

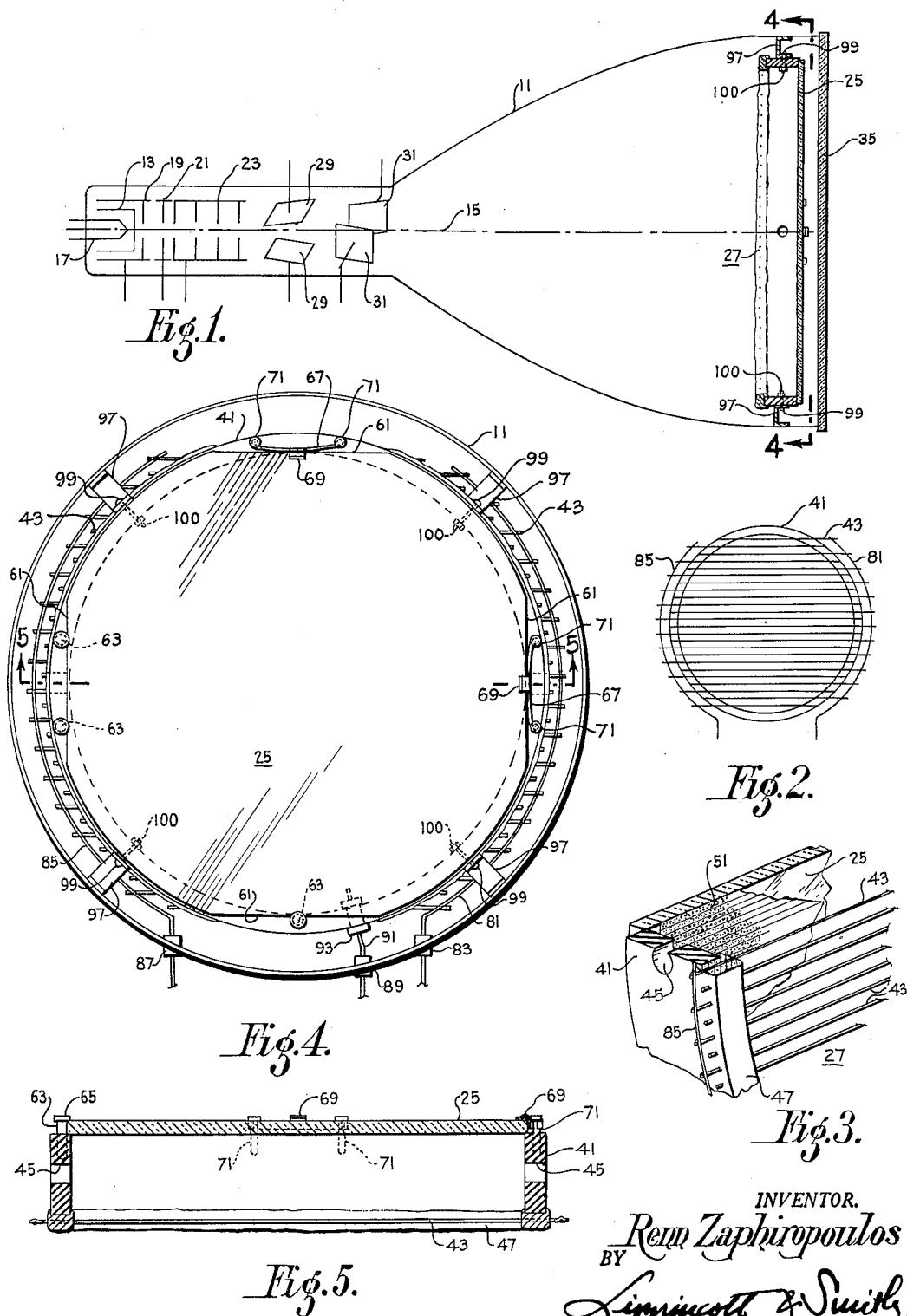
Feb. 28, 1956

R. ZAPHIROPOULOS
HOOP ELECTRODE STRUCTURE

2,736,832

Filed May 22, 1953

2 Sheets-Sheet 1



INVENTOR.
Rem Zaphiropoulos
BY *Lippincott & Smith*
ATTORNEYS

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2 Sheets-Sheet 2

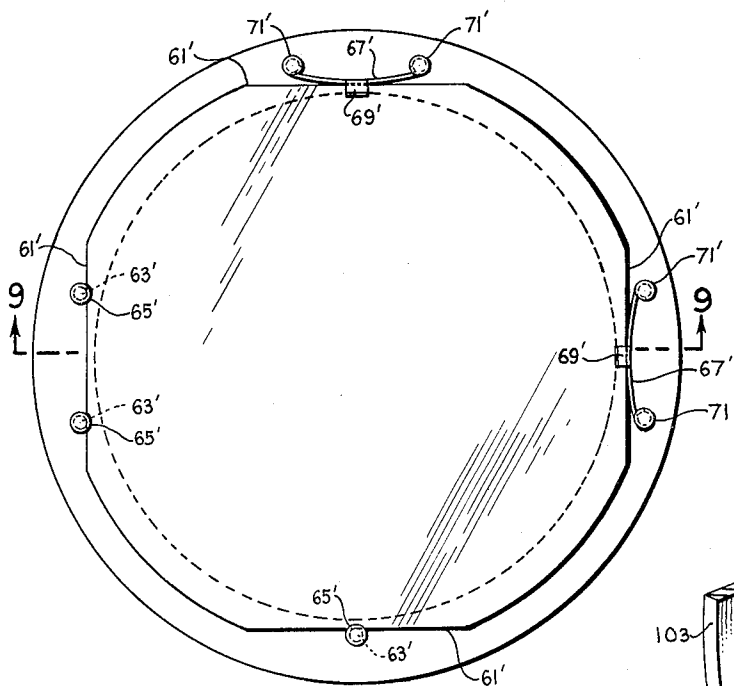


Fig. 8.

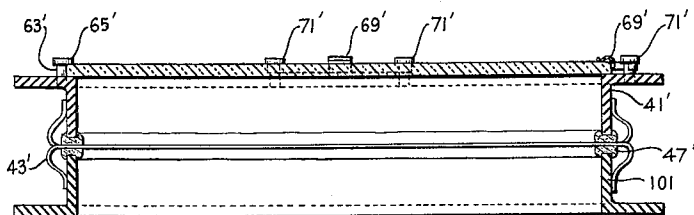


Fig. 9.

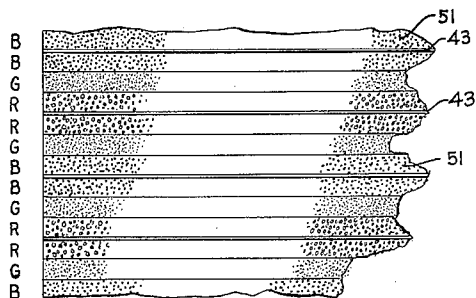


Fig. 6.

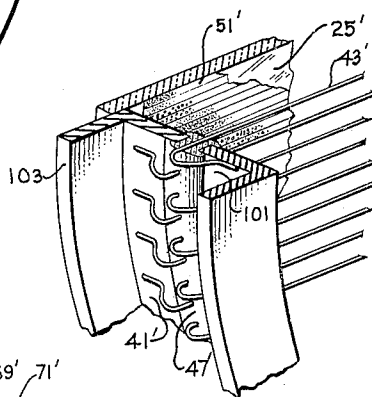


Fig. 7.

INVENTOR.
Renn Zaphiropoulos
BY *Lippincott & Smith*
ATTORNEYS

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HOOP ELECTRODE STRUCTURE

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

Application May 22, 1953, Serial No. 356,717

17 Claims. (Cl. 313—78)

In the television art, various structures have been developed in the past for altering the angle of incidence of the scanning beam or beams impinging upon the target or screen area of cathode-ray tubes. However, such prior art structures are generally of a complex nature to achieve the desired control of the angle of incidence of the impinging cathode ray beam upon the target in accordance with the portrayal of color of the individual picture elements to be represented. Particularly, this invention is concerned with the provision of a simple multiple strand grid structure, for location in proximate relation to the target or screen area to be impacted, such that the application of suitable potentials to the grid and target structures, relative to the electron beam source, permits the grid-wire strands to develop a suitable electric field to alter the angle of incidence of the scanning beam and to focus the beam to substantially sub-punctiform size in at least one dimension on the target area. The electrode structure of the present invention is usable in a tube of the character described, for example, in United States patent application of Ernest O. Lawrence, Serial No. 219,213, filed April 4, 1951, issued October 26, 1954, as Patent No. 2,692,532 and entitled "Cathode-Ray Focusing Apparatus," the instant invention being directed particularly to the lens elements being operable in accordance with the circuit arrangements set forth in the identified application.

