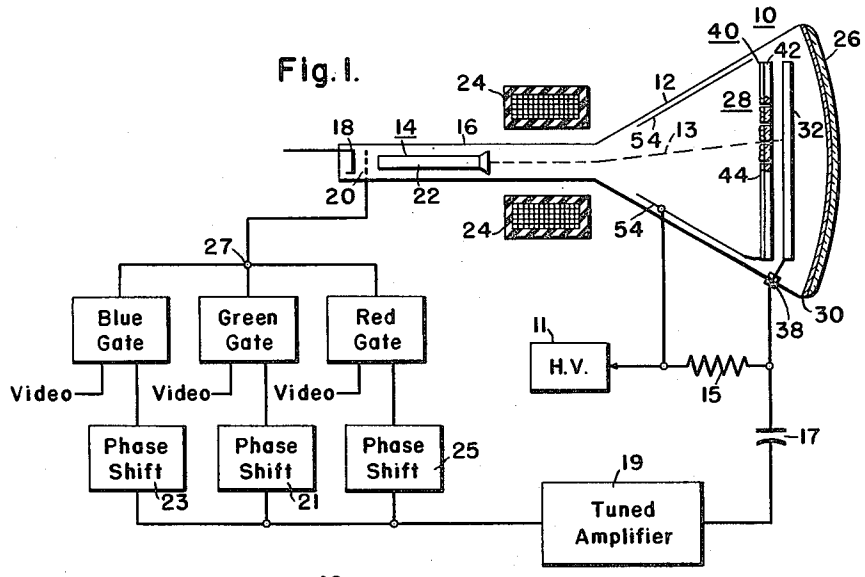
May 14, 1957 A. B. WELCH 2,792,522

COLOR TELEVISION TUBE

Filed Sept. 18, 1953

Fig. 1.



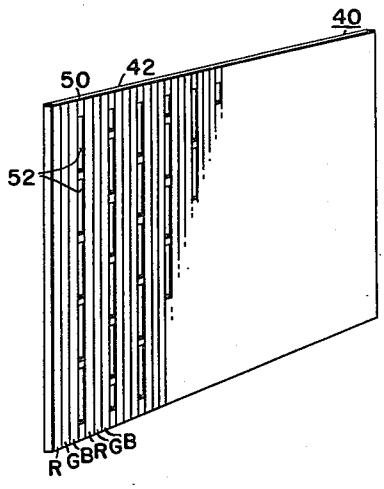


Fig. 2.

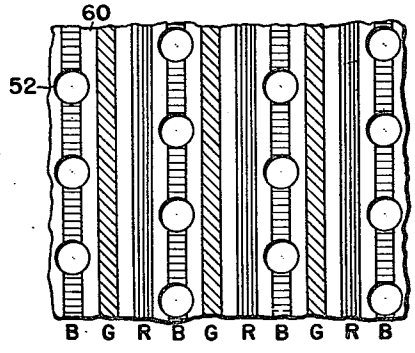


Fig. 3.

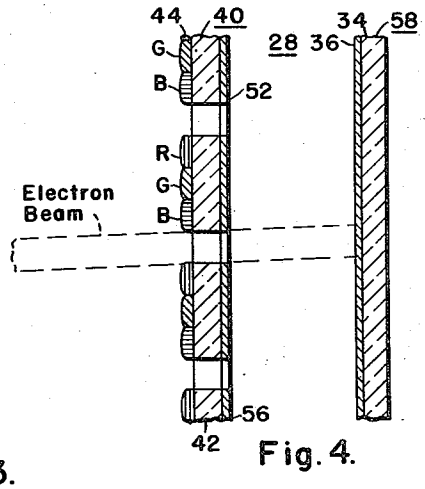


Fig. 4.

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United States Patent Office 2,792,522
Patented May 14, 1957

2,792,522

COLOR TELEVISION TUBE

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Application September 18, 1953, Serial No. 381,067

12 Claims. (Cl. 315—12)

This invention relates to cathode ray tubes and more particularly to improvements therein for obtaining control signals corresponding to the position of the electron beam.

It is an object of my invention to provide an improved cathode ray tube for the reproduction of a television image in natural colors.

It is another object to provide an improved system for the reproduction of color images in which a video signal representative of a given color is applied at a predetermined point on the scanning raster of the cathode ray tube to modulate the intensity of the electron beam.

