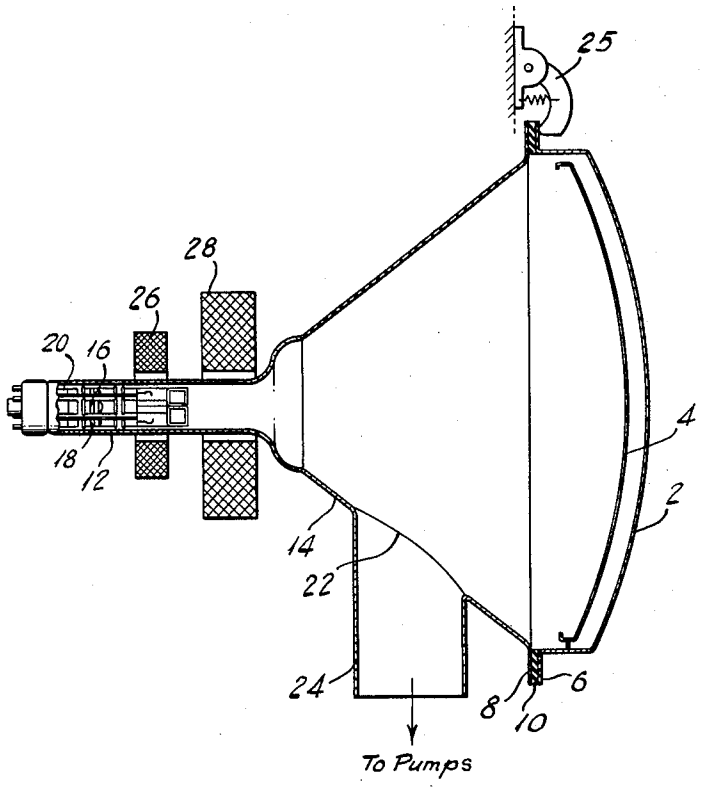
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METHOD OF FORMING COLOR PHOSPHOR MOSAIC
FOR TELEVISION PICTURE TUBES
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METHOD OF FORMING COLOR PHOSPHOR MOSAIC FOR TELEVISION PICTURE TUBES

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My present invention relates to color television reproducing tubes of the type employing three "color guns" the electron beams from which scan the phosphor mosaic through a mask to selectively activate phosphor dots of the corresponding color, and comprises an improved method for producing the phosphor mosaic that insures a more accurate correlation between the gun positions and the locations of the phosphor dots of the mosaic.

A brief description of one presently standard process for forming the three color mosaic screen of color television picture tubes will aid in an understanding of the invention and of the advantages flowing from the practice thereof. The face plate of a picture tube, prior to assembly on the tube, is first uniformly covered with a slurry comprising a blue phosphor powder, an alcohol which polymerizes when exposed to ultraviolet light, for example polyvinyl alcohol, and a dichromate. After the slurry is partially dried, a showdow mask, comprising a sheet having closely spaced small holes therein, is positioned over the slurry. The plate and mask are then mounted on a horizontal frame with the mask lowermost. A source of ultraviolet light, positioned with reference to the plate at a location corresponding to that of the "blue gun" is then energized to irradiate the phosphor composition through the holes of the mask and to thereby polymerize the polyvinyl alcohol and render it insoluble. The mask is then removed and the unexposed portion of the phosphor composition washed off the face plate. After heating to dry and harden the dots remaining on the plate, a slurry containing another color phosphor, usually the green phosphor, is then flowed over the face plate carrying the formed blue dots, the mask replaced in the exact initial position and the new composition irradiated by ultraviolet light from a source located as will be the "green gun" of the picture tube. The same process is repeated in forming the red dots.

In mosaic color screens made in the above described manner or by the well known method of phosphor settling, the correlation between the dot positions and the electron guns is not entirely accurate and various correcting means have to be provided to avoid "fringing" or color overlap. The larger the mosaic, the greater the difficulty in correcting for misalignment of the dots. One reason why the conventional process positions the color dots inaccurately it because light rays, which travel in straight lines, are used for determining the dot locations, whereas electrons, which do not travel in straight lines because of the action of the deflection field, and which are affected by the earth's magnetic field, are used during reproduction. Corrective lenses which are ordinarily used in an attempt to correct for the differences between the paths of the light rays and of the electron beams are only partially successful. One method of reducing color fringing with mosaics made by the convention processes is to use a mask during reproduction having the same number of holes as that used in making the mosaic but of smaller size. This method results

in better color purity but reduces luminosity and yields poor picture detail.

In accordance with the invention, it has been found that by a relatively slight variation in the conventional procedures, electron beams, instead of ultraviolet light rays, may be used to locate the color dots on the face plate. Thus identical paths may be traced by the spot locating and picture reproducing beams, no corrective means are required, no reduction in size of hole in the reproducing shadow mask is necessary and full advantage of the scanning beam may be taken to insure greater color brillancy and finer picture detail.

In order to utilize electron beams for dot location two apparent obstacles had to be overcome. It was expected that the photosensitive chemicals in the phosphor composition would not polymerize when exposed to electron bombardment, and that this phosphor composition would dry and become unusable under vacuum conditions necessary during dot formation for duplication of the electron paths in the finished tube. I found experimentally that when a phosphor composition was subjected to electron bombardment under conditions corresponding to those during reproduction of an image in a finished tube, the photosensitive chemicals of the composition polymerized in the same way as when irradiated with ultraviolet light and that polmerization was substantially complete within a period of only a few minutes. I also found that if the air pressure between the electron source and face plate upon which the color dots are to be placed is relatively rapidly reduced and electron scanning of the phosphor composition effected promptly upon attainment of the correct low pressure, the phosphor composition retains sufficient liquid for efficient use.

