

May 10, 1960

R. ZAPHIROPOULOS  
COLOR STRUCTURE FOR CATHODE-RAY TUBES  
DESIGNED FOR POLYCHROME  
IMAGE REPRODUCTION

2,936,399

Filed July 12, 1954

3 Sheets-Sheet 1

FIG - 1 -

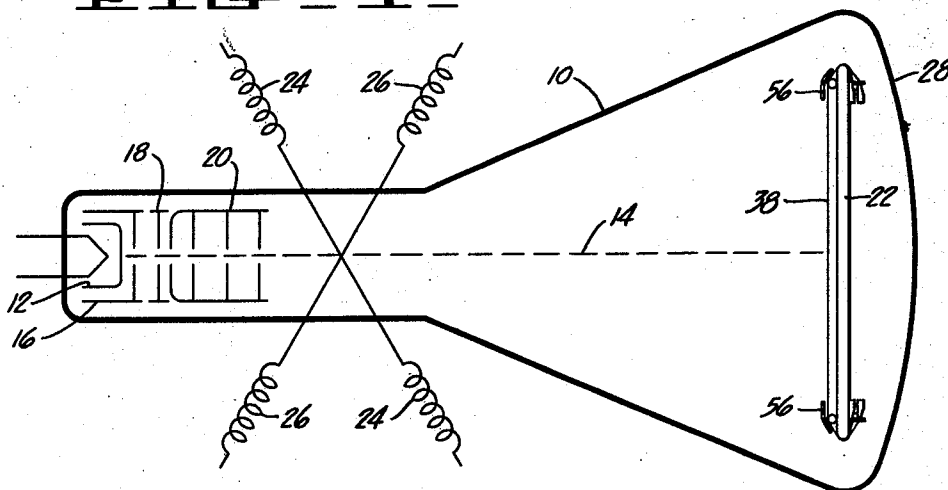


FIG - 2 -

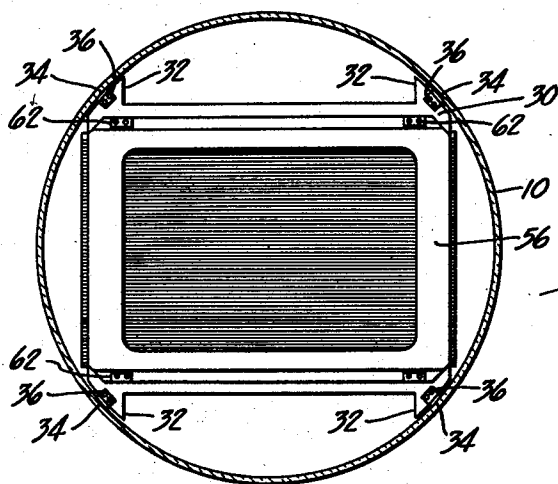
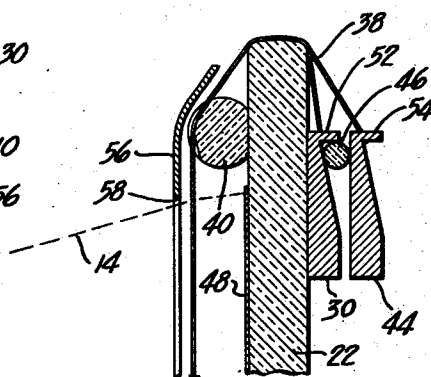


FIG - 3 -



INVENTOR.

RENN ZAPHIROPOULOS

BY

*Edward J. Murray, Jr.*  
AGENT

May 10, 1960

R. ZAPHIROPOULOS  
COLOR STRUCTURE FOR CATHODE-RAY TUBES  
DESIGNED FOR POLYCHROME  
IMAGE REPRODUCTION

2,936,399

Filed July 12, 1954

3 Sheets-Sheet 2

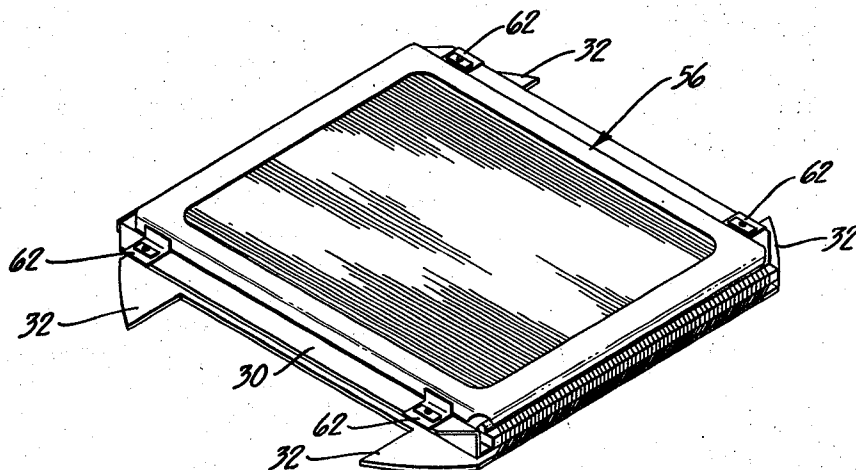


FIG. 5

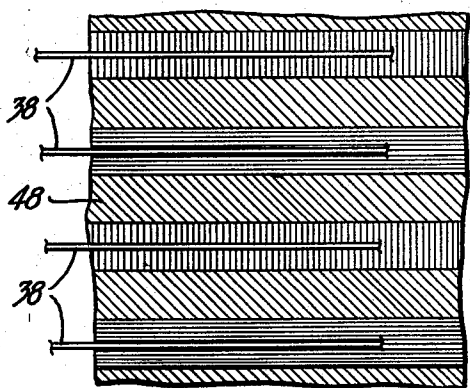


FIG. 4

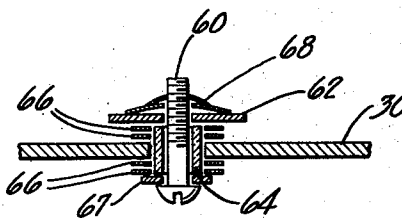


FIG. 6

INVENTOR.

