March 5, 1957 G. F. BARNETT 2,784,334

PRECISION DUAL BEAM CATHODE-RAY TUBE

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Fig. 1.

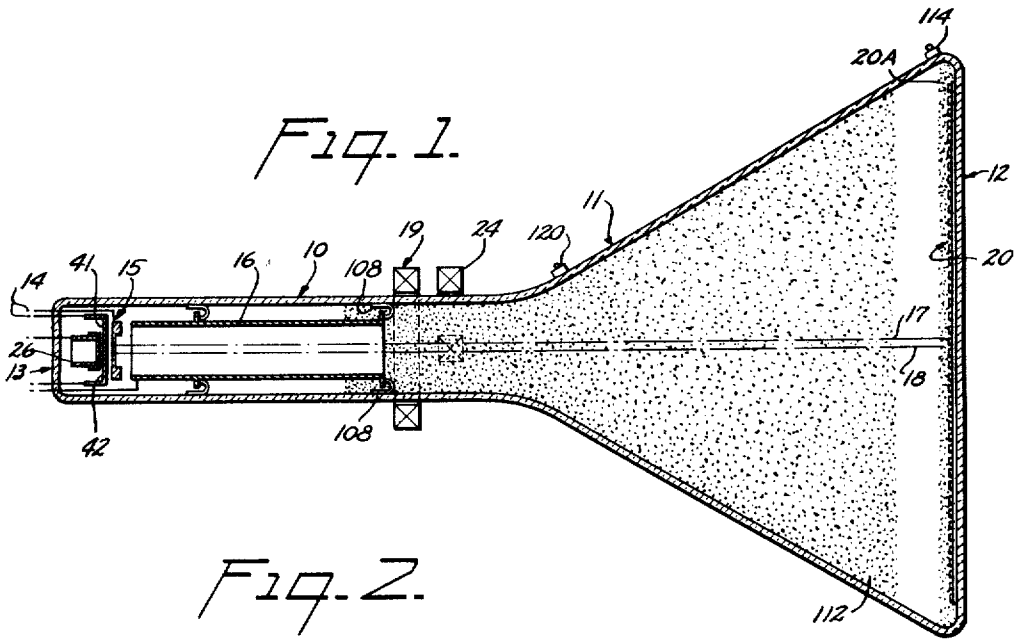


Fig. 2.

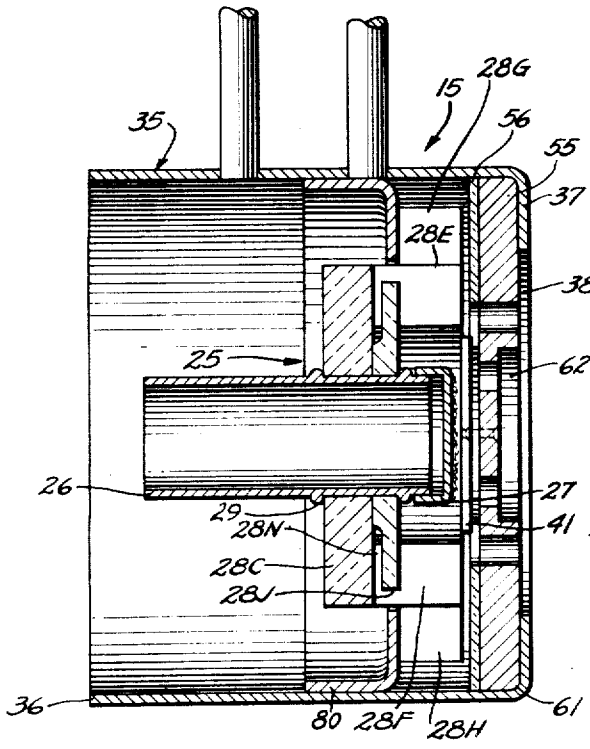


Fig. 3.

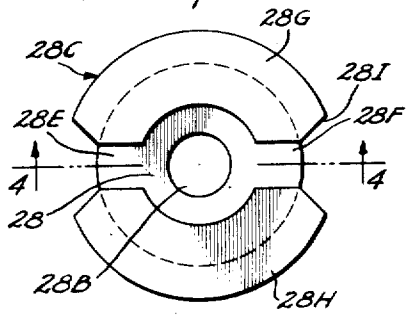
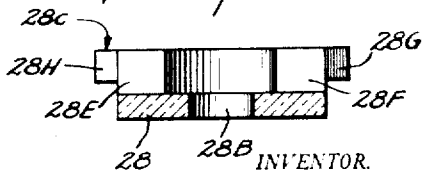


Fig. 4.



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Fig. 5.

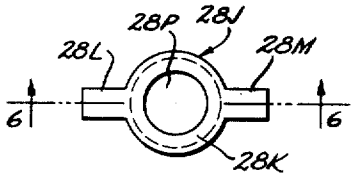


Fig. 6.

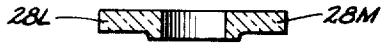


Fig. 10.

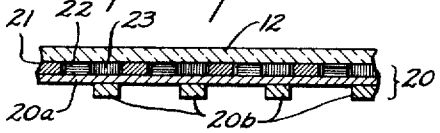


Fig. 7.