The present invention has particular merit when viewed in combination with a target or screen area having light producing phosphor coatings of different characteristics deployed thereon in cyclically repeating sequences, so that light observable in selected different colors results from beam impact on the target. Such a target is usually constructed so that one dimension at least of each type phosphor coating is less than picture element size. Preferably, the phosphor coating is comprised of strips of phosphor capable of producing, upon excitation thereof, primary or component colors of an additive polychrome system, with the color light developed being, for example, red, blue and green.

The grid of the present invention is comprised of a cylindrical section or hoop frame across which electrical conducting means, in the form of linear conductors or individual strands, are adapted to be secured. Preferably, a resilient circular hoop is employed for locating and supporting the individual grid conductor strands. External force may be applied to the hoop to cause it to assume an oblong shape whereupon the individual strands are then secured thereacross such that when the external force is relieved, the hoop in returning to its original shape imposes substantially uniform tension on the individual strands; external means, for example, in the form of a jig or loom having built-in accuracy being employed originally to locate the strands in substantially coplanar mutually parallel relationship, such relationship is preserved by the tensioning arrangement.

Retaining means are provided for attaching the hoop to a phosphor coated translucent base plate comprising

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the target or screen area. Mounting means are provided for securing the thus assembled structure within the viewing end of a cathode-ray tube so that the developed scanning cathode-ray beam must pass through the grid in order to impact the target and produce thereon luminous effects, as desired.

The grid then functions as one component of an electron lens system to focus the electron scanning beam into a substantially linear trace having a width less than the width of a phosphor strip or area on the target; the distance between the target and grid being illustratively of the order of ten times the spacing between adjacent strands (although this is in no way critical) and the potential relative to the electron source which is adapted to be applied to the target being approximately three to four times that applied to the grid. By establishing a difference of potential, of the order of magnitude of $\frac{1}{4}$ of that normally on the grid, between alternate strands of the grid, the angle of incidence of the trace is altered; the beam being deflected in the direction of the strands which are most positive relative to the electron beam source. If the spacing between adjacent strands is substantially equal to the width of a color cycle, the beam may be caused to impact the phosphor coated target at any desired position, thereby admitting of complete color reproduction. This is true whether the strands are aligned parallel with or normal to the phosphor strips as is explained in the Lawrence application hereinbefore mentioned.

Appropriate terminal structure is provided for applying the relative potentials as outlined to alternate strands of the grid structure; alternate strands comprising one set of grid wires and the strands respectively intermediate the alternate strands comprising a second set of grid wires. The strands comprising one set of conductors may extend beyond the hoop in one direction, and the strands comprising the other set of conductors, are extended beyond the hoop in an opposite direction to permit semi-circular terminal bars to be spot-welded or otherwise electrically respectively connected to strands of the sets, thus permitting unlike potentials relative to the beam source to be applied to the sets.

A modification of the present invention contemplates the employment of a pair of hoops of resilient material axially aligned and secured together by insulating cement having imbedded therein the sets of conducting strands (extending as substantially parallel chords across the hoops) with the extremities of one set of strands being spot-welded or otherwise electrically connected to one hoop and the extremities of the strands of the other set being likewise attached to the other hoop thus providing convenient terminal provisions. A phosphor coated translucent base plate comprising a target or screen area as hereinbefore outlined is secured to the attached hoops in abutting engagement with one end thereof through retaining means affording positive transverse or longitudinal alignment of the phosphor strips of the segments thereon relative to the grid strands while also providing a structure capable of yielding as necessary under extreme temperatures developed in the "bake-out" or preparation of the tube and subsequently assuming the initially aligned position. Such retaining means provide a convenient arrangement for securing the translucent base plate, which may comprise a boro-silicate glass having an extremely low coefficient of expansion relative to the resilient metal hoops without necessitating apertures or openings in the glass, the hoop material having a coefficient of expansion equal to or less than that of the conducting strands thus prohibiting strand fracture during bake-out.

Accordingly, among the objects of the present invention are the following: to provide a deflecting and focusing electrode structure suitable for employment within

conventional cathode-ray tubes; to provide multiple strand grid electrode structure which offers a minimum of interception to the infalling cathode rays; to provide electrode structure of this nature adapted, upon the application of suitable potential thereto, to alter the angle of incidence of the scanning beam electrons which impact the target; and more specifically, to provide a combination grid and target structure admitting of maximum viewing area for television tubes; to provide structure of this character particularly designed for efficient production; to provide a multi-electrode grid and target assembly admitting of accurate and persistent alinement of the individual grid strands; and to provide such structure having incorporated therein a convenient tensioning arrangement for the grid strands.

