Feb. 25, 1947. P. C. GOLDMARK 2,416,301

COLOR TELEVISION

Filed Aug. 26, 1943 2 Sheets-Sheet 1

Fig. 1.

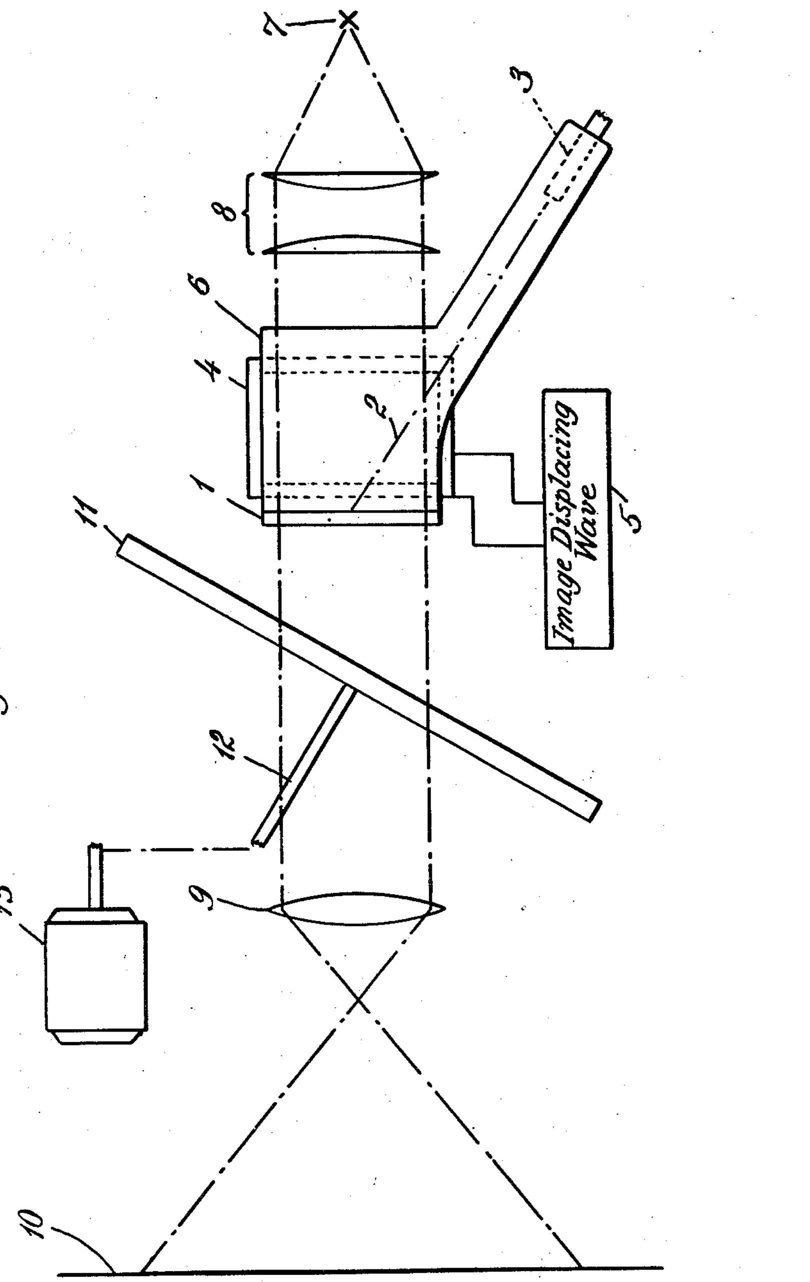

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Fig. 2,

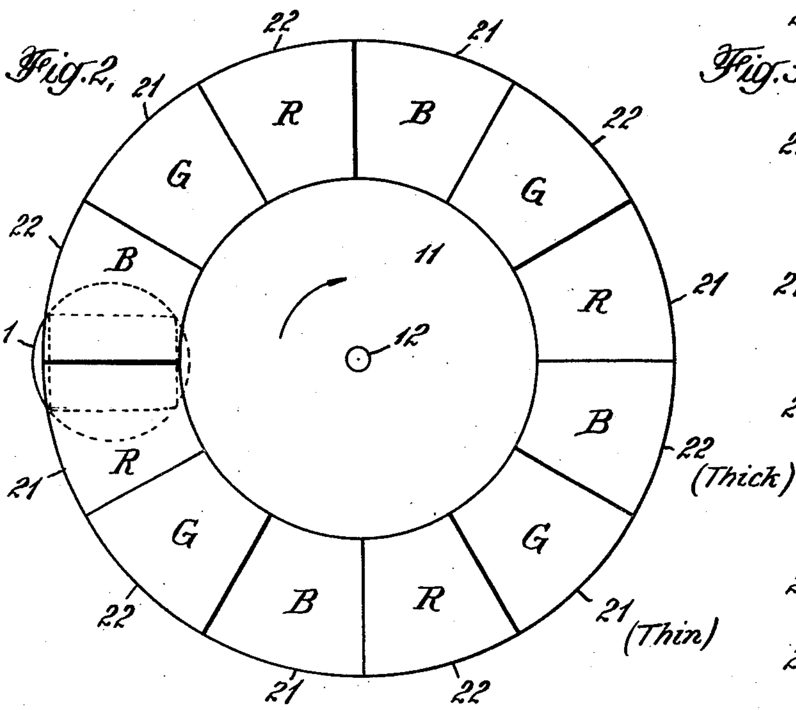


Fig. 3,

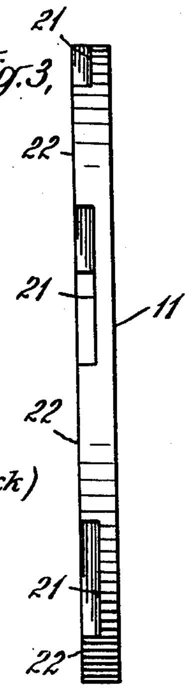


Fig. 4a,

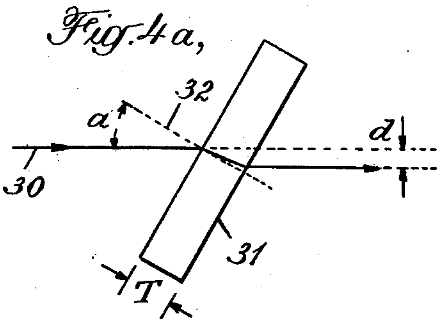


Fig. 4b,

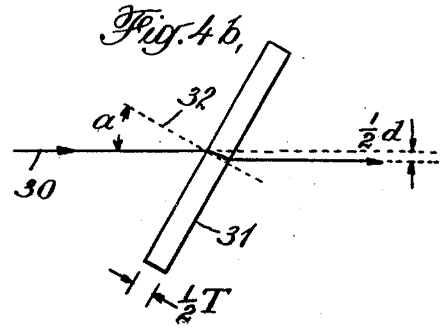


Fig. 5a

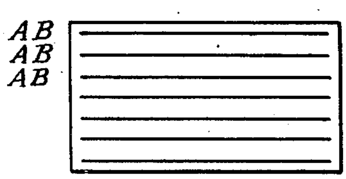
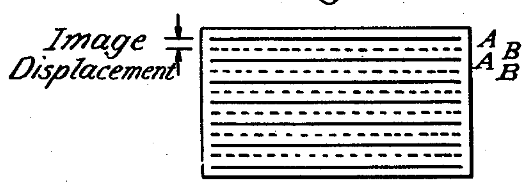


Fig. 5b.



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Patented Feb. 25, 1947 2,416,301

UNITED STATES PATENT OFFICE

2,416,301

COLOR TELEVISION

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Application August 26, 1943, Serial No. 500,039

12 Claims. (Cl. 178—5.4)

This invention relates to the reproduction of color-television pictures with a cathode-ray controlled light valve having storage characteristics. It has for its principal object the provision of an improved additive-color television method and apparatus adapted to produce and project screen images of high luminous intensity and color quality derived from video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors.

Commercially acceptable projection of black and white television pictures has been achieved with known types of cathode-ray tubes by projecting directly the images with lenses, or mirrors, or both, on a viewing screen. But screen images so produced with known arrangements are not sufficiently brilliant to permit viewing in other than a substantially darkened enclosure.

When cathode-ray tube television images are viewed in an undarkened room through color filters directly, for example, in accordance with the improvements described in my United States Letters Patent No. 2,304,081, granted December 8, 1942, the accompanying loss of light is to a large degree offset by an increase in contrast range due to the second power absorption of the incident light as against the first power absorption of the radiated light. But that advantage is not attainable in a projection system where color filters are interposed between a light valve and an external reflecting screen.

