention, for the purpose of applying the initial deposit of silver or other metal to the mica support 5, one or more sources of metal are provided inside the envelope 1. In order to enable a uniform deposit of metal over the whole area of the screen more than one metal source is provided and in accordance with the preferred form of the invention two metal sources of silver are provided in the tube, one of which is shown in Fig. 1. These silver sources are each in the form of a helix 7 of tungsten wire mounted on a support 8, the support being preferably made of mica and mounted substantially at right angles to the plane of the screen support 5. As shown in Fig. 2 each support 8 carries an additional helix 9 the purpose of which will be hereinafter referred to. Each helix is provided with a coating of silver either by electro-depositing the silver thereon or by applying the silver by other suitable processes, such as by cathode sputtering. The helices may be connected in series and brought to external contacts whereby they can be connected to a suitable source of heating current so that on heating the helices the silver is vaporated onto the surface of the support 5. The support 8 may be shaped as shown in Fig. 1 in order substantially to prevent deposition of the silver on the parts where silver is not required, particularly onto that part of the tube through which the image is projected. The two sources are mounted adjacent to the vertical edges of the support 5 and are arranged as shown in Fig. 2. This figure illustrates the construction of a supporting frame for the helices, the frame being arranged to be collapsible so that it can be inserted through a narrow opening in the envelope 1 and erected in the form shown in Fig. 2. As stated above, the supports 8 are preferably made of mica and at their upper edges they are provided with metal plates 10 riveted thereto, the upper ends of the supports 8 being maintained when in the erected position at the required distance apart by a strut 11 the ends of which are provided with metal plates 12 riveted thereto and attached to the plates 10 by flexible metal strips 10a.

The strips 10a permit the framework to be collapsed on moving the supports 8 outwardly, but maintain the supports 8 substantially at right angles to the strut 11 when erected. The helices 7 are mounted on the supports 8 through the

medium of angle plates 13 riveted to the supports 8, the helices 9, when the latter are employed as hereinafter referred to being connected to the lower angle plates 13 and to angle plates 14, as shown. The lower ends of the supports 8 are provided with struts 14a which are suitably sealed into the envelope of the tube to hold the frame in position. If desired, additional supports or struts may be provided in order to aid in maintaining the framework in the required position. It will be seen that metal sources are placed on the outer surfaces of the supports 8 so that on projection of the image for transmission on to the screen 5, there is little possibility of shadows being formed on the screen due to the presence of the metal sources.

In practice, sufficient silver will be applied to the helices 7 so that on evaporating the whole of the silver deposited thereon, the required amount of silver will be applied to the support 5.

By the arrangement described, the elements can be mounted within the tube prior to the deposition of silver on to the support 5, thus facilitating manufacture and avoiding possibility of damage compared with the known construction on which the support is provided with its deposition of silver prior to mounting within the tube.

In another form of the invention, instead of employing a number of metal sources for providing uniformity in the deposited layer, an annulus or other suitably-shaped source may be provided substantially surrounding the said screen. Further, instead of plating or otherwise coating the aforesaid helices with silver, beads of silver or other suitable metal may be provided within the convolutions of the helices. In another construction, the metal to be deposited is welded or otherwise fixed to small grid-like meshes adapted to be heated by passing a current through them to evaporate the metal. The filaments or grid-like meshes and the sources of metal, if carefully matched, may be heated in series without reducing the uniformity of the resultant layer and, consequently, fewer gas-tight seals will be required compared with a construction in which all the filaments or meshes are heated separately. The grids, instead of having metal mechanically attached thereto, may be electro-plated with the required metal or may have the metal evaporated thereon. Alternatively, metal plates, to which the required metal is attached or which are plated with the required metal may be provided within the envelope and adapted to be heated by eddy currents to evaporate the metal.

In the production of a tube after the silver from the sources 7 is deposited on the support 5, the tube is heated at about a temperature of 650 degs. C. to cause aggregation of the silver. Such globules are subsequently oxidised in known manner and thereafter a photo-sensitive material, such as caesium, is introduced, preferably to a slight excess, so that the sensitivity of the mosaic screen so formed is reduced slightly below the maximum sensitivity obtainable. The tube may then be heated for a short time at a temperature of about 180 degs. C. after which it is sealed from the evacuating pump.