RENN ZAPHIROPOULOS

BY

*Howard J. Murray, Jr.*  
AGENT

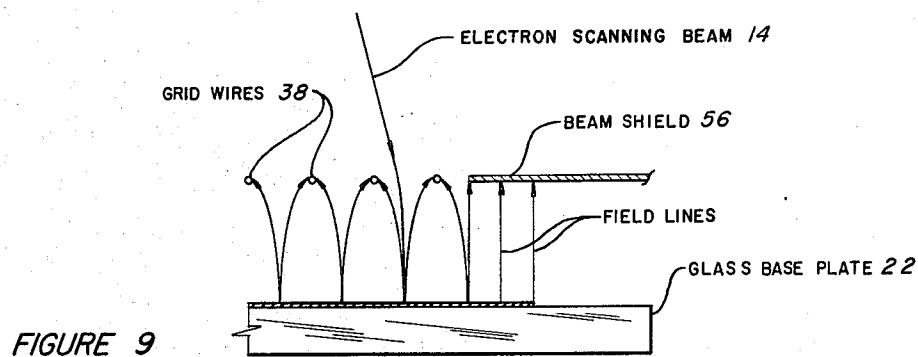
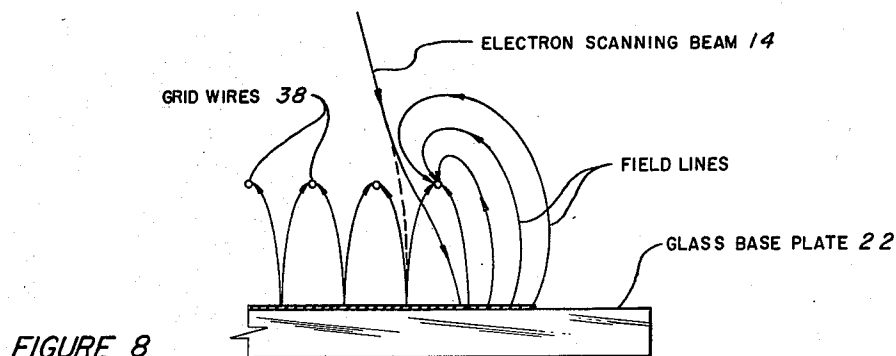
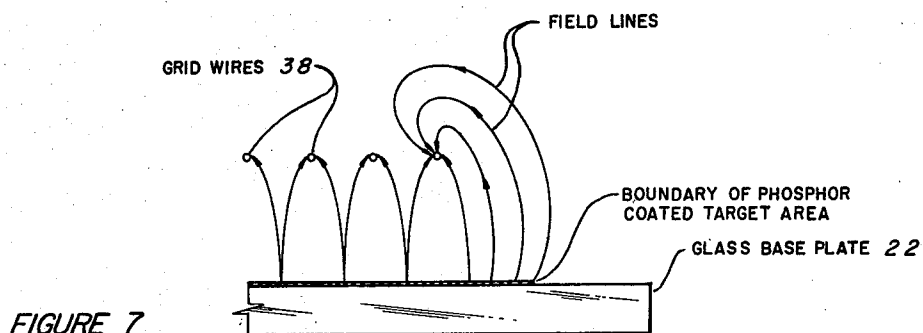
May 10, 1960

R. ZAPHIROPOULOS  
COLOR STRUCTURE FOR CATHODE-RAY TUBES  
DESIGNED FOR POLYCHROME  
IMAGE REPRODUCTION

2,936,399

Filed July 12, 1954

3 Sheets-Sheet 3



INVENTOR.

RENN ZAPHIROPOULOS

BY

Howard J. Munay, Jr.  
AGENT

1

2,936,399

## COLOR STRUCTURE FOR CATHODE-RAY TUBES DESIGNED FOR POLYCHROME IMAGE REPRO- DUCTION

Renn Zaphiropoulos, Oakland, Calif., assignor to Chromatic Television Laboratories, Inc., New York, N.Y., a corporation of California

Application July 12, 1954, Serial No. 442,545

12 Claims. (Cl. 315—21)

The present invention relates to cathode-ray tubes of the type adapted to effect the reconstitution of polychrome images. More particularly, the invention relates to a color structure for such cathode-ray tubes which is characterized by its ability to enhance the fidelity of the reconstituted image by restricting the electron scanning beam to an impingement area coextensive with the phosphor coating on the target electrode.

