

June 29, 1954

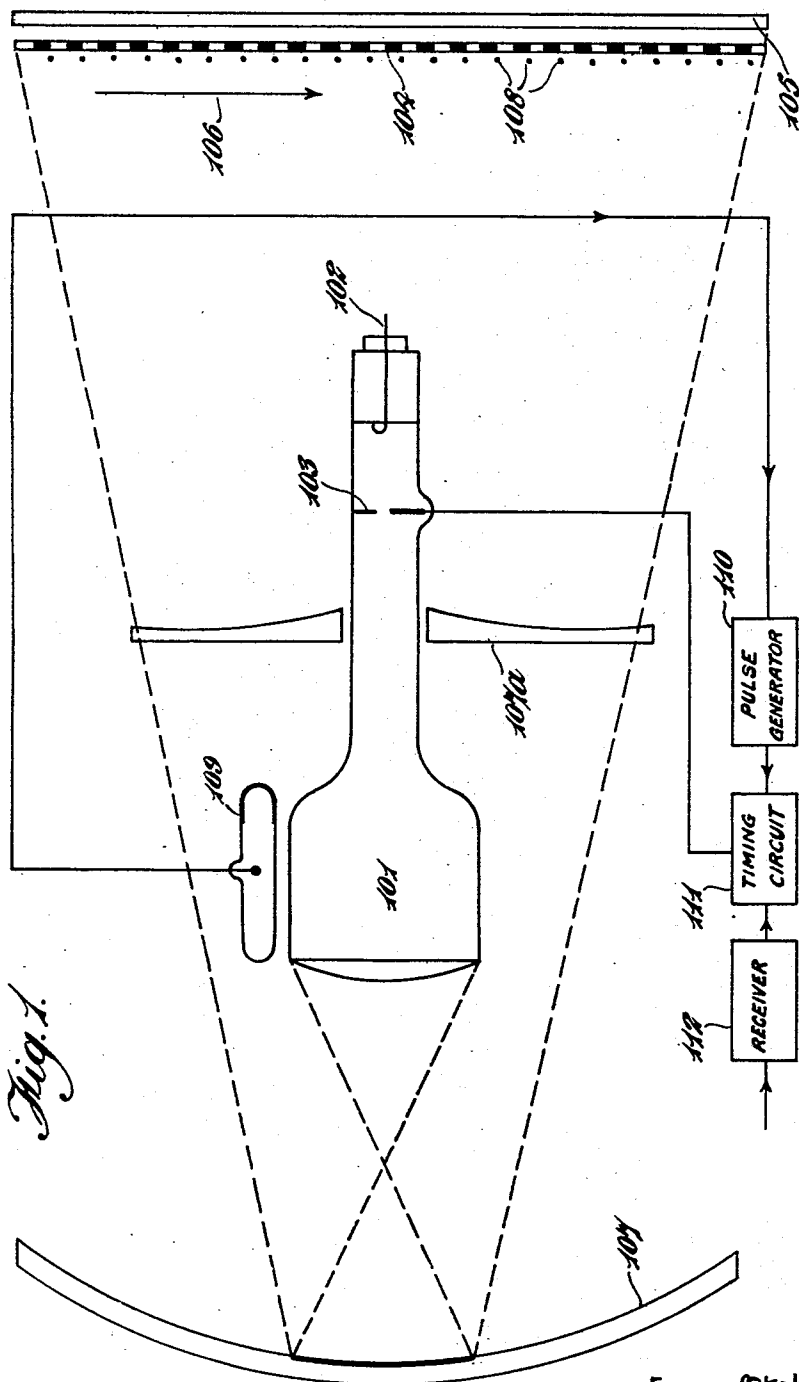
F. OKOLICSANYI

2,682,571

TELEVISION

Original Filed Nov. 12, 1947

2 Sheets-Sheet 1



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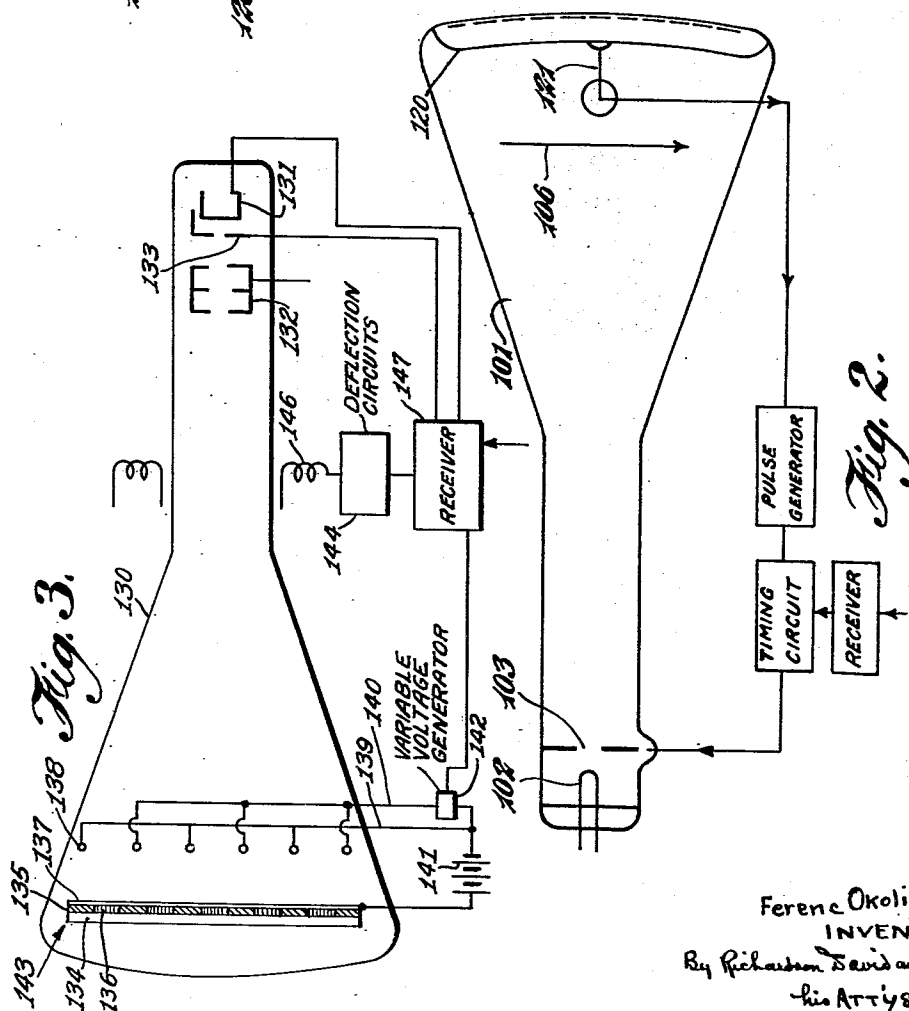
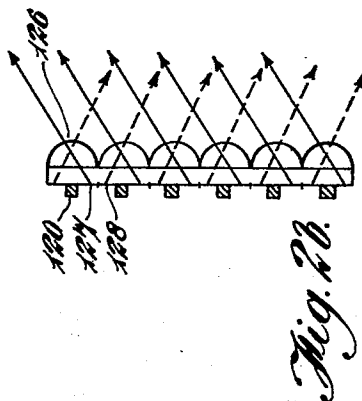
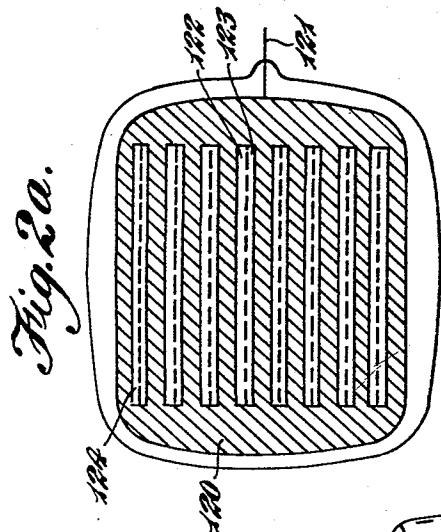
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UNITED STATES PATENT OFFICE

2,682,571

TELEVISION

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Original application November 12, 1947, Serial No.
785,417, now Patent No. 2,532,511, dated De-
cember 5, 1950. Divided and this application
October 24, 1950, Serial No. 191,837

9 Claims. (Cl. 178—5.4)

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This application is a division of my co-pending patent application, Serial No. 785,417, filed November 12, 1947, now Patent Number 2,532,511, which in turn has been reissued as Reissue Number 23,672.

