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ELECTRON GUN STRUCTURE

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Fig. 1.

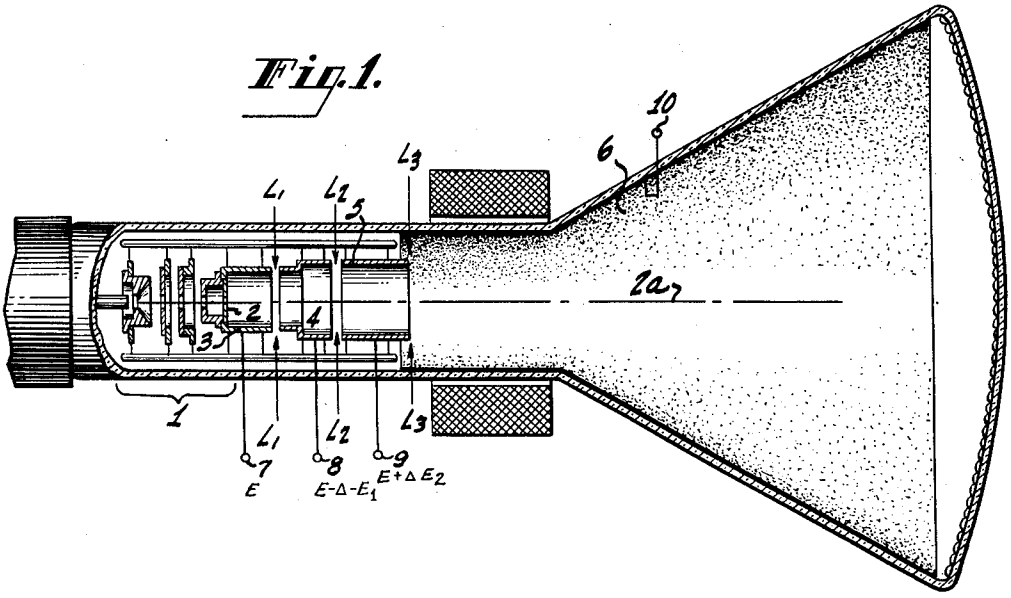
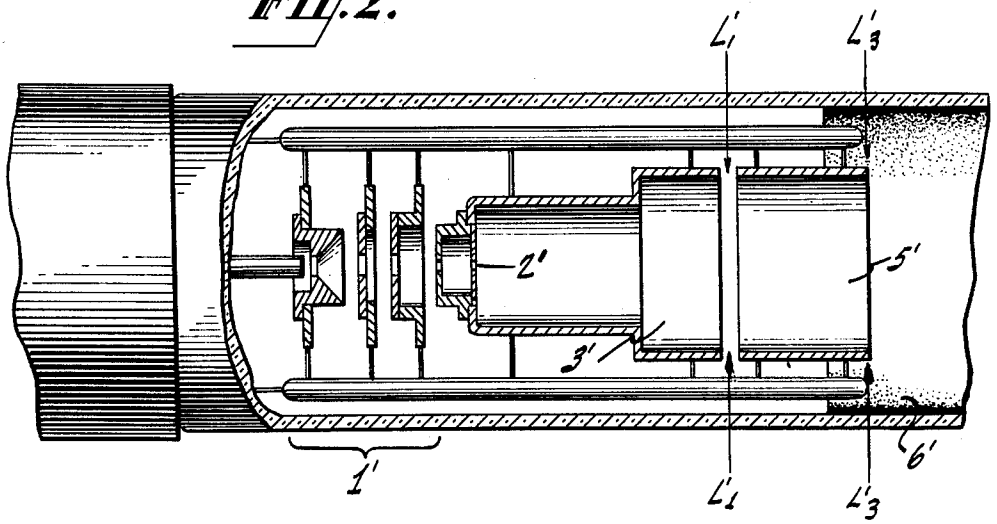


Fig. 2.



INVENTOR:
RONALD C. KNECHTLI

BY
William A. Zaleusk
ATTORNEY

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ELECTRON GUN STRUCTURE

Ronald C. Knechtli, Cranbury, N.J., assignor to Radio Corporation of America, a corporation of Delaware

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2 Claims. (Cl. 315—15)

This invention relates to cathode ray tubes or kinescopes, and it has for its object to provide a novel and improved means for obtaining a high focusing sensitivity in such tubes.

Another object of the invention is to provide a video-focusing system for electron guns in which the amplitude of the voltage required for focusing does not exceed the amplitude of the modulation voltage of the gun.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

The invention is useful in any cathode ray tube or kinescope where high current within a small spot of constant size is required, for example in a single beam line-screen color kinescope.

The spot on the screen of a cathode ray tube or kinescope is an electron optical image of a definite cross-section of the electron beam. In order to obtain a small spot, this cross-section, called the "object," is usually made as small as possible. In conventional electron guns, the "object" is a low voltage cross-over whose size and position are functions of the current; hence, for given adjustment of the imaging system (constant focusing) the spot size is a function of the current. For small currents (of the order of 100 μa. or less) this effect usually is negligible; for higher currents, it becomes important since at high currents space charge produces a defocusing of the beam which results in a variation of spot-size with current.

In high voltage object-defining aperture guns of the type illustrated in the two figures of the drawing the "object" is a cross-section of the beam defined by a small object-defining aperture. The size and position of the "object" are independent of currents; therefore up to 500 μa. or even more, the spot size is practically independent of current. For higher currents, however, even in guns of this type the spot size varies with current when the focusing voltages are kept constant; the effect of space charge with increasing current is indeed equivalent to a weakening of the imaging electron lenses.