The foregoing will be more apparent to those skilled in the art from a reading of the following detailed description thereof when taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a semi-diagrammatic view, partly in cross section, of a conventional type cathode-ray tube employing therein an electrode structure in accordance with the present invention;

Fig. 2 is a schematic front elevational view of the electrode structure of Fig. 1 as seen from the electron beam source with suitable terminal arrangements for the grid strands being apparent;

Fig. 3 is an isometric view of a portion of the electrode structure of the present invention to show the mutual arrangement of the base plate, hoop support and conducting grid strands;

Fig. 4 is a view in end elevation of the electrode structure deployed in the cathode-ray tube of Fig. 1 as seen along the plane 4—4 of that figure;

Fig. 5 is a view in section of the electrode structure shown in Fig. 4, taken along the plane 5—5 thereof;

Fig. 6 is a detailed view of a portion of the base plate showing the phosphor strips thereon and grid strands positioned relative thereto;

Fig. 7 is an isometric view of a portion of an electrode structure in accordance with a modification of the present invention;

Fig. 8 is a view in end elevation of the electrode structure in accordance with the modified form of invention to show suitable retaining means for locating and securing the base plate to the hoop means; and,

Fig. 9 is a view in cross-section of the electrode structure of Fig. 8 taken along the plane 9—9 thereof.

In the drawings Fig. 1 shows a conventionally shaped cathode-ray evacuated envelope 11 within which the electrode structure in accordance with the present invention is adapted to be mounted. The neck of the cathode-ray tube houses the usual elements such as an indirectly heated cathode 13 which supplies electrons for a cathode-ray scanning beam, represented by the trace 15 when heated by the filament 17. Adjacent to and partially surrounding the cathode 13 there is provided a control grid or electrode 19 suitably apertured to permit the passage of electrons comprising the scanning beam. The control grid performs the function of modulating the emitted stream of electrons in accordance with potential applied thereto relative to the cathode 13. First and second anodes 21 and 23 are adapted to provide initial and final acceleration for the electrons in the scanning beam insofar as the potential distribution, established in the neck of the tube, indicates. The anodes also serve to focus the electron beam, indicated by the trace 15, to a spot, having a diameter of the order of one dimension of a picture element, in the region of a target or screen area comprising the translucent phosphor coated base plate 25, in the absence of potential on the strand grid generally represented at 27.

A set of deflecting plates comprising the usual horizontal plates 29 and vertical plates 31 (or, where desired, externally positioned electromagnetic deflecting coils) is

provided for conventional scanning purposes. Horizontal and vertical is used herein in a descriptive sense only, as the electrode structure of the instant invention is operative with either horizontal or vertical scanning as will be more apparent hereinafter. Thus, the scanning beam is caused to scan the target or translucent backing 25 to produce luminous effects visible through a viewing area shown as the glass end 35 of the cathode ray envelope 11.

Figs. 2 through 4 show a hoop 41 of tubular configuration open at both ends located in abutting engagement with the translucent plate 25 and adapted to support the grid generally represented at 27. The hoop or tubular member 41 is preferably of spring steel or other resilient metal capable of returning to a substantially circular configuration upon the alleviation of external forces applied to compress or oblong the hoop. It is this feature which permits a plurality of conducting strands 43 to be secured across one end of the hoop 41 in substantially mutually parallel relationship with such a relationship being maintained through tension imposed on the strands by the hoop upon its assuming the normal or circular configuration. The hoop 41 is provided with a pair of diametrically opposed holes 45 through which a bolt may be passed with a nut being tightened down on the bolt to oblong the hoop. With the hoop 41 in its oblong state insulating cement such as that manufactured under the trade-name "Insa-lute," having characteristics of minimum release of gas during tube preparation or bake-out, is brushed or daubed onto the edge of the hoop 41 in the form of a mound 47. The conducting strands 43 which are substantially uniformly spaced and parallelly alined by an external jig or loom are then placed in the Insa-lute mound 47 and held in position by the jig until the "Insa-lute" sets or hardens. It is to be understood that although the strands 43 are stated to be "substantially uniformly spaced," such a recitation contemplates sufficient graduation in the spacing as to compensate for deviations in the angle of incidence of the beam between the axis and the edges of the target.

The conducting strands 43 may be comprised of stainless steel, nickel wire or the like having a coefficient of expansion equal to or exceeding that of the hoop material thereby permitting at least part of the tension imposed on the strands by the hoop 43 to be relieved during bake-out and re-established subsequent thereto. The wire employed as the strand material has a minimum diameter (i. e.) of the order of 6 mils to intercept as few electrons as possible. With 6 mil wire the individual strands are normally under a tension of about 2 pounds which is sufficient to maintain parallelism.