The present invention relates to systems and methods for the conversion of electrical signals into luminous images and vice versa, and has for its main object the provision of a system wherein a color shift is performed by purely electronic means without the use of moving parts.

The invention in its simplest form is based upon the phenomenon that if a fine grid composed of very thin parallel wires, preferably metallic wires, is placed close to the picture screen or a cathode ray tube (into the path of the electron beam if inside the tube), then a service of dark lines (the Crookes Shadow) appear on the screen behind the wires, whilst certain definite portions of the screen between the wires appear as lines of normal or even of increased brightness. By the application of a homogeneous static or magnetic field, the dark lines appear at different, slightly shifted places between the wires whilst the bright lines appear at previously dark places. The wires can be placed so that they are parallel to the direction of the scanning lines or at right angles to them or at any intermediate angle, and the same phenomenon is observed. It is preferred, however, not to arrange them parallel to the scanning lines for reasons that will be explained hereinafter. From the foregoing it is obvious that a grid of this nature can be employed to impart a line structure to the reproduced image, the geometrical characteristics of this line structure being determined solely by the geometrical characteristics of the grid and being entirely independent of the scanning process employed to build up the picture. Furthermore, by connecting the grid or an electrode or the above said field to an energy source of an oscillatory nature of suitable waveform it is clear that the position of this line structure can be shifted backwards and forwards in space, but of course at the frequency of the oscillatory source.

This phenomenon is made use of according to one aspect of the invention to a television receiver by arranging a grid of this nature near to the picture screen and by arranging an oscillatory source of electric energy synchronized with incoming signals to cause the position of the line structure to depend at any instant upon the color component being reproduced, an associated stationary optical system including alternating elements for imparting different coloring being ar-

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ranged so that in any given position of the line structure the emergent light is in accordance with the momentarily transmitted appropriate color.

According to another aspect of the invention the inverse of this arrangement is employed in a television transmitter tube of the iconoscope type, the optical system in this case being placed in the path of the incident light to produce an image on the signal-producing screen which consists of alternate strips of different colors, whilst the grid is arranged near the screen to cause the distribution of electrons produced by the scanning beam to assume a line structure the position of which coincides with the strips of one color or the other according to the potential applied to the grid.

Theoretically, the direction of the grid wires and filter strips can form any angle with the direction of the scanning lines, but in practice it is preferred to arrange them at right angles to the line scanning direction. If they lie parallel and if their number differs slightly from the number of sharply adjusted scanning lines, unpleasant interference or striated (beat frequency) patterns will be formed. This possibility is completely avoided by arranging them at right angles.

It is clear that the arrangement of the present invention can be very easily arranged to receive several types of color transmissions. For example if the color is changed line-by-line instead frame-by-frame, a square wave oscillator would be locked to the line synchronizing impulses, so that the line structure imparted by the voltages on the wire grid would be shifted in position at the line frequency. This is, of course, a very important feature of the invention in view of the effects of color-flicker and thus of the "bandwidth" of transmission.

As will appear hereinafter the invention in its broadest sense is not limited to the provision of a grid in close proximity to the surface scanned by the actual cathode ray beam, nor is it limited to the provision of a color shift voltage acting simultaneously over all parts of the scanned surface to shift the line structure from one position to the other.

To achieve the aims of the system of the invention, three distinct but cooperating elements are required. These elements are:

(I) Means for imparting to the electron image up by the scanning system of the receiver the above-mentioned line structure. The geometrical characteristics of this line structure are determined solely by the geometrical characteristics of a grid, and are entirely independent of the scanning process employed to build up

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the picture. This grid will hereinafter be referred to as the "color electrode" or as the "master grid."

(II) Means for deflecting or shifting the "electronic copy" of the master grid i. e. the electron image which has the line structure imposed thereon by the color electrode, so that the bright lines therein may be moved into a number of positions which correspond to the number of color components being transmitted. These means will hereinafter be referred to as the "color deflector."

(III) Means for imparting to the electron image (or to the fluorescent image produced by said electron image) a number of color components, one color component corresponding to each of the positions which it may occupy under the influence of the color deflector. These means will hereinafter be referred to as the "color screen" or as the "color raster."