It is another object to provide an improved system for the reproduction of color images in which a video signal representative of a given color is applied at a predetermined time on the scanning raster of the cathode ray tube to modulate the intensity of the electron beam.

It is another object to provide an improved sensing system to obtain control signals corresponding to the position of the electron beam on the scanning raster of a cathode ray tube.

These and other objects are effected by my invention as will be apparent from the following description taken in accordance with the accompanying drawing throughout which like reference characters indicate like parts, and in which:

Figure 1 is a representation of a television receiving system embodying my invention;

Fig. 2 is a partial perspective view of a screen which may be incorporated into the cathode ray tube shown in Fig. 1;

Fig. 3 is a front view illustrating a modification of a portion of the screen shown in Fig. 2 embodying my invention which may be incorporated into the cathode ray tube shown in Fig. 1; and

Fig. 4 shows a sectional top view of a modified target structure which may be utilized in the cathode ray tube shown in Fig. 1 embodying my invention.

Referring in detail to Fig. 1, a special cathode ray tube 10 is provided comprising an evacuated envelope 12 of suitable shape and material. An electron gun 14 of a suitable type is provided in the neck portion 16 of the envelope 12. A cathode 18, an intensity control element 20 and a focusing electrode 22 of the electron gun 14 are shown for purposes of explanation. An electron beam 13 projected by the electron gun 14 is provided with a suitable electrostatic or electromagnetic deflection means for scanning a raster I have illustrated electromagnetic deflection means schematically by the deflection coils 24.

The electron beam 13 is projected toward the viewing face 26 of the envelope 12. A target assembly 28 is provided within the envelope for the electron beam 13, and is positioned near the viewing face 26.

A shielding electrode 30 which is of a transparent conductive material is deposited on the interior or exterior surface of the face plate 26 and serves to reduce any stray electrostatic pickup by the target assembly 28. The target assembly 28 comprises a collecting electrode 32 positioned

near the viewing face 26. The collecting electrode 32 is of a transparent conductive material such as Nesa. The collecting electrode 32 may be supported in any known manner. An output terminal 36 is provided for the collecting electrode 32 through the envelope 12 to the exterior thereof. A screen member 40 and a part of the target structure 28 is positioned between the electron gun 14 and the collecting electrode 32. The screen 40 comprises a supporting member 42 of a transparent material having a phosphor coating 44 applied on the side thereof facing the electron source 14.

The phosphor coating 44 comprises a plurality of groups of phosphor strips or lines B, G, R. In the embodiment shown of a three-color system, each group contains in the following sequence a first strip B of a phosphor material such as zirconium silicate activated by silver that emits blue light upon electron bombardment, a second strip G of a phosphor material such as zinc cadmium sulphide activated by silver that emits green light upon electron bombardment, and a third strip R of a phosphor material such as aluminum borilicate activated by chromium that emits red light upon electron bombardment.

In the embodiment shown in Fig. 1, the phosphor lines B, G and R are vertical with respect to the viewer with the electron beam 13 scanning a raster transverse to the phosphor lines B, G and R. However, it may be desirable in some applications that the phosphor lines B, G and R be horizontal or at an angle with the horizontal. The orientation of the phosphor lines is limited only in that the electron beam 13 must scan across the phosphor lines B, G and R.

The phosphor lines B, G and R may be deposited on the support member 42 in any suitable manner such as silk screening. The phosphor lines B, G and R may be deposited so that each group substantially covers the entire surface of the support member 42 as shown in Fig. 2 or may be made narrow to cover only a part of the entire area of the support member 42 as shown in Fig. 3. The advantage of utilizing a narrow strip phosphor line with an uncovered area between each of the phosphor strips G, B and R is that the electron beam 13 may have a larger diameter without causing color contamination.