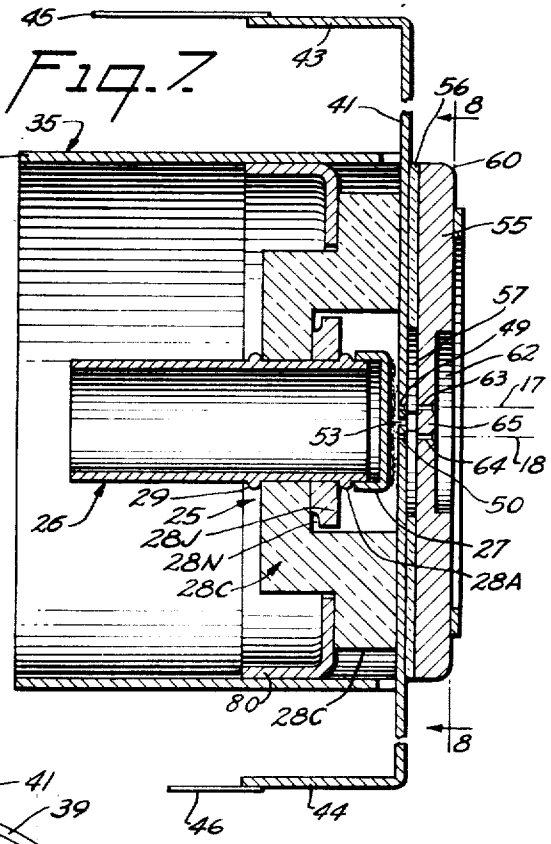


Fig. 8.

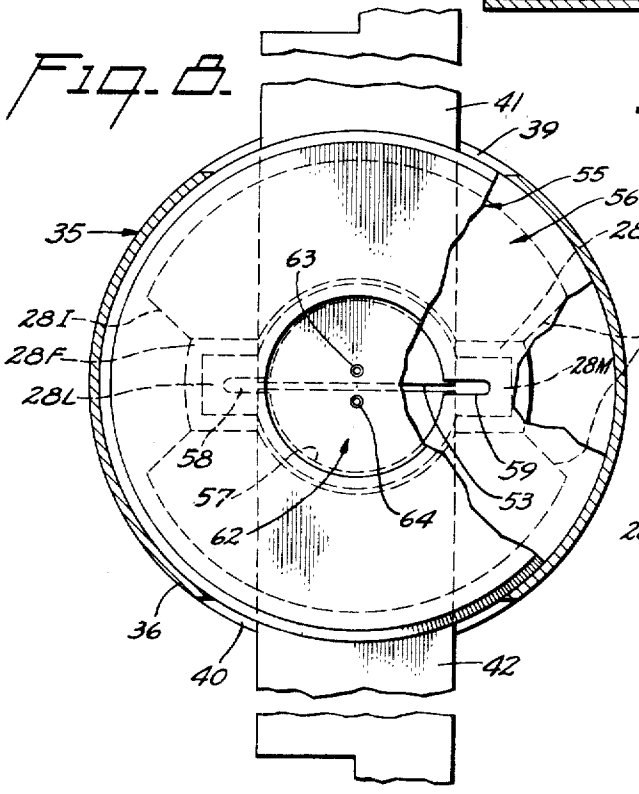
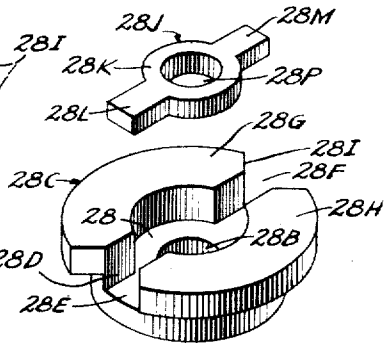


Fig. 9.



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2,784,334

PRECISION DUAL BEAM CATHODE-RAY TUBE

Guy F. Barnett, Roslyn, Pa., assignor to Philco Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Application March 29, 1955, Serial No. 497,616

13 Claims. (Cl. 313—69)

This invention relates to electron beam transducing tubes, and more especially it relates to cathode-ray tubes having a plurality of closely spaced electron beams.

The invention is in the nature of an improvement on the kind of electron tube disclosed in application Serial No. 428,744, filed May 10, 1954.

A principal object of the invention is to provide a precision cathode-ray tube having a plurality of closely spaced beams of high current density and substantially entirely free from beam interaction, whereby the beams can be focused by the same focusing system and can be deflected by the same beam deflection system.

Another object is to improve the operating characteristics and the precision assembly of dual beam color television picture tubes and the like.

As pointed out in said application Serial No. 428,744, ordinary cathode-ray tubes, such as are used as black and white or monochrome reproducers, are not practical for color television since the scanning beam spot, for a given fineness of detail, of detail, must be focused to much smaller size. Furthermore, the beam current or intensity requirements for a color picture tube are much more stringent than for monochrome tubes. The said prior application Serial No. 428,744 discloses a novel combination and organization of elements whereby a satisfactory color picture tube can be produced with utmost precision. In that type of tube it has been found that dimensional variations of even slight order, which are permissible in black and white or monochrome tubes, are not permissible in color tubes. The problem is even more complex where the color tube is of the kind employing two closely spaced sharply focused beams which must maintain their spacing at all times without undesirable interaction. While tubes made according to the said copending application have been found entirely satisfactory for the production of brilliant and sharp color displays on the tri-color screen, I have found that this performance can be improved by a simplification in the electron gun assembly.

