ELECTRON GUN WITH A MULTI-ELEMENT ELECTRON LENS

BACKGROUND OF THE INVENTION

The present invention relates to an electron gun for producing and directing a plurality of electron beams, and more specifically to the means for focusing the beams on a target.

In a conventional color television picture tube having a multiple beam electron gun, each electron beam is passed through a separate electron lens which focuses each beam to a point on the target screen. The lens is essentially an electrostatic field which deflects the individual rays of the electron beam toward a common point as they pass through the lens. This field is normally established between two spaced electrodes positioned transverse to the beam paths. The electrodes have a series of apertures through which the electron beams pass. The characteristics of the lenses may be altered by changing the electrostatic field, which is usually accomplished by varying the voltage between the electrodes, the size of the apertures, the separation distance of the electrodes, or a combination of the above.

In some cases in order to reduce spherical aberration, it is desirable to have a long focal length electron lens. Since the voltage of the focus electrode must be restricted to values which do not cause arcing at the picture tube base, the focal length can most easily be lengthened by increasing the aperture size and/or the electrode spacing. However, if the spacing between the electrodes becomes too large (in excess of about 1.5 mm), the electrostatic focusing field becomes susceptible to interference from other electrostatic fields within the electron gun. Conversely, each focusing field created by the large spacing also interferes with the adjacent electrostatic focusing fields. Ideally therefore, the electron lens should have a relatively large diameter aperture, about 8 mm and a small electrode spacing about 1.5 mm.

The physical design of the electron gun also places several restraints on this configuration. In an in-line electron gun, as shown in U.S. Pat. No. 3,772,554 issued on Nov. 12, 1973 to Richard Hughes, there is a very close spatial relationship between the electron beams. Due to this close relationship, the lens characteristics may be adjusted only by varying the spacing of the electrodes since the aperture size is already maximized. Therefore, in order to duplicate the characteristics of the ideal large aperture lens in an in-line electron gun, the electrode spacing must be several times the maximum tolerable limit of 1.5 mm.

SUMMARY OF THE INVENTION

An electron gun has a control grid electrode, a screen electrode, and two accelerating and focusing electrodes spaced along the electron beam path from a cathode. Between the two accelerating and focusing electrodes is a wide gap. Within the gap are several electrode plates, each having an aperture therethrough aligned with the beam path.

Included within the electron gun is a resistor having two ends each attached to a different accelerating and focusing electrode. The resistor has a series of taps which are connected to the electrode plates.

BRIEF DESCRIPTION OF THE DRAWINGS

In the appended drawings:

FIG. 1 is a side view of the improved electron gun.

FIG. 2 is a top view of the improved electron gun.

FIG. 3 is a sectional view taken on line 3—3 of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

The embodiment of the present invention, as shown in FIGS. 1 to 3, depicts an in-line electron gun; however, the present invention may be used on any geometrical gun configuration employing a wide-gap electron lens.

Refering to FIGS. 1 through 3, an electron gun 10 comprises two parallel glass support rods 28 between which various gun elements are mounted. At one end of the glass support rods 28 are mounted several support straps 14 on which three cathodes 12 are fastened. Following the support straps 14 are a control grid electrode 16, a screen grid electrode 18, a first accelerating and focusing electrode 24, and a second accelerating and focusing electrode 26 mounted in that order. The three cathodes project electron beams along three coplanar beam paths 30. The control grid electrode 16 and screen grid electrode 18 are closely spaced flat metal elements each containing three apertures 17 and 19 respectively, which are aligned with a different beam path 30, as shown in FIG. 3. The first accelerating and focusing electrode 24 is closely spaced from the screen grid electrode 18 and comprises two rectangular shaped cups 20 and 22 joined at their open ends. The closed ends of cups 20 and 22 each have three apertures such that each aperture is aligned with a different beam path 30. The apertures 21 in first cup 20 are larger than those in screen grid electrode 18 and the apertures 32, 34, and 36 in the second cup 22 are slightly larger than those in first cup 20.

Spaced from first electrode 24 is the second accelerating and focusing electrode 26 in the shape of a rectangular cup having a base 27. The base 27 faces toward the first electrode 24 and has three apertures 38, 39, and 40, preferably slightly larger than the apertures of the second cup 22. Middle aperture 39 is aligned with middle aperture 34 in the second cup 22. The two outer apertures 38 and 40 are slightly offset outwardly with respect to the corresponding aperture 32 or 36 respectively, in second cup 22. A shield cup 42 with a base 43 is attached to the second electrode 26 so that the base covers the open end of the second electrode. The shield cup 42 has three apertures 41 through its base 43, each aligned with one of the beam paths 30. The shield cup 42 also has three bulb spacers 44 attached to and extending from its open end.

Six metal plates 46 are mounted on the glass support rods 28 between the first electrode 24 and the second electrode 26 so that the spacing between each pair of plates does not exceed 1.5 mm. Each of said plates 46 includes three apertures 48 approximately equal in size to the apertures 32, 34, and 36 in the second cup 22. Each aperture 48 is aligned with a separate beam path 30. A resistor 50 is mounted on one of the glass support rods 28, adjacent to the position of the plates 46. Resistor 50 is a thin cermet film 49 deposited on a substrate 51 which is bonded to one of the glass support rods 28. In order to operate within the cathode ray tube, the resistor 50 must have a very small temperature coefficient of resistivity and must be able