In Fig. 2 I have shown an embodiment of the screen structure 40 shown in Fig. 1. The screen structure 40 contains a plurality of strip areas 50 on the surface of the support member 42, upon which no phosphor has been deposited. This strip area 50 precedes each group of phosphor strips B, G and R. The strip 50 has substantially the same width as any of the phosphor strips G, B and R. Within the exposed strip area 50 there are provided electron apertures or electron transmissive regions 52 in the support member 42. One possible method of placing the apertures 52 in the supporting member 42 would be the utilization of a glass material as the supporting member 42 and photoetching of the desired apertures 52 prior to the depositing of the phosphor strips G, B and R. The apertures 52 may be of any suitable length or size and the separation between the apertures 52 on the strip area 50 should be of less distance than the diameter of the electron beam 13. The construction as shown in Fig. 2 of using a plurality of apertures 52 rather than one elongated aperture covering substantially the whole area of one strip 50 allows a stronger support structure 42.

It is also possible to space the strips 50 with the apertures 52 between alternate groups of phosphor strips G, B and R or even a greater number of groups and still obtain suitable sensing or control signals.

The screen 40 is connected to the second anode or shell 54 which is in the form of a conductive coating on an interior portion of the envelope 12. A high direct

current voltage source 11 of the order of 15 kilovolts is connected to the shell 54 and the screen 40. The high voltage source 11 is also connected through a resistor 15 to the terminal 38 of the collecting electrode 28. The terminal 38 of the collecting electrode 28 is also connected through a condenser 17 to a tuned limiting band pass amplifier 19. The tuned circuit of the amplifier 19 is designed to resonate at a frequency corresponding to the rate of color group scanning and the tuned circuit is driven by the pulse component received from the collecting electrode 28. The tuned circuit of the amplifier 19 may also be adjusted to the most prominent frequency component corresponding to the aperture scanning rate and the frequency multiplied to the color group scanning rate. The output of the amplifier 19 is connected to three separate phase shift circuits 21, 23 and 25. The phase shift circuits 21, 23 and 25 are connected respectively to a green, blue and red video gate. The video signals representative of green, blue and red video information are connected through their respective gating circuits to a common connector 27 which is connected to the intensity control electrode 20 of the electron gun 14.

The operation of the apparatus of Figs. 1 and 2 may be described as follows. The electron gun 14 projects an electron beam 13 toward the target structure 28. The electron gun 14 is biased so that a small current will flow without video information applied to the intensity control electrode 20 of the electron gun 14. This small current or dark current must be of sufficient value that when the electron beam 13 passes through one of the apertures 52, a signal will be obtained from the collecting electrode 32 of sufficient value to actuate the control circuit to gate the video channels.

A deflection signal derived from a suitable receiving circuit (not shown) is applied to the deflection coils 24 to cause the electron beam 13 to scan a raster on the screen 40 transversely to the phosphor strips G, B and R.

As the electron beam 13 scans across the screen 40, a pulse is generated in the collecting electrode 32 each time the electron beam 13 scans across an aperture 52. The alternating component of pulsating direct current obtained from the collector 32 passes through the blocking condenser 17 to the tuned amplifier circuit 19. The tuned circuit amplifier 9 is adjusted to resonance at a frequency corresponding to the rate of color group scanning, and the pulses impressed thereon drive the resonant circuits of the amplifier 19. The output of the amplifier 19 is connected to three phase shift circuits 21, 23, 25 of suitable type which delays the sine wave received from the amplifier in such a manner that the phase shift circuit 25 will open the red gate permitting red video information to be applied to the intensity control electrode 20 of the electron source 14 when the scanning beam 13 is approximately in the center of the R phosphor strip. The phase shift circuit 21 which controls the gating circuit in the green video information channel opens the green video channel permitting video information to be applied to the intensity control grid 20 of the electron source 14 substantially when the electron beam 13 is in the center of the G phosphor strip. The phase shift circuit 23 which controls the gating circuit within the blue video information channel opens the blue gate when the electron beam 13 is substantially on the center of the B strip. By utilizing a sine wave to control the gating circuits, it is possible to have the video information applied to the phosphor strips G, B and R reach a maximum substantially at the center of each strip which will decrease the possible color contamination.

