May 29, 1962 R. D. EATON 3,037,136

CATHODE RAY TUBE

Original Filed May 4, 1953 2 Sheets-Sheet 1

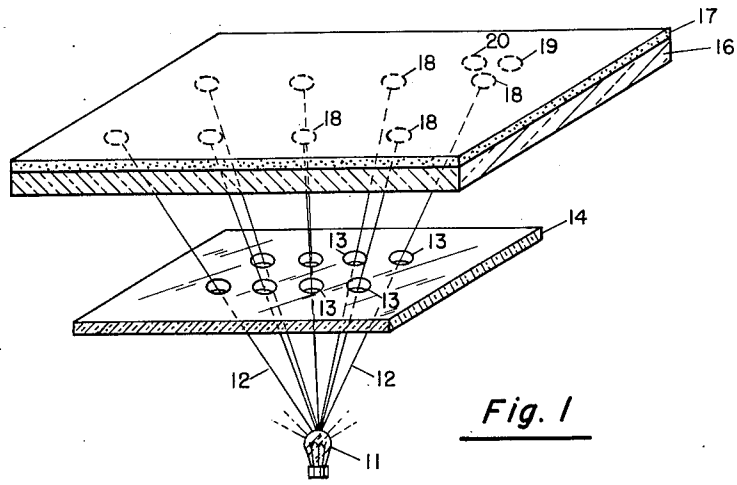


Fig. 1

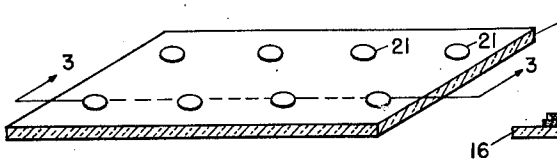


Fig. 2

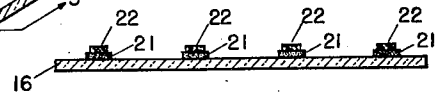


Fig. 3

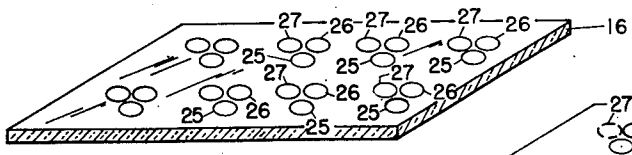


Fig. 4

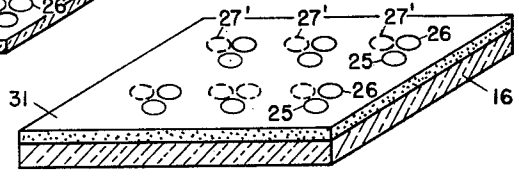


Fig. 5

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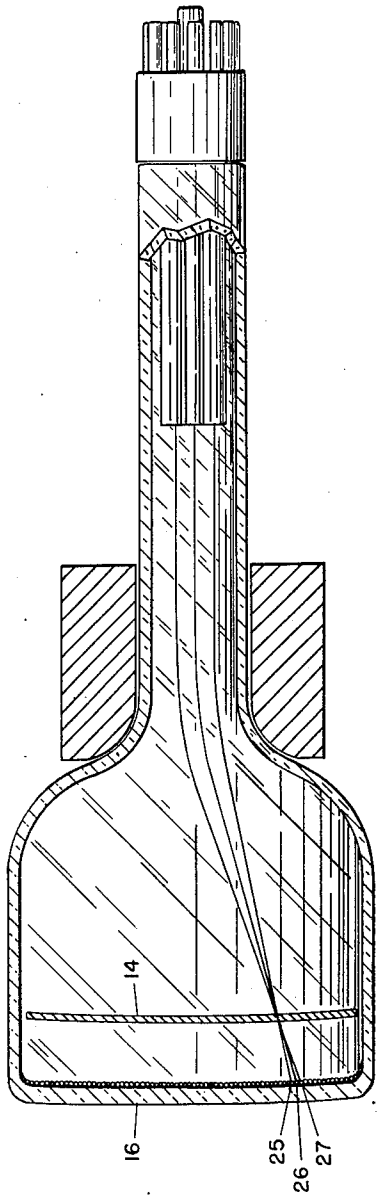


Fig. 6

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3,037,136

CATHODE RAY TUBE

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Original application May 4, 1953, Ser. No. 352,911. Divided and this application Oct. 14, 1954, Ser. No. 462,287

9 Claims. (Cl. 313—92)

This application is a division of my application Serial No. 352,911, filed May 4, 1953, now abandoned, entitled "Process for Making Color Television Tubes."

