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M. W. GREEN
COLOR-KINESCOPIES, ETC
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2,579,665

Fig. 2

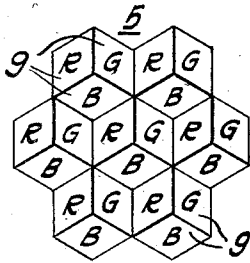


Fig. 1

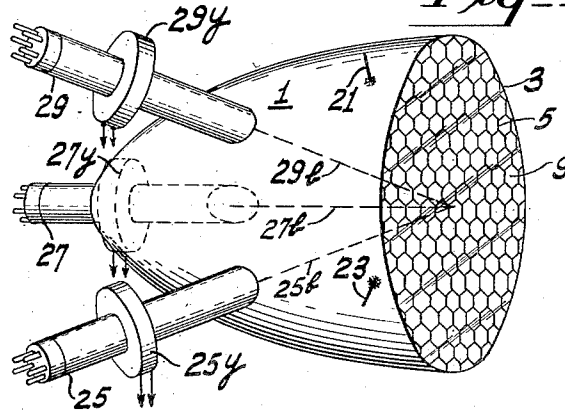


Fig. 3

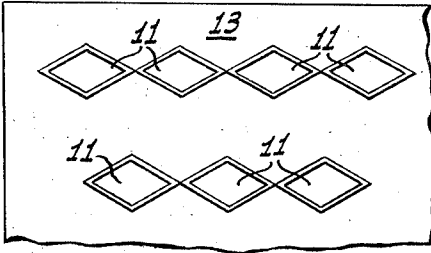


Fig. 4

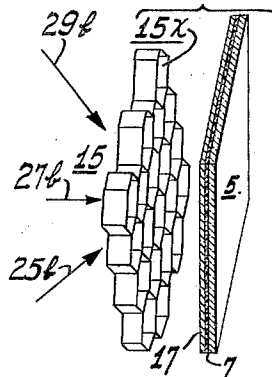


Fig. 5



Fig. 6

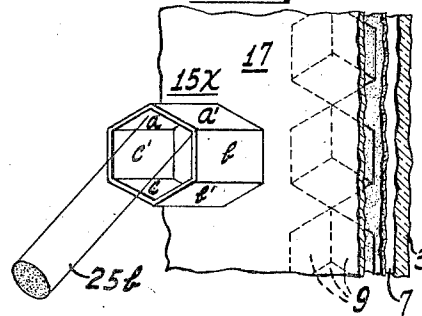
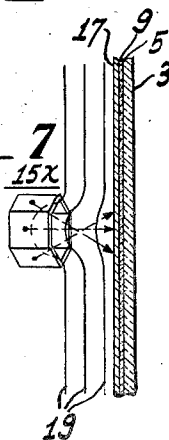


Fig. 7



INVENTOR
Milton W. Green
BY *Roderick Malcolm*
ATTORNEY

UNITED STATES PATENT OFFICE

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COLOR-KINESCOPES, ETC.

Milton W. Green, Princeton, N. J., assignor to
Radio Corporation of America, a corporation
of Delaware

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1

This invention relates to cathode-ray tubes and will be described as applied to a color-kinescope of a kind suitable for use in translating video signals, transmitted by any conventional electronic color-television system, into color im-

ages of the object or scene being televised. Stated generally, the principal object of the present invention is to provide a cathode-ray tube which shall possess all of the following advantages: (1) Low beam-velocity and low deflection-current, with resulting economies in the construction and operation of the tube and its associated power supply system. (2) Low-initial cost and (3) uniform wide-angle visibility.

More specifically, the present invention contemplates, and its practice provides: (1) A color-kinescope employing accelerating voltages of the order of, say 500 volts, instead of, say, ten kilovolts (as required in some present-day color-kinescopes). (2) A color-kinescope which, in its construction, presents no complex mechanical alignment problems, such as are encountered in kinescopes of the kind employing a two-dimensional punctiform mask and target assembly. (3) A color-kinescope wherein the sub-elemental phosphor areas, upon which the color-images appear, are contained on a substantially plane foundation surface, instead of on discrete surfaces disposed at different angles with respect to the observer (as in the case of kinescope employing a "honey-comb" screen).