Accordingly, one of the principal features of this invention is to provide a novel dual beam gun construction for a cathode-ray tube wherein ultra precision ceramic elements are provided for gauging and spacing the dual control grid strips from the cathode emission surface. Those ceramic elements effectively insulate the grid strips from the associated metal parts or electrodes, and at the same time provide a rigid clamping member to receive the clamping thrust of a retainer ring or the like, whereby the grid strips are clamped against a mica insulator which separates them from a special dual beam shield convergence electrode.

In accordance with another feature of the invention, the ceramic precision members are specially shaped and assembled to decrease the likelihood of electrical leakage between the cathode and grid which might otherwise result from undesirable deposition of conductive material from the heated cathode on to the surrounding ceramic parts.

A further feature relates to a novel combination of ceramic elements which cooperate with a tubular internally heated cathode sleeve to provide a highly accurate means for controlling the spacing between the cathode emission surface and a plurality of coplanar flat grid electrodes, which spacing must be within very close tolerances and very much less than those encountered in conventional cathode-ray tubes.

A still further feature relates to a novel combination of keyed ceramic members for reducing the cost of manufacturing cathode-ray tubes of the type disclosed in application Serial No. 428,744, filed May 10, 1954. This reduction in manufacturing cost is in part achieved by reducing the number of precision surface grinding or lapping operations required for the cathode-to-grid ceramic spacers, and by enabling the cathode emission surface to be accurately gauged and fixed without requiring the pre-matching of each ceramic element to a particular cathode.

A still further feature relates to an improved combination of keyed ceramic elements for an electron gun, which reduces the manufacturing cost while maintaining a high order of anti-deposition shadowing in the assembled gun.

A still further feature relates to the novel organization, arrangement, and relative location and interconnection of parts, which cooperate to provide an ultra precise dual beam cathode-ray tube of high current beam density and with closely spaced non-interacting beams.

In the drawing, which shows by way of example one preferred embodiment,

Fig. 1 is a schematic plan view of a dual beam tube embodying the invention;

Fig. 2 is a greatly magnified cross sectional view of the electron gun of Fig. 1;

Fig. 3 is a plan view of one of the precision-ground ceramic elements according to the invention;

Fig. 4 is a sectional view of Fig. 3 taken along the line 4—4 thereof;

Fig. 5 is a top plan view of another ceramic shadowing element that is keyed to the element of Fig. 3;

Fig. 6 is a sectional view of Fig. 5 taken along the line 6—6 thereof;

Fig. 7 is a highly magnified sectional view of the gun of Fig. 1 taken at right angles to the sectional view of Fig. 2;

Fig. 8 is a sectional view of Fig. 7 taken along the line 8—8 thereof, and with certain parts broken away to show the construction more clearly;

Fig. 9 is an exploded perspective view of the manner of keying the ceramics of Figs. 3 and 5 together;

Fig. 10 is a highly magnified cross sectional view of part of the face plate and fluorescent screen of the tube of Fig. 1.

While the invention will be described as embodied in a cathode-ray tube for the reproduction of colored pictures or images employing a phosphor screen of the tricolor strip kind, it will be understood that the invention can be used in other kinds of electron beam transducing tubes, such as storage tubes, multiplex signaling tubes, or any other tube where two discrete but closely spaced electron beams are to be acted upon by the same focusing system and by the same deflection system and without mutual interaction between the beams.

As indicated in Fig. 1, a tube according to the invention may comprise any well-known form of evacuated enclosing bulb consisting of the usual glass neck portion 10 which is joined to the funnel-shaped portion 11, this funnel-shaped portion being closed off by the transparent viewing face portion 12. The opposite end of the neck portion 10 has sealed thereto any well-known type of glass header 13 through which the various lead-in wires 14 are

sealed preferably, although not necessarily, in circular array. Supported within the neck portion **10** in the manner to be described hereinbelow, is an electrode assembly according to the invention. This assembly comprises in general a dual beam electron gun **15** which will be described in detail hereinbelow, and an elongated tubular anode **16**. The anode **16** is of much longer axial length than that customarily employed in black and white cathode-ray tubes, and is supported firmly but resiliently against the inner wall of neck **11** at a plurality of spaced planes by means of the metal spring fingers to be described.

Gun **15** is, according to the invention, designed to develop a dual beam, the two beams being indicated by the numerals **17**, **18** (Figs. 1 and 7). Beam **17** will be referred to herein as the color transducing beam, while beam **18** will be referred to as the monitoring or indexing beam. Surrounding neck **10** is any well-known form of electromagnetic focusing yoke schematically indicated at **19** for focusing the dual beams **17**, **18**, as respective minute spaced spots on the fluorescent screen **20**. Screen **20** may be attached or deposited directly on the interior surface of face plate **12**, or if desired, it can be applied to any suitable light transparent sheet which can be mounted within the tube, in close proximity to face plate **12**.

