Feb. 24, 1953 C. W. GEER 2,629,838

COLOR TELEVISION SCREEN WITH CORRECTION FOR OVERPLAY

Filed Aug. 4, 1949

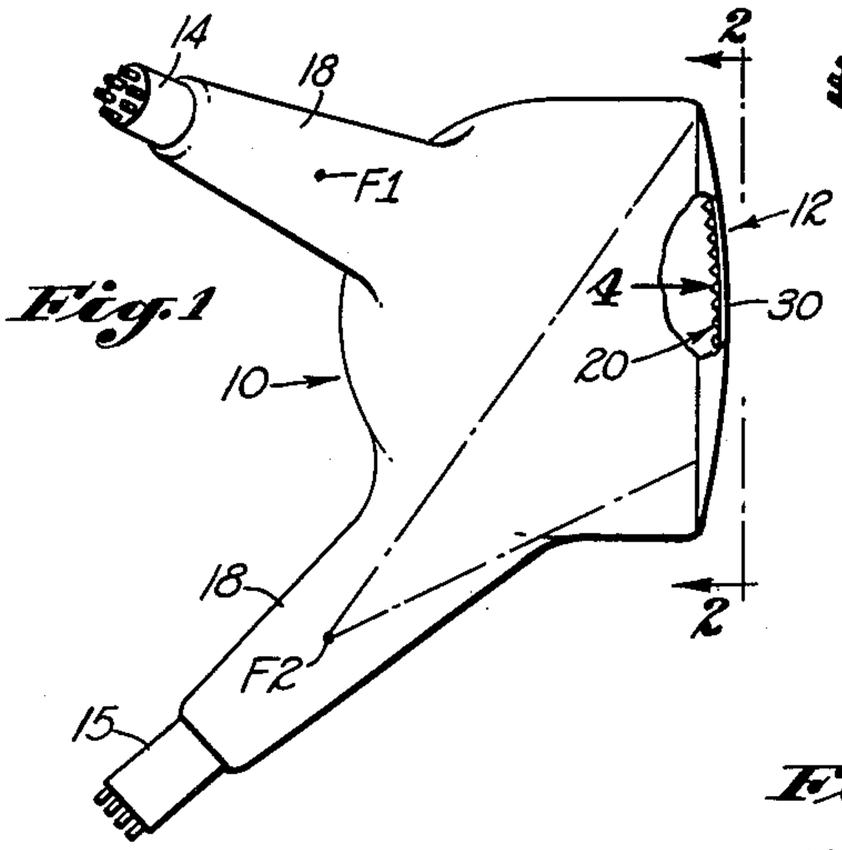

Fig. 1

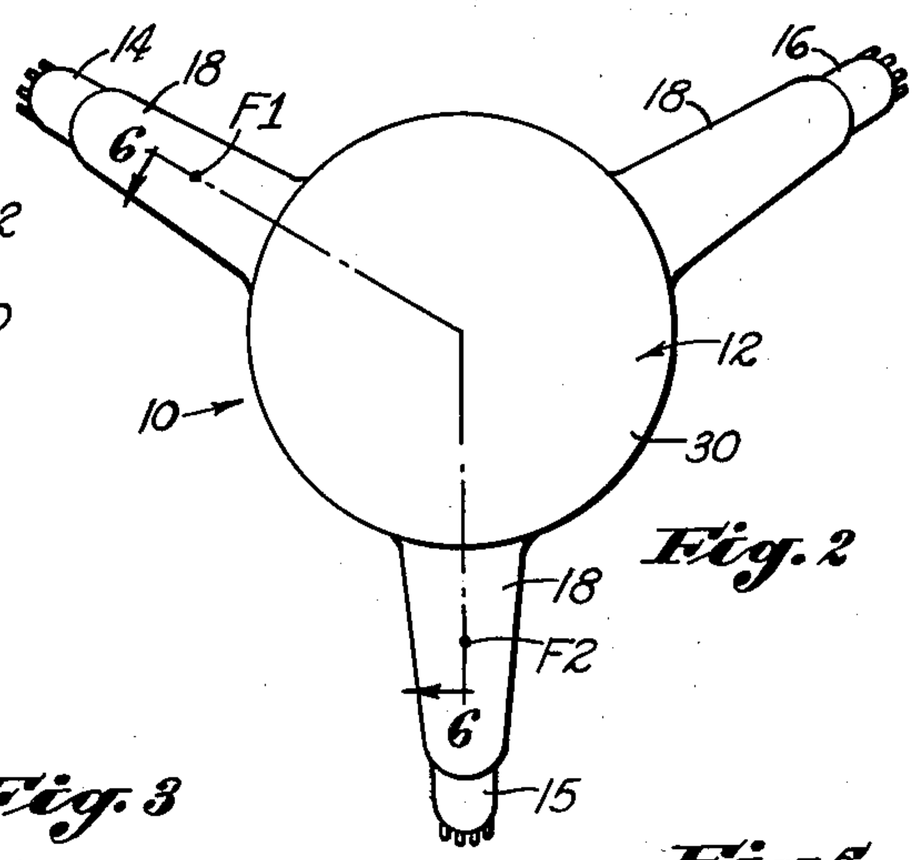

Fig. 2

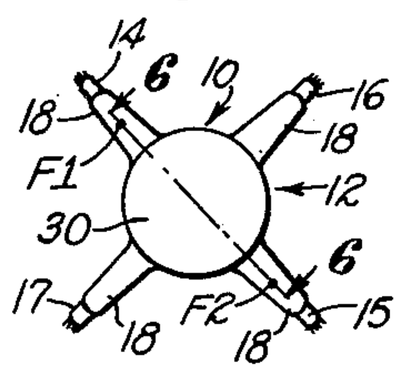

Fig. 3

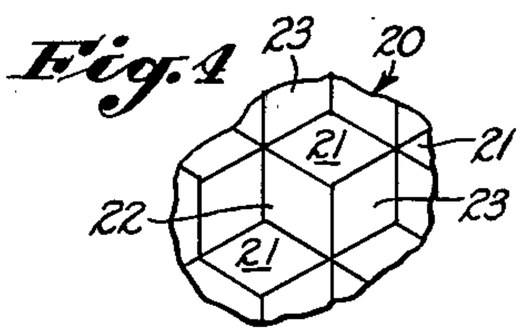

Fig. 4

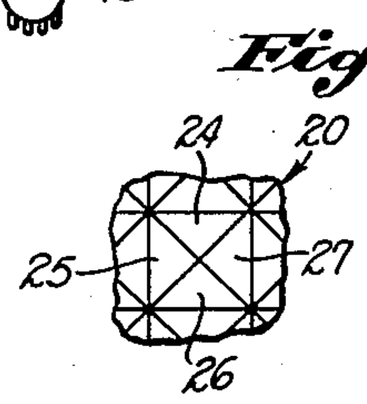

Fig. 5

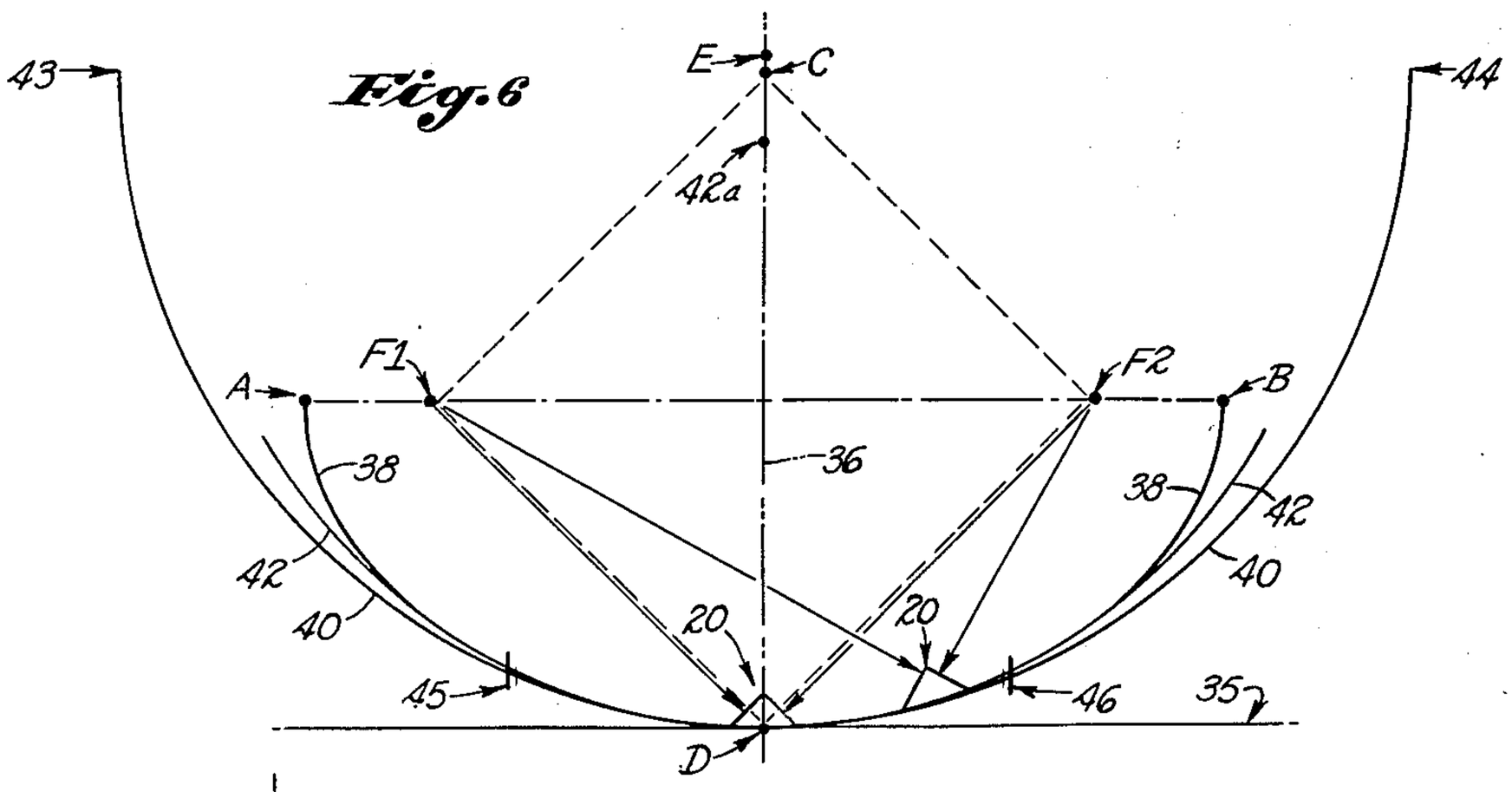

Fig. 6

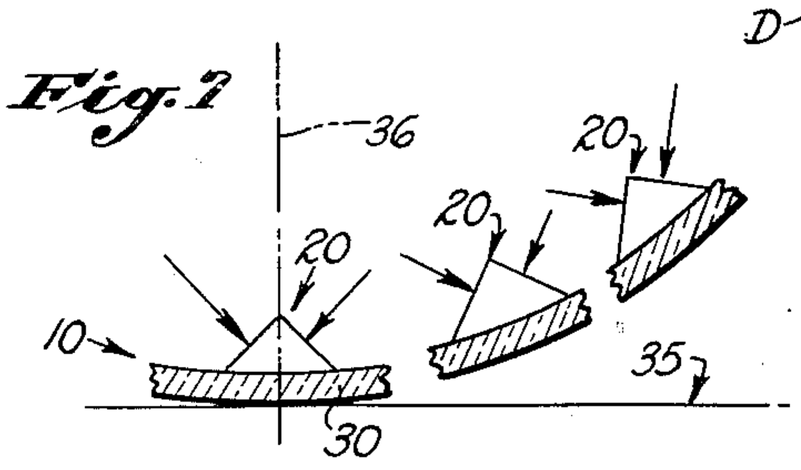

Fig. 7

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COLOR TELEVISION SCREEN WITH CORRECTION FOR OVERPLAY

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This invention relates to television screens and particularly to television screens adapted for the production of color effects in receiving sets.

An important object of the invention is to furnish a screen by means of which color effects may be accurately rendered with clear images.

Another object of the invention is to yield a color television screen which will avoid overshooting or overplay of respective electron beams as they scan the screen, where the screen comprises a multiplicity of minute pyramids having faces to receive electron beams which are respectively directed toward the