It is not essential that the above three elements are necessarily structurally separated. For example, the color electrode and the color deflector may consist of one single grid structure, with which, however, are associated means for applying a fixed voltage to produce electron-optical cylindrical lenses to impart to the electron image its line structure, whereby the grid acts as the color electrode, and also means for imparting a varying difference of potential between different parts of the grid, to cause the line structure to assume a number of different positions, whereby the grid also acts as the color deflector. In general therefore the above-described three elements are to be considered more by the functions they perform, though it will be clear that such functions cannot be performed without some related structure. However one single structure may perform two or more functions and one of the functions may even be performed by an electrode of the receiving tube which is also present to perform one of the functions of the usual known television receiving tube.

In its broadest aspect the invention therefore comprises a television system provided with a cathode ray tube including a scanned surface, means including a master grid arranged to impose a line structure on the electron distribution over said scanned surface, said line structure being an electronic copy of the master grid, means for periodically deflecting said line structure into two or more alternate positions in succession, and color selective means arranged in fixed spatial relationship to said positions.

Various forms which the elements above-referred to can take will now be described:

(I) The color electrode or the master grid. In the simplest case it consists of a grid or a slotted plate, which serves to cast an electron shadow on the final screen of the tube. It may in this case be at the same potential as this screen. It operates in the same manner as the well known "Crookes Shadow." Where, however, the final screen of the tube consists of a conductor, for example, in the form of a grid or a transparent metal layer (as will be described in more detail below with reference to the color filter) an electron focusing effect may be produced, by maintaining a suitable difference of potential between the screen and the electrode.

Alternatively, two or more grid structures may be employed, held at different potentials, to bring about a focusing of the electrons into

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the desired line structure. The well known principles of design of electron optical system are applicable to the design of such multiple grid system.

(II) The color deflector. As mentioned above, in certain suitable cases, where the color electrode is composed of a number of electrically separated parts, the function of the color deflector may be realized by applying suitable potentials to the parts of the color electrode. However, the deflection of the electron image which has imparted thereto a line structure by the color electrode may be deflected by a suitably placed electromagnetic or electrostatic deflecting system. Such a system would have imparted thereto square wave currents or voltages derived from incoming synchronizing signals which correspond to changes in the color component being transmitted. Such deflecting systems may follow well understood principles of design.

(III) The color screen or raster. This consists essentially of a structure which imparts to the reproduced image its desired color characteristics. It has a subdivided structure in which strips of material having the property of imparting to the electron image (or its fluorescent optical counterpart) one color component in one of the positions alternate with other strips of material capable of imparting to it the other color component or components in its other position or positions.

To produce a visible image from an electron image in the standard television receivers, a fluorescent material is required. In the simplest arrangement for the purposes of explanation, the color electrode simply consists of sets of alternating strips of different fluorescent powders, each set of which is fluorescent with one of the respective transmitted color components. The color deflector moves the electron image first on to one set, then on to the next, then on to the third (according to the number of color components being transmitted). Fusion of the individually colored lines may be achieved by interposing a ground glass screen at a suitable short distance from the fluorescent color electrode.

However, a continuous fluorescent screen giving a white visible image may be used, in which case the color screen may consist of a number of glass rods of different colors interwoven with a fine metallic wire cross-mesh to give added strength.

The exterior of a thin and flat mica plate inside the cathode ray tube, having internally a white fluorescent screen, may be painted with suitable transparent paints of the required colors.

Although the main object of the invention is to provide means for effecting the reproduction of images in natural colors and the preceding description and succeeding particular description refers only to color television it is obviously within the scope of the invention to transmit alternating groups of signals representing the members of a stereoscopic pair and to separate the images of the receiver by the methods of the present invention combined with the usual two colors' method of stereoscopic reproduction. In other words, at the receiver the alternating groups of signals would have imparted thereto different colors by the methods of the present invention and would be viewed through spectacles having different colored windows.

The invention will now be described by way

of example with reference to the accompanying drawings in which:

Fig. 1 shows a television receiver according to the present invention.

Figs. 2, 2a and 2b show an alternative system operating on the principle of the system shown in Fig. 1; and Fig. 3 is a diagrammatic representation of a color television receiving system according to another embodiment of the present invention.

