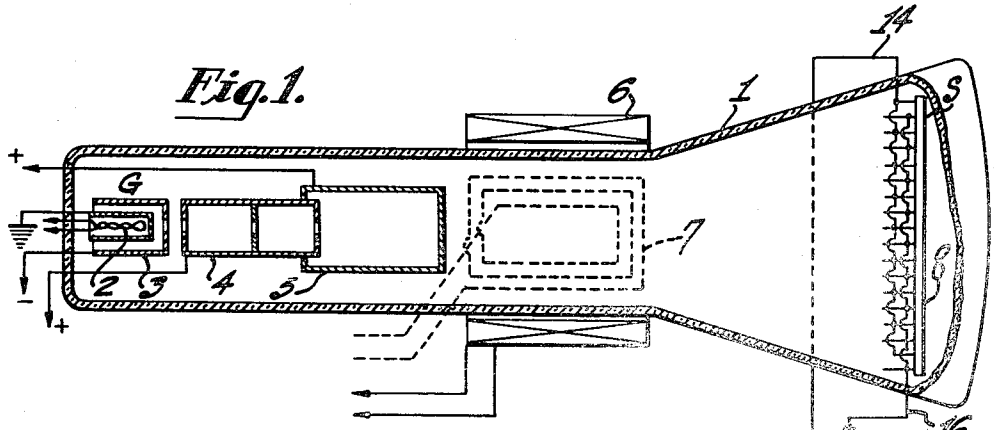
Oct. 16, 1951 R. L. SNYDER, JR 2,571,991

COLOR TELEVISION TUBE

Original Filed Oct. 22, 1946

Fig. 1.



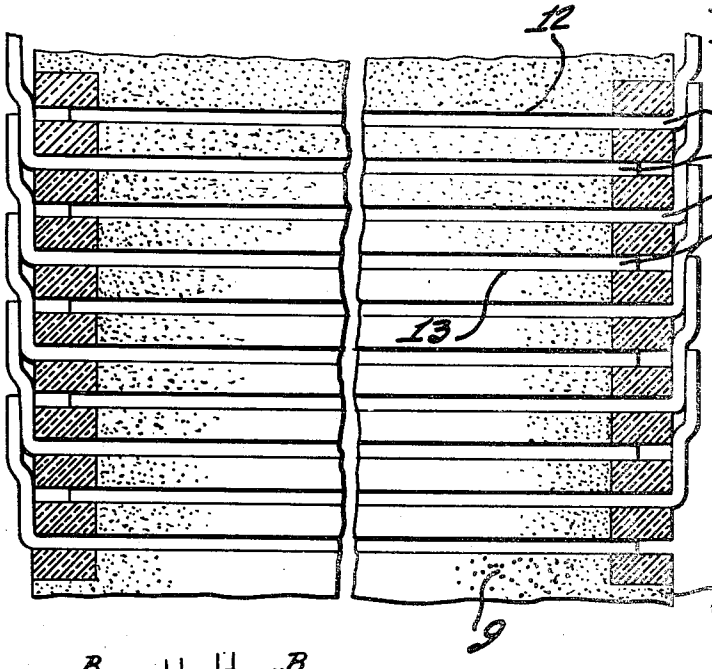


Fig. 2.

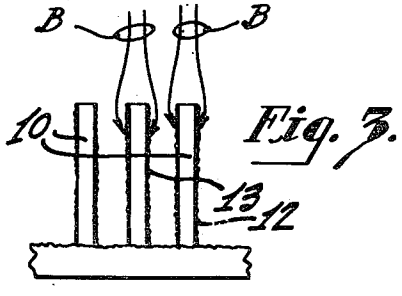


Fig. 3.

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UNITED STATES PATENT OFFICE

2,571,991

COLOR TELEVISION TUBE

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Continuation of application Serial No. 704,953, October 22, 1946. This application January 31, 1950, Serial No. 141,611

16 Claims. (Cl. 313—92)

1

This invention relates to cathode ray tubes for color television and to phosphor screens for such tubes.

This application is a continuation of my copending application Serial No. 704,953, filed October 22, 1946, now abandoned, and assigned to the same assignee as the present application. It is expressly noted that I am not abandoning the invention described and claimed in my said copending application.