screen from different angles, and the faces upon which the beams impinge are respectively coated with different phosphors adapted to yield different colors upon proper energization by the respective electron beams.

A particular object is to dispose such pyramidal faces at appropriate angles, substantially right angles, to the respective beams at all positions of such beams as they scan the screen.

The general type of television color screen abovementioned, is disclosed and claimed in my co-pending application, Serial No. 544,384, filed July 11, 1944 which issues as United States Letters Patent No. 2,480,848. It comprises a carrying surface provided with a multiplicity of trihedral or other pyramids of small sizes below the resolving power of the eye at normal viewing distances. The surfaces of the trihedrons are arranged in repeating geometrical patterns with corresponding faces facing in the same direction, the three series of faces of the trihedrons facing regularly in different directions, the faces of each series facing in a given direction being coated with a given phosphor which, when energized by the respective electron beams, is activated to luminescence to yield a given color, which may be one of the primary colors or other principal color as desired. Instead of three series of faces, other series such as two or four may be employed. These series of faces, being coated with phosphors yielding corresponding principal colors when activated, thus give natural color effects to the observer's eye. Such a television screen is disposed within a cathode ray tube or a bulb, often known as a "kinescope" and usually is provided with an electron gun for each series of faces, each respective gun being disposed to direct corresponding electron beams toward the respective phosphor-coated pyramidal faces so that the beams will impinge upon the faces as nearly perpendicularly thereto as possible. These electron guns are controlled by respective signals originating in known transmitting apparatus em-

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ployed. However, as the beams from the respective guns move while conventionally scanning the screen, their angle of impingement upon the respective faces constantly varies with respect to the general plane of the screen, both as the respective beam is moved from side to side of the screen and as it is moved from top to bottom of the screen.