Since the projection of additive-color images requires the interposition of color filters the average light transmission of which is of the order of twenty per cent, it is apparent only light valves which can produce images having luminous intensities several times that sufficient for acceptable black and white image projection, may be employed.

Among the known systems which are capable of producing images of sufficiently high luminous intensity to permit of additive-color projection of television pictures is that which depends upon the development of opaque areas in microcrystalline layers of ionic crystals under the action of electron bombardment; and, that which utilizes a suspension light valve consisting of a large number of opaque particles of dissymmetric shapes suspended in an insulating fluid wherein the orientation of the particles produced by an electron beam determines the light transmission properties of the valve. Both of those cathode-ray controlled light valves exhibit desired storage effects.

A description of the system first above referred to is given in the Proceedings of The Institute of Radio Engineers for May, 1940 (vol. 28, pp. 203–212) in an article entitled "A system of large-screen television reception based on certain electron phenomena in crystals" by A. H. Rosenthal. The second of the systems is described in the Proceedings of May, 1943 (vol. 31, pp. 208–214) in an article entitled "Light valve for television reproduction" by J. S. Donal, Jr., and D. B. Langmuir.

It has been demonstrated that satisfactory color rendition and adequate detail can be obtained without objectionable flicker with interlaced scanning within a standard television band for black and white picture transmission. For example, the system described in my pending application Serial No. 355,840, filed September 7, 1940, is one with which satisfactory commercial results have been obtained. The use of three primary colors and double interlacing has been found to be eminently satisfactory. Published description of the advantages of interlaced scanning in color television will be found in Electronics for October 1940 (pp. 32–74) and in the Proceedings of The Institute of Radio Engineers for April, 1942 (vol. 30, No. 4, pp. 162–182).

The use of cathode-ray controlled light valves having desired storage characteristics, including the photo-conductive or electron opacity types hereinabove referred to, for the reception of additive-color television video signals of image areas line-scanned in a series of field scansions the successive sets of uniformly spaced parallel lines of which correspond to different colors, presents the problem of color carryover due to storage effects. For example, assuming that three primary colors are to be employed with double interlacing and that storage in any area of the image transparency persists until the electron beam has returned to the same point, two successive interlaced fields would appear under one and the same color filter resulting in color carryover and the production of images having undesired or false color values.

In pending application Serial No. 366,400, filed November 20, 1940, specific improvements are described which successfully overcome the tendency to color carryover in transmitting systems utilizing storage type cathode-ray pickup tubes with effective interlaced scanning. In accordance with those improvements, instead of scanning different interlaced sets of lines of the scanning or light image receiving area of the storage tube during successive field scanning periods, only a single set of uniformly spaced parallel lines is scanned. The spacing of the scanned set of lines, however, is the same as the spacing or line pitch of one set of lines in interlaced scansion so that the scanned lines are non-contiguous. Then the optical image on the scanning or light image receiving area is optically displaced, or the electronic image is electrically displaced, as the case may be, during the interval between successive scansions, in an amount sufficient to cause a plurality of different interlaced sets of lines of the image to be superposed and successively coincide or pair with the non-contiguous set of lines of the scanning or image receiving area. Obviously, multi-color video signals transmitted by such a system are in effect, the same as though optical or electrical displacement and the scanning of non-contiguous lines had not been resorted to.

In accordance with the present invention cathode-ray-controlled light valves having desired storage characteristics in that each successive transparency image can be maintained during a substantial portion, closely that of the field period, may be utilized for the production of large screen additive-color images of high luminous intensity and color value. This is achieved by displacing electrically the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the successive transparency images of successive fields to be formed in paired-line coincidence relation. The required electrical displacement may be readily attained by adding to the vertical scanning wave at alternate fields, an appropriate current or voltage component, depending upon whether magnetic or electrostatic deflection is employed, to control the movement of the modulated electron beam. Thereupon, interlaced relationship of alternate sets of lines at the viewing screen may be produced optically by interposing preferably adjacent the valve, and between the transparency images and the viewing screen, a rotatable optical disk for shifting optically at each alternate field, the light rays from the image of a set of lines in an amount sufficient to produce effectively at the viewing screen interlacing of the successive sets of lines of the successive fields. Color filters may be combined conveniently with the glass plates of the optical disk.