Cathode-ray tubes having a grid of essentially parallel wires located adjacent to a striped phosphor screen are now known in the art. Such a grid may, in some cases, serve as one component of an electron lens system to focus the beam electrons into a pattern of thin lines nominally registered with the discrete phosphor areas of the screen, as is shown, for example, by Ernest O. Lawrence in his United States Patent No. 2,692,532, granted October 26, 1954.

One type of cathode-ray tube incorporating this principle, which may be termed "post-deflection-focusing," and also called "PDF," is designed with a relatively large number of narrow component-color phosphor strips laid down in a predetermined sequence to form a screen, or target electrode. These phosphor strips luminesce, when impacted by the cathode-ray beam, in various component colors of the image to be synthesized. Purely as an example, the order in which the phosphor strips are laid down may be red, green, blue, green, red, green, etc., bearing in mind that the "color" of a phosphor as used herein refers to the color of the light emitted therefrom which reaches the eye of an observer. An electrically-conductive coating overlies the phosphor strips, and is produced in some preferred manner, such as by aluminization.

In order that the path of an electron arriving at the phosphor screen from the cathode emitter may be controlled in a selective manner in the vicinity of the target, a grid assembly is located adjacent to the phosphor screen, and, with the latter, comprises a color control structure of the type to which the present invention is particularly applicable. Such a grid is formed of a large number of wires, or linear conductors, extending in the same general direction as the phosphor strips, and lying in the path of electrons directed to the target electrode from the electron gun of the cathode-ray tube. The wires of the grid assembly are electron-optically related to the phosphor strips so that, in this electron-optical sense, there is a wire aligned with each blue strip, and similarly a wire aligned with each red strip. It should be borne in mind that this electron-optical alignment incorporates whatever spacing corrections are necessary to compensate for variations introduced into the tube operation by changes in the instantaneous angle of impingement of the cathode-ray beam as it scans the target, and also by changes in deflection sensitivity at portions of the target electrode as symmetrically located with respect to the tube axis. However, these corrections form no part of the present invention, and are mentioned merely as an aid in understanding the operation of a tube of the nature set forth. All of the wires

2

associated with the red strips are connected to a common terminal, while the blue wires are similarly joined together electrically.

Between the actual, or nominal, plane of the wire grid assembly and the conductive coating on the phosphor strips a difference of potential is established. By properly choosing the magnitude and polarity of this potential difference, a series of converging electrostatic fields for the beam electrons is created. These converging fields (which may be likened in an optical sense to cylindrical lenses) cause the beam electrons arriving at the wire grid from the electron gun of the tube to form a fine line structure on the phosphor target. It will be appreciated that the particular scanning operation by means of which the beam electrons are caused to trace a raster at the plane of the grid wires has no direct geometrical relationship to the actual line structure developed on the target electrode, the latter being determined solely by the configuration of the wires of the grid assembly.

Inasmuch as the grid wires, as stated above, are electron-optically aligned with the phosphor strips, a zero potential difference between the "red" and "blue" terminals of the grid will result in the beam electrons undergoing a focusing action alone, and hence these electrons may be caused to impinge the target within the boundaries of a particular strip such as green. If the conductors associated with the red strips are then made positive relative to the conductors electron-optically related to the blue strips, the beam electrons will be subjected to an auxiliary, or micro-, deflection over and above that due to the deflection providing the raster, so that the lines of impingement of such electrons will now lie within the respective boundaries of the red strips. Similarly, electrons will strike the blue strips when the wires associated with such strips are suitably positive with respect to the red wires. Different component colors of the image are thus displayed according to the potential difference (if any) existing between the two sections of the grid wire assembly.

In designing one color structure of the above type, the grid wires are chosen to be essentially coplanar, and are maintained in position relative to the phosphor strips of the target by means of spacer elements. The spacing between the plane of the grid wires and the phosphor-coated surface of the target is critical in many respects, and must remain substantially unchanged during operation of the cathode-ray tube. One preferred construction in which the grid wires and the target electrode are formed as a unit is illustrated and described in United States Patent #2,683,833 of the present applicant granted July 13, 1954.

In the assembly of the last-mentioned patent, a light-transmissive base plate (which may be of glass) is employed as a target backing. This base plate is secured to a grid frame by the strand conductors, or wires, of the grid. A pair of spacer elements is fixed to one surface of the base plate, and defines a window, or target area, therebetween which may be coated with phosphor strips having the desired color characteristics. Means are provided for securing the electrically-conducting wires to the frame so that these wires extend across the window, or target area, of the base plate, and are positioned therefrom by the spacer elements. In one embodiment, the grid wires, or linear conductors, are divided into two sets of alternate strands, and suitable means are provided for applying potentials to each set of strands. In this particular showing, the frame is divided into two sections, with each section serving a separate set of strands and also being electrically insulated from the other.

It will thus be recognized that in this form of construction the glass plate is "sandwiched" between the wires of the grid, on one hand, and the two frame portions, on the other. These two frame portions are pressed to-

gether by the tension of the wires associated with the outer frame portion, and this pressure acts to hold the frames, base plate and wires in a unitary assembly. Suitable insulating means between the two sections of the frame are also provided in order to permit different potentials to be applied to the two sets of grid wires.