As a consequence, beams desired to fall only upon a given series of faces tend to overplay or overshoot their respective target faces at various parts of the screen and fall obliquely upon portions of contiguous phosphor-coated faces which are intended to be energized only by electron beams from one of the otner guns. Such overshooting or overplaying of electron beams tends correspondingly to activate the phosphors of other faces at undesired intervals and results in corresponding color confusion of the image to the extent that a true color image is not realized unless appropriate correction is made.

It is therefore one object of this invention to provide a pyramid arrangement which corrects such overshooting by varying arrangements of the pyramid faces to avoid overshooting or overplaying of respective beams in a manner to energize phosphors on other faces not intended to be energized thereby. I have found that pyramids having appropriate angles at their apexes may be progressively leaned or tipped toward the central axis of the screen as the periphery of the screen is approached by the respective beams so that the respective beams impinge upon the respective pyramidal faces either in approximately perpendicular relationship, or at least in such relationship, with respect to the trihedral or other apex angles, that no overplay of the indicated nature will occur. Satisfactory arrangements may be attained by employing a concave surface as the screen support having a curvature to be hereinafter described, whereby the increasing curvature toward the periphery serves automatically to tip the various pyramids whose axes are disposed perpendicular to the respective tangents. One such screen support may be in the form of a segment of a spherical surface where the discharge points of the electron guns are disposed approximately at the ends of diameters of the semisphere from which the segment is cut whereby the angle of impingement between the beams formed by any two guns is approximately a right angle. Thus, where tetrahedrons are employed, the angle of impingement between the beams of the two opposite guns is subtended by a chord which is the

diameter at whose ends the respective guns are located. A similar relationship, of course, exists between the respective faces of trihedrons and any two of the three guns used therewith. Similarly, other concaved surfaces may be employed, such as that wherein the intersection of the concave surface by a plane through the central axis (a line perpendicular to tangents at the center) of the concave support is in the form of the side of minimum curvature of an ellipse. Thus, one preferred form is that where the minor axis of the ellipse is 0.965 times the distance between the two foci of the ellipse, the discharge points of the respective guns being located at such foci. In other terms, such an ellipse is that wherein the eccentricity of the ellipse (the ratio of the distance between the foci to the major axis) is about 0.72.

Other appropriate curvatures, other objects of the invention, and the various features of the invention will become apparent to those skilled in the art upon reference to the following description and the accompanying drawing wherein certain embodiments of the invention are disclosed.

In the drawing:

Fig. 1 is principally a side elevation of a television bulb of the kinescope type within which an improved color screen of the present invention is located, a portion of the bulb being broken away to indicate the screen relationship, three electron guns being present;

Fig. 2 is a front elevation of the bulb of Fig. 1 as indicated by the line **2—2** of Fig. 1;

Fig. 3 is a front elevation of a bulb employing four electron guns;

Fig. 4 is a fragmentary elevation of the inner face of the screen, as indicated by the arrow **4** of Fig. 1, where the pyramids are of trihedral construction;

Fig. 5 is a similar fragmentary elevation of the inner face of the screen of Fig. 3 where the pyramids are of tetrahedral construction and four electron guns are used;

Fig. 6 is a diagrammatic view representing the relationships between the electron guns and the pyramids on the screen approximately as indicated on the line **6—6** of Fig. 2 where three electron guns are employed, and as represented by a straight diameter **6—6** in Fig. 3 where four electron guns are employed; and

Fig. 7 is a fragmentary diagrammatic radial section taken on a screen diameter to represent the progressive tipping of the pyramids toward the center of the screen as the pyramids lie farther radially outward toward the periphery of the screen.