As viewed on the screen the successive color images will appear as though they had been projected without application of the described steps of electrical displacement followed by optical displacement.

The invention will be better understood by reference to the accompanying drawings considered with the following description, and the scope thereof will be defined in the claims.

In the drawings:

Fig. 1 is a schematic illustration of a preferred embodiment of the invention;

Fig. 2 is a front view of the rotatable optical disk shown in Fig. 1 which produces optical displacement of the images at the viewing screen to produce thereat effective interlacing of the sets of lines of the successive fields;

Fig. 3 is a side view of the rotatable optical disk;

Figs. 4*a* and 4*b* illustrate the principle of the optical displacement produced upon rotation of the optical disk of Fig. 2; and

Figs. 5*a* and 5*b* illustrate respectively, the manner in which displacement of the development of the images of the sets of lines of each alternate field effects substantial paired-line coincidence of the sets of lines of successive fields, and the manner in which optical displacement of the images at the viewing screen produces effective interlacing of the successive sets of lines of the successive fields.

Referring now to Fig. 1, there is represented schematically at 1 the element which depends upon the development of opaque areas in micro-

crystalline layers of ionic crystals to form an optical transparency image, or, in the alternative, the element at 1 may consist of a large number of opaque particles of dissymetric shapes suspended in an insulating fluid wherein the orientation of the particles forms an optical transparency image, both under the action of electron bombardment by a modulated electron beam 2 produced by the electron gun 3, and modulated and controlled in a manner well known, not illustrated.

The electrical displacement of the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the successive transparency images to be formed in paired-line coincidence relation may be effected by suitable deflecting means here shown as a coil 4 energized by a suitable image displacing wave generator 5. In any event, the required electrical displacement may be effectively attained by adding to the vertical scanning wave at alternate fields an appropriate current or voltage component, depending upon whether magnetic or electrostatic deflection is employed to control the movement of the modulated electron beam 2.

The optical transparency images formed at the element 1 of the cathode-ray controlled light valve 6 are intensely illuminated by the light source 7 which is preferably of constant high luminous intensity. The light source 7, the condenser lens 8 and the object lens 9 are arranged in a manner substantially similar to the corresponding elements of an optical system used for the projection of motion picture film images and serve to form on the viewing screen 10 greatly enlarged images corresponding to the successive transparency images at the element 1.

The modulated electron beam 2 produced by the electron gun 3 and modulated and deflected in manners well known to the art, develops the transparency images to be projected to the viewing screen 10 as it impinges on the element 1. Since either one of the forms of element 1 above described possesses desired storage characteristics in that each successive transparency image is maintained during a substantial portion of the field period, preferably closely that of a full field period, the resulting transparency images are capable of substantial magnification for the production of large screen images at the viewing screen 10.

In the light path between the element 1 of the cathode-ray controlled light valve 6 at which the transparency images are formed, and the viewing screen 10 there is interposed and arranged preferably adjacent the element 1, a rotatable optical disk 11 adapted to shift optically the images of sets of lines of alternate fields at the viewing screen 10 in an amount sufficient to produce effectively thereat interlacing of the successive sets of lines of the successive fields. The disk 11 is rotatable about an axis 12 by the motor 13.

The disk 11 is provided with a plurality of optically flat glass segments arranged as shown in Figs. 2 and 3, the glass segments having parallel faces in the plane of the disk 1 but being of different thicknesses, as shown. The plane of the disk 11 is arranged at an angle with respect to the effective plane of the transparency images formed at the element 1 (measured in a plane normal to the said effective plane and substantially perpendicular to the scanning lines) so that the glass plates of different thicknesses will produce different displacements in a vertical direction of light rays passing therethrough.

Referring to Fig. 2 the optical displacement disk 11 suitable for effective operation with double interlacing and three colors, is provided with two series of optically flat glass segments 21 and 22, respectively, spaced around the periphery of the disk at equal intervals. The faces of the glass segments are parallel in the plane of the disk. The segments of the series 22 are thicker than those of series 21, as will be seen more readily in Fig. 3. The segments are colored successively red, green and blue in sequence around the disk as indicated by the letters R, G and B. The glass segments may themselves be colored or, what is more convenient and practical, Wratten gelatin filters may be affixed to the glass segments, as by optical cement.