In Fig. 3 I have shown another modification of the screen shown in Fig. 2. This modification has several advantages over the slit type screen utilized in Fig. 2. The use of round or square holes presents a less noticeable aperture pattern than a series of slits to the observer. Square holes permit more position sensing current to pass through than round holes when the beam is scanning a path halfway between the horizontal center lines of apertures while it is possible that fabrication of the round holes would be less difficult. The use of the round or square apertures 52 shown in Fig. 3 spaced horizontally at some multiple of the color group repetition rate permits placing phosphor strips of one color directly on the vertical center lines of the apertures. The overall brightness of the image will not be lost if the apertures 52 are placed in the most efficient of the color phosphors such as blue or green. The modification shown in Fig. 3 allows greater center-to-center spacing of the color strips G, B and R and permits the use of larger electron beam diameters without color contamination. The device in Fig. 3 also has the advantage that the strips G, B and R may be made narrow to cover only part of the total area of the screen. The incorporation of the screen of Fig. 3 into Fig. 1 would not change the operation of the tube.

In my invention it is required that a small spot or sharply focused electron beam 13 be used to prevent color contamination. As the electron beam scans up and down or from left to right from the center of the screen surface 40, the required focal length for the electron beam 13 varies. The focal length of the electron lens may be varied in known manners, such as dynamic focusing techniques, or by curving the screen to the shape of a spherical section with a center of radius at the center of deflection of the electron beam. By curving the screen the electron beam focal length is constant over the entire screen.

In Fig. 4 I have shown a modified target assembly structure 28 in which the screen 40 comprising the supporting member 42 and the phosphor coating 44 deposited thereon are of similar nature to that shown in Figs. 1 and 2 but on the rear side of the supporting structure 42 with respect to said electron gun 14 is deposited an electron sensitive layer 56 of a transparent conductive layer. The receptor or collector electrode 32 of Fig. 1 is modified by depositing a transparent coating 36 on the side of a supporting structure 34 of a material capable of high secondary emission to form an electrode 58. In this application the sensing signal would be obtained from the electron sensitive layer 56 rather than the electrode 58.

The operation of the modified target assembly 28 shown in Fig. 4 would be similar to that described above as to Figs. 1 and 2, except that the electrons in the electron beam 13, after passing through apertures 52, would strike the secondary emissive layer 36 of the electrode 58, and the secondary and reflected primary electrons would be collected by the electron sensitive layer 56 to obtain a sensing signal. This would result in an amplification of the sensing signal by the secondary emission of the layer 36. The device shown in Fig. 4 also requires that the voltage on the electron sensitive surface 56 be of a positive value compared to that on the electrode 58 to collect the electrons.

My invention provides a device which is simple in construction, does not suffer from ambient light and various other problems associated with those devices utilizing photocell sensing pickup. My device also does not have the high capacitance between the final anode and conducting strips on the screen, nor does it suffer from the masking effect of a sensing grid positioned between the screen and the electron source. My invention also permits the use of a minimum number of apertures across the screen, and also the tuned amplifiers provide a sine wave which permits the use of a simple resistor-capacitor combination in lieu of the delay line network commonly associated with this type of electron beam control.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various other changes

and modifications without departing from the spirit and scope thereof.

I claim as my invention:

1. A television tube comprising an evacuated envelope, an electron source for projecting an electron beam, a target electrode for said electron beam, said target electrode comprising a support member having a plurality of phosphor areas deposited on the surface thereof facing said electron source, said target electrode having a plurality of apertures, a receptor electrode positioned on the opposite side of said target electrode with respect to said electron source for intercepting electrons passing through the apertures of said target electrode for producing a control signal in response to the bombardment of said electrons and means for utilizing said control signal to control the excitation of said phosphor areas by said electron beam.

2. A color television tube comprising an evacuated envelope, means for projecting an electron beam, a target for said electron beam having a plurality of vertical phosphor strips, said target also having a plurality of apertures uniformly spaced transversely across said phosphor strips, a secondary electron emissive surface positioned to the rear of said target for intercepting electrons passing through the apertures of said target, and means for collecting the secondary emission from said electron emissive surface.

3. A color television tube comprising an image screen, said screen comprised of a support member having a plurality of adjacent groups of vertical phosphor strips thereon, each of said groups of phosphor strips representative of the selective component colors and each strip within each of said groups representative of a different selected color component, said image screen having a plurality of vertical rows of apertures, said rows of apertures being spaced uniformly horizontally across said image screen, an electron beam scanning means for scanning a raster on said image screen transversely to said phosphor strips, and output means for deriving a signal in response to the electrons passing through said apertures.