Color television tubes as heretofore made and used contained a screen giving white light with a color filter rotating in front of the screen for producing the colors of the picture by synchronizing the movement of the filter with the colors produced at the transmitter. This is not entirely satisfactory as the filters are mechanically controlled and it is difficult to keep the mechanism in synchronism. Also, the initial cost of the apparatus and maintenance expense is relatively high.

It is an object of this invention to produce color television at the receiving station without rotating mechanical parts.

Another object of the invention is to produce the colors of a picture entirely by electron control.

Another object of the invention is to provide a multicolor phosphor target electrode and to direct the cathode ray beams to the phosphor areas of the target producing the color called for by the incoming signals.

Another object of the invention is to provide an electron discharge device for color image reproduction comprising a target electrode including a transparent plate and strips of electrically conducting material arranged adjacent to the transparent plate and having coatings of phosphor material on surfaces thereof such as the side surfaces which can be hit by the electron beam of the tube and can be observed through the transparent plate without requiring passage of light through the conducting strips. Preferably, alternate strips are connected in one group having phosphor coatings fluorescing in one color, the other strips are connected together in a group having phosphor coatings fluorescing in a second, different color and the transparent plate has thereon a phosphor coating fluorescing in a third color different from the coatings on the conducting strips. The conducting strips are preferably arranged in substantially parallel relation edgewise of the plate and substantially at right angles to the direction of scanning of the electron beam.

2

Other objects of the invention will appear in the following specification, reference being had to the drawing in which:

Fig. 1 is a plan section of a cathode ray tube illustrating the invention, being taken on a plane parallel to the line scansion;

Fig. 2 is an elevation of a small section of the phosphor screen suitably enlarged to show the construction; and

Fig. 3 is a diagrammatic illustration showing the manner in which the beam produces the colored light.

Referring to the drawing, the tube comprises an evacuated envelope 1 of glass, or other suitable material, containing at one end a gun G of usual construction and at the other end, the phosphor screens of my invention. The gun G may comprise the usual indirectly heated cathode 2, grid 3, and first anode 4, the last two of which have suitable apertures for the control and passage of the beam. A second anode 5 also may be used. The cathode would be connected to to a negative terminal of the voltage supply and the grid would be maintained slightly more negative. The first anode would be connected to a positive terminal of the supply and the second anode to a positive terminal of considerably higher voltage as is well understood in the art. The beam from the gun may be scanned over the target electrode S by horizontal deflection coil 6 and vertical deflection coil 7 but electrostatic deflection may be used when desired. Either electromagnetic or electrostatic focusing means may be used, the latter being indicated in the drawings.

The target S comprises a thin transparent plate 8 of glass, for example, on which is a coating 9 of a translucent phosphor material adapted to fluoresce with one color, say red. On, or closely adjacent to, the plate 8 is a plurality of metal strips also constituting part of the target S and arranged in spaced relation somewhat like a Venetian blind. The strips are preferably perpendicular to the direction of line scansion. Alternate strips 10 are soldered or otherwise conductively secured together at the right side, as shown in Fig. 2, and strips 11 are similarly joined at the left side. Strips 10 are coated with a phosphor material 12 to produce another color, say blue, and strips 11 are coated with a phosphor material 13 that fluoresces, say yellow (Fig. 3). Materials are known in the art that fluoresce under cathode ray beam bombardment in the colors red, blue and yellow, but by way of example it may be said that chromium activated

aluminum berylliate or zinc cadmium sulphide with silver activator with suitable proportions of cadmium fluoresces red; zinc sulphide with silver activator fluoresces blue, and zinc cadmium sulphide with copper activator fluoresces yellow and these may be used on the screen as described.

Strips 10 are connected by conductor 14 to a control device 15 and strips 11 are connected by conductor 16 to that device.

The operation of my improved tubes is as follows:

At the transmitter, alternate frames, or lines, in the pick-up tubes, say the former, are scanned to produce red, blue and yellow colors in regular sequence. These may be transmitted in various ways, say in succession. At the receiver the signals may be applied to the grid 3 in known ways to intensity modulate the beam in proportion to the amplitude of the signals. Since the deflecting saw tooth or other generators are running in synchronism with the deflection generators of the pick-up tube, device 15 can be connected to the frame scansion generator and made to perform in the way given below.