Screen **20** may comprise a series of regularly repeated sets of tri-color strips **21**, **22**, **23** (see Fig. 10), which extend parallel to one another in a direction vertical to the plane of the sheet of drawing, as seen in Fig. 1. Preferably these strips are spaced slightly from each other, but need not necessarily be. Each of these tri-color sets comprises a strip **21** which, for example, may be of any well-known fluorescent material which fluoresces blue when struck by the transducing beam **17**; strip **22** may be of a material which fluoresces green. In accordance with well-known color principles, even when the strips of each tri-color set are energized in time succession by the beam **17**, the combination of colors because of visual retention and inability to resolve lines at normal viewing distance and because of the phosphorescent effect, produce a resultant single visual color whose hue will be dependent upon the relative intensities with which the individual color strips in each set are excited by the beam **17**. The elemental width of the beam **17** in the direction of the horizontal line scan should not be greater than the width of each color strip, and preferably is substantially less than in the conventional black and white picture tube, wherein the scanning beam, for substantially the same picture definition, can have a width approximately three times as wide as the beam **17**. Therefore, in the type of tube according to this invention, it is necessary, for image brightness equivalent to the black and white tube, that the beam **17** have a peak intensity which is many times that required in such black and white tubes. Furthermore, it has been found necessary to prevent inter-modulation between the dual beams **17**, **18**. This inter-modulation prevention is achieved by a beam-convergence and beam-shielding electrode of the form described in Serial No. 428,744, filed May 10, 1954.

By any well-known magnetic horizontal and vertical deflection yokes represented schematically at **24**, surrounding the neck **10**, the two beams **17** and **18** are moved synchronously or in unison so as to scan the screen **20** in successive parallel lines extending substantially transverse to the length of the tri-color strips of screen **20**.

All the fluorescent strips **21**, **22**, **23**, etc., are provided with a thin electron permeable coating **20***a*, of low secondary electron-emissivity but which is electrically conducting and transparent to the beam **17**. Typical of such materials is aluminum, magnesium, or beryllium. The coating **20***a* can be deposited so that it also acts as a mirror to reflect the fluorescent light from the fluorescent strips outwardly through the face plate **12** which face plate, of course, should be substantially uniformly transparent to all the desired visible light rays from the screen **20**. Suitably deposited on the coating **20***a* on the side facing the gun **15** are spaced strips **20***b* of a material having a high secondary emissive power or at least of a power which is substantially higher than that of the coating **20***a*. For example, the strips **20***b* may be of gold or other high atomic number metal such as platinum or tungsten, or of an oxide such as magnesium oxide or any other equivalent high ratio secondary emitter. The secondary emission strips **20***b* are applied over the coating **20***a* but only in registry with fluorescent strips of a particular color, for example the secondary emission strips **20***b* may be applied so as to be in registry over the red fluorescent strips **23**. By means of the coating **20***a*, the screen as a whole can be connected to the positive pole of a suitable direct current power supply by means of a conductor sealed through the wall of the cathode-ray tube bulb. For a detailed description of the action of the indexing beam **18** with respect to the secondary emission strips **20***b*, reference may be had to Serial No. 242,264, filed August 17, 1951, now Patent No. 2,742,531. Suffice it to say for the present that each time the indexing beam **18** strikes one of the secondary emission strips **20***b*, it produces a pulse of secondary electron current. This pulse can be picked up by a suitable electron collector electrode, such for example as a conductive coating on the interior wall of the bulb adjacent to, but spaced from, the screen **20**.

Because of the extremely small width of the scanning beam and because of the high beam intensity required, conventional gun constructions used in black and white tubes are not feasible for this type of tube. Furthermore, the parts of the gun must be made with extreme precision and yet capable of assembly in such a way that in the final assembled unit the desired uniformity of precision is maintained, even between large batches of such guns.

For that purpose, the gun construction such as illustrated in the drawing has been devised and has been found to produce the desired results. Referring to the drawing, the gun **15** includes a cathode sub-assembly **25** consisting of a tubular metal sleeve **26** of nickel or the like, which is closed off at its forward end by metal cap **27** also of nickel which may be welded to the sleeve **26**. The cap **27** may have a flat surface or it may have a rounded or dome-shaped contour. The cap **27** is slidably telescoped on to the end of sleeve **26** and its position thereon is adjusted with respect to the top surface of member **28C** by means of mechanical jigs and fixtures whereupon it is welded in its adjusted position. Cathode sleeve **26** passes through a corresponding central opening **28B** in the disc-like bottom **28** of a unitary ceramic member **28C**, which is shown in separate detail in Figs. 3, 4 and 9. Member **28C** has an integral cylindrical side wall **28D** which is provided with diametrically opposite slots **28E**, **28F**. The wall **28D** has integrally formed therewith at its upper end outwardly extending substantially semi-circular flanges **28G**, **28H**. Preferably, the opposite ends of the flanges are cut away at an angle as indicated at **28I** to improve shielding from conductive sublimates from the heated cathode.

The entire top face of member **28C**, including the flanges, is precision ground or lapped to an accuracy of .0001 inch, because this ground face forms the basic reference plane upon which depends the minute accurate spacing between the cathode surface and the coplanar flat grid strips **41**, **42** (see Figs. 1, 2, 7, and 8). For that reason, ordinary ceramic surfaces should be avoided. For example, with such conventional ceramics there may be high and low points on the ceramic surface which would preclude the maintenance of the desired minute and uniform clearance between the cathode and grids. The top surface of member **28C** may be lap-ground in a machine such for example as is used in lapping the surfaces of piezo crystals and the like, so that the flatness of the said face has an accuracy of 0.0001 inch.