It has frequently been found that tubes constructed as described above exhibit a white glow at the extreme edges of the reproduced image. It has been determined that this glow is caused, at least in part, by electrons in the scanning beam impinging upon the target beyond the boundaries of the phosphor coating. This condition may arise due to a variation in the horizontal deflecting voltage (which increases the length of each trace) or by manual variations in the size control adjustments which result in the height and/or the width of the raster to be increased to a point where it extends beyond the area of the base plate which is coated with phosphor. The white glow above referred to (and which is readily apparent under such conditions) is believed to be due to an electrostatic charge built up on the bare glass base plate due to bombardment thereof by the scanning beam electron.

It has also been found, during operation of tubes of the above type, that it is difficult to prevent the electric field associated with the aluminum coating on the phosphor target, as well as the electric field in the vicinity of the contact point between such aluminum coating and the lead-in cable, from "leaking" around the periphery of the wire grid and thus affecting the trajectory of the electrons of the scanning beam. Such "leakage" in the electric field of this aluminized layer results in a display of incorrect color at the extreme edges of the image in a manner highly objectionable to an observer.

It has still further been found that it is necessary to collect as many as possible of the secondary electrons emitted from the color grid during operation of a tube of this nature in order to prevent such secondary electrons from falling back indiscriminately on the phosphor-coated target and thus giving the resulting image a "washed-out" appearance or lack of contrast.

It is a principal feature of the present invention, therefore, to provide a structure for use with a cathode-ray tube of the class described which is not only simple in design but which is capable of overcoming at one and the same time each of the undesirable features listed above. That is, the structure of the present invention acts (1) as a mask between the gun and the target electrode of the tube so as to intercept electrons which would otherwise impinge such target beyond the boundaries of the phosphor coating, (2) as an electrostatic shield to prevent appreciable leakage into the beam path of the electric field from the aluminum, and (3) to collect (when a suitable potential is applied thereto) the secondary electrons emitted from the color grid during operation of the tube.

One object of the present invention, therefore, is to provide an electron shield, for use with a color structure of the nature set forth, which acts in effect as an "overseam interceptor" to enhance the fidelity of the developed polychrome image.

A further object of the invention is to provide an electron shield, for use with a color structure of the nature set forth, which serves to confine the electric field associated with the conducting coating on the phosphor target to a region of the cathode-ray tube where such electric field has no undesired effect upon the electrons in the scanning beam.

A still further object of the invention is to provide a shield of the above nature which further serves to collect when a suitable potential is applied thereto, at least a portion of the secondary electrons emitted from the color grid structure during tube operation.

An additional object of the present invention is to provide a shield of the above nature which is simple in

construction and capable of being fabricated at low cost.

Other objects and advantages of the present invention will be apparent from the following description of a preferred form thereof and from the drawing, in which:

Figure 1 is a semi-diagrammatic view of a cathode-ray tube showing in cross-section a color structure provided with an overscan interceptor designed in accordance with the present invention;

Figure 2 is a plan view of the color structure of Figure 1 showing the overscan interceptor of the present invention in greater detail;

Figure 3 is an enlarged view of a portion of Figure 1;

Figure 4 is a plan view of a portion of the target area of Figure 2;

Figure 5 is a perspective view of the color structure of Figures 1 through 4 showing in greater detail the relationship between the overscan interceptor and the frame;

Figure 6 is a cross-sectional view of one preferred method of attaching the overscan interceptor of Figures 1 through 5 to the frame structure of the color assembly; and

Figures 7, 8 and 9 show the manner in which the electric field lines at the edges of the phosphor-coated target area are prevented by the beam shield of the present invention from causing color contamination in the reproduced image.

Referring now to the drawings, there is shown in Figure 1 a cathode-ray tube certain parts of which are conventional. For example, in the neck end of the tube, and within the envelope 10, there is an indirectly-heated cathode 12 which acts as a source of electrons for development into a scanning beam. The latter is indicated schematically by the trace 14. Adjacent to, and partially surrounding the cathode 12, is a control grid or electrode 16 suitably apertured to permit the passage of electrons which are subsequently formed into the beam 14. The control grid 16 functions in the usual manner to modulate the emitted stream of electrons in accordance with the potential applied thereto relative to the cathode 12. Also in the neck end of the tube there is provided a first anode 18 to which suitable potentials may be applied so as to result in the initial acceleration of the electrons emitted from the cathode 12. Adjacent to the first anode there is positioned a second anode 20 for supplying an additional acceleration to the electrons and also for focusing the developed beam.

Deflecting coils, comprising a horizontal pair 24 and a vertical pair 26, are provided for the usual scanning purposes. Obviously, the terms "horizontal" and "vertical" are used herein in a descriptive sense only. Thus the electron beam 14 is caused to scan a target, consisting of the phosphor-coated base plate 22, to produce light which is visible through the end wall 28 of the envelope 10.

The base plate 22 may be secured in the viewing end of the cathode-ray tube in many different ways. One possible method is shown in Figure 2, and incorporates a contoured support, or frame section, 30 adapted to fit within the envelope of the tube and hence maintain the base plate 22 in position adjacent to the end wall 28. The frame section 30 is accordingly provided with a plurality of lugs 32 which are shown in Figure 2 as having a contour generally similar to the internal periphery of the envelope 10. In the case of a metal envelope 10, small angles 34 may be welded to the inside surface of the envelope at positions where it is desired to attach the lugs 32. The lugs are joined to the angles by means of bolts or rivets 36 which preferably pass through ceramic bushing (not shown) and which are provided with insulating discs on each end to isolate electrically the support for frame section 30 from the envelope 10. Other means of attachment may be employed, especially when glass instead of metal envelopes are used.