Stated generally, the foregoing objects and advantages are achieved, in accordance with the invention, by the provision of a cathode-ray tube containing a three-dimensional grille-like target having secondary-electron emissive surfaces upon which signal-modulated electron-beams, or beam parts, are respectively directed at low velocities, and a two dimensional phosphor screen upon which the secondary-electrons are selectively directed by electron-optical means.

The invention is described in greater detail in connection with the accompanying drawing, wherein:

Fig. 1 is a view in perspective of a three-gun kinescope embodying the invention, the dimensions of the groups of phosphor color-areas on the screen being enlarged the more clearly to indicate their form and pattern of distribution.

Fig. 2 is a greatly enlarged plan view of a small section of the luminescent screen of the kinescope of Fig. 1, the drawing being marked to indicate the color of the light emitted by each sub-elemental phosphor area.

Fig. 3 is a plan view of a stencil which may be

2

employed in laying down the sub-elemental phosphor areas on the foundation surface of the screen.

Fig. 4 is a side view in perspective showing a phosphor screen and a honeycomb target constructed and arranged in accordance with the principle of the invention.

Fig. 5 is a view in perspective of a corrugated strip of secondary-electron emissive metal employed in fabricating the honeycomb target of Fig. 4.

Fig. 6 is a view from the gun side of the mask and screen assembly of Fig. 4, showing the angles at which the primary-electrons approach the several secondary-electron emissive inner faces of the cells of the honeycomb mask and

Fig. 7 is a side view, partly in perspective, showing the target and screen assembly of Figs. 4, and 6, the drawing being marked with equipotential lines to illustrate the manner in which the secondary-electrons from the inner faces of the target are selectively directed to the different color phosphor-areas on the screen.

The kinescope shown in Fig. 1 comprises an evacuated envelope having a bulbous portion or main chamber 1 which is provided with a translucent window 3 through which a color-screen 5 is visible. The screen 5 comprises a foundation surface 7 which may be the inner face of the window and, upon said surface, a multiplicity of groups 9 of sub-elemental picture areas R, B, G, respectively (Fig. 2). When, as in the instant case, the kinescope is designed to re-create images in three colors, each of the picture-area-groups 9 comprises a closed, substantially plane, six-sided polygon made up of the three juxtaposed parallelograms R, B, and G shown in Fig. 2. Alternatively, if the kinescope is to be of the two-color variety, the screen pattern may be made-up of juxtaposed four-sided plane figures (not shown). Each of the sub-elemental areas is coated with a phosphor material capable of emitting light of a color (e. g. red R, blue B, green G) individual to that area, when struck by electrons.

The separate phosphor materials may be laid down on the foundation surface 7 of the screen through the apertures 11 of a stencil 13 (Fig. 3). The stencil 13 may comprise a "silk-screen," if the phosphors are to be laid down by printing, and may be made of metal if the phosphors are to be deposited by settling them from a liquid suspension, in a settling tank, not shown. In either event, the same stencil, when re-positioned with respect to the previously applied

phosphor areas, may be used in laying down the other phosphors on the other areas.

As taught by Leverenz in U. S. Patent 2,310,863; when the sub-elemental areas R, G, B of each phosphor-group 9 on the screen are to emit red (R), green (G), and blue (B) light, respectively, the materials of which said areas are composed, may comprise: chromium activated aluminum beryllate or zinc cadmium sulfide activated with silver, for the red areas; alpha-williemite activated with manganese or zinc cadmium sulfide activated with silver, for the green areas; silver-activated zinc sulfide and zirconium silicate for the blue areas.

