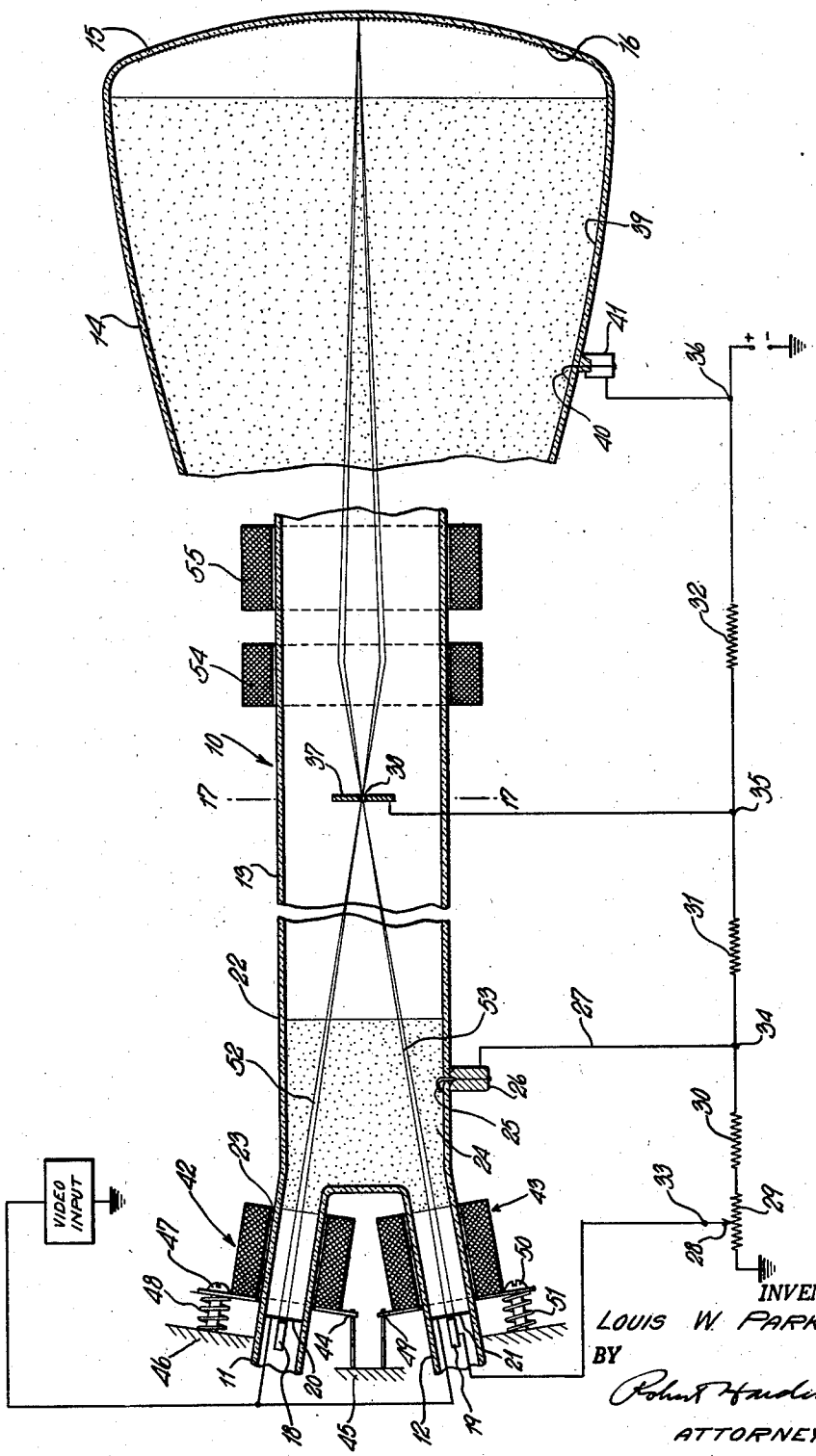
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PROJECTION CATHODE-RAY TUBE

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PROJECTION CATHODE-RAY TUBE

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This invention relates to cathode-ray tubes and more particularly to such tubes which are to be used as high intensity fluorescent light sources.

A principal object of the invention is to provide a novel construction of cathode-ray tube for image projection purposes.

Another object is to provide a cathode-ray tube of high fluorescent light intensity by employing a special multiple electron gun construction for developing a high current density in the final cathode-ray beam without correspondingly increasing the second anode voltage, or without correspondingly increasing the electron velocity at the screen.

A further object is to provide a fluorescent image projection tube wherein a plurality of electron guns are mounted and correlated with a common electron baffle electrode to produce what may be termed a single composite virtual cathode of elemental beam cross-section.