Adapted to fit within the member 28C is a separate ceramic member 28J (see Figs. 2 and 5 to 9). This member has an annular body portion 28K whose outer diameter is substantially less than the internal diameter of the cylindrical wall 28D of member 28C. Member 28J also has a pair of diametrically opposite arms 28L, 28M, which are narrower than the slots 28E, 28F in member 28C so as to be spaced from the sides of said slots. The bottom face of member 28J is adapted to seat against the bottom 28 of member 28C with the arms 28L and 28M located in slots 28E, 28F, as shown in Figs. 2, 7, and 8. The arms 28L and 28M are not as thick as the annular section 28K, thus leaving an annular gap 28N (Figs. 2 and 7) between the lower face of member 28J and the member 28C. This gap therefore provides a shadowing notch extending completely around the inner periphery of member 28C and prevents the deposition from the cathode of a complete conductive path on and around the surface of member 28C. Furthermore, because of the fact that the arms 28L, 28M are located above the bottom of the slots 28E, 28F, the said arms also act as barriers to avoid the deposition of conductive material in the bases of the slots. Thus, the members 28J and 28C cooperate so as completely to protect the inner surface of the ceramics from acquiring any completely conductive paths, which would otherwise tend to occur by reason of the evaporation thereon of conductive material from the heated cathode. The central opening 28P is of the same diameter as the opening 28B, both of these openings being only slightly larger than the peripheral size of cathode sleeve 26.

In order to anchor the cathode sleeve with respect to members 28C and 28J, a pair of peripheral beads 28A, 29, are formed on the sleeve. The bead 29 can be preformed and the bead 28A can be formed after the keyed ceramic members are assembled in their keyed relation.

The metal cap 27 is then placed on the end of the sleeve 26 and it is adjusted thereon so as to obtain the desired planar spacing with respect to the ground top face of ceramic member 28C. This spacing can be examined through any well known microscopic viewer. It will be noted that while the element 27 is located below the top lapped surface of ceramic 28C, the desired spacing adjustment can be observed through the relatively wide and opposite slots 28E and 28F. However, the desired spacing is obtained by mechanical jigging at the time the welding is done. These slots also provide passageways through which a suitable spot welding electrode can be inserted to weld the cap in its position on sleeve 26. The top surface of cap 27 can then be sprayed in any well known manner to coat it with any of the well known electron emissive materials customarily used in cathode-ray tubes. For example, it may be coated with a mixture of barium and strontium compounds which are eventually broken down in the conventional processing of cathode-ray tubes to produce electron emissive oxides.

If found necessary, the cathode coating may be subjected to a precision shaving operation so as to render it perfectly flat while at the same time maintaining the desired spacing between the coating and the flat grid strips.

The above described precision cathode subassembly 25 is arranged to be concentrically supported within a cylindrical metal member 35 having a cylindrical wall 36. The forward end of member 35 is bent at right angles to form a flat annular flange 37 forming a central window 38. Wall 36 adjacent the forward end of member 35 is provided with diametrically opposite cutouts or windows 39, 40 (see Fig. 8) through which are arranged to be radially inserted a pair of flat metal control grid strips 41, 42. These grid strips lie flat against the precision-ground face 28H of member 28C, it being understood that the cutouts 39 are deep enough on the wall of member 36 so that the grid strips 41, 42 are out of electrical contact with member 36. Each of the grid strips has a right-angled bent-back portion 43, 44, to which respective flexible metal connector strips 45, 46, can be welded, these flexible strips in turn being welded at their opposite ends to respective control grid lead-ins sealed vacuum-tight through the glass header 13.

As shown in the greatly enlarged partial view of Fig. 7 and Fig. 8, the control grid strip 41 has a grid aperture 49 through which beam 17 passes for intensity control. Likewise, grid strip 42 has a grid aperture 50 through which the beam 18 passes. Each grid aperture is located close to the edge of its strip so that the distance between the center lines of the two grid openings is approximately .026 inch. Likewise, when the grid strips are finally assembled in place, their adjacent edges are spaced apart by a minute gap 53, for example of from .0015 to .005 inch. It has been found that this small gap enables the two grids to be insulatingly spaced from each other, and yet it is of sufficient narrowness to provide an effective barrier against the passage of electrons therethrough.

However, it has been found necessary to design the insulated parts which contact the grid and the cathode so that the possibility of conductive current leakage between the grid and cathode is substantially eliminated. Furthermore, it is necessary to maintain the strips 41, 42 free from mechanical distortion and with a minimum spacing between the grids and cathode. In order to insulate and at the same time to space the control grid strips 41, 42, from the next adjacent dual beam convergence and inter-beam shielding electrode 55, there is provided a flat mica insulator ring 56 having a thickness of .005–.010 inch. Ring 56 has a central enlarged circular opening 57 provided with diametrically opposite slots 58, 59, and is assembled in place so that slots 58, 59, overlie the gap 53, the said slots being substantially wider than the gap 53, thus reducing the likelihood of leakage across that gap. From the foregoing it will be seen that the spacing between the composite electrode 55 and the flat control grids is only a small fraction of the distance between the center lines of the respective grid openings. Because of this substantial difference in relative spacings it is possible for the electrode 55 to act as an electrostatic shield whereby variations in potential of one grid do not cause any modulation of the beam passing through the other grid.