The hoop 41 is next secured to the base plate 25 in suitable orientation with phosphor strips 51 (Figs. 3 and 6) placed thereon. In this latter figure, one suitable arrangement of phosphor strips for effecting color reproduction is shown as the blue, green and red light producing phosphor strips deployed respectively in that order with the intermediate green light producing phosphor strip having a width one-half that of the blue and red light producing phosphor strips. However, twice as many green light producing strips are employed as blue and red and accordingly equal areas of the primary light producing phosphors comprise the coated surface of the target area or translucent base plate 25. In Fig. 6 the strands 43 are shown located parallel with edges of the phosphor strips and respectively intermediate the blue and red light producing phosphor strips when viewed from the electron beam source. Thus, the spacing between adjacent strands substantially corresponds to the width of a single color cycle adapted to produce light of the primary colors contemplated within the representative situation herein assumed for purposes of explanation.

A further feature of the invention resides in the arrangement provided for securing the metal hoop 41

to the translucent base plate 25, properly oriented in position as explained in connection with Fig. 6. As the base plate may comprise a boro-silicate glass, it will be appreciated that coupling structure which does not require holes or apertures in the glass base plate 25 is highly desirable since such holes establish local stresses in the glass plate and encourage fracture thereof. Accordingly, the base plate 25 is provided with a plurality of ground flats 61 adapted to cooperate with a plurality of pins 63 (preferably at least two pins abutting one of the ground flats) to locate the base plate and hoop in the described orientation. The pins 63 may also be provided with heads 65 (Fig. 5) adapted to overlap the base plate 25 partially to retain the recited mutual relationship. To allow for differential expansion and to complete the attachment there is provided a pair of spring clamps 67 each having a tab 69 adapted to overlap the base plate 25 in the region of certain of the ground flats 61 with suitable pins 71 being set in the hoop 41 to retain the spring clamps 67 in position.

Fig. 4 also shows one suitable arrangement permitting like or different potentials relative to the beam source to be applied to alternate sets of strands 43. Alternate individual strands 43 extend farther beyond the hoop 41 on the right hand side thereof, as is shown in Fig. 4, to permit a semi-circular terminal bar 81 to be electrically connected thereto, as by spot-welding, thereby forming one set of conducting strands; the terminal conducting bar being extended through insulator 83 externally of the envelope 11 when the electrode structure is positioned within the cathode ray tube. Electrical connection is established to the strands 43, respectively intermediate the strands contacted by conductor 81, through a semi-circular terminal conductor 85 secured to the intermediate strands 43 which project beyond the hoop 41 on the left hand side thereof, as is also shown in Fig. 4. In similar manner, external electrical connection is made to terminal conductor 85 through insulator 87 set in the envelope 11. A further insulator 89 is provided in envelope 11 through which a connection 91 is extended internally of the hoop 41 through an insulator 93 to permit suitable potential to be applied to a thin aluminum coating (not shown) sputtered, settled or otherwise deployed over the phosphor strips 51. Such an aluminum coating is now generally employed in the art, and for further information concerning this coating, reference may be had to the copending application of this applicant for U. S. Letters Patent, Serial No. 307,436, filed September 2, 1952.

The electrode structure as now assembled is adapted to be inserted within the viewing end of the cathode ray envelope 11 and secured therein, the viewing end closure 35 subsequently being suitably secured to the envelope 11 prior to evacuation.

In the case of a metal envelope 11, suitable U-shaped angles 97 preferably resilient to allow for differential expansion between the envelope 11 and hoop 41 during bake-out, may be welded to the inside surface of the envelope to permit bolts or set screws 99 to be secured in the hoop 41, thereby conveniently mounting the electrode structure. The bolts 99 pass through ceramic bushings (not shown), being also provided with insulating discs on each end thereof, i. e., between the hoop 41 and nuts 100 and between the hoop 41 and the U-shaped angles 97 to provide electrical isolation between the envelope 11 and electrode structure in general.

Obviously, other means of attachment may be employed to replace the angles 97 with a necessary requirement being electrical isolation between the envelope and electrode structure. In similar fashion, if glass envelopes are to be employed, lead-ins may be formed in the envelope and heavy wire supports may be sealed therethrough and attached to the

hoop 41, replacing the angles 97. However, as the more recent trend is toward the employment of metal shells as contrasted with glass envelopes, any showing of structure suitable for attachment to glass envelopes is omitted for the sake of simplicity.