A feature of the invention relates to a cathode-ray tube having a plurality of similar electron guns which develop independent beams that converge at a common plane where an apertured electron baffle electrode is provided to produce a composite virtual cathode of elemental cross-section. The electron image at this baffle is then acted upon by a magnetic lens system to produce a focussed image thereof on the fluorescent screen of the cathode-ray tube.

Another feature relates to the novel organization and location of parts which cooperate to provide an improved cathode-ray tube for the direct projection of fluorescent images, such for example as in television projection tubes and the like.

Other features and advantages will be apparent after a consideration of the following detailed descriptions and the appended claims.

Referring to the drawing which shows in structural schematic and circuit form one preferred embodiment, there is illustrated an evacuated envelope 10 of glass or other material such as customarily employed in cathode-ray tube construction. This envelope comprises a plurality of diverging neck portions 11, 12, which join a common substantially cylindrical or tubular body portion 13. Portion 13 joins an enlarged or bulbous portion 14 which is closed by the usual flattened window portion 15. Window 15 is coated interiorly with a layer 16 of any well-known fluorescent material which emits fluorescent light when bombarded by cathode rays.

Preferably, the neck portions 11 and 12 are each arranged at an acute angle with respect to

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the central longitudinal axis of the envelope, so that the central longitudinal axis of these necks intersect at the plane 17—17. Suitably supported within each neck is an electron-emitting cathode 18, 19, which is of any well-known type used in cathode-ray tubes and comprising for example a tubular metal sleeve within which is insulatingly supported a heater filament or coil. The end of each sleeve facing the screen 16 is coated with electron-emissive material to develop a beam of electrons when the associated sleeve is raised to a suitable temperature. Adjacent each cathode is an apertured control electrode 20, 21, which electrodes are arranged to be excited in parallel with variable signals, such for example as those received from the video amplifier of any well-known television receiver.

The internal surface of the envelope between the point 22 and point 23, is coated with a conductive paint such for example as "Aquadag" or colloidal graphite 24, which is contacted by a lead-in wire 25, sealed through the wall of the envelope and provided externally with a metal connector cap 26. Cap 26 is connected by conductor 27 to a predetermined point, for example +1000 volts D. C. in a suitable source of D. C. supply. The cathodes 18 and 19 can be suitably biased positively with respect to the grounded end of the D. C. source by a potentiometer slider arm 28, and the voltage divider resistor 29. It will be observed that a suitable source of D. C. potential, e. g. 8000 volts, is connected across resistors 29, 30, 31, 32 in series, so that the point 33 can be given any desirable bias, for example from 0 to 50 volts. The points 34, 35 and 36 are then respectively at approximately +1000 volts, +1500 volts and +8000 volts. In the well-known manner, the coating 24 acts as the first or accelerating anode which is common to the two cathode-ray beams emitted from the cathode sleeves 18 and 19.

Suitably mounted within the portion 13 of the envelope and at the plane 17—17, is a metal baffle electrode 37, which has a central opening 38, located on the central longitudinal axis of the tube. This baffle 37 is connected to the point 35 which is approximately 500 volts higher in positive potential than the coating 24. The bulb portion 14 of the tube is provided on its interior with a conductive coating 39 similar to coating 27, and this coating is connected through a suitable lead-in wire 40, to an external contact cap 41, which is connected to the 8000 volt potential tap 36.

The tube is mounted in a suitable support (not shown). Surrounding the neck portion 11

is any well-known form of magnetic beam focussing unit 42. Likewise, surrounding the neck portion 12 is a similar beam focusing unit 43. These units 42 and 43 are adjustably mounted so as to change the orientation of the focussing magnetic field within the respective neck of the tube and thereby correspondingly control the trajectory of the focussed beam from the respective cathode in such a way that the two beams converge and are focussed at the baffle opening 38. One particular manner of providing this adjustability is illustrated in the drawing. For example, the device 42 may consist of the usual electromagnetic focussing coil which is pivotally supported for example at point 44 on a suitable rigid support 45, and the opposite side of the coil is adjustably supported from a corresponding fixed support 46, through the intermediary of an adjusting screw 47, and a compression spring 48. Thus by turning screw 47 the orientation of the focusing coil 42 with respect to the central longitudinal axis of the neck 11, can be readily arranged. Likewise, the focussing unit 43 is pivotally supported at a point 49 and is provided on the opposite side with an adjusting screw 50 and a corresponding compression spring 51. In order to facilitate the focussing of the two beams 52, 53 at the opening 38, the side of baffle 37 facing the cathodes 18 and 19, is coated with fluorescent material. The screws 47 and 50 are adjusted so that the portion of each of the beams which strikes the baffle 37 is at a minimum. In the well-known manner, the current through the windings of the focussing coils 42 and 43 can be adjusted to obtain an accurate focus of the beams 52 and 53 at the opening 38. The invention is not limited to an adjustment wherein the cross-section of the converging beams at the plane 17 is less than the size of the opening 38. If the two beams are improperly focussed, this will result merely in a lowering of the brilliancy of the picture on the screen 16, but will not affect its sharpness. This result is obtainable by reason of the fact that the intersecting beams form in effect a virtual cathode at the opening 38, and the size or cross-section of this virtual cathode is fixed by the size of the opening 38 regardless of the degree of focussing by units 42 and 43. Located between the member 37 and the screen 16 is any well-known form of magnetic field producing device 54, which acts as an electron lens to form on the screen 16 an image of the virtual cathode at the opening 38. Also located between the magnetic lens 54 and the screen 16 is any well-known form of beam-deflecting arrangement 55 for deflecting the beam in coordinate directions so as to scan the screen 16 in the conventional manner. Instead of using electromagnetic focussing coil units 42 and 43, each of these units may consist of permanent magnets.