Where it is desired to apply a layer of silver of other suitable metal over the surface of the mosaic screen in accordance with the specification of British Patent No. 458,586, the metal is obtained from the silver sources which are provided in the tube as above described. Where the

tube is designed so that the initial layer of metal to form the mosaic screen is applied from the interior of the tube, it is then preferred to provide the additional metal sources 9 for effecting the additional coating of metal in accordance with the aforesaid British patent. In Fig. 2 it will be seen that each support 8 carries two helices 7 and 9 both of which are provided with a vaporisable metal, one of each pair of helices employed for initially coating the support 8 while the other helix of each pair is employed for providing the additional metal layer. The helices 7 and 9 are so electrically connected that either set can be heated as desired. Alternatively, the sources of metal for the additional coating may be constructed in accordance with the modification hereinbefore referred to.

As stated above, when applying the additional layer of metal, it is difficult to regulate the quantity deposited on the screen and in accordance with a further feature of the invention the cathode ray tube described, since metal sources are provided within the tube, is capable of being operated during deposition of the additional metal layer in order accurately to deposit the additional metal layer. In carrying this feature of the invention into effect, the tube described is connected in circuit for operation and an image of an object is projected on to the screen 5 whereby picture signals are generated on scanning the screen. The picture signals after amplification are fed to a receiving or monitoring tube and the helices or other sources of metal are heated until the picture reproduced in the monitoring tube acquires the required degree of sharpness. Heating of the helices is then discontinued, after which the tube may again be heated at a temperature of the order of 100 degs. to 200 degs. C. and, in most cases where the additional layer is silver, satisfactory results will be obtained at temperatures between 170 degs. and 180 degs. C.

It will be understood that should the sensitivity of the tube decrease during its life, additional metal can be deposited on the screen to improve the sensitivity thereof without the necessity of breaking down the tube, since the required source of metal is provided within the tube.

In cases where the tube with the metal sources is only employed for the deposition of the initial metal layer, which is subsequently aggregated, it is preferred, as stated above, to apply to the helices or other metal sources only sufficient silver or other metal to form the required thickness on the screen support. In some cases, however, more metal than is required for this initial layer may be provided so that the sources can subsequently be employed for providing the additional coating of metal on to the mosaic screen after the screen is photo-sensitized.

It will be appreciated from the above that the tube constructed in accordance with the invention enables silver or other suitable metal to be applied to the support for the screen or to the mosaic screen when formed during the manufacture of the tubes, or, subsequently, during the life thereof, and, in addition, enables silver or other suitable metal to be deposited in accordance with the above described method.

Various modifications may be made in my invention without departing from the general features and embodiments thereof and I desire, therefore, that any and all of such modifications which fall fairly within the spirit and scope of the hereinafter appended claims may be utilized.

I claim as my invention:

1. A method of producing cathode ray tubes employing photo-electric mosaic screens in an evacuated envelope and in which a thin layer of silver or other suitable metal is adapted to be deposited over substantially the whole of that surface of the screen on which the individual photo-electric elements of the mosaic are formed, comprising the step of determining, after evacuation and sealing of the envelope, the amount of metal to be deposited upon the photo-electric mosaic to increase the sensitivity and definition thereof to a maximum by projecting an image on to the screen, scanning the screen to produce picture signals, reproducing the picture signals and causing the metal to be deposited on to the screen during production of the picture signals, and continuing such deposition until the reproduced picture acquires the required degree of sharpness.

2. The method of preparing a photosensitive mosaic surface upon an electrode within a cathode ray tube wherein a cathode ray beam for scanning is developed which comprises the steps of depositing an insulating layer upon said electrode, depositing a continuous film of conductive material upon the insulating layer, thermally reducing the film to produce a mosaic surface comprising a plurality of electrically isolated formed particles each of substantially microscopic size, oxidizing the formed particles, photoelectrically sensitizing the formed particles, thermally removing the photoelectric deposit from areas intermediate the formed particles, tracing the developed cathode ray beam across the formed mosaic surface to produce signals representative of the surface condition, depositing additional conducting material upon the mosaic surface simultaneously with the scanning operation, limiting the period of deposition of the second conducting material in accordance with observations of the signals resulting from scanning, and subsequently heating the formed mosaic over a temperature range of the order of 100° to 200° C.