In operation the application of like potentials (relative to the beam source) to the terminals 81 and 85, i. e., the individual strands 43, appearing intermediate the red and blue light producing phosphor strips (Fig. 6) as viewed from the beam source, causes the beam, represented by the trace 15, to impinge upon the green phosphor strip, it being focused to a substantially linear trace having, of course, some width which in actual practice is less than the transverse dimension of a single phosphor strip, by the electrical lenses formed between the conducting strands and the aluminum coated phosphor target area, the aluminum coating insuring a substantially uniform potential distribution on the target area. When different potentials relative to the beam source are applied to adjacent conducting strands, i. e., to the two sets of strands supplied by terminals 81 and 85 respectively, the beam is deflected into the red or blue region depending upon which set of strands 43 is more positive. In this latter situation, the beam is also focused to a substantially linear trace by means of the electron lenses formed between the plane of the conducting strands 43 and the aluminum film. Thus, the angle of incidence of the beam may be altered as desired and the beam may be caused to impact the phosphor coated target to provide complete color reproduction.

By way of example, the second anode 23 and the electrode structure of the present invention may be maintained 3 to 4 kilovolts above the cathode 13 and the target or aluminum film may have 12 to 16 kilovolts applied thereto relative to the cathode. The application of 500 to 700 volts between the sets of conducting strands will then serve to deflect the beam trace as herein outlined.

In the embodiment of the invention shown in Figs. 7 through 9, the heretofore mentioned terminal conductors 81 and 85 have been eliminated and instead the separate sets of conducting strands 43' are electrically connected respectively to hoop 41' and additional hoop 101. The hoop 41' is adapted for abutting engagement with the base plate 25', peripheral flange 103 being provided on the hoop 41' to permit a greater area of contact for abutting engagement while also serving as a support for the pins 63' provided with heads 65' adapted to overlap the base plate 25' in the region of the ground flats 61' thereof. Also, the pins 71' adapted to locate the spring clamps 67' having tabs 69' overlapping the base plate 25' are tapped into or otherwise secured in the flange 103. As will be apparent from the hereinbefore related description, this arrangement permits differential expansion between the material of the hoop 41' and glass base plate 25'. The provision of the flange 103 permits the tubular portion of hoop 41' to be made of finer gauge materials, thus reducing the weight of the electrode structure. Obviously, this feature could be incorporated, if desired, in the modification of the invention first described.

Assembly of the electrode structure shown in Figs. 7 through 9 may be effected in the manner hereinbefore described wherein a pair of bolts (not shown) is adapted to extend respectively diametrically of the hoops 41' and 101 with associated nuts being tightened down on the bolts to oblong the hoops, or, oblonging may be effected through an external saddle or yoke. Insulating cement of "Insa-lute" character is then brushed or daubed onto the peripheral edge of hoop 41' disposed away from the base plate 25' in the form of a mound 47' adapted to receive the strands 43' properly oriented in position with respect to the phosphor strips 51' and held by an external jig or loom. The oblonged hoop 101 is then pressed into the "Insa-lute" mound 47' and the cement is allowed to

harden. The particular mixture of "Insa-lute" employed should be selected to have a coefficient of expansion approximately equal to that of the material employed as the hoop or frame material, thus permitting substantially uniform expansion of the hoops and insulating cement during tube bake-out. The "Insa-lute" is, however, sufficiently flexible as to yield as necessary with the hoops when the external force applied to the hoops is relieved and they assume their original substantially circular configuration, bearing in mind the fact that the hoops are only compressed a few hundredths of an inch.

After the "Insa-lute" has set and the hoops have assumed their normal shape, the extremities of the strands 43' are alternately connected to the hoops 41' and 101, as by spot-welding, to provide terminals whereat unlike potentials relative to the beam source may be applied to the separate sets of strands thus formed. Although the particular material comprising the strands 43' should have a coefficient of expansion at least equal to or greater than that of the material employed in the hoop structure, it should be noted that a difference in the coefficients of expansion of the strand material and the "Insa-lute" mixture presents no serious difficulties, since only a small portion of the strands are contained within the "Insa-lute" mound 47' and any differential expansion in these portions is infinitesimal.

What is claimed is:

1. Electrode structure comprising a light-transmissive base plate, hoop frame means positioned adjacent to one face of the base plate, resilient means securing the hoop frame means to the base plate, electrically conducting linear strands strung in substantially parallel chord fashion across the hoop frame means, and insulating means for securing the conducting strands to the hoop frame means in substantially uniformly spaced positions.