Referring to Fig. 4: In back of the screen 5, and slightly spaced from it, is a three-dimensional target or grille 15 consisting of many small hexagonal cells 15x. The apertures of each cell correspond in area and in outline with the polygonal groups 9 of phosphor areas on the foundation surface of the screen and are aligned with individual ones of said groups. The axial dimension of the grille 15 is about the same as a diameter drawn between opposite inner faces of one of its hexagonal cells. The grille 15 may be fabricated by stacking a large number of thin metal strips 15s which have previously been formed (as with a corrugating roller, not shown) into the shape shown in Fig. 5.

At least the six inner faces $a-a'$, $b-b'$, $c-c'$ of each hexagonal cell 15x are constituted of a material having a secondary-electron to primary-electron emissive-ratio equal to or greater than one-to-one. In the interests of simplicity the entire grille may be constituted of such a material, e. g. silver magnesium. Alternatively, the grille structure 15 may be made of copper or other relatively non-emissive material and coated on all of its inner surfaces with ceasiated silver or other relatively highly emissive material.

It will be observed upon inspection of Figs. 4, 6 and 7, that there is an auxiliary electrode in the form of a metallic film 17 disposed in the space between the screen 5 and grille 15. In the instant case, this conductive film 17 comprises aluminum deposited, in vacuo, by an evaporation process, on top of the phosphor coatings 9 of the screen 5. It may however comprise a metal chloride (e. g. zinc or tin) applied in the form of a hot spray to the glass foundation 7 beneath the phosphor layers 9. In either event this film-like electrode 17 is of microscopic thinness and is transparent to electrons. As will hereinafter more fully appear, the electrode 17 serves, when suitably energized, to establish an electron-lens field, indicated by the equipotential lines 19 (Fig. 7), in the space between the grille 15 and screen 5. The direct current potential required to establish the lens field 19 is applied between the leads 21 and 23 (Fig. 1), which will be understood to be connected within the main chamber 1 to the grille 15 and screen 5, respectively.

Either a single electron-gun or a battery of three guns may be used with the target, screen and lens assembly of the present invention. The kinescope which has been selected for illustration, is of the three-gun variety. The guns are contained in separate necks 25, 27 and 29 (Fig. 1) disposed 120° apart about the longitudinal axis of the envelope. The vacuous space in said necks and in the bulbous portion 1 of the envelope is continuous. When the electron-beams 25b, 27b and 29b (Figs. 4-6) are subjected to a scanning movement, imparted by the magnetic

yokes 25y, 27y and 29y, the beams approach the grille 15 at discrete angles. Each beam "sees" but two of the six inner faces $a-a'$, $b-b'$ or $c-c'$ of the cells 15x of the mask 15. Thus, referring to Fig. 6 the angle of approach of the beam 25b is such that it strikes only the two top inner apex faces $a-a'$ of the cell 15x. None of the electrons of which said beam is comprised strike the other faces ($b-b'$ or $c-c'$) nor do any of them pass through the cell without being intercepted by the faces $a-a'$. The impact of the primary-electrons upon said inner faces $a-a'$ of the cell 15x releases secondary-electrons, which, as shown in Fig. 7, are focused by the lens field onto an appropriate one of the sub-elemental phosphor areas (R, B or G Fig. 2.) Similarly, when the beams 27b or 29b enter a cell 15x from the directions of the arrows shown in Fig. 4 they will release secondary-electrons from the inner surfaces $b-b'$, $c-c'$, respectively. The curvature of the lens-field 19 is such that the secondary-electrons from said adjacent pairs of emissive surfaces are focused upon selected ones of the sub-elemental phosphor areas R, B and G on the screen 5.

As with other kinds of "directional" screen-assemblies, the screen-assembly of the present invention may be used in a cathode-ray tube (e. g. a kinescope or storage-tube) of the "one-gun" variety. When the tube contains but a single electron-gun, the beam is deviated and rotated to points corresponding to the points of origin of the three-gun beams, so that it too approaches the grille 15 at angles individual to the pairs of surfaces ($a-a'$, $b-b'$, $c-c'$) which are allotted to the different sub-elemental areas 9 on the screen 5.