Referring now to Figure 1 of the accompanying drawings, the receiver therein illustrated comprises a normal cathode ray tube 101, the cathode 102 and control grid 103 being shown, but not the remaining electrodes or deflectors. A black-and-white picture is produced on the fluorescent screen of the tube and this is projected on to the receiving screen 105 by means of a Schmidt optical system consisting of a concave mirror 107 and correcting plate 107a. In front of the viewing screen and, if desired, on the same plate is placed a filter 104 consisting of alternate red and green strips running at right angles to the scanning direction 106. In front of the filter is arranged a master grid 108 consisting of parallel metal wires or strips having a highly reflecting surface, one such wire lying opposite the junction of each pair of filter strips. As the scanning beam passes across each wire in turn, a flash of light is reflected into the photo-electric cell 109. This cell fires a pulse generator 110 the output of which will consist of short voltage pulses occurring at color element frequency. This generator is not responsive to any changes of illumination occurring on the viewing screen, but only to the high frequency flashes produced by reflection from the metal wires of the grid 108. The pulses from 110 pass through a timing circuit 111 to the control grid, arriving on this grid as negative pulses of sufficient amplitude to substantially cut-off the electron beam for the duration of each pulse. Clearly the effect will be to produce an electronic copy of the grid 108 on the surface of the fluorescent screen so that the black-and-white image will consist of alternate dark and white lines running parallel to the wires of the master grid 108. The timing circuit 111 includes a resistance condenser combination and also a valve the internal resistance of which determines the time-constant of the whole combination. This internal resistance is changed from one value to another by applying the appropriate synchronizing impulses from the receiver circuits 112 to the control grid of the valve. Consequently during one colour period which may be the duration of a frame, but is preferably the duration of a line or an element, a certain time delay is imposed on the pulses arriving at the grid 103 whilst during the next colour period, the magnitude of this delay is changed by an amount sufficient to ensure that the bright lines of the projected image are shifted to coincide with the filter strips of the appropriate colour.

An alternative arrangement is shown in Figs. 2 and 2a. Here the interruption of the electron beam is caused by pulses derived from the impact of the beam itself on a metallic grid 120 connected through wire 121 to the pulse generator 110, thus avoiding the use of a photo-electric cell. Different colours are imparted by using fluorescent powders 122 and 123 of different colour emission deposited in the gaps 124 of the grid, in the form of alternating strips. In Fig. 2 is shown how such an arrangement can be em-

ployed to produce projected pictures. The fluorescent screen 125 is a uniform screen producing white light, and carries the grid 120 on one surface. On the opposite surface it is provided with a series of parallel transparent flutings 126. Each fluting lies opposite one of the metallic strips and acts as a short focus cylindrical lens focussed on the screen. Consequently as the line image shifts from one position 127 to the other 128 (Figure 2b), the direction of the beam of light emerging from the cylindrical lens will change through a considerable angle. The beam is focussed on the viewing screen by a large projection lens or mirror such as 107 in Fig. 1 and this mirror is arranged to receive the light beams on one or other distinct part of its surface and each of these parts can be covered by the appropriate homogeneous colour filter. Clearly this optical system has the advantage that the use of a composite colour filter made up of adjacent strips is avoided, and the use of this system is not restricted to the embodiment described in Figs. 2 and 2a.

In the embodiment of Fig. 3, a cathode-ray tube 130 includes a cathode 131, an anode 132, a control grid 133, and a target or display screen generally indicated at 143. The output of a television receiver 147 is connected between the control grid 133 and cathode 131 of the tube. The screen 143 includes a transparent support 134 on which are laid down a plurality of strips 135 and 136 of different fluorescent powders, fluorescent in the different colors of an additive system. For simplicity the system of strips in the tube of Fig. 3 is shown as a two-color system, in which strips 135, fluorescent in red for example, are alternated with strips 136, fluorescent in green for example. The strips are thus laid down in a repeating cyclic order. While only a small number of strips are shown in the figure, it is to be understood that in the tube as constructed a large number of very narrow strips would be employed.