2. Electrode structure comprising, in combination, a light-transmissive base plate, hoop means having an end thereof in abutting engagement with a face of the base plate, flexible clamp retaining means for securing the base plate and hoop means in said engagement, a plurality of electrically conducting strands deployed across the other end of the hoop means in substantially mutually parallel relationship, and means for securing said strands to said hoop means.

3. Electrode structure comprising, in combination, a light-transmissive base plate having a plurality of phosphor strips capable upon excitation of producing different colored light deployed in cyclically repeating array on one surface thereof, hoop means having an end thereof in juxtaposition with said surface of the base plate, retaining means for securing the hoop means to said base plate, a plurality of electrically conducting strands strung across the hoop means in substantially mutually parallel relationship, the spacing between adjacent strands being substantially equal to the width of a single color cycle of phosphor strips, insulating means for securing the conducting strands to the hoop means, and connections for applying potential to the conducting strands.

4. Electrode structure comprising, in combination, a light-transmissive base plate, hoop frame means axially aligned with the base plate with one end thereof abutting one face of the base plate, electrically conducting strands strung in substantially mutually parallel array across the hoop frame means, and insulating means for securing the conducting strands to the hoop frame means in substantially uniformly spaced positions.

5. Electrode structure comprising, in combination, a light-transmissive base plate, a hoop having an end thereof in abutting engagement with a face of the base plate, retaining means for securing the base plate and hoop in said engagement, a plurality of electrically conducting strands deployed across the other end of the hoop in substantially mutually parallel relationship with extremities of alternate strands extending beyond the hoop along an arc thereof and extremities of strands intermediate

the alternate strands extending beyond the hoop along another arc opposed to said arc, insulating means for securing said strands to said hoop, and terminal conductors respectively in electrical connection with the alternate and intermediate strands.

6. Electrode structure comprising, in combination, a light-transmissive base plate having a plurality of phosphor strips capable upon excitation of producing different colored light deployed in cyclically repeating array on one surface thereof, hoop means having an end thereof in juxtaposition with said surface of the base plate, flexible retaining means for securing the hoop means to said base plate, a plurality of electrically conducting strands strung across the other end of the hoop means in substantially coplanar mutually parallel relationship, the spacing between adjacent strands being substantially equal to the width of a single color cycle of phosphor strips, insulating means for securing under tension the conducting strands to the hoop means, and connections for applying potential to the conducting strands.

7. Electrode structure comprising, in combination, a light-transmissive base plate, a pair of hoop frames in axial alignment positioned adjacent to one face of the base plate, resilient means securing the hoop frame means to the base plate, electrically conducting strands strung in substantially mutually parallel array across the hoop frames, insulating means for securing the hoop frames together and the conducting strands to the hoop frames in substantially uniformly spaced positions, alternate strands being in electrical connection with one of the hoop frames and strands intermediate the alternate strands being in electrical connection with the other of said hoop frames.

8. Electrode structure comprising, in combination, a light-transmissive base plate, a pair of hoop frames in axial alignment having an end thereof in abutting engagement with a face of the base plate, flexible retaining means for securing the base plate and one of the hoop frames in said engagement, a plurality of electrically conducting strands deployed across the hoop frames in substantially mutually parallel relationship, insulating means for securing the hoop frames together and the strands intermediate the hoop frames, and means electrically connecting alternate strands to said one of the hoop frames and remaining strands to the other hoop frame.

9. Electrode structure comprising, in combination, a light-transmissive base plate having a plurality of phosphor strips capable upon excitation of producing different colored light deployed in cyclically repeating array on one surface thereof, a pair of hooped frames in axial alignment having an end thereof in juxtaposition with said surface of the base plate, flexible retaining means for securing one of the hoop frames to said base plate, a plurality of electrically conducting strands strung across the hoop frames in substantially coplanar mutually parallel relationship, the spacing between adjacent strands being substantially equal to the width of a single color cycle of phosphor strips, insulating means for securing the hoop frames together and the conducting strands to the hoop frames, alternate strands being in electrical connection with said one hoop frame and strands respectively intermediate the alternate strands being in electrical connection with the other of said hoop frames.

10. Electrode structure comprising, in combination, a light-transmissive base plate, grid frame supporting means in the form of a resilient tubular member open at each end and having one end thereof positioned in abutting engagement with the base plate, retaining means for securing the tubular member to the base plate, a plurality of conducting strands disposed in substantially mutually parallel relationship across the other end of the tubular member, insulating means for securing the strands across the tubular member in electrical isolation therefrom, said tubular member and insulating means having coefficients of expansion of approximately the same order and said

strands having a coefficient of expansion at least equal to that of the tubular member whereby fracture of the strands is precluded when the electrode structure is submitted to elevated temperatures, and connections for applying different potentials to adjacent strands.