5

However, since these constructional features form no part of the present invention, and furthermore are mentioned in applicant's above-referred-to copending application, no further details regarding them will be set forth herein.

About the support, or frame section, 30 and the base plate 22 there are stretched electrically-conducting strands which appear as shown in Figure 2 when viewed from the electron beam source. These strands are generally identified by the reference numeral 38 in the drawings (note especially Figure 4). Affixed to the surface of the target 22 against which the electron beam is adapted to impinge is a pair of insulating spacer elements respectively designated by the numerals 40 and 42 (Figure 2). These spacers, as well as the base plate 22 may comprise a borosilicate glass, but in any event should possess substantially the same coefficient of expansion. These spacer elements provide the dual functions of aligning and supporting the strands 38 in substantially coplanar relation at a uniform distance from the surface of the target 22.

In order that each pair of adjacent strands 38 may serve as one component of an electron lens to focus the beam electrons into a substantially linear trace on the target 22, and at the same time provide structure for deflecting the focused trace from one phosphor area to another, means are provided for separating the strands 38 into two electrically-insulated sets of conductors. In accordance with the present invention, this means includes a two-section frame comprising a pair of continuous loops or rectangular forms as indicated by the showing of Figures 2 and 3. Thus, an additional member 44 is employed in conjunction with the frame section 30 described in connection with Figure 2. This frame section 44 may be generally similar in outline and general configuration to that of the frame section 30, except that it does not possess the lugs 32. As indicated by the cut-away portion of Figure 2, the frame section 44 underlies the frame section 30 (as viewed from the cathode end of the tube) and is maintained in spaced-apart relation therefrom by the presence of a pair of insulating separators consisting of the vitreous rods 46.

As is apparent from Figure 3, the frame member 30 is disposed adjacent to that side of the target 22 which faces the end wall 28 of the cathode-ray tube. An aluminized phosphor coating 48, preferably in accordance with the showing of Figure 4, is disposed on the opposite (or gun) side of the base plate 22 between the glass spacer elements 40 and 42.

Each extremity of the frame section 30 associated with a termination of the grid wires 38 is provided with a notch or indentation 50 (Figure 3) cut into that surface thereof which is opposite to the one contacting the base plate 22. This notch 50 extends parallel to that edge of the frame section 30 to which the grid conductors 38 are to be attached in a manner set forth below. The vitreous rods 46 (which may be of glass) are adapted to be in part receivable within these notches, and the former are chosen to be of such diameter that the frame section 44 (when resting upon the glass rods 46 as shown in Figure 3) is maintained in spaced-apart relationship from the outer surface of the frame section 30. It will be apparent from Figure 3 that when the grid wires or conductors 38 are looped around the slotted edge (not shown) of the frame section 44 in the manner described below, and when a suitable tension is imparted thereto, then the frame section 44 acts to hold the glass rods 46 firmly seated within their respective notches. Inasmuch as the glass rods 46 are not compressible, there can be no electrical contact between the frame sections 30 and 44 regardless of the degree of tension imparted to the grid conductors.

Although fully set forth in applicant's patent mentioned above, it might be stated that the edges 52 and 54 of the frame sections 30 and 44, respectively, are slotted to permit the grid wires 38 to be looped therearound, with alternate wires being looped around the same particular

6

frame section. Those alternate ones of the grid wires 38 to which a particular potential is to be applied are looped around the slotted edge 52 of the frame section 30, while the remaining ones of the grid wires 38 to which a different potential is to be applied are looped around the slotted edge 54 of the frame section 44. To establish and maintain a proper spacing of the wires, the spacer bars 40 and 42 are precisely notched, or slotted, in some preferred manner such as described in the above-mentioned application. Also, if desired, the edges of the base plate 22 around which the wires are passed may be provided with slots each adapted to receive an individual conducting strand 38.

One set of alternate conductors is thus in contact with the frame section 30, and a single terminal connection to this frame section will provide for the application of a substantially uniform potential to the wire strands associated therewith. The second set of conducting strands is formed in the same manner as the first set. The glass rods 46 provide completely adequate insulation between the frame sections 40 and 44, and, if desired, a cementitious composition known by the trade name "Insalute" may be applied to the notched edges 52 and 54 of the frame sections 30 and 44 respectively and in order to insure that the wires remain in the notches formed in the edges of the frame sections.

The relative position of the conducting strands, or grid wires, 38 and the red, green and blue phosphor strips which are applied to that surface of the base plate 22 impacted by the electron scanning beam is shown in Figure 4. Although the particular arrangement of the phosphor strips forms no part of the present invention, nevertheless a desirable arrangement has been shown to consist of alternate red and blue strips with a strip of green interposed therebetween. The strip widths are chosen in accordance with tube design so as to provide electro-optical rather than physical relationships between the grid wires and the phosphor strips. Each adjacent pair of grid wires accordingly is designed to subtend (in an electron-optical sense) a portion of the target electrode surface which includes phosphor areas of each of the component colors. Generally speaking, it may be said that the distance between adjacent grid wires is substantially equal in one dimension to a single elemental area of the image to be resolved by the cathode-ray tube.