The composite beam convergence and inter-beam shielding electrode 55 is arranged to seat against the inside face of flange 37, and therefore the outside diameter of electrode 55 closely fits the inside diameter of cylinder 36. As shown more clearly in the sectional view of Figs. 2 and 7, electrode 55 has a thickness which is many times greater than the thickness of the grid strips and of the insulator spacers and also is many times thicker than the thickness of face 37 of member 35. Thus, electrode 55, in addition to performing the various electric functions to be described, also acts as a solid backing or stiffener for the entire gun. Preferably, the forward marginal edge 60 is roundly chamfered to fit snugly within the corresponding curved inner edge 61 of member 35.

The central part of the forward face of electrode 55 is formed with a circular recess 62 having a depth of approximately .02 inch. The unrecessed thickness of electrode 55 is provided with two spaced openings 63, 64, symmetrically located on opposite sides of the center line of the electrode, these two openings being spaced by the unperforated central portion 65. Openings 63, 64, are spaced apart on centers a distance which is the same as the spacing between the centers of control grid openings 49, 50. Similarly, the openings 63, 64, each has a cylindrical portion and a forward frusto-conical portion. The two beams 17, 18, which emerge through the respective grid openings 49 and 50, would ordinarily diverge away from the central longitudinal axis of the gun. However, by choosing a suitable diameter and

depth for the recess **62**, and by choosing a suitable thickness for the insulator spacer **56**, and by applying the proper potential to electrode **55**, that electrode acts as a convergence electrode for the beams. This causes the beams after they leave their respective control grid apertures to be subjected to a converging action. In the absence of such a convergence electrode, the beams after leaving their respective and closely spaced grid apertures would diverge. These unexpected and novel results are obtained by locating the said composite shielding and convergence electrode **55** in a region extremely close to the control grids and by applying to that composite electrode a potential which is substantially the same as the inherent field position potential at that region. In other words, the composite electrode **55** acts as an electrostatic shield between the two dual grids while at the same time it acts to converge the emergent beams, and without drawing any beam current, and without exerting any focusing or defocusing action on the beams. Thus, the two beams maintain their accurate spaced trajectories so that they can be focused by a common focusing yoke **19** on to the fluorescent screen with the same spacing regardless of the portion of the fluorescent screen **20** scanned by the beams. Furthermore, while electrode **55** acts as a single or common convergence electrode to maintain the desired spacing between the two focused beams, it also acts through its central unperforated portion **65** as an electrostatic shield to prevent cross-modulation between the two beams. It has been found that in the absence of this central portion **65**, the two beams may undesirably cross-modulate each other when used in certain types of circuits. To achieve this shielding action, it is desirable that the convergence electrode **55** be extremely close to the grid openings **49**, **50**, and this also minimizes the beam current drawn by it. Also the electrode **55** is preferably maintained at a potential substantially the same as that of the region in the anode-cathode field in which it is located, so that the configuration of the equi-potential lines is not substantially altered by its presence, and it does not exert any substantial focusing or defocusing action on the beam. More particularly the face of electrode **55** confronting the cathode **27** is preferably kept at this potential.

By providing the ceramic member **28C** with integral flanges **28G**, **28H**, the flanges can be used as a thrust receiving member to hold the electrodes in their clamped stacked array. Furthermore, I have found that with this particular construction it is possible to assemble the flat grid strips **41**, **42** in direct contact with the upper flat lap-ground face of member **28C** thus avoiding the use of a separate mica ring for that purpose. I have found that the use of such mica rings between such closely gauged electrodes, as between the cathode emission surface and the flat grids, is undesirable not only because of the tendency of the mica to flake and crack but also because the mica has a smooth surface which may permit lateral slippage between the grid strips when the parts are assembled and fastened in place. By using a lap-ground ceramic flanged member, such as disclosed, it is possible to have a direct metal-to-ceramic contact between the flat grid strips and the ceramic gauging surface, without the danger of grid slippage during assembly or operation of the tube.

Furthermore, by precision lap-grinding of the forward flat surface **68***b* of member **28C**, the desired precise close spacing between the cathode coating and the flat grids **41**, **42**, is permanently maintained. It has been found practical with this arrangement, therefore, to provide a spacing between the cathode and grids of as little as .003 inch plus or minus .0004 inch, while preserving the necessary freedom from deposit leakage.

The manner of assembly of the various parts of the gun is as follows. The single composite beam-convergence, anti-cross-modulation electrode and stiffener element **55** is inserted into member **35** until it seats against flanges **28G**, **28H** and welded in place. Disc **56** is then inserted. The two grid strips **41**, **42** are then inserted from opposite radial directions through windows **39** and **40**. The cathode sub-assembly, including the elements **26**, **27**, **28C**, **28J**, is then inserted into member **35** until the flat face of member **28C** rests against the grid strips. Then the cathode sub-assembly retainer ring **80** is inserted and may be welded to the member **35**.