Having further reference to the drawing, Fig. 1 illustrates an evacuated glass, cathode-ray tube or bulb **10** of the kinescope type having at its front a concave viewing screen **12**, its rearward portion being provided with three electron guns **14**, **15**, and **16** arranged 120° apart as indicated in Fig. 2. A similar structure is shown in Fig. 3 except that a fourth electron gun **17** is used in order to provide for four principal colors. The various electron guns are carried by integral necks **18**, and these necks are so mounted with respect to the screen **12** as to direct beams from the respective guns toward the trihedral or tetrahedral pyramids at angles approximating 45° to the general plane of the screen **12**, which is parallel to a plane tangent to the central point of the screen and to the elevation line **2—2**. Thus, the guns of Figs. 1 and 2 are not only arranged

at angles of 120° to each other but are also tipped toward the screen **12** at angles of about 45°. Similarly adjacent guns of Fig. 3 are arranged at 90° to each other, these guns also being tipped with respect to the screen at angles of about 45°.

As to manipulation of the electron guns **14**, **15**, **16**, and **17** to scan the screen **12**, this will be controlled by means well understood in the television art. Similarly, the employment of analyzing equipment to segregate and present color signals in proper frequencies to the respective electron guns in correspondence with the natural colors of the image being televised is likewise known in the art. Therefore, explanation and description of such aspects, which are no part of the present invention, are not presented here.

Where three electron guns and trihedral, pyramidal screen elements are employed, as in Figs. 1, 2, and 4, the three exposed faces of the trihedrons are provided with three different phosphors to yield different cathodo-luminescences representing desired principal colors such as red, blue, and green, and where four electron guns and tetrahedral, pyramidal screen elements are required, as in Figs. 3 and 5, four phosphors yielding different cathodo-luminescences will be employed to provide desired colors.

In general, the pyramids of Figs. 4 and 5 are indicated at **20**, regardless of whether they are trihedral or tetradedral, and in the case of the trihedral pyramids of Fig. 4, the corresponding three faces are respectively indicated at **21**, **22**, and **23**, and in the case of the tetrahedral pyramids of Fig. 5, the corresponding four faces are represepted at **24**, **25**, **26**, and **27**.

The pyramidal screen elements **20** are mounted upon the inner face of a screen wall **30** (Figs. 1 and 7) which is formed from appropriate transparent or translucent material, such as glass, plastic, or the like. The pyramids **20** may be integral with such transparent or translucent material, or they may be separately produced and attached thereto as required. The screen elements may be shaped by appropriate ruling or engraving upon an appropriately curved master form or die, or upon a corresponding flat member, the screen structure being finally shaped in any desired manner, such as against a properly curved mold under conditions providing sufficient softening for the production of the required curvature.

According to an improvement of this invention, the curvature of the screen **12** is such with respect to the points of electron emission from the various electron guns that the electron beams, as they scan the screen, will always fall approximately perpendicularly upon the respective faces of the pyramidal elements **20**. As viewed in Figs. 6 and 7, this is accomplished by reason of the fact that the curvature of the screen causes the various pyramidal elements **20** to tip toward the central axis of the screen, which, as viewed in Figs. 6 and 7, is a vertical line rising perpendicularly from the lowermost point of the screen and therefore being perpendicular to the plane tangent to the center of the screen. Such tangent plane is indicated by the line **35** in Figs. 6 and 7 and such central perpendicular axis is indicated by the line **36**.

As illustrated in Fig. 6, a perforated form of curvature for the concave screen, at each diameter, is represented by the side of minimum curvature of an ellipse of such construction that

where the emission points of the corresponding electron guns are placed at the foci, the beams from such guns fall approximately perpendicularly upon the respective pyramidal faces as the beams move during their scanning operations. A suitable ellipse may be determined in either of two manners. In the first, the minor axis of the ellipse is to be approximately 0.965 times the distance between the foci which are indicated at F_1 and F_2 in Fig. 6, these relative positions being also indicated by the same reference characters in Figs. 1, 2, and 3. Such an ellipse may also be established by providing an eccentricity of about 0.72, this eccentricity being the ratio of the distance between the foci F_1 and F_2 to the major axis of the ellipse which is the distance between the points indicated at A and B in Fig. 6. The minor axis above mentioned is the line extending between the points C and D in Fig. 6 located at the opposite sides of the ellipse. Such an elliptical curve is indicated at 38.

Another appropriate concavity for the screen 12 and its support 30 is a shallow segment of a sphere whose radius approximates the minor axis CD of the above mentioned ellipse of Fig. 6 and where the emission points of the corresponding electron guns are to be disposed at the foci of such ellipse, such a curve being indicated at 40. Possibly such a curve with a radius equal to F_1F_2 would be useful in many instances, its center thus being at E in Fig. 6. However, an arcuate curve having a radius approximating 8/9, or between 7/8 and 9/10, of said minor axis, apparently is a preferable curvature, the latter curve being indicated at 42 and having its center at 42*a*. In this case, the emission points of the guns would be at the points F_1 and F_2, or approximately at these points. Such a curve may be otherwise described as having a radius (D–42*a*) which is approximately 8/9 of the radius (DC) of a larger circle in whose semicircle a square (approximately DF_1CF_2) may be inscribed, one of whose diagonals (DC) is the radius of the larger circle, the ends of the other diagonal of the square defining approximately the loci of the emission points of the respective electron guns. Thus, these emission points will be at or close to the points F_1 and F_2. Another appropriate curvature would be any compromise between the elliptical curve 38 and the arcuate curve 40.