The principles of the relative displacements of the light rays produced by the series of glass segments 21 and 22 will be understood by referring to Figs. 4*a* and 4*b*. A ray of light 30 impinges on a glass plate 31 at an angle a with the normal 32 to the surface thereof. In accordance with well known principles of optics, in passing through the glass plate the ray of light 30 undergoes a displacement d given by the following formula:

$$d = T \times \sin a\left(1 - \frac{\cos a}{\sqrt{\mu^2 - \sin^2 a}}\right) \qquad (1)$$

As indicated by the formula the displacement d is a function of the thickness T of the glass plate, the angle of incidence a, and the index of refraction μ. For a given μ and a given angle a, however, the displacement is directly proportional to the thickness T. This is illustrated in Figs. 4*a* and 4*b* where a thickness of glass segment ½T produces a displacement ½d, one-half that of a thickness T.

If the difference in plate thickness is $T_2 - T_1$ and the corresponding difference in displacement is $d_2 - d_1$, then

$$T_2 - T_1 = \frac{d_2 - d_1}{\sin a\left(1 - \frac{\cos a}{\mu}\right)} \qquad (2)$$

For an image size of two (2″) inches and three hundred seventy-five (375) lines per frame (allowing 10% for blanking) the displacement required is $^2/_{338}''=0.152$ mm.; then

$$T_2 - T_1 = \frac{.152}{.259\left(1 - \frac{.259}{2.25}\right)} = .7 \text{ mm.}$$

If the angle of incidence a equals 15° and the refractive index $\mu=1.5$ the difference in plate thickness will be as shown above, namely, 0.7 mm.

Referring now to Figs. 5*a* and 5*b*, the manner in which effective interlacing of the sets of lines of successive fields is produced at the viewing screen will be explained. Fig. 5*b* illustrates a conventional double-interlaced scanning pattern composed of a set of lines A interlaced with a set of lines B. For convenience of description, these lines will be understood first as representing lines of a light image of an object field. Fig. 5*a* illustrates the manner in which the transparency images of the sets of lines of successive fields are formed in paired-line coincidence relation as a result of the electrical displacement of the development of the transparency images of the sets of lines of each alternate field. And again Fig. 5*b* illustrates the images of the sets of lines of the successive fields at the viewing plane or screen as a result of the optical displacement of the light rays from the transparency images of the sets of lines of each alternate field in an amount sufficient to produce effectively at the viewing plane the interlaced relation of the lines A and B.

The operation of the apparatus is as follows: Disk 20 is rotated at such a speed that successive segments 21—22 traverse the area of the element 1 in the low-frequency direction at field-scanning frequency. To accomplish this, the motor 13 is synchronized with the vertical deflection of the electron beam 2 and the ratio of drive between motor and disk properly chosen. For a field frequency of 120 scansions per second, and the twelve-segment disk shown, the disk 20 will rotate at 600 R. P. M.

Assume that a red thin segment 21 is traversing the area of the effective image plane of element 1 of the cathode-ray controlled light valve 6, there will appear at the viewing screen 10 the red aspect of the image of a set of lines A. As the image of the next set of lines B of the successive field form a transparency image in the effective plane of the element 1 they are obscured by the next segment 22, colored green and thicker than the segment 21. The difference in thickness is chosen as above explained so that the images of the lines B are displaced optically at the viewing screen 10 in an amount sufficient to produce effectively thereat the interlaced relation illustrated in Fig. 5*b*. In double interlacing the displacement at the screen (in magnified relation) or at the element 1, is the distance between interlaced lines, that is, the distance between adjacent lines A and B of Fig. 5*b*. As soon as the red and green segments have traversed the area of the effective image plane of element 1 the blue segment is interposed and traverses that area. Thus, full interlaced detail is obtained at the viewing screen even though the transparency images of the sets of lines of successive fields are formed in paired-line coincidence relation at the element 1 as a result of the electrical displacement of the development thereof.

The actual displacement or shift required to produce the effective interlaced relation is quite small for a large number of lines. Therefore, by making the thickness T of segments 22 sufficiently great, the angle of incidence a of the disk may be made only a few degrees.

It is advantageous to have the disk and the modulated electron beam 2 so phased and related that the beam and the boundary line between the successive segments of the disk 20 coincide as nearly as possible throughout a single period. Thus as soon as a line of the image at element 1 is completed, it will be in a condition to have formed thereat in paired-line coincidence relation the image of the line of the alternate field.