When the header **13**, which carries the mount including the gun **15** and the anode **16**, is sealed to the lip of the neck portion 6, the bulb is subjected to the usual exhaust, bombarding and gettering processes well known in the art, the exhaustion taking place through a suitable exhaust tubulation (not shown) forming part of the header **13**. This tubulation is in the well known manner sealed off when the processing has been completed. A conductive coating **112** extends internally along the neck **10** and part of the funnel-shaped portion of the bulb and is contacted by the fingers **108** to form a continuation of anode **16**. For a detailed description of how such a tube can be used to reproduce a color subject matter on the screen **20** under control of received tri-color video signals applied to grid **41**, reference may be had to application Serial No. 242,264, filed August 17, 1951.

From the foregoing, it will be seen that there is provided a cathode-ray tube having the desired minuteness of cross section in the transducing beam **17** and in the monitoring or indexing beam **18**, while maintaining the required beam intensity for peak color excitation and also while preserving the fixed space relation between the two beam trajectories without cross beam intermodulation. It has been found that the desired conductive electrical isolation of the extremely close grids is obtained without danger of leakage, and it is possible to reduce the fluorescent spot by as much as five times that obtainable with ordinary cathode-ray guns. Furthermore, these advantages are obtained by using relatively simple electrode structures and assembly operations. It has also been found possible with the tube as disclosed to produce high definition colored television pictures with utmost brilliancy of hues.

While in the foregoing the grid strips **41** and **42** are arranged with the line joining the grid openings parallel to the length of the tri-color strips of screen **20**, it will be understood that those grid openings may be oriented at any other angle with respect to the tri-color strips so long as the grid apertures are maintained in the same plane and are maintained the same distance with respect to the cathode emission surface.

As explained in said application Serial No. 242,264, filed August 17, 1951, the beam **18** acts as an indexing beam which, each time it strikes the secondary emission strips **20***b*, causes a pulse of secondary electrons to be emitted therefrom. This pulse then serves as an indication of the position of the transducing beam **17** with respect to the particular set of tri-color strips being scanned thereby; and this pulse can be used to overcome any non-homogeneity or non-linearity in the horizontal deflection scanning field, or it can be used to overcome any non-uniformity in the width of the color strips. This indexing pulse can also be used as described in said application Serial No. 242,264, filed August 17, 1951, to compare the time phase relation between the received tri-color video signals and the special phase between the transducing beam **17** and the respective tri-color strips which it is scanning.

The metal coating **20***a* for screen **20** extends beyond the margin of that screen and is provided with a suitable external metal contact button **114** for connection to a suitable potential tap on a direct current power supply. For example, that tap may be approximately 25 kilovolts.

The anode coating **112** is likewise provided with an external contact button **120** which is connected to a suitable tap, for example of 30 kilovolts. The negative terminal of the direct current source may be connected

to the cathode sleeve **26** and grounded. The control grids **41** and **42** may be suitably biased with respect to the cathode **26**, for example to potentials in a range from 75 to 200 volts. The composite shielding and convergence electrode **55** can be connected to a suitable potential tap, for example of 600 volts, corresponding, as hereinabove mentioned, to the potential of the region of the anode-cathode field in which it is located. The screen **20** is coupled through a suitable coupling condenser to suitable indexing circuits from which indexing signals are derived and supplied to color signal control circuits to control the application of color signals from the tricolor signal source to grid **41** as described in the above identified application Serial No. 242,264, filed August 17, 1951.

As described in said application Serial No. 242,264, grid **42** is supplied with a high frequency modulating signal from any suitable index beam control circuits.

By this arrangement it is possible, therefore, to keep the color transducing beam **17** and the monitoring beam **18** always at the proper spacing and with the desired minuteness of spot size on the screen **20**, and accuracy of registration between the transducing beam **17** and the correct color strip is assured at all times.

Various changes and modifications may be made in the disclosed embodiments without departing from the spirit and scope of the invention.

What is claimed is:

1. A precision cathode assembly unit for an electron gun and the like, comprising a tubular cathode sleeve, insulator means to which said sleeve is anchored, said insulator means including a first insulator member having a base with an upstanding wall, a second separate insulator member seated within the first member and defining therewith a shadowed region extending around the inner periphery of the first member to prevent the formation of a complete conductive path which tends to result from material deposited from the cathode sleeve when heated, each of said members having a central aperture through which said sleeve passes, and means to anchor said members and sleeve together as a rigid unit.

2. A precision cathode assembly unit for an electron gun and the like, comprising a tubular cathode sleeve, ceramic means in which said sleeve is anchored, said ceramic means including a first ceramic member having a base with a substantially cylindrical wall, a second and separate ceramic member seated within the first member, at least one opening in the said cylindrical wall to provide radial access to said sleeve, means forming part of said second member and located in said opening to protect said wall against the formation of a complete conductive path which tends to result from material evaporated from the cathode sleeve when heated.

3. A precision cathode assembly unit for an electron gun and the like, comprising a tubular cathode sleeve, insulator means in which said sleeve is centrally anchored, said insulator means comprising a first ceramic member having a cylindrical wall with a pair of slots to provide radial access to said sleeve, and a second ceramic member having a central circular portion with a pair of radially extending arms located within said slots, the said central portion of said second ceramic member being of smaller diameter than the internal diameter of said wall.

4. Precision spacer and insulator means for a tubular metallic electrode comprising a first ceramic member having a base with a cylindrical wall, a pair of slots in said wall, and a second ceramic member seated within the first member and having a pair of integral arms each located within one of said slots for keying the two members together while providing a shadowed region extending around the inner periphery of said first member.