This invention relates to color television, and particularly to a cathode ray tube structure and apparatus and processes for producing and manufacturing color television screens of the dot-phosphor type or lime-phosphor type.

Objects of the invention are to produce a new and improved cathode ray tube structure for color television screens more accurately and at lower cost than has been possible heretofore. Other objects will be apparent.

Basically, the invention contemplates the production and structure of color television tubes and screens by a method in which light is directed through a mask and onto a screen or plate coated with a photographic emulsion. The emulsion is photographically developed, and then removed in all areas except where the light has impinged thereon. Suitable phosphor material is then attached to the remaining emulsion areas. The process may be repeated to affix differently colored phosphors to different parts or areas of the screen, i.e., phosphors which produce light of different colors when struck by electrons.

Referring to the drawing,

FIG. 1 shows apparatus for directing a light beam onto a photographic emulsion in accordance with a preferred embodiment of the invention,

FIG. 2 shows a color screen from which a photographic emulsion has been removed except where light has impinged thereon,

FIG. 3 is a cross-sectional view of FIG. 2 taken on the line 3—3 thereof, and shows phosphor material affixed to emulsion areas on the screen,

FIG. 4 shows a portion of a completed color television screen made in accordance with the invention,

FIG. 5 shows a color television screen made in accordance with an alternative embodiment of the invention, and

FIG. 6 is a side elevational view of a cathode ray tube with portions broken away and showing an embodiment of the invention incorporated within the tube.

The invention is accomplished, in its preferred embodiment, by the apparatus shown in FIG. 1. A point source of light **11** directs rays **12** of light through suitable apertures **13** in a mask plate **14** and thence through a transparent glass plate **16** onto a photo-sensitive emulsion layer **17**. Impingements of the light rays **12** on the emulsion **17** are indicated by the numerals **18**. The emulsion **17** preferably comprises a gelatin type silver emulsion which has been sprayed or flow-coated onto the glass plate **16**. The relative positions of the emulsion **17**, the mask plate **14**, and the light source **11**, and the positions of the apertures **13** in the mask plate **14**, are such that the impingement areas **18** will occur at suitable locations for a desired type of color phosphor which will be positioned as described later on. It is to be understood that the masking plate **14**, as described, is for forming a dot-type screen, in which dots **18**, which will represent one color, are positioned as aforesaid, and other dots **19**, **20**, will be positioned as described hereafter. However, instead of dot structures, the mask **14** may comprise a line-type structure or any other desired configuration.

After the photographic emulsion has been exposed in areas **18**, as described, the emulsion **17** on the plate **16** is developed in the normal photographic manner to give a silver image, and is then placed in a bleach bath, as for example, a solution comprising sodium bichromate 2 to 4%, 2% hydrochloric or acetic acid, and a small amount of potassium bromide (such as .5%). The bleach changes the silver into silver chromate and, at the same time, hardens and tans the gelatin in the vicinity around the developed silver. The emulsion **17**, and plate **16**, are then placed in warm water (at about 110° F.), and the undeveloped gelatin melts off whereas the hardened dot-pattern gelatin areas **18** remain on the plate **16**. The plate **16**, which now contains hardened gelatin dots, as indicated at **21** (see FIG. 2), is then placed into a hypo bath wherein the silver chromate is removed, leaving only gelatin in the dots **21**.