An electrically conducting layer 137 overlies the strips and is connected to one terminal of a source 141 of voltage outside the tube. Adjacent the screen in the path of the electron beam developed by the cathode 131 is located a grid made up of a plurality of conducting wires 138. The wires are coplanar and are parallel to the target screen and to the long dimension of the strips, both strips and wires being seen in cross section in Fig. 3. A wire is provided for each cycle of strips 135 and 136, and the wires are divided into a plurality (two) of electrically separated groups or parts by the conductors 139 and 140. These conductors are of course disposed at the side of the screen so as not to interfere with the beam travel. A fixed difference of potential may be applied between the wires of the grid and the conducting layer by means of voltage source 141, and a varying difference of potential may be applied by means of a variable voltage generator 142 between the electrically different groups of grid wires connected to leads 139 and 140. The voltage applied by source 141 between layer 137 and lead 139 is also applied via generator 142 between layer 137 and lead 140, the generator serving only to add or subtract as to lead 140 the voltage output of that generator. Consequently the voltage of source 141 is applied between the grid as a whole and the layer 137.

In operation of the system of Fig. 3, the beam emanating from the cathode 131 is deflected across the screen to trace a raster thereon by means of a deflection generator 144 and sweep deflectors

connected thereto, one pair of which is shown at 146. The voltage difference imposed between all of the wires of the grid and the layer 137 imposes a line structure on the raster by the formation of an electron optical cylindrical lens between the grid and layer for each pair of adjacent wires of the grid. The voltage developed by generator 142 shifts the line structure on the screen to fall successively on red strips and on green strips. The voltage generator may be connected to the receiver 147 for locking the operation of generator 142 with synchronizing impulses of the received signal. For example if color is changed line by line, the generator 142 would be locked to the line synchronizing impulses so that the line structure imparted by the voltages on the grid of wires 138 would be shifted in position at the line frequency.

I claim:

1. In a polychrome television receiver incorporating a cathode ray tube the electron beam of which is adapted successively to scan individual areas of a phosphor target respectively representative of different chromatic characteristics of an image; the combination of a circuit for developing a control pulse series indicative of the repetition rate of one predetermined chromatic characteristic in the image developed by said scanning operation; a signal channel located between the input of said receiver and the control grid of said cathode ray tube, said channel being designed successively to pass component signals indicative of the same chromatic image characteristics represented by the individual areas of said phosphor target; a time-delay network having a plurality of selectable delay periods; a circuit for applying the control pulses of said series through said delay network to the control grid of said cathode ray tube cyclically to blank the scanning beam thereof at a frequency equal to that at which the said control pulses are developed but with a time displacement equal to the delay period of said network; and means for selecting the delay period of said network in accordance with the particular component signal being applied at any instant to the grid of said cathode ray tube through said channel.

2. A color television image reproducing system comprising a cathode ray tube having a striped phosphor screen and means for developing and deflecting an electron beam thereacross to trace a raster thereon, said screen including a plurality of strips of phosphors fluorescent in a plurality of colors, said strips being disposed side-by-side in a cyclically repeating fashion, said tube further having an electrically conducting layer overlying said strips and a grid made up of a plurality of essentially coplanar conducting wires disposed adjacent said screen in the path of said beam and substantially aligned with said strips, a wire being provided for each cycle of said strips, said wires being divided into a plurality of electrically separate groups, means for applying a fixed voltage between said wires and layer to produce between each adjacent pair of said wires and layer an electron optical cylindrical lens to impart a line structure to said raster, and means for imparting a varying difference of potential between electrically different groups of said wires.

3. A color television receiving system comprising a cathode ray tube having means for developing and deflecting an electron beam to trace a raster on the surface of a target, said

target including a plurality of phosphor strips representing individual color components of an additive system, said strips being laid down in a repeating cyclic order, said tube further having an electrically conducting layer disposed on said phosphor strips and a grid of substantially coplanar wires positioned adjacent to said layer in the path of said beam, said wires being substantially parallel to said target and to the long dimension of said strips, means for applying a voltage between said grid and said layer to produce for each pair of adjacent wires of said grid an electron optical cylindrical lens between said grid and layer, whereby there is imposed a line structure on said raster, and further means for applying a varying difference of potential between different parts of the grid whereby the position of said line structure is shifted on said raster.

4. A cathode ray tube comprising a transparent support, a plurality of strips of phosphors fluorescent in a plurality of colors disposed on said support in a repeating cyclic order, means to develop a beam of electrons to trace a raster on said strips, an electrically conducting layer overlying said strips, and a plurality of linear conductors supported between said means and support substantially parallel to each other and to the long dimension of said strips at a substantially uniform distance from said support, a conductor being provided for each cycle of said strips, said conductors being divided into a plurality of electrically separated parts, whereby one potential difference may be applied between one part of said conductors and said layer and another potential difference may be applied between another part of said conductors and said layer.