5. A precision cathode assembly unit for electron guns and the like, comprising a tubular metallic electrode, first and second ceramic members through which said tubular electrode passes, the first ceramic member having a base with an upstanding wall, the upper end of which is precision ground, said wall having at least one slot therein, the second ceramic member being seated within the first member, said second ceramic member having an integral extension located within said slot but spaced from the sides thereof, said second member having a central section which is spaced from the inner periphery of said wall to form therewith a shadowed region extending therearound, said precision ground upper end of the first member serving as a precision reference level for the end of said sleeve with respect to another electrode.

6. A precision cathode assembly unit for electron guns and the like, comprising a tubular cathode having a cap at one end coated with electron emissive material, a pair of insulator members the first one of which has a base with an integral cylindrical wall, the second member of said pair being preformed as a separate unit and being seated within the first member to provide a shadowed region extending around the inner surface of said wall, each of said members having aligned central openings to receive said sleeve and with the said cap recessed below the upper end of said wall, said upper end being precision ground to provide a precision flat reference level for gauging the spacing between said cap and an adjacent electrode.

7. A cathode assembly unit according to claim 6, in which said first member has a pair of oppositely located slots in its cylindrical wall, and said second member has a central annular portion with radially extending arms that are located within said slots but in spaced relation to the slot walls, the undersurface of said second member being undercut to porvide an annular shadowing gap between it and the base of the first member.

8. An electron gun comprising a strip-like electrode having a flat portion with a beam defining opening therein, a tubular cathode sleeve having one end coated with electron emissive material said end arranged to be located in precise closely spaced relation to said flat portion of said electrode, insulator means forming an integral unit with said cathode sleeve for maintaining said closely spaced relation, said insulator means comprising a first ceramic member having a cylindrical wall and base with the base having a central aperture through which said sleeve passes, a second and separate ceramic member cooperating with the first member to provide a shadowed region on the inner surface of the first member to protect said surface against the formation of a complete conductive path of material evaporated from said sleeve, the upper face of said wall being precision ground flat, and means to anchor said sleeve and both of said members together as a unit with the end of said sleeve recessed below said ground surface, and means to clamp said flat portion of said electrode in direct contact against said precision ground flat surface.

9. A dual beam electron gun comprising a pair of electrodes each having a flat portion with a beam-defining opening adjacent one end, said electrodes arranged to be held in coplanar relation with their said ends in closely gapped relation, a tubular cathode sleeve having a cap at one end arranged to be held in closely spaced relation to said flat portions of said electrodes, a first ceramic member having a base with an upstanding wall the upper face of which is precision ground flat, a second separate ceramic member seated within the first member, said sleeve passing through aligned central openings in both said members, means rigidly anchoring said sleeve to form a cathode unit with said members, said second member having an annular central portion which is of smaller dimension than the inner dimension of said wall to provide an anti-deposition shadowed region therearound, and means to clamp both said pair of metal electrodes with their flat portions in direct contact against said precision ground flat surface.

10. A dual beam electron gun according to claim 9

in which said cathode sleeve has a cap telescoped over the upper end thereof, said cap carrying electron emissive material which is to be maintained in accurately gauged spacing below the said precision ground flat surface, said first ceramic member having at least one opening in said wall in alignment with said cap to provide lateral access to said cap and to block off the formation of a continuous leakage path between said pair of electrodes.

11. A dual beam electron gun according to claim 9 in which the means to clamp said pair of electrodes with their flat portions in contact against said ground flat surface includes a double beam convergence electrode having a pair of beam converging openings in alignment respectively with the beam defining openings in said pair of electrodes, an insulation spacer between said convergence electrode and said pair of electrodes, a cylindrical metal member having a portion at one end against which said convergence electrode is seated, and a retainer ring within the opposite end of said cylindrical member for centering said cathode unit and for holding said cathode unit, and said convergence electrode and said insulator spacer against said portion of said cylindrical member.

12. A precision dual beam electron gun for cathode-ray tubes and the like, comprising a cathode sub-assembly unit consisting of a tubular cathode sleeve, a first ceramic member having a base with an integral cylindrical wall, a second ceramic member seated within

the first member and having projections which are in registry with corresponding openings in said cylindrical wall, said ceramic members having their dimensions correlated to provide an anti-deposition shadowed region extending around the inner surface of the first member; a pair of flat metal electrodes each of which lies flat against the upper end of said wall which upper end is precision ground to provide a reference level for said electrodes with respect to the end of said cathode sleeve, said flat metal electrodes being pressed against said ground end with the ends of the said metal electrodes being in minute closely spaced relation to provide an electron barrier gap therebetween and each electrode having a minute beam defining opening closely adjacent the edges of said gap.

13. A precision dual beam electron gun according to claim 12 in which the said upper end of said first ceramic is provided with integral radially extending flanged surface to provide an extended flat precision ground surface against which said flat electrodes are seated.

References Cited in the file of this patent

UNITED STATES PATENTS

1,159,307	White	Nov. 2, 1915
2,146,365	Batchelor	Feb. 7, 1939
2,244,358	Ewald	June 3, 1941
2,507,979	Kelar	May 16, 1950
2,641,727	Pohle	June 9, 1953