In order to intercept scanning beam electrons which might otherwise fall upon the base plate 22 beyond the boundaries of the phosphor coating, a shield or "overscan interceptor" is provided between the electron gun of the cathode-ray tube 10 and the grid wire assembly consisting of the linear electrodes 38. This shield, identified by the reference numeral 56, is in the form of a generally rectangular mask composed of suitable conducting material. The beam shield 56 is secured in spaced-apart relation to the frame 30 in the manner best shown by Figure 5, that is, by four tabs on lugs 62 respectively located near the corners of the shield and insulated from the frame in a manner to be described in connection with Figure 6. However, it might be stated at the present time at the opening in the beam shield 46 (or, in other words, the window area) is of such dimensions that the electron beam 14 is caused to impinge upon the outer surface of the shield when it is deflected by the coils 24 and 26 to a degree such that, in the absence of the shield, it would strike the base plate 22 beyond the edges of the phosphor coating 48. This feature is best shown by reference to Figure 3, where the inner edge 58 of the mask 56 is shown as limiting the impingement of the electrons on the plate 22 to an area approximately co-extensive with the area of the phosphor coating. Electrons in the scanning beam 14 which are deflected beyond this point by the coils 24 and 26 impinge the outer surface of the conducting mask 56, and, consequently, are prevented from striking the uncoated base plate 22 to result in the white glow which has heretofore been occasionally pres-

ent during operation of tubes of the type under consideration.

The beam shield 56, as best indicated by Figures 3 and 5, is preferably composed of a single sheet of metal having its two edges parallel to the grid wires 38 of flanged configuration and its remaining two edges in part bent downwardly as best shown in Figure 5, so that the shield at this point is maintained substantially equi-distant from the grid wires 38 after such wires contact the spacer bars 40 prior to passing around the edge of the base plate 22 as best shown in Figure 3.

As above mentioned, the beam shield 56 is positioned relative to the frame 30 by means of four tabs 62 respectively located near the four corners of the mask and secured thereto by some suitable method such as welding. The details of the structure for insulating each one of these tabs 62 from the frame 30 is best shown in Figure 6, and may consist of a screw 60 which passes through an opening in the frame 30 and in one of the tabs. In order to insulate electrically the frame 30 from the tabs and hence from the beam shield 56, a ceramic bushing 64 is provided between the frame and each screw 60. A plurality of washers of some insulating material such as mica (identified by the reference numeral 66) may be used according to the length of the bushing 64. A slotted metal washer 67 may also be associated with each screw head. Each of the screws 60 is held in place by a nut 68 which may be of "locking" design. It will now be seen that the structure of Figure 6 results in the screw 60 being isolated electrically from the frame 30 by the ceramic bushing 64 and the mica washers 66, and hence contact between the screws 60 and the beam shield tab 62 will not result in any electrical contact between the shield 56 and the frame 30.

The reason for preventing such electrical contact between the beam shield 56 and the frame 30 is that, in many cases, it is desired to apply a potential to the beam shield 56 which is different from the potential applied to the frame 30. This permits the shield 56 to serve as a collector of secondary electrons emitted when the electron scanning beam 14 strikes the grid wires 38 during operation of the cathode-ray tube. If the beam shield 56 is suitably positive with respect to the mean potential of the grid wires 38, then these secondary electrons, instead of falling back upon the phosphor-coated base plate 22, will instead be attracted to the beam shield 56, and hence the latter will serve to prevent any contamination of the resulting image which would otherwise be produced by these spurious electrons.

Since the conducting mask 56 overlies the grid wires 38 around the periphery of the grid assembly, the former also acts as an electrostatic shield in the manner shown by Figures 7, 8 and 9 to prevent any electric field from the aluminum coating on the phosphor target (and also any field surrounding the contact point where a lead to this aluminized surface is brought from exterior to the cathode-ray tube) from leaking around the edge of the wire grid and thus having a deleterious effect upon the trajectory of electrons directed toward the phosphor-coated base plate 22 from the electron gun. Previously, it was customary to wind a few extra turns of wire upon one of the frame sections to produce this isolating effect, but the beam shield 56 of the present invention eliminates the necessity for winding these extra turns of wire. Other shielding means previously thought necessary may also be dispensed with, and hence the overall cost of the grid assembly is considerably lowered.

It will be understood that the particular securing means shown in Figure 6 for positioning the beam shield 56 relative to the frame 20 has been shown merely as an example, and that other fastening means are obviously applicable. Furthermore, the particular configuration of the beam shield 56 may be modified according to the configuration of the wire grid assembly with which it is to be employed, and also according to the particular

design of the color structure as a whole. It is only necessary that the under surface of the mask 56 be positioned relatively close to the grid wires 38 so as to perform the shielding effect brought out above.