At the close of the red scansion, conductor 14 will be made positive and conductor 16 negative so that the beam B is deflected sufficiently to strike the phosphor coating 12 on strips 10 during this scansion (Fig. 3). The screen therefore will fluoresce blue for this scansion and the blue light varying with the strength of the signals will be viewed through the thin glass plate 8. When the blue scansion ends conductors 14 will go negative and conductor 16 positive. This causes the beam B to strike the coating 13 on strips 11. Yellow light is thus produced during this scansion. When the yellow scansion ends conductors 14 and 16 will go to the same low potential, say zero, and the beam B will pass between the strips 10 and 11 and strike the red phosphor material 9 on the glass plate 8. During this scansion, red light will be observed. The light of the phosphor 9 in plate 8 is radiated directly to the observer. The light from the edges of the phosphors on the sides of strips 10 and 11 is also radiated directly to the observer, while the light from the sides of such strips reaches the observer by reflection from adjacent areas. Since the frame scansion frequency is too high to be noted by the eye, the three colors will blend together and produce substantially the true colors of the scene pick-up at the transmitter.

It will thus be apparent that the invention provides a cathode ray tube for color image reproduction, in which the electron beam is controlled at the target S by electrostatic fields derived from voltages impressed upon the phosphor-coated control strips 10 and 11 and having their major components transverse to the incident path of the beam as it approaches the target. Within the regions between adjacent control elements, the beam is more easily, i. e. by lower voltages, deflected to, or away from, the surface of a control element than would be the case if the control elements were part of the plate 8. Furthermore, my improved tube does not require accurate or critical registration of the phosphor areas relative to each other. That is, the phosphor deposit on the glass plate 8 may be put down as an over-all coating luminescing at one color, and there is no need to register the phosphor areas on strips 10 and 11 with any particular phosphor areas on plate 8.

It will be apparent that a two color target may also be made by connecting all the strips together and alternately directing the beam to the phosphor materials on the strips and the glass plate.

Instead of viewing the image from the end of the tube, as indicated in Fig. 1, one may view it from the gun side of the screen by constructing the tube envelope in a way well known in the art with the gun positioned at an angle to the screen. This has the advantage of viewing the colors of strips 10 and 11 directly without the light passing through the phosphor on plate 8.

Various other modifications may be made without departing from the spirit of the invention.

What I claim as new is:

1. In a color television cathode ray beam tube, a target comprising a foundation having a phosphor material adapted to produce colored light on a surface thereof, and a plurality of spaced strips positioned edgewise to said foundation surface, said spaced strips having on their side surfaces phosphor material adapted to produce colored lights differing from each other and from that of the first mentioned phosphor material.

2. In a color television cathode ray beam tube, a target comprising a foundation having a phosphor material adapted to produce one color on a surface thereof, a plurality of spaced strips positioned edgewise to said foundation surface and closely adjacent thereto, the side surfaces of a first series of alternate ones of said strips having a phosphor material thereon adapted to produce a second color and the side surfaces of a second series of alternate ones of said strips having a phosphor material thereon adapted to produce a third color.

3. In a color television cathode ray beam tube, means for forming and directing an electron beam along a path, a target arranged transversely to said beam path and comprising a foundation having a phosphor material adapted to produce colored light on a surface thereof, a plurality of spaced strips positioned edgewise to said foundation surface, said spaced strips having on the side surfaces thereof phosphor material adapted to produce different colored light, and means for applying potentials to the strips causing said beam to land selectively on said phosphor material on the surfaces of said strips and on said phosphor material on said foundation.

4. In a color television cathode ray beam tube, means for forming and directing an electron beam along a path, a target arranged transversely to said beam path and comprising a foundation having a phosphor material adapted to produce one color on a surface thereof, and a plurality of spaced strips positioned edgewise to said foundation surface and closely adjacent thereto, the side surfaces of a first series of alternate ones of said strips having a phosphor material thereon adapted to produce a second color and the side surfaces of a second series of alternate ones of said strips having a phosphor material thereon adapted to produce a third color, and means for varying the potentials applied to said strips to cause the beam to land on the phosphor material on the surfaces of one series of alternate strips during one scansion, on the phosphor material on the surface of the other series of alternate strips during a second scansion, and on the phosphor material on said foundation during a third scansion.