Again, a shallow segment of a sphere formed with any radius may be employed where the discharge points of the respective electron guns are to be disposed at the outer ends of opposing radii or of the respective diameter, such as indicated at 43 and 44, whereby the angle of impingement between beams from the guns, being subtended by such diameter, is necessarily 90°. These relationships are, of course, those existing as viewed in the respective plane in which the axes of any two given guns lie, whether on a straight diameter with four guns and tetrahedrons, as indicated by the line 6—6 of Fig. 3, or on a different plane as indicated by the line 6—6 of Fig. 2 representing three guns and trihedrons.

Under all of these circumstances it will be apparent that the apex angles of the pyramids approximate 90° as between any two faces and consequently provide proper correction regardless of whether three or four guns with corresponding trihedrons or tetrahedrons are employed. Relative portions of the concave members to be used as a screen with respect to the various curves mentioned may lie approximately

between the short vertical lines 45 and 46 indicated in the lower portion of Fig. 6.

As will be apparent from the showing of the drawing and the above descriptive matter, the pyramids of the screen, whether they be trihedrons or tetrahedrons, present a plurality of series of faces, the face of each series being faced generally in the same direction whereby to receive electron beams from the respective guns, and the axes of the pyramids are tipped inward toward the central axis of the screen, this tipping increasing progressively with respect to the plane of reference represented by the line 35 of Fig. 6 as respective pyramids lie radially farther out from the screen center. Any such error as exists in any screen whose diameters are constructed as described will be small, and this error can be easily corrected by correspondingly reducing the trihedral or tetrahedral angle below 90°, the axis of the respective pyramid being directed so as to bisect the angle formed between the two respective electron beams impinging on such pyramid.

Since modifications of the generic invention herein disclosed will occur to those skilled in this art, it is intended to protect all variations which fall within the scope of the patent claims.

I claim as my invention:

1. A television screen for overplay correction and comprising: a supporting surface; and a multiplicity of pyramids on said surface, each of which presents a plurality of impingement faces for electron beams of a corresponding plurality of electron guns, each face of each pyramid being directed in substantially the same direction as corresponding faces of all the other pyramids and forming therewith a corresponding plurality of series of faces, each series carrying a given phosphor activatable by respective electron beams to yield a given principal color, pyramids at the center of the screen having their axes perpendicular to the corresponding screen portion, the axes of the pyramids outside said center being progressively tipped increasingly toward the screen center of the screen as the pyramids lie progressively farther outward from said screen center, whereby to dispose the respective faces in planes substantially perpendicular to the respective beams and thereby to compensate for angular change of direction of the respective electron beams as the respective guns scan said screen.

2. A television screen for overplay correction and comprising: a supporting surface; and a multiplicity of pyramids carried on said surface, each of which presents a plurality of impingement faces for electron beams of a corresponding plurality of electron guns, each face of each pyramid being directed in substantially the same direction as corresponding faces of all the other pyramids and forming therewith a corresponding plurality of series of faces, each series carrying a given phosphor activatable by respective electron beams to yield a given principal color, said surface carrying said pyramids possessing concavity and said pyramids having their pyramidal axes approximately perpendicular to tangents at their respective points of curvature whereby pyramids disposed radially outward from the screen center are progressively tipped toward said screen center as the pyramids lie progressively further outward from the screen center to dispose the respective faces in planes substantially perpendicular to the respective beams and thereby to compensate for angular change of direction of the respective electron

beams as the respective guns scan said screen.

3. A television screen for overplay correction and comprising: a supporting surface; and a multiplicity of pyramids carried on said surface, each of which presents a plurality of impingement faces for electron beams of a corresponding plurality of electron guns, each face of each pyramid being directed in substantially the same direction as corresponding faces of all the other pyramids and forming therewith a corresponding plurality of series of faces, each series carrying a given phosphor activatable by respective electron beams to yield a given principal color, said surface carrying said pyramids possessing concavity and said pyramids having their pyramidal axes approximately perpendicular to tangents at their respective points of curvature whereby pyramids disposed radially outward from the screen center are progressively tipped toward said screen center as the pyramids lie progressively further outward from the screen center to dispose the respective faces in planes substantially perpendicular to the respective beams and thereby to compensate for angular change of direction of the respective electron beams as the respective guns scan said screen, the curvature of the said surface being the surface of a segment of a sphere within whose outer limits the discharge points of said guns are to be located.