The plate **16** is then partially dried, taking care that the glass areas between the dots **21** are completely dried. The plate **16** is then quickly heated to the point where the gelatin dots **21** become sticky or tacky. Then a phosphorescent material having a particular color response such as, for example, willemite which phosphoresces in a green color, is sprayed or powdered over the surface of the plate **16**. The phosphor material will adhere to the tacky gelatin dots **21** but may be shaken or blown off the remaining surface of the plate **16**. Thus, a first dot pattern of a particular color-responsive phosphor material has been formed (see FIG. 3) in the form of phosphor dots **22** affixed to gelatin dots **21** on the glass plate **16**.

Another type of phosphor material representing a different color may now be applied in a similar manner, as described above, i.e., the plate **16** is again coated with a photographic emulsion **17**. Either the light source **11**, the mask **14**, or the plate **16**, is shifted slightly so that the light rays **12** impinge upon the emulsion **17** at different places, such as that indicated symbolically by the numeral **19** in FIG. 1, with respect to the original dots **18**. The above-mentioned steps of developing, bleaching, melting off undeveloped gelatin, and fixing in a hypo bath, are repeated. A second type of phosphor having a second desired color response characteristic, such as blue color, is now applied to the surface of the plate, where it adheres only to the newly formed gelatin dots represented by the numeral **19** in FIG. 1. The final second phosphor dot structure is indicated by the numerals **26** in FIG. 4, whereas the first phosphor dot structure is indicated by the numerals **25**.

The above-mentioned procedure may now be repeated to form a third phosphor dot structure, as indicated by the numerals **27** in FIG. 4. In the preferred dot patterns, as shown, the three types of phosphor materials are arranged to form color-dot triads in the well-known manner. Alternatively, the phosphor patterns may be in the forms of strips or other desired shapes.

A complete method has been described for forming a three-color television screen. The screen may be mounted in a color television tube in the well-known manner, preferably with a masking plate, similar to the masking plate **14**, positioned parallel to and behind the color plate **16** so that an electron beam or beams may be directed through apertures in the masking plate and against the various color-representative phosphor areas **25**, **26**, **27**, whereupon the phosphors produce light in accordance with their respective responsive characteristics.

Instead of forming the third color dot pattern as described above, the process may be simplified, in certain

instances, by applying the third phosphor to the entire remaining area of the plate **16** after the first phosphor patterns **25**, **26**, have been constructed. As shown in FIG. 5, this alternative third phosphor structure comprises a coating **31** of the third type of phosphor on the surface of the glass plate **16** between and around the first two types of phosphors **25** and **26**. The areas of the third type of phosphor **31** which will be utilized in the final dot-type television tube, are indicated by the dotted areas **27'**.

The third type of phosphor material may be applied to the plate **16**, in the alternative method, by dipping the plate **16** (containing the two types of phosphor dots **25—26**) into water temporarily. Excess water is blown off with air. The plate is then dipped into a solution of thin oil or water repellent lacquer. At this stage, the gelatin dots holding the first and second phosphor materials **25**, **26**, will have absorbed water, and the remainder of the glass is wetted by the oil or water repellent lacquer. The third color (red, for example) of phosphorescent material, preferably in powdered form, is blown on or sprayed over the entire plate, the excess being blown off with air. This leaves the entire plate **16** covered with the third type of phosphor except for the dot areas covered by the first and second types of phosphor material. The plate **16**, with the three phosphor materials thereon, is baked whereupon the gelatin and the oil (or water repellent lacquer) is burned to carbon and then is converted to carbon dioxide (CO_2), leaving only the three phosphor materials sticking to the plate **16**. A coating of potassium silicate (3 to 5%) is then sprayed or flowed over the plate and phosphor materials, and functions to aid in holding down the phosphor materials to the glass plate.