11. Electrode structure comprising, in combination, a light-transmissive base plate, grid frame means in the form of a resilient tubular member open at each end and having one end thereof positioned in abutting engagement with the base plate, flexible retaining means for securing the tubular member to the base plate, a plurality of conducting strands disposed in substantially mutually parallel relationship across the other end of the tubular member, insulating means for securing the strands under tension to the tubular member in electrical isolation therefrom, said tubular member and insulating means having coefficients of expansion of approximately the same order and said strands having a coefficient of expansion at least equal to that of the tubular member whereby longitudinal expansion of the strands exceeds transverse expansion of the tubular member when the electrode structure is submitted to elevated temperatures, and a pair of terminal conductors respectively in electrical connection with alternate strands and strands intermediate the alternate strands.

12. Electrode structure comprising, in combination, a light-transmissive base plate having a plurality of phosphor strips capable upon excitation of producing different colored light deployed in cyclically repeating array on one surface thereof, grid frame means in the form of a resilient tubular member open at each end having one end thereof positioned in abutting engagement with the base plate, flexible retaining means for securing the tubular member to the base plate, a plurality of conducting strands disposed in substantially mutually parallel relationship across the other end of the tubular member, the spacing between adjacent strands being substantially equal to the width of a single color cycle of phosphor strips, insulating means for securing the strands under tension to said other end of the tubular member in electrical isolation therefrom, said tubular member and insulating means having coefficients of expansion of approximately the same order and said strands having a coefficient of expansion at least equal to that of the tubular member whereby fracture of the strands is precluded when the electrode structure is submitted to elevated temperatures and connections for applying different potentials to adjacent strands.

13. Electrode structure comprising, in combination, a translucent base plate having a plurality of phosphor strips capable upon excitation of producing different color light deployed on a surface thereof in cyclically repeating array, at least one tubular member located in abutting engagement with said surface of the base plate, a plurality of conducting strands extending across the end of the tubular member disposed away from said one end in substantially mutually parallel relationship, said strands being respectively spaced apart by a distance substantially corresponding to the width of a single color cycle of phosphor strips, insulating means for securing the strands in spaced relationship to the tubular member and in electrical isolation therefrom, a pair of electrical terminals respectively connected to alternate strands to define a first and second set of strands whereby unlike potentials may

be applied to the sets of conducting strands, retaining means for locating the tubular member and conducting strands relative to the phosphor strips and, flexible means for securing the tubular member to the base plate.

14. Electrode structure comprising, in combination, a translucent base plate having a plurality of phosphor strips capable upon excitation of producing different color light deployed on a surface thereof in cyclically repeating arrangement, at least one tubular member located in abutting engagement with said surface of the base plate to leave the phosphor strips exposed therethrough, a plurality of conducting strands extending across the end of the tubular member disposed away from said one end in substantially mutually parallel relationship, said strands being respectively spaced apart by a distance substantially corresponding to the width of a single color cycle of phosphor strips and oriented substantially respectively parallel with edges of the phosphor strips, insulating means for securing the strands in spaced relationship to the tubular member and in electrical isolation therefrom, a pair of electrical terminals respectively connected to alternate strands and strands respectively intermediate the alternate strands to define a first and second set of strands, retaining means for locating the tubular member with the conducting strands substantially parallel to the phosphor strips and flexible means for securing the tubular member to the base plate.

15. Electrode structure comprising, in combination, hoop frame means of resilient material, a plurality of electrically conducting strands of a material having a coefficient of expansion at least equal to that of the hoop frame means deployed across the hoop frame means in substantially mutually parallel relationship, and means for securing said strands to said hoop frame means in electrical isolation therefrom.

16. Electrode structure comprising, in combination, a hoop frame of semi-resilient material, a plurality of electrically conducting strands strung across one end of the hoop frame in substantially mutually parallel relationship, and insulating means for securing the conducting strands to the hoop frame in substantially uniformly spaced positions.

17. Electrode structure comprising, in combination, a pair of hoop frames of substantially equal diameter in co-axial alinement, insulating means for securing the hoop frames together in said alinement, and a plurality of electrically conducting strands stretched across the aligned hoop frames in substantially mutually parallel relationship being secured in said relationship by the insulating means, alternate strands of said plurality connecting to one of the hoop frames and strands respectively adjacent to said alternate strands being connected to the other of said hoop frames.

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