While the drawing shows a tube having two separate electron guns for producing the intersecting and converging cathode-ray beams, it will be understood that a greater number of such guns may be employed. For example, if six guns are employed, the tubular body portion 10 will terminate in six separate neck portions similar to portions 11 and 12, all these portions being symmetrically arranged around the longitudinal central axis of the tube so that each gun produces an individual cathode-ray beam which is focussed at the opening 38 to produce the desired composite virtual cathode thereat.

The above described arrangement has the advantage that it is possible to obtain an almost unlimited quantity of electrons from the virtual cathode at the opening 38. According to known theory, the maximum emission from the usual oxide cathode is two milliamperes per square millimeter. Since in the usual cathode-ray tube, the maximum size of the cathode area is limited to ¼ square millimeters, only about ½ milliampere is available for cathode current, and the actual beam current may be even less. On the other hand, the brilliancy of the scanning spot on the screen 16 is determined by the watts of power dissipated on it by the beam. To obtain as much as 10 watts dissipation on the screen of the usual projection type cathode-ray tube. it is necessary to use as much as 30 kilovolts and about 330 microamperes beam current. With the arrangement above described, the voltage applied to the coating 39 may be reduced to 25% of its usual value, for example 8000 volts D. C., and the beam current can be increased, depending upon the number of separate guns that are employed for producing the single virtual cathode above described. Probably the maximum beam current at which well-known saturation effects can be neglected, is about 2 milliamperes with 8000 volts electron velocity at the screen. A practical value would be 8000 volts electron velocity and 1.2 milliamperes beam current. This value is not difficult to obtain and produces the same brilliancy as other projection type tubes which require 30 kilovolts for the second anode potential.

While one particular embodiment has been described herein, it will be understood that various changes and modifications may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A cathode-ray tube comprising an envelope having a fluorescent screen, a plurality of electron guns for developing respective electron beams, an electron baffle electrode having a central opening symmetrically disposed with respect to said beams, and having a focus-indicator surface facing said guns which is coated with fluorescent material to fluoresce when said beams impinge thereon, means to focus said beams at said opening to form a virtual composite cathode thereat, and an electron lens for forming on said screen an image of said composite virtual cathode.

2. A cathode-ray tube comprising an envelope having a fluorescent screen, a plurality of electron guns for developing respective electron beams, a common electron baffle electrode for said beams, said baffle having a focus-indicator surface facing said guns which is coated with fluorescent material to fluoresce when said beams impinge thereon, separate forcussing means for said beams, means to adjust said focussing means to focus said beams at the electron opening in said baffle, and a magnetic lens for imaging on said screen the composite electron beam as it passes said baffle opening.

3. A cathode-ray tube comprising an envelope having a fluorescent screen, said envelope having a plurality of diverging neck portions, an electron gun located in each neck portion to produce respective electron beams whose trajectories cross-over at a point between the guns and the screen, an apertured electron baffle electrode having its aperture located at said cross-over point and energized to produce a composite virtual cathode at said aperture, said baffle having a focus-indi-

cator surface facing said guns which is coated with fluorescent material to fluoresce when said beams impinge thereon, and an electron lens for imaging upon said screen the said composite virtual cathode.

4. A cathode-ray tube comprising an envelope having a fluorescent screen, said envelope having a plurality of diverging neck portions, an electron gun located in each neck portion to produce respective electron beams whose trajectories cross-over at a point between the guns and the screen, first and second accelerating anodes for said guns, an apertured electron baffle electrode located between said anodes and having its aperture located at said cross-over point, said baffle having a focus-indicator surface facing said guns which is coated with fluorescent material to fluoresce when said beams impinge thereon, and an electron lens for imaging upon said

screen the composite electron beam as it passes the baffle aperture.

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