Having thus described the invention, what is claimed is:

1. An electrode assembly for a cathode-ray tube, said electrode assembly comprising a light-transmissive electrically-insulating base plate, a pair of essentially planar electrically-conductive frame sections positioned side-by-side both with respect to one another and with respect to a surface of said base plate facing the end wall of said cathode-ray tube, each of said pair of frame sections having two extremities respectively associated with oppositely-disposed edges of said base plate, a pair of spacer bars affixed to that surface of said base plate facing the electron gun of said cathode-ray tube, said pair of spacer bars respectively lying adjacent and substantially parallel to the said oppositely-disposed edges of said base plate so as to include therebetween a raster area, a first electrically-conducting means in the form of a first set of substantially parallel linear conductors secured in position at the said oppositely-disposed extremities of one of said pair of frame sections and extending from one of the said extremities around that edge of said base plate associated therewith, over one of the said spacer bars, across the raster area of said base plate, over the other of said spacer bars, and around the opposite edge of said base plate to the other extremity of said one frame section, a second electrically-conducting means in the form of a second set of substantially parallel linear conductors secured in position at the said oppositely-disposed extremities of the other of said pair of frame sections and extending from one of said extremities around that edge of said base plate associated therewith, over one of the said spacer bars, across the raster area of said base plate, over the other of said spacer bars, and around the opposite edge of said base plate to the other extremity of said other frame section, the linear conductors of said first and second sets being interspersed across said raster area so that the conductors of said first set lie between the conductors of said second set, a pair of insulating elements interposed between the two frame sections of said pair for holding the latter in spaced-apart relation, whereby a difference of potential may be applied therebetween and hence between said first and second sets of linear conductors, a phosphor coating on that surface of said base plate facing said electron gun, and an electron shield positioned by one of said frame sections so as to lie between said base plate and the electron gun of said cathode-ray tube and having a "window" area so proportioned as to restrict the impingement of said base plate of electrons from the electron gun of said cathode-ray tube to an area substantially co-extensive with that of the phosphor coating and means to electrically insulate the frame section and the shield from each other.

2. The combination of claim 1 comprising in addition, a terminal connection adapted to supply to said shield a potential which is relatively positive with respect to the average potential applied to said two sets of linear conductors, whereby said shield will act to collect secondary electrons emitted from said conductors by impingement thereon of scanning beam electrons during operation of said cathode-ray tube.

3. An electrode assembly for a cathode-ray tube having an electron gun, said electrode assembly comprising a pair of frame sections each having wire-engaging means on oppositely-disposed edges thereof, a transparent plate, a continuous wire wound back-and-forth across one surface of said plate and wire engaging means on the said frame sections to clamp said one frame section to the other surface of said plate, at least two electrical insulators respectively disposed adjacent to the wire-engaging means of said one frame section, a second continuous wire wound back and forth across said one surface of said plate, a second wire-engaging means on the second

said frame sections to clamp said second frame section to said first frame section through the said electrical insulators, whereby such insulators act to maintain said two frame sections in spaced-apart relation, a phosphor coating on that surface of said transparent plate traversed by said first and second continuous wires, shield, and means for supporting said shield in insulating relationship to at least one of the said frame sections and lying between the electron gun of said cathode-ray tube and the said transparent plate, said shield defining an opening such that the scanning beam electrons from said gun are restricted to an impingement area on said plate which is substantially co-extensive with the area covered by said phosphor coating.

4. In an electrode assembly for a cathode-ray tube, said electrode assembly comprising a light-transmissive electrically-insulating base plate, a pair of essentially planar electrically-conductive frame sections positioned side-by-side both with respect to one another and with respect to a surface of said base plate facing the end wall of said cathode-ray tube, each of said pair of frame sections having two extremities respectively associated with oppositely-disposed edges of said base plate, a pair of spacer bars affixed to that surface of said base plate facing the electron gun of said cathode-ray tube, said pair of spacer bars respectively lying adjacent and substantially parallel to the said oppositely-disposed edges of said base plate so as to include therebetween a raster area, a first electrically-conducting means in the form of a first set of substantially parallel linear conductors secured in position at the said oppositely-disposed extremities of one of said pair of frame sections and extending from one of the said extremities around that edge of said base plate associated therewith, over one of the said spacer bars, across the raster area of said base plate, over the other of said spacer bars, and around the opposite edge of said base plate to the other extremity of said one frame section, a second electrically-conducting means in the form of a second set of substantially parallel linear conductors secured in position at the said oppositely-disposed extremities of the other of said pair of frame sections and extending from one of said extremities around that edge of said base plate associated therewith, over one of the said spacer bars, across the raster area of said base plate, over the other of said spacer bars, and around the opposite edge of said base plate to the other extremity of said other frame section, the linear conductors of said first and second sets being interspersed across said raster area so that the conductors of said first set lie between the conductors of said second set, a pair of insulating elements interposed between the two frame sections of said pair for holding the latter in spaced-apart relation, whereby a difference of potential may be applied therebetween and hence between said first and second sets of linear conductors, and a phosphor coating on that surface of said base plate facing said electron gun, the combination of an electron shield insulatingly supported by one of said frame sections so as to lie between said base plate and the electron gun of said cathode-ray tube and having a "window" area so proportioned as to restrict the impingement on said base plate of electrons from the electron gun of said cathode-ray tube to an area substantially co-extensive with that of the phosphor coating, and connector means securing said shield to one of said frame sections for applying a potential thereto which is relatively positive with respect to the average potential applied to said two sets of linear conductors.

5. An electrode assembly for a cathode-ray tube having an electron gun, said electrode assembly comprising a transparent plate, a phosphor coating on said plate, a grid composed of a plurality of linear conductors arranged in substantially parallel relationship, means to position said conductors so that they lie in a single plane approximately equidistant from the phosphor coating

on said plate and between said plate and the electron gun of said cathode-ray tube, an electron shield between said grid and said electron gun, said shield having a "window" area so proportioned as to restrict the impingement on said plate of electrons from said gun to an area substantially coextensive with that of the said phosphor coating and means to support the shield in insulating relationship to the coating and grid.