3. The method of preparing a photosensitive mosaic surface upon an insulating target electrode within a cathode ray tube wherein a cathode ray beam for scanning is developed which comprises the steps of positioning the target electrode within the tube envelope, depositing a continuous film of conductive material upon the target electrode, thermally reducing the film to form a plurality of electrically isolated particles each of substantially microscopic size, oxidizing the formed particles, photoelectrically sensitizing the formed photoelectric mosaic surface, thermally removing the photoelectric deposit from areas intermediate the formed particles, tracing the developed cathode ray beam across the formed mosaic surface to produce signals representative of the surface condition, depositing additional conducting material upon the mosaic simultaneously with the scanning operation, limiting the period of deposition of the second conducting material in accordance with observations of the signals resulting from scanning, and subsequently heating the formed mosaic over a temperature range of the order of 100° to 200° C.

4. The method of preparing a photosensitive mosaic surface upon an insulating target electrode within a cathode ray tube wherein a cathode ray beam for scanning is developed which comprises the steps of depositing a continuous film of conductive material upon the target electrode, thermally reducing the film to produce a mosaic surface comprising a plurality of elec-

trically isolated formed particles each of substantially microscopic size, oxidizing the formed particles, photoelectrically sensitizing the formed photoelectric mosaic surface, removing the photoelectric deposit from areas intermediate the formed particles, scanning the mosaic surface with the developed cathode ray beam, depositing additional conducting material upon the mosaic surface simultaneously with the scanning operation, limiting the period of deposition of the second conducting material in accordance with observations of the signals resulting from scanning, and subsequently heating the formed mosaic.

5. The method of improving the sensitivity of mosaic electrode structures formed from photoelectrically sensitized isolated metallic particles supported upon a dielectric support base within an electron tube which comprises the steps of depositing a metal coating over predetermined portions of the activated mosaic surface, scanning during periods of metal deposition, limiting the period of deposition of the metal coating in accordance with observations of the signals resulting from scanning and subsequently heating at a low temperature.

6. The method of improving the sensitivity of a mosaic electrode structure formed from photoelectrically sensitized isolated electrically conducting metallic particles supported upon a dielectric support base within an electron tube wherein a cathode ray beam for scanning is developed to form a mosaic surface which comprises the steps of tracing the developed cathode ray beam across the formed mosaic surface, depositing additional conducting material upon the mosaic surface simultaneous with the scanning operation, limiting the period of deposition of the second conducting material in accordance with observations of the signals resulting from scanning, and subsequently heating the base to a temperature within a temperature range of the order of 100° to 200° C.

7. The process of forming a mosaic light sensitive surface on a non-conducting base within a cathode ray tube wherein a cathode ray beam for scanning is developed which comprises applying to the base a metallic coating, thermally converting the coating into a plurality of isolated metallic particles each microscopic in size to form a mosaic surface, photosensitizing the individual isolated metallic particles, tracing the developed cathode ray beam across the formed mosaic surface, depositing an additional metallic coating upon the mosaic surface simultaneously with the scanning operation, limiting the period of deposition of the second conducting material in accordance with observations of the signals resulting from scanning, and subsequently heating the formed mosaic over a temperature range of the order of 100° to 200° C.

8. The process of forming a mosaic light sensitive surface upon a non-conducting base within an electron tube which comprises applying a metal compound to the base, reducing the compound to form a mosaic surface of isolated metallic particles microscopic in size by the application of heat, applying a layer of alkali metal upon the surface of the base, removing the alkali metal between the particles, depositing an additional metal compound coating over predetermined portions of the activated mosaic surface, scanning during periods of metal deposition, limiting the period of deposition of the additional metal coating in accordance with observations of the signals resulting from scanning and subsequently heating at a low temperature.

9. The method according to claim 1, wherein after such an amount of metal has been deposited as will ultimately produce maximum sensitivity and definition, the tube is heated to a temperature on the order of 100° to 200° C.

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