5. An electron discharge device comprising, electron gun means for forming an electron beam along a path, and a target electrode positioned transversely to said beam path, said target electrode including a foundation and a plurality of spaced strips mounted edgewise to a surface of said foundation, and a phosphor coating on the side surfaces of said spaced strips.

6. An electron discharge device comprising, an electron gun means for forming an electron beam along a path, a target electrode spaced from said gun means and positioned transversely to said beam path, deflecting field means between said gun and said target for scanning said beam over a surface of said target electrode, and a plurality of spaced strips mounted edgewise to said target surface and perpendicular to the direction of line scansion, and a phosphor coating on the side surfaces of said strips.

7. An electron discharge device comprising, an electron gun means for forming an electron beam along a path, a target electrode spaced from said gun means and positioned transversely to said beam path, deflecting field means between said gun and said target for scanning said beam over a surface of said target electrode, and a plurality of spaced conductive strips mounted edgewise to said phosphor surface, a phosphor coating on said target surface and on the side surfaces of said strips, and means connecting alternate ones of said strips electrically together.

8. A target electrode for an electron discharge device, said electrode comprising a transparent plate and a plurality of spaced strips mounted edgewise to one surface of said transparent plate, a phosphor coating on the side surfaces of said spaced strips.

9. A target electrode for an electron discharge device, said electrode comprising a transparent plate and a plurality of spaced strips mounted edgewise to one surface of said transparent plate, a phosphor coating on the side surfaces of said spaced strips, and a different phosphor coating on said transparent plate surface between said spaced strips.

10. A target electrode for an electron discharge device, said electrode comprising a support plate and a plurality of conductive elements having surfaces extending substantially perpendicularly from a face of said support plate, and a phosphor coating on said element surface.

11. An electron discharge device comprising, an electron gun means for forming an electron beam along a path, a target electrode positioned transversely to said beam path, said target electrode including a support plate and a plurality of conductive elements having surfaces extending substantially perpendicularly from a face of said support plate, and a phosphor coating on said element surfaces.

12. A target electrode for an electron discharge device, said electrode comprising a support plate and a plurality of conductive elements having surfaces extending from a face of said support plate, a phosphor coating on said element surfaces, and a different phosphor coating on said supporting plate face between said conductive elements.

13. An electron discharge device comprising electron gun means for forming an electron beam along a path, and a target electrode positioned transversely to said beam path and including a transparent plate and a plurality of control means adjacent to said plate for providing an electrostatic field with a major component transverse to said beam path, said control means including a plurality of spaced strips mounted edgewise to said plate and having phosphor coatings on the side surfaces thereof and connections for applying operating voltages to the control means.

14. An electron discharge device for color image reproduction comprising electron gun means for forming an electron beam along a path, and a target electrode positioned transversely to said beam path, said target electrode including a plate having a substantially plane surface and a plurality of spaced strips mounted edgewise to said plate and having phosphor coatings on side surfaces thereof.

15. A color television cathode ray tube comprising apparatus for producing an electron beam and directing it along a path, a target electrode arranged transversely to said beam path, said target including a transparent plate member and a plurality of spaced strips positioned edgewise to said plate member and closely adjacent thereto, the side surfaces of a first series of alternate ones of said strips having a phosphor material thereon adapted to produce a colored luminescence and the side surfaces of a second series of alternate ones of said strips having a phosphor material thereon adapted to produce luminescence of a different color, a lead connected substantially equi-potentially to the strips in the first series of strips and another lead connected substantially equi-potentially to the strips in the second series of strips for varying the potential applied to said strips to cause the beam to land on said surfaces of one or the other of the series of alternate strips dependent on the potentials applied to them.

16. An electron discharge device for color image reproduction having an envelope and apparatus for producing a beam of electrons therein and having associated therewith apparatus for controlling and directing the electron beam, a transparent plate arranged transversely to the path of the electron beam and having on one side a translucent coating of material which, when hit by the electron beam, fluoresces in one of the primary colors and opaque deflecting plates interposed between the electron beam producing apparatus and the transparent plate, said deflecting plates including conducting material to which voltage capable of deflecting the electron beam can be applied and having coatings of material fluorescing in other primary colors applied to them on surfaces which can be hit by the electron beam and can be observed through the transparent plate.

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