4. A television screen for overplay correction and comprising: a supporting surface; and a multiplicity of pyramids carried on said surface, each of which presents a plurality of impingement faces for electron beams of a corresponding plurality of electron guns, each face of each pyramid being directed in substantially the same direction as corresponding faces of all the other pyramids and forming therewith a corresponding plurality of series of faces, each series carrying a given phosphor activatable by respective electron beams to yield a given principal color, said surface carrying said pyramids possessing concavity and said pyramids having their pyramidal axes approximately perpendicular to tangents at their respective points of curvature whereby pyramids disposed radially outward from the screen center are progressively tipped toward said screen center as the pyramids lie progressively further outward from the screen center to dispose the respective faces in planes substantially perpendicular to the respective beams and thereby to compensate for angular change of direction of the respective electron beams as the respective guns scan said screen, the curvature of the said surface being the surface of a segment of a sphere within whose outer limits the discharge points of said guns are to be located, the radii of said sphere being approximately equal to twice the distance between a gun discharge point and the perpendicular to the center of the screen.

5. A television screen for overplay correction and comprising: a supporting surface; and a multiplicity of pyramids carried on said surface, each of which presents a plurality of impingement faces for electron beams of a corresponding plurality of electron guns, each face of each pyramid being directed in substantially the same direction as corresponding faces of all the other pyramids and forming therewith a corresponding plurality of series of faces, each series carrying a given phosphor activatable by respective electron beams to yield a given principal color, said surface carrying said pyramids possessing concavity and said pyramids having their pyramidal axes approximately perpendicular to tangents at their respective points of curvature whereby pyramids disposed radially outward from the screen center are progressively tipped toward said screen center as the pyramids lie progressively further outward from the screen center to dispose the respective faces in planes substantially perpendicular to the respective beams and thereby to compensate for angular change of direction of the respective electron beams as the respective guns scan said screen, the curvature of the said surface being such that each diameter of said concavity is formed on the side of minimum curvature of an ellipse whose foci constitute the locus of the discharge points of the guns and the length of whose minor axis approximates the distance between said foci.

6. A television screen for overplay correction and comprising: a supporting surface; and a multiplicity of pyramids carried on said surface, each of which presents a plurality of impingement faces for electron beams of a corresponding plurality of electron guns, each face of each pyramid being directed in substantially the same direction as corresponding faces of all the other pyramids and forming therewith a corresponding plurality of series of faces, each series carrying a given phosphor activatable by respective electron beams to yield a given principal color, said surface carrying said pyramids possessing concavity and said pyramids having their pyramidal axes approximately perpendicular to tangents at their respective points of curvature whereby pyramids disposed radially outward from the screen center are progressively tipped toward said screen center as the pyramids lie progressively further outward from the screen center to dispose the respective faces in planes substantially perpendicular to the respective beams and thereby to compensate for angular change of direction of the respective electron beams as the respective guns scan said screen, the curvature of the said surface being such that each diameter of said concavity is formed on the side of minimum curvature of an ellipse whose foci constitute the locus of the discharge points of the guns and the length of whose minor axis is about 0.965 times the distance between said foci.

7. A television tube comprising in combination: a screen at one end of said tube; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color upon energization from that of each other series of faces; and a plurality of electron guns carried by said tube and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective series of faces from points spaced from said screen, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the corresponding screen portion, and the axes of the pyramids beyond the center of the screen being tipped toward said center, the degree of tipping increasing progressively as the pyramids lie progressively farther outward from the screen center, whereby to compensate for change in angularity of beams from said guns as they scan said screen.

8. A television tube comprising in combination: a screen at one end of said tube; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color upon energization from that of each other series of faces; and a plurality of electron guns carried by said tube and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective series of faces from points spaced from said screen, said screen possessing concavity and said pyramids having their axes approximately perpendicular to tangents at their corresponding screen portions whereby pyramids disposed radially outward from the screen center are tipped toward said center, the degree of tipping increasing progressively as the pyramids lie progressively further outward from the screen center to compensate for change in angularity of beams from said guns as they scan said screen.

9. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, the curvature of said concave screen whereby said tipping is effected serving to compensate for change in angularity of electron beams from said guns as they scan said screen.

10. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, the curvature of said concave screen being such that each diameter of said screen is formed on the side of minimum curvature of an ellipse within whose confines the emission points of the respective electron guns are located.

11. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, the curvature of said concave screen being such that each diameter of said screen is formed on the side of minimum curvature of an ellipse, the foci of said ellipse constituting the locations of the emission points of the respective guns, and the length of the minor axis of said ellipse approximating the distance between said foci.

12. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, the curvature of said concave screen being such that each diameter of said screen is formed on the side of minimum curvature of an ellipse, the foci of said ellipse constituting the locations of the emission points of the respective guns, and the length of the minor axis of said ellipse being 0.965 times the distance between said foci.

13. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids

being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, the curvature of said concave screen being such that each diameter of said screen is formed on the side of minimum curvature of an ellipse having an eccentricity of about 0.72, and the emission points of the respective electron guns being located approximately at the foci of said ellipse.

14. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, said concave screen being the surface of a shallow segment of a sphere within the limits of which the emission points of said guns are located.

15. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with

the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, said concave screen being the surface of a shallow segment of a sphere within the limits of which the emission points of said guns are located, the radius of said sphere being approximately equal to twice the distance between a gun emission point and the central axis of said screen.

16. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, and the faces of said pyramids being exposed at angles of approximately 90° with respect to the respective beams projected by the respective electron guns.

17. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen, each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, the curvature of said screen being such that each diameter of said concavity is in the form of a shallow segment of a circle whose radius approximates eight-ninths of the radius of a larger circle within whose semi-circle a square may be inscribed, one of whose diagonals is approximately a radius of the larger circle, the ends of its other diagonal being approximately the loci of the emission points of the respective electron guns.

18. A television tube comprising in combination: a bulb; a concave screen at one end of said bulb; a multiplicity of pyramids on said screen,

each pyramid presenting a plurality of impingement faces, corresponding faces of the pyramids being faced generally in the same direction and constituting a corresponding plurality of series of faces, each series of faces carrying a phosphor yielding a different color from that of each other series of faces upon energization, pyramids at the center of the screen having their axes substantially perpendicular to the plane of the screen as a whole, and the curvature of the concavity of the screen on each radius causing the axes of the pyramids beyond the center of the screen to be tipped toward said center, the degree of tipping progressively increasing by reason of said curvature as the pyramids lie progressively farther outward from the screen center; a plurality of electron guns carried by said tube adjacent its end opposite from said screen and corresponding in number with the number of said series of faces, said guns being directed angularly toward the respective faces from points spaced from said screen, the curvature of said concave screen whereby said tipping is effected serving to compensate for change in angularity of electron beams from said guns as they scan said screen, each diameter of said concavity being formed on a curve which is a compromise between a side of minimum curvature of ellipse whose foci constitute the loci of the emission points of the electron guns and the length of whose minor axis approximates 0.965 times the distance between said foci, and a shallow segment of a circle whose radius approximates eight-ninths of the radius of a larger circle radius approximately equal to the minor axis of said ellipse, such minor axis and larger circle radius constituting one diagonal of a square, the ends of whose other diagonal define approximately the loci of the emission points of the respective electron guns.

19. A color television tube of the class described, including a concave screen, the curvature of which lies between a side of minimum curvature of an ellipse and a segment of a semi-circle whose radius approximates the minor axis of the said ellipse.

20. A color television tube of the class described, including a concave screen, the curvature of which lies between a side of minimum curvature of an ellipse and a segment of a semi-circle whose radius approximates between $\frac{7}{8}$ and $\frac{9}{10}$ of the minor axis of the said ellipse.

21. A color television tube of the class described, including a concave screen, the curvature of which lies between a side of minimum curvature of an ellipse and a segment of a semi-circle whose radius approximates the minor axis of the said ellipse and electron guns, the discharge points of which are disposed within the said semi-circle.

22. A color television tube of the class described, including a concave screen, the curvature of which lies between a side of minimum curvature of an ellipse and a segment of a semi-circle whose radius approximates between $\frac{7}{8}$ and $\frac{9}{10}$ of the minor axis of the said ellipse and electron guns, the discharge points of which are disposed within the said semi-circle.

23. A color television tube of the class described, including a concave screen, the curvature of which lies between a side of minimum curvature of an ellipse and a segment of a semi-circle whose radius approximates the minor axis of the said ellipse and electron guns, the discharge points of which are disposed at the foci of the said ellipse.

24. A color television tube of the class described, including a concave screen, the curvature of which lies between a side of minimum curvature of an ellipse and a segment of a semi-circle whose radius approximates between $\frac{7}{8}$ and $\frac{9}{10}$ of the minor axis of the said ellipse and electron guns, the discharge points of which are disposed at the foci of the said ellipse.

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