5. In a cathode ray tube adapted for polychrome image reproduction, said tube having means for developing an electron beam to trace a raster on the surface of a target composed of phosphor strips representing individual color components of an additive system, said strips being laid down in a cyclic order, the combination of an electrically conducting layer disposed on the phosphor-coated surface of said target, and a grid of wires positioned adjacent said target between said target and said beam developing means with said wires substantially parallel to the long dimension of said strips, at least one wire being provided for each cycle of said strips, said wires being divided into a plurality of electrically separated groups, whereby upon the application of varying potential differences between separate groups of said wires and said target there is imparted a line structure upon the raster traced by said beam upon said target, the position of said line structure varying with variation of said potential differences.

6. A color television image reproducing system including a cathode-ray tube having a cathode, a target area, means for developing and deflecting an electron beam to scan said target area in line by line fashion, and a control electrode, the target area of said tube being formed of a plurality of groups of parallel strips of phosphors positioned side by side in a cyclically repeating pattern, each said group including strips fluorescent in at least two component colors of an additive color system, said strips being inclined to the line scanning direction of said electron beam, said tube further including a plurality of substantially parallel linear conducting members

lying substantially in a single plane adjacent said target area in the path of said beam, one of said members being associated with each of said groups so that the rate of impingement of said beam on successive ones of said conducting members, as said beam scans across the strips of said target, is the same as the frequency at which successive ones of said groups of said strips are traversed by the beam, means for developing an electrical signal from the impingement of said beam on each of said members, and a time delay network having a plurality of delays coupled to said signal developing means, said time delays differing successively by substantially the times required for said beam to scan from a position of impingement on one of said strips to a position of impingement on an adjacent strip.

7. In a color television receiving system: a cathode-ray tube including a cathode, a control electrode, an electron beam accelerating electrode, an image screen made up of a plurality of strips of phosphors fluorescent in a plurality of colors disposed side by side in a repeating cyclic order, and a plurality of linear conducting members disposed adjacent said screen in the path of said beam and substantially aligned with said strips, at least one conducting member being provided for each cycle of said strips; means associated with said tube to scan said beam across said screen in a raster the lines of which are inclined to the length of said strips; means for developing a control signal from the impingement of said beam on each of said members as said beam is scanned over said screen; a time delay network having a plurality of delays; and means coupling said control signal developing means to said time delay network.

8. A color television receiving system comprising means to derive demodulated video signals from a received wave, a cathode-ray tube having a cathode, a control electrode, a striped phosphor screen and means for developing and deflecting an electron beam thereacross to trace a raster thereon in line by line fashion, said screen including a plurality of strips of phosphors fluorescent in a plurality of colors, said strips being disposed side by side in cyclically repeating fashion, a grid made up of a plurality of linear conducting members disposed adjacent said screen in the path of said beam and substantially aligned with said strips, one such member being provided for each cycle of said strips, means to develop a control signal each time said beam impinges on one of said members, a time delay network having a plurality of delay

periods successively substantially equal to the times required for said beam to pass in scanning from impingement on one of said members to impingement on the successive strips of the cycle of strips associated with said one member, means coupling said control signal developing means to said network, and means actuated by said control signals as delayed by said network to control the application of said video signals between said grid and cathode.

9. In a color television receiving system: a cathode-ray tube including a cathode, a control electrode, a target, means to generate and accelerate an electron beam toward said target, a plurality of phosphor strips fluorescent in a plurality of colors disposed on said target in a repeating cyclic order, a plurality of linear conducting members disposed adjacent said target in the path of said beam and substantially aligned with said strips, at least one conducting member being provided for each cycle of said strips, all of said members occupying the same position relative to their associated cycle of strips; a radio receiver adapted to derive video signals and scanning signals from a received wave; means responsive to said scanning signals to deflect said beam across said target to trace thereon a raster the lines of which are inclined to the length of said strips; means to develop a control signal each time said beam impinges on one of said conducting members; a time delay network including a plurality of delay periods differing from one another by substantially the times required for said beam to scan from a position of impingement on one of said strips to a position of impingement on an adjacent one of said strips, means coupling said control signal developing means to said network, and means actuated by said control signals as delayed by said network to control the application of said video signals between said grid and cathode.

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