4. A color television tube comprising an image screen, said image screen comprising a support member having a plurality of adjacent groups of vertical phosphor strips thereon, each of said groups of phosphor strips being representative of the selective component colors and each strip within each of said groups being representative of a different selected color component, said image screen having electron transmission sections uniformly spaced within selected phosphor strips, means for scanning an electron beam raster transversely to said phosphor strips, and a receptor electrode positioned to the rear of said image screen with respect to said scanning means for intercepting electrons passing through said transmission sections.

5. A color television tube comprising an image screen having a plurality of adjacent groups of vertical phosphor strips, each of said groups of phosphor strips being representative of the selective component colors and each strip within each of said groups representative of a different selected color component, said image screen having a plurality of vertical rows of apertures in registration with each of a selected component color phosphor strip, an electron gun with means for scanning a raster transversely to said phosphor strips, and means positioned to the rear of said image screen with respect to said electron gun for deriving the electron current passing through the apertures in said image screen.

6. A color television tube comprising an image screen having a plurality of adjacent groups of vertical phosphor strips, each of said groups of phosphor strips being representative of the selective component colors and each strip within each of said groups representative of a different selected color component, said image screen having electron transmission sections positioned within a selected color phosphor strip of each group, an electron source with means for scanning said phosphor strips transversely and a receptor electrode positioned to the rear of said image screen so as to intercept electrons passing through said electron transmission sections.

7. A color television tube comprising an image screen having a plurality of adjacent groups of vertical phosphor strips, each of said groups having a first phosphor capable of emission of light of a blue color, a second phosphor strip capable of emission of light of a green color, a third phosphor strip capable of emission of light of a red color, said image screen having a plurality of apertures located in each of said first phosphor strips, means for scanning said phoshor strips transversely with an electron beam, and an electron sensitive electrode positioned to the rear of said image screen with respect to said electron beam.

8. A color television tube comprising an image screen having a plurality of adjacent groups of vertical phosphor strips, each of said groups having a first phosphor capable of emission of a blue color light, a second phosphor strip capable of emission of a green color light, a third phosphor strip capable of emission of a red color iight, electron transmission sections located in each of said phosphor strips capable of emission of light of a blue color, means for scanning said phosphor strips transversely with an electron beam and an electron sensitive electrode positioned on the opposite side of said image screen with respect to said electron beam for producing a control signal.

9. A color television image reproducing system comprising the combination of an image screen having a plurality of groups of vertical phosphor strips, each of said groups of phosphor strips being representative of the selected component colors and each strip within said group representative of a different selected component color, said image screen having a plurality of rows of apertures uniformly spaced horizontally across said image screen, an electron gun for scanning said phosphor strips transversely with an electron beam, a secondary emissive electrode positioned on opposite side of said image screen with respect to said electron gun and an electron sensitive layer for developing a sensing signal.

10. A color television tube comprising an image screen, said image screen comprising a foundation of a transparent material having a plurality of groups of adjacent vertical strips of phosphor material deposited thereon, each of said groups of phosphor strips being representative of selected component colors and separated by an uncoated area, said uncoated area having a plurality of apertures located therein, an electron gun for scanning a raster on said image screen and a transparent electron sensitive electrode positioned on the opposite side of said image screen with respect to said electron gun for producing a control signal, and means for utilizing said control signal to gate said electron gun.

11. A color television tube comprising an image screen, said image screen comprising a supporting number of transparent materials having a plurality of vertical phosphor strips, a first strip comprising a coating of phosphor material capable of emission of light of a blue color, a second strip comprising a phosphor material capable of emission of light of a green color and a third strip comprising a phosphor material capable of emission of light of a red color, each of said phosphor strips being separated by an uncoated area, uniformly spaced apertures located in each of said first strips, an electron gun for scanning a raster transversely to said phosphor strips, output means for producing a control signal in response to the passage of electrons from said electron beam through the apertures in said image screen, and means for utilizing said control signal to control the excitation of said phosphor strips for said electron gun.

12. In combination a scanning system comprising an apertured target electrode to be scanned, said target electrode comprising a support member and a plurality of electron sensitive areas thereon, an electron gun for pro-

ducing an electron beam, said electron beam having movement relative to said target for scanning said target, an electron sensitive electrode output means separated from and positioned on the opposite side of said target electrode with respect to said electron gun for producing a control signal in response to electrons passing through said apertures, and means for utilizing said control signals to gate said electron beam.

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