The single figure of the accompanying drawing to which reference may now be had, illustrates diagrammatically equipment suitable for use in practicing the invention.

In the drawing the face plate upon which a three color phosphor dot mosaic is to be formed in accordance with the invention is indicated at **2** and the shadow mask at **4**. The flange **6** of the face plate is sealed to a flange **8** of an evacuatable chamber by means of a rubber gasket **10**. The evacuatable chamber is preferably of the general shape and of the dimensions of the color television tube in which the face plate **2** carrying the formed mosaic will be incorporated. The chamber comprises a glass neck **12** and a metal horn **14** sealed to the flaired end of the glass neck **12** and terminating about its periphery in the flange **8**. Within the neck are three color guns **16**, **18** and **20** positioned with respect to the face plate **2** in accordance with the positions of the three color guns of the completed television tube. A large port **22** in the side of the metal horn **14** connects through piping **24** to a suitable vacuum system, such as a diffusion pump (not shown). A convergent yoke **26** and deflection coil **28**, which are preferably identical with those used with the finished tube, are positioned about the neck **12**. The color guns are substantially identical with the guns to be used in the finished tube except that preferably the cathodes are replaced by tungsten filaments to avoid the necessity of activation each time they are energized. The chamber comprising the neck **12** and horn **14** is positioned horizontally so that the effect of the earth's magnetic field upon the electron paths will be the same as in the color picture tube.

After the phosphor composition including the light sensitive constituent has been placed on the face plate **2**, uniformly distributed and partially dried and the mask **4** mounted in the face plate, the face plate carrying the mask is sealed to the flange **8** of the horn. The chamber is then evacuated to a pressure of about 10^{-4} mm. of

mercury. The gun corresponding to the phosphor color is then energized and proper sweep voltages applied to the deflection coil **28**. Also the proper convergent voltages are applied to the convergent yoke **26** so that the electron stream will approach the shadow mask **4** from the correct angle at the edges of the field. The voltages applied to the gun are the same as those which will be used in the final tube and hence the electrons follow the same paths in the chamber that they follow in the finished tube. The exposure time to the electron beam is between two and four minutes. The pump is then turned off, air admited to the chamber and the face plate removed. After removal of the shadow mask **4**, washing off of the unexposed composition to leave the formed phosphor dots and drying the process is repeated with a phosphor composition of another color as heretofore described.

In order that the face plate **2** will be properly oriented when replaced for location of the succeeding phosphor dots suitable alignment fingers such as that indicated at **25** are provided for cooperation with orienting dimples in the flange of the face plate. Preferably the walls of the chamber, and particularly of the glass neck **12**, are relatively thick compared to the wall of a color television receiver to prevent possible distortion under vacuum and to aid in the precision line-up of the guns.

The foregoing description applies to one suitable type of apparatus for practicing the invention. Various other equipment might be employed. For example, although rapid exhaustion of the chamber is preferred to insure against premature drying of the phosphor composition, it is possible to pratice the invention using as the exhaust chamber the actual tube which will later have the face plate permanently secured thereto. In this case the exhaust has to be done through the exhaust tubulation of the picture tube and therefore a longer time is required to reduce the pressure within the chamber. One advantage, however, is that possible misalignment of the color guns in the finished tube in relation to one another does not affect the positioning of the dots, as they are positioned in such a way as to correct for the defect in the gun locations.

The new method of the invention for forming a color phosphor dot mosaic has now been described. Although the invention has been explained with particular reference to the slurry method of deposition of the photo-sensitive phosphor composition on the face plate of a tube, the invention is not concerned with the particular technique employed for deposition of the compositions but only with the novel method of exposure of the deposited composition to form the phosphor dot mosaic. Certain advantages of the invention with reference to the correct positioning of the dots has been indicated. A further advantage of the new method is that it permits the use of "post deflection focusing" which is a term applied to the

application of accelerating voltage between the color mask and screen. When such accelerating voltage is applied it produces a smaller cross section of electron beam at the screen than the area of the hole through which the beam passes and therefore permits the use of a mask with larger holes. Thus a larger proportion of the electron beam passes through the mask. With the conventional technique of forming the dots by ultraviolet light this post deflection focusing is of no value since one can not increase the size of the holes because then the dots would overlap. About fourfold increase in brightness of the screen can be effected by the use of the present process combined with post deflection focusing.

A further advantage of the new process is that wire grids instead of shadow masks can be used. The present process utilizing ultraviolet light can not be used directly with wire grids because the wires do not cast big enough shadows. With the method of the present invention no problem is involved as the wires of the grid create "electron shadows."

A further advantage in the new process is that not only can the time of exposure of the phophor composition to the electron beam be controlled but also the intensity of the bombardment can be controlled. The result is accurate positioning of the dots, avoidance of the use of correcting means and reduction or elimination of shrinkage due to poor purity of colors.

The following is claimed:

1. In the method of preparing a phosphor mosaic screen for color television picture tubes wherein a photosensitive color phosphor composition on a face plate is exposed through a mask to radiation from a source located with respect to the face place in accordance with the intended location of the electron color gun during reproduction, the improvement which comprises utilizing an electron gun as such source, providing an enclosure for the electron source and phosphor composition, evacuating such enclosure at a rate rapid enough to bring the pressure down substantially to that within a picture tube without substantial reduction of liquid content of the phosphor composition, scanning the composition through the mask with a beam of electrons from the gun and completing the scanning operation while the composition is still moist.

2. The improvement according to claim 1 wherein the face plate is maintained in vertical position during the scanning of the phosphor composition by the electron beam to compensate for the effect of the earth's magnetic field on the electron beam.

References Cited in the file of this patent

UNITED STATES PATENTS

2,727,828 Law ---------- Dec. 20, 1955.