Figs. 2 and 3 illustrate a disk having alternate thick and thin segments. The same result may be obtained by reducing the thickness of the thin sections to zero, that is, having the sections entirely in air, thus simplifying the construction. A corresponding change in thickness of the thick segments would then be made. In such cases, sections 21 may represent merely the thickness of a gelatin color filter. It will be understood that the phrase "transparent segments of different thickness", and similar phrases, as used herein, include the case where some of the segments are entirely air.

Instead of attaching the color filters to the glass segments, a separate color filter disk may be employed. In such case the color disk may be made of larger diameter and with more sections than the glass disk, so as to follow the formation of the images more accurately. It is not necessary to have the separate filter disk rotate in a plane parallel to that of the glass segment disk, since the filter disk is not required to effect displacement of the images. Thus the filter disk could be arranged to rotate in a plane parallel to the effective image plane of the element I and preferably close thereto.

In the foregoing description of the optical image displacement disk, the use of glass segments of different thickness to produce image shifts or displacements in different amounts, has been explained. From Formula 1, however, it will be apparent that segments of the same thickness and different refractive index (μ) could be used instead, or a combination of different thicknesses and different refractive indices. Ordinarily it will be advantageous to use glass of the the same refractive index and different thickness.

The accuracy required for the optical displacement of the images is easily obtainable, in view of the fact that for variations in vertical linearity of one part in ten, the resultant spacing between alternate sets of lines in different areas of the picture will also be within the same tolerance. When judging quality interlacing, this is considered as highly satisfactory. However, it is important that the image size in vertical direction should be maintained within ten percent of a predetermined dimension since the amount of optical displacement has been based on a definite image height. Assuming that hum interference has been taken care of and substantial paired-line coincidence relation is attained substantially precise effective interlacing of the successive sets of lines may be obtained upon proper adjustment of the vertical image size control.

While the method and apparatus of the invention is especially designed for use with devices exhibiting desired storage characteristics and effects, and intended to solve problems peculiar thereto, features of the invention may be employed with non-storage devices if desired.

Many modifications of the invention may be made without departing from the spirit and scope of the invention as defined in the claims. It is to be understood that different means may be employed for displacing the images electrically and optically other than those specifically described. Other modifications will be apparent to those skilled in the art. Furthermore, some features of the invention may be employed in systems widely different from those herein specifically described.

I claim:

1. In a color-television receiving apparatus including a cathode-ray tube having storage characteristics and adapted to translate video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the method of substantially avoiding color carryover and the production of images having undesired color values due to said storage characteristics which comprises, producing optical transparency images corresponding to each successive set of lines of the received video signals, maintaining each of said transparency images during a substantial portion of a field period, electrically displacing the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the transparency images of successive fields to be formed in paired-line coincidence relation, thereby preventing the formation thereof in interlaced-line relation, optically projecting each of the successive transparency images to a viewing plane with light of substantially constant high luminous intensity, and optically displacing the light rays from the transparency images of the sets of lines of each said alternate fields in an amount sufficient to produce effectively at said viewing plane interlacing of the successive sets of lines of the successive fields.

2. In color television receiving apparatus adapted to translate video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the combination which comprises, a cathode-ray controlled light valve having storage characteristics and adapted to produce optical transparency images corresponding to each successive set of lines of the received video signals and to maintain each of said images during a substantial portion of a field period, means for electrically displacing the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the transparency images of successive fields to be formed in paired-line coincidence relation, thereby to prevent the formation of the successive transparency images in interlaced relation, means providing a viewing plane, a substantially constant light source of high luminous intensity for projecting each of said transparency images to the said viewing plane, and optical means interposed in the light path between said transparency images and the viewing plane for displacing optically the light rays from the transparency images of the sets of lines of each said alternate fields in an amount sufficient to produce effectively at said viewing plane interlacing of the successive sets of lines of the successive fields, whereby color carryover and the production of images having undesired color values due to said tube storage characteristics may be substantially avoided at the viewing plane.