6. An electrode assembly according to claim 5 in which said grid is composed of two interlaced and mutually insulated sets of linear conductors.

7. An electrode assembly according to claim 6, comprising, in addition, connection means to apply a potential to the shield which is different from the potential applied to each of the said sets of linear conductors.

8. An electrode assembly for a cathode-ray tube having an electron gun, said electrode assembly comprising a transparent plate, a phosphor coating on said plate, a grid composed of two interlaced and mutually insulated sets of linear conductors arranged in substantially parallel relationship, means to position said conductors so that they lie essentially in a single plane between said electron gun and said transparent plate and approximately equidistant from the said phosphor coating, means for applying a difference of potential between the said two sets of linear conductors, an electron shield, means to support said shield between said grid and said electron gun and in insulating relationship to each, and means to apply to said shield a potential which is relatively positive with respect to the average potential applied to the said two sets of linear conductors, whereby said shield will act to collect secondary electrons emitted from said conductors by impingement thereon of scanning beam electrons during operation of said cathode-ray tube.

9. An electrode assembly for a cathode-ray tube wherein electrons are adapted to be directed from electron gun means to impinge in beam formation upon a target area to produce thereon images in color comprising grid support frame means secured to the tube wall and positioned substantially adjacent to the target area, means to support a multiplicity of grid linear conductors by the support frame means in substantially parallel relationship to each other and uniformly spaced from the target area thereby to control, with the application of a potential difference therebetween, the path of electrons from the electron gun means to the target, a raster mask and shield electrode having an opening therein of a size proportional of that of the raster to be traced on the target, and means to support the shield between the grid and the electron gun means and adjacent to the grid in insulated relationship thereto.

10. In a cathode-ray tube including an envelope containing at least one electron gun and a screen adapted to be illuminated by electrons from the gun, an electron permeable mask in the path of electrons from the gun to the screen between which and the screen is adapted to be formed an electron accelerating field, said mask having apertures through which pass electric flux lines extending between said screen and said mask, whereby an electron attraction region having a field potential slightly higher than the potential of said mask is established on the side of said mask facing said gun, an electron impermeable shield on the side of said mask facing said gun, said shield extending about the periphery of said mask and forming a frame for an aperture the projection of which on said screen defines the boundary of the area of said screen desired to be illuminated by electrons from said gun, at least the inside edge of said shield lying in a plane spaced from said attraction region in the direction of said gun, and means for maintaining said shield at a potential not less than the potential of said mask.

11. In a cathode-ray tube including an envelope containing at least one electron gun and a screen adapted to be impinged by electrons from the gun, an electron

11

permeable mask in the path of electrons from the gun to the screen between which and the screen is adapted to be formed an electron accelerating field, said mask having apertures through which pass electric flux lines extending from said screen to said mask, whereby an electron attraction region having a field potential slightly higher than the potential of said mask is established at a location spaced from said mask on the side thereof away from said screen, an electron impermeable shield positioned intermediate said electron gun and said mask and framing an aperture through which electrons pass from said gun to said screen, at least the inside edge of said shield being located in a plane spaced from said electron attraction region in the direction of said gun, and means for maintaining said shield at a potential not less than the potential of said attraction region whereby to inhibit attraction to said attraction region of electrons in the vicinity of said shield.

12. In a cathode-ray tube including an envelope containing at least one electron gun and a screen adapted to be illuminated by electrons from the gun, a mounting member attached to the interior wall of the tube envelope, an electron impermeable sheet metal shield secured to the mounting member and forming a hollow frame the projection of which on said screen delimits the area of

12

said screen illuminated by electrons from the gun, an electron permeable mask supported by the mounting member and disposed in the path of electrons from the gun to the screen, said mask and screen being adapted to be maintained at a potential difference such as to form an electron accelerating electrostatic field therebetween, said mask having apertures through which pass electric flux lines extending between said screen and said mask, whereby an electron attraction region having a field potential slightly higher than said mask is established on the side of said mask facing said gun, said shield having a potential not less than that of said mask, at least the inside edge of the frame formed by said shield being spaced from said electron attraction region in the direction of said electron gun.

## References Cited in the file of this patent

## UNITED STATES PATENTS

|           |                 |                |
|-----------|-----------------|----------------|
| 2,263,733 | Knoll           | Nov. 25, 1941  |
| 2,497,660 | Devine          | Feb. 14, 1950  |
| 2,611,100 | Faulkner et al. | Sept. 16, 1952 |
| 2,661,437 | Beckers         | Dec. 1, 1953   |
| 2,683,833 | Zaphiropoulos   | July 13, 1954  |
| 2,728,872 | Smith           | Dec. 27, 1955  |

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 2,936,399

May 10, 1960

Renn Zaphiropoulos

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 51, for "of" read -- on --; column 10, line 29, for "aply" read -- apply --; line 60, for "havnig" read -- having --.

Signed and sealed this 11th day of April 1961.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

ARTHUR W. CROCKER  
Acting Commissioner of Patents

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 2,936,399

May 10, 1960

Renn Zaphiropoulos

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 51, for "of" read -- on --; column 10, line 29, for "aply" read -- apply --; line 60, for "havnig" read -- having --.

Signed and sealed this 11th day of April 1961.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

ARTHUR W. CROCKER  
Acting Commissioner of Patents