By readjustment of the electron lenses, i.e. by making them stronger with increasing beam current, the above effect can be compensated and the spot size kept constant. The present invention provides a system in which this readjustment (video-focusing) is accomplished with a video-focusing voltage whose amplitude does not exceed the amplitude of the modulation voltage of the gun. A feature of the system resides in the provision of an additional focusing electrode designed to produce considerable changes of focusing through small changes of its potential. According to the invention, the same signal may be used for the modulation and for the video-focusing of the tube, and little additional expense is required for the video-focusing. Furthermore, constant spot size is obtained up to the highest current delivered by the gun.

The invention is described more in detail in connection with the accompanying single sheet of drawings, in which:

Fig. 1 is a diagrammatic illustration of a cathode ray tube or kinescope having a video-focusing system embodying the present invention; and

Fig. 2 is a corresponding view of a similar tube without said video-focusing system, and which, in the following description, is used for purposes of comparison with the tube of Fig. 1.

The cathode ray tube illustrated diagrammatically in Fig. 1 comprises an object forming system 1, an object-defining aperture 2 from which the electron beam emerges, a first electron lens L_1 consisitng of the electrodes 3 and 4, a second electron lens L_2 consisting of the electrodes 4 and 5, and a third electron lens L_3 consisting of the electrodes 5 and 6. Appropriate focusing potentials may be applied to the respecitve electrodes 3 to 6 by means of terminals 7 to 10, respectively, which are shown connected thereto. In the case of electrode 4, provision is made to add in series to the average focusing potential, a control potential which varies along with variations in the intensity of the electron beam. That is, there is superimposed on the voltage of electrode 4 the video modulating voltage in an amount which does not exceed the amplitude of the video modulation voltage applied to the control grid of the gun.

The object forming system 1 functions to reduce the cross-section of the electron beam to such an extent that the beam may pass with an acceptable efficiency through the object-defining aperture 2. The said system also minimizes the spread of the beam passing this aperture.

The coaxial lenses L_1, L_2 and L_3 are designed to reproduce on the phosphor screen of the tube an image of the object-defining aperture 2. Typical operating voltages for the system of Fig. 1 are:

Voltage of object-defining aperture 2 and of electrode 3: $V_3=2.5$ kv.
Voltage of electrode 4: $V_4=2.5-\Delta V$
Voltage of electrode 5: $V_5=8$ kv.
Voltage of electrode 6: $V_6=25$ kv.

$$\Delta V=V_0+V_f$$

V_0=bias voltage of the order of a few hundred volts
V_f=video focusing voltage (of an amplitude $\simeq$ 100 v., e.g.)

The characteristic feature of the present invention is the electrode 4 which I call the "video-focusing electrode." One side of this electrode is part of the electrostatic lens L_1, the other side is part of the lens L_2.

In the absence of video-focusing, only two lenses are required in general for proper imaging of the object-defining apertures on the screen of a kinescope. Such an imaging system is illustrated in Fig. 2 in which the reference characters correspond with those used in Fig. 1 but have "primes" affixed thereto. In this system, some video-focusing could be obtained by varying the potential of the electrode 3', controlling the strength of the lens L_1'. This procedure, however, requires a video focusing voltage of an amplitude too large to be practical.

In the system of Fig. 1, the strength of both lenses L_1 and L_2 is controlled simultaneously by the potential V_4 of the electrode 4. For $V_4<V_3<V_5$, decreasing V_4 increases simultaneously the strength of L_1 and L_2. Hence, the system of Fig. 1 is more sensitive to changes in the focusing voltage V_4 than a system of the type of Fig. 2 is to changes of the focusing voltage of electrode 3'. Application of the same video signals to the focusing electrode 4 as are applied to the control grid of the gun provides considerable changes of focusing through small changes of the potential of electrode 4. Thus, defocusing which would otherwise accompany an increase in beam intensity due to the application of video signals to the control grid of the gun is corrected by the simultane-

ous effect of applying the same control potential to electrode 4. In Fig. 1, the strength of two lenses is controlled simultaneously by the same potential, while in Fig. 2 only one lens is controlled.

It will thus be evident that the invention provides means for obtaining a high focusing sensitivity in a cathode ray tube or kinescope. It may be used to advantage in high current guns, where defocusing caused by space charge calls for video-focusing. This situation arises especially in single beam line-screen kinescopes, where high currents within small spot size are required.

What is claimed is:

1. An electron lens focusing system of the class described, comprising in combination: an electron gun structure having an object-defining aperture formed therein from which an electron beam emerges, a first focusing electrode disposed in proximity to said aperture, a second focusing electrode disposed beyond said first electrode in the direction of travel of said beam and spaced therefrom to define a first electron lens therewith, a third focusing electrode disposed beyond said second electrode in the direction of travel of said beam and spaced therefrom to define a second electron lens therewith, means for maintaining said third, first and second electrodes at focusing potentials which decrease from electrode to electrode in the order named, and means for superimposing on the focusing potential of said second electrode a control potential which varies along with variations in the intensity of said electron beam, whereby defocusing which would otherwise accompany increasing beam intensity is corrected by the simultaneous effect of said control potential on said first and second electron lenses.

2. A focusing system according to claim 1, wherein said electrodes are of circular cross-sectional configuration transversely of said beam and are coaxially arranged.

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