3. In color television receiving apparatus adapted to translate video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the combination which comprises, a cathode-ray controlled light valve having storage characteristics and adapted to produce optical transparency images corresponding to each successive set of lines of the received video signals and to maintain each of said images during a substantial portion of a field period, means for electrically displacing the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the transparency images of successive fields to be formed in paired-line coincidence relation, thereby to prevent the formation of the successive transparency images in interlaced relation, means providing a viewing plane, a substantially constant light source of high luminous intensity for projecting each of said transparency images to the said viewing plane, and a continuously operating optical assembly interposed in the light path between said image plane and the viewing plane for displacing optically in one direction the light rays from the transparency images of the sets of lines of each said alternate fields in an amount sufficient to produce effectively at said viewing plane interlacing of the successive sets of lines of the successive fields, whereby color carryover and the

production of images having undesired color values due to said tube storage characteristics may be substantially avoided at the viewing plane.

4. In color television receiving apparatus adapted to translate video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the combination which comprises, a cathode-ray controlled light valve having storage characteristics and adapted to produce optical transparency images corresponding to each successive set of lines of the received video signals and to maintain each of said images during a substantial portion of a field period, means for electrically displacing the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the transparency images of successive fields to be formed in paired-line coincidence relation, thereby to prevent the formation of the successive transparency images in interlaced relation, means providing a viewing plane, a substantially constant light source of high luminous intensity for projecting each of said transparency images to the said viewing plane, and a rotatable disk having a plurality of transparent segments spaced therearound interposed in the light path between said image plane and the viewing plane and positioned so that as the disk rotates said segments are successively and progressively interposed in the path of the light rays forming the images at the viewing plane to produce an optical shift of the images of the sets of lines of alternate fields in an amount sufficient to produce effectively at said viewing plane interlaced relationship of the images of the successive sets of lines of the successive fields, whereby color carryover and the production of images having undesired color values due to said tube storage characteristics may be substantially avoided at the viewing plane.

5. In color television receiving apparatus adapted to translate video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the combination which comprises, a cathode-ray controlled light valve having storage characteristics and adapted to produce optical transparency images corresponding to each successive set of lines of the received video signals and to maintain each of said images during a substantial portion of a field period, means for electrically displacing the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the transparency images of successive fields to be formed in paired-line coincidence relation, thereby to prevent the formation of the successive transparency images in interlaced relation, means providing a viewing plane, a substantially constant light source of high luminous intensity for projecting each of said transparency images to the said viewing plane, and a rotatable disk having a plurality of transparent segments spaced therearound and positioned so that as the disk rotates said segments are successively interposed in the path of the light rays forming the images at the viewing plane, each segment being interposed progressively during a field period, the face of the disk being at an angle to the effective plane of the transparency images measured in a plane normal thereto, the thicknesses and indices of refraction of said plurality of segments being correlated with said angle so that successive segments shift the images at the viewing plane by different amounts predetermined to produce effectively at said viewing plane interlacing of the successive sets of lines of the successive fields, whereby color carryover and the production of images having undesired color values due to said tube storage characteristics may be substantially avoided at the viewing plane.

6. In color television receiving apparatus adapted to translate video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the combination which comprises, a cathode-ray controlled light valve having storage characteristics adapted to produce optical transparency images corresponding to each successive set of lines of the received video signals and to maintain each of said images during a substantial portion of a field period, means for electrically displacing the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the transparency images of successive fields to be formed in paired-line coincidence relation, thereby to prevent the formation of the successive transparency images in interlaced relation, means providing a viewing plane, a substantially constant light source of high luminous intensity for projecting each of said transparency images to the said viewing plane, and color filter means interposed in the path of light to said viewing plane from said transparency images and adapted to expose said viewing plane to a plurality of color aspects of the transparency images, and a rotatable disk having a plurality of transparent segments spaced therearound and positioned so that as the disk rotates the segments successively traverse the light rays forming the images at said viewing plane, said segments being constructed and positioned to produce a shift of the images at the viewing plane in an amount to produce effectively thereat interlacing of the successive sets of lines of the successive fields, whereby color carryover and the production of images having undesired color values due to said tube storage characteristics may be substantially avoided at the viewing plane.

7. In color television receiving apparatus adapted to translate video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the combination which comprises, a cathode-ray controlled light valve having storage characteristics and adapted to produce optical transparency images corresponding to each successive set of lines of the received video signals and to maintain each of said images during a substantial portion of a field period, means for electrically displacing the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the transparency images of successive fields to be formed in paired-line coincidence relation, thereby to prevent the formation of the successive transparency images in interlaced relation, means providing a viewing plane, a substantially constant light source of high luminous intensity for projecting each of said transparency images to the said viewing plane, and color filter means positioned and adapted to cyclically and progressively change the color aspect of the images at the viewing plane from one color to the next of a plurality of colors during successive field periods, and image shifting means comprising a rotatable disk having a plurality of transparent segments spaced therearound and po-

sitioned so that as the disk rotates said segments are successively interposed in the path of light forming said images at the viewing plane, said segments being constructed and adapted to progressively displace alternate images at the viewing plane in an amount sufficient to produce effectively thereat interlacing of the successive sets of lines of successive fields, whereby color carryover and the production of images having undesired color values due to said tube storage characteristics may be substantially avoided at the viewing plane.