As a second alternative embodiment, if desired, the third phosphor structure on the plate **16** may be formed from the second type of phosphor material. Thus, only two kinds of phosphor material are required for forming a three-color phosphor structure, as follows. The first phosphor structure **25** (see FIG. 4) is applied to the plate **16** in the manner described above. This first phosphor may be, for example, a blue-responsive type of phosphor. Then the second and third phosphor dot structures **26**, **27**, are applied to the screen **16**, using the same type of phosphor material such as, for example, a red-responsive phosphor, for both of the dot structures **26**, **27**. One of the red-responsive dot structures, such as the dot-pattern **27**, is suitably contaminated so as to be made responsive in a third color, such as yellow. This conversion of the red responsive phosphor into a yellow responsive phosphor may be accomplished by contaminating the red-responsive phosphor dots **27** with silver, as follows, using, for example, zinc phosphate as the red-responsive phosphor.

The dot structures **26**, **27** are initially formed of red-responsive phosphor material. The structures are then exposed, in differing amounts, to light. For example, the dots **26** may be exposed 10 seconds, and the dots **27** may be exposed 30 seconds. The screen is then photographically processed as has been described, except that the screen is bleached only long enough to thoroughly bleach out the silver from the lesser-exposed dots **26**. Some silver remains in the greater-exposed dots **27**. The screen is then baked to accomplish contamination of the "red" dots **27** by the remaining silver, whereupon the "red" dots **27** are converted into yellow-responsive dots **27**. This results in a three-color screen having "blue" dots **25**, "red" dots **26**, and "yellow" dots **27**, these three color responses having been produced from only two kinds of phosphor material. This novel process might be carried further, so as to produce three kinds of color-responsive areas from a single phosphor material.

While preferred embodiments and modifications of the invention have been shown and described, still other embodiments and modifications thereof will be apparent to those skilled in the art. The scope of invention is defined in the following claims.

What is claimed is:

1. A cathode ray tube having a transparent faceplate and a fluorescent screen thereon comprising a plurality of discrete dots of different colored light emitting phosphors positioned on achromatized bodies formed on said faceplate by a photographic process and an apertured mask supported axially adjacent said faceplate.

2. A cathode ray tube having a transparent faceplate and a fluorescent screen thereon, said screen comprising a plurality of discrete dots of different colored light emitting phosphors, said dots being positioned on achromatized bodies of developed formerly light-sensitive material and an apertured mask supported axially adjacent said faceplate.

3. A screen for a cathode ray tube comprising a transparent plate and a discontinuous coating on one face thereof composed of discrete particles of different colored light emitting fluorescent material positioned on achromatized developed formerly light sensitive bodies, each comprising a smooth surfaced form-sustaining body.

4. A screen for color television comprising a support plate, a pattern of achromatized developed formerly photosensitive gelatin attached to and covering part of the surface area of said plate, and phosphor material of selected colored light emitting characteristics attached to said pattern.

5. In a cathode ray tube having a transparent faceplate, a composite screen mounted on one surface of said faceplate comprising: a group of first color emitting phosphors positioned in discrete geometric patterns on a first group of formerly photosensitive bodies, whereby a first given area of said surface is coated; a group of second color emitting phosphors positioned in discrete geometric patterns on a second group of formerly photosensitive bodies, said second group being interspersed with said first group whereby a second given area of said surface is coated; a third color emitting phosphor positioned on a formerly photosensitive body occupying the remaining uncoated area of said surface.

6. The screen of claim 5 wherein said geometric patterns are similar.

7. The screen of claim 6 wherein said geometric patterns are dots.

8. The screen of claim 6 wherein said geometric patterns are stripes.

9. In a cathode ray tube having a transparent faceplate and an apertured mask supported axially adjacent said faceplate, a fluorescent screen comprising a plurality of achromatized bodies of developed formerly light sensitive material positioned on said faceplate and a like plurality of different colored light emitting phosphors positioned on corresponding said bodies.

References Cited in the file of this patent

UNITED STATES PATENTS

2,083,203	Schlesinger	June 8, 1937
2,607,684	Nowak	Aug. 19, 1952
2,625,734	Law	Jan. 20, 1953
2,646,528	Werenfels et al.	July 21, 1953
2,683,769	Banning	July 13, 1954
2,687,360	Michaels	Aug. 24, 1954

FOREIGN PATENTS

654,504	Great Britain	June 20, 1951