It will be noted that in cathode-ray tubes of the present invention the intensity of the light-images developed upon the screen is, primarily, a function of the secondary-electron to primary-electron emission ratio of the inner faces, ($a-a'$, etc.) of the mask or grille 15. Therefore, the beam-accelerating voltage need only be a small fraction of that required in cathode-ray tubes wherein the intensity of the light depends directly upon the density and velocity of a beam of primary electrons.

Attention is also called to the fact that since the individual apertures in the grille 15 correspond substantially in outline and dimensions to the polygonal groups 9 of phosphor areas, and are mounted directly in line with said groups, no complex problems of parallax arise in plotting the phosphor pattern on the screen, or in aligning the grille apertures therewith. The construction of the grille is simplified by the fact that unlike the honeycomb grille structures heretofore used in color-kinescopes, the inner faces of the grille cells need not be coated, e. g. with different phosphor compounds individual to different color-components.

Furthermore, since the luminescent phosphor areas upon which the images appear, are all disposed in a single plane (or curved) surface, (instead of upon numerous angularly disposed faces, as in a honeycomb screen) the observation of said images is not limited to persons positioned directly in front of the tube-window.

Although the invention has been described as embodied in a "color-kinescope" it is believed apparent that its utility is not limited to cathode-ray tubes containing a "colored-phosphor" screen.

What is claimed is:

1. An electron-beam tube comprising an evacuated envelope containing; a foundation surface, a multiplicity of sub-elemental phosphor covered areas disposed in duplicate groups on said surface, an apertured target electrode mounted in spaced relation with respect to said foundation surface, the apertures in said target corresponding in outline to said groups of phosphor areas and disposed in register with respective ones of said groups, and the target surfaces that define the boundaries of said apertures comprising a secondary-electron emissive material; electron-gun means for selectively activating said secondary-electron emissive target surfaces, and electrode means for establishing in the space between said target and said foundation surface an electron-lens field for directing secondary-electrons from selected ones of said target surfaces to particular ones of said sub-elemental phosphor areas.

2. A color-kinescope in accordance with claim 1 and wherein said electrode means comprises an electron-transparent metallic layer disposed between said target electrode and said foundation surface.

3. The invention as set forth in claim 2 and wherein said electron-transparent metallic layer is supported upon said sub-elemental phosphor areas.

4. The invention as set forth in claim 2 and wherein said electron-transparent metallic layer is supported directly upon said foundation surface.

5. A color-kinescope comprising an evacuated envelope having a transparent window and containing an electron-sensitive screen disposed in a position to be viewed through said window, said screen comprising: a transparent foundation surface and a multiplicity of sub-elemental phosphor areas disposed in duplicate polygonal groups on said surface, the sub-elemental areas

of each group being constituted of phosphor materials capable of emitting light of a color individual to that area, an apertured target electrode mounted in spaced relation with respect to said surface, the apertures in said target corresponding substantially in area and in outline to individual ones of said polygonal groups of phosphor areas, and the target surfaces that define the boundaries of said apertures comprising a secondary-electron emissive material; electron-gun means for selectively activating said secondary-electron emissive target surfaces, and electrode means for establishing in the space between said target and said foundation surface an electron-lens field for directing secondary-electrons from selected ones of said target surfaces to particular ones of said sub-elemental colored-phosphor areas.

6. The invention as set forth in claim 5 and wherein said sub-elemental phosphor areas are disposed in hexagonal groups of three, and the phosphor materials of which said three sub-elemental areas are comprised are capable of emitting red, blue and green light respectively.

7. The invention as set forth in claim 6 and wherein the secondary-electrons that activate said different light-emissive phosphor materials are derived respectively from two adjacent ones of the six secondary-electron emissive boundary surfaces of the apertures in said target electrode.

MILTON W. GREEN.

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The following references are of record in the file of this patent:

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