8. In color television receiving apparatus adapted to translate video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the combination which comprises, a cathode-ray controlled light valve having storage characteristics and adapted to produce optical transparency images corresponding to each successive set of lines of the received video signals and to maintain each of said images during a substantial portion of a field period, means for electrically displacing the development of the transparency images of the sets of lines of each alternate field in an amount sufficient to cause the transparency images of successive fields to be formed in paired-line coincidence relation, thereby to prevent the formation of the successive transparency images in interlaced relation, means providing a viewing plane, a substantially constant light source of high luminous intensity for projecting each of said transparency images to the said viewing plane, and a rotatable disk having a plurality of transparent segments spaced therearound, said disk being positioned adjacent the said light-valve so that as the disk rotates said plurality of segments will be successively interposed in the path of the light rays forming the images at the viewing plane, the face of said disk being at an angle to the effective plane of the transparency images in a plane which is normal thereto, the thicknesses and indices of refraction of said plurality of segments being correlated with said angle so that as the disk rotates successive segments displace the images at the viewing plane in an amount sufficient to produce effectively thereat interlacing of the successive sets of lines of successive fields, whereby color carryover and the production of images having undesired color values due to said tube storage characteristics may be substantially avoided at the viewing plane.

9. In an electronic color television receiving apparatus including a cathode-ray controlled light valve having storage characteristics and adapted to translate additive-color video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the method of producing large screen images of high luminous intensity and color value which comprises, producing optical transparency images in paired-line coincidence relation corresponding to each set of lines of successive fields of the received video signals, projecting with substantial magnification each of said images to a viewing plane with light of substantially constant high luminous intensity, optically displacing the light rays from the transparency images of the sets of lines of each alternate field in an amount sufficient to produce at said viewing plane effective interlacing of the successive sets of lines of successive fields, and rendering each of the successive images at the viewing plane in its color aspect.

10. In electronic color television receiving apparatus adapted to translate additive-color video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors, the combination which comprises, a cathode-ray controlled light valve having storage characteristics and adapted to produce optical transparency images in paired-line coincidence relation corresponding to each set of lines of successive fields of the received video signals and to maintain said images for a substantial portion of a field period, a viewing screen, an optical system including a light source of constant high luminous intensity adapted to project with substantial magnification to said viewing screen each of said images, means for optically displacing the light rays from the transparency images of the sets of lines of each alternate field in an amount sufficient to produce at said viewing screen effective interlacing of the successive sets of lines of successive fields, and multi-color filter means interposed in the light path between said screen and the said images adapted to render each of the successive images at the viewing plane in its color aspect.

11. In a system for television reception having a storage element whose light transmitting properties may be varied in response to electron bombardment thereof, the method of operating such system which comprises successively scanning said element with a modulated electron beam in a series of sets of uniformly spaced parallel lines in paired-line coincidence relation, illuminating one side of said element with light of substantially constant intensity, and optically displacing the rays of light from each alternate set of lines in an amount sufficient to enable viewing of the successive light images in effective interlaced-line relation.

12. In a system of color television reception having an element whose light transmitting properties may be varied in accordance with electron bombardment thereof and whose storage characteristics permit of the maintenance of transparency images thereat for a substantial period, the method of translating received additive-color video signals of image areas line-scanned in a series of field scansions, the successive sets of uniformly spaced parallel lines of which correspond to different colors which comprises, successively scanning said element with an electron beam modulated with said video signals in a series of sets of uniformly spaced parallel lines in paired-line coincidence relation to form transparency images thereat of each successive set of lines corresponding to the received signals, illuminating substantially the entire area of one side of said element with light of substantially constant high intensity, color filtering the rays of light from each set of lines, and optically displacing the rays of light from said alternate set of lines in an amount sufficient to enable viewing of the successive light images in effective interlaced-line relation.

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