

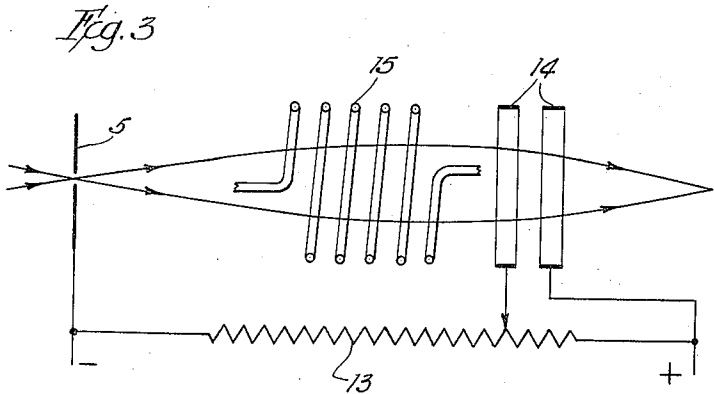
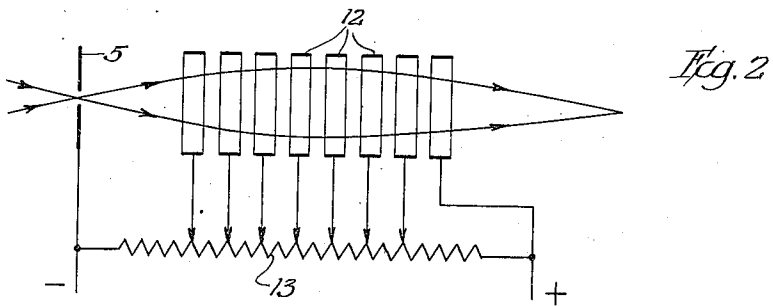
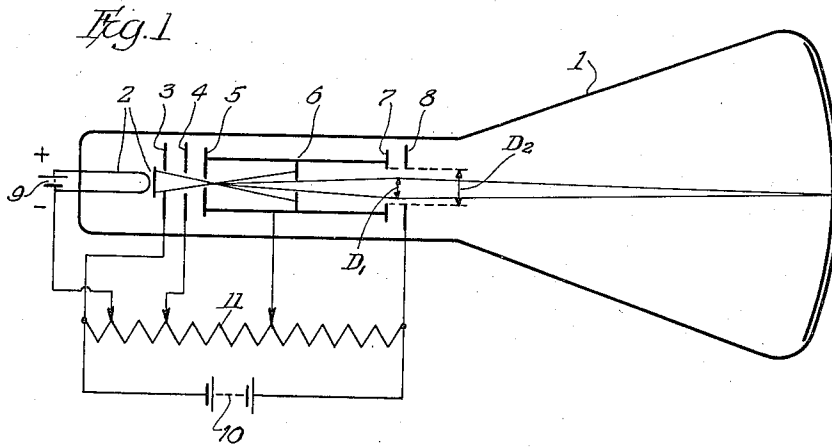
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CATHODE RAY TUBE

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## CATHODE RAY TUBE

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2 Claims. (Cl. 250—27.5)

The invention relates to improvements in cathode ray tubes, in particular Braun tubes.

It is an object of the invention to provide a method and means for reducing the chromatic aberrations of electron lenses used in Braun tubes.

The electrons emitted from a source of electrons possess a characteristic variety of velocities depending upon the manner of their generation.

This inequality of speeds for instance for electrons produced by a glow discharge is different from that produced by an irradiance of the body with light. Corresponding to this variety of speeds the electrons leaving the source at different angles with respect to the optical axis possess different radial speed components. It is now well known, that the focal length of all conventional electric or magnetic condenser lenses is increased when the initial speed of the electrons is increased. This means, however, that at a greater distance from their source those electrons having a high radial speed component are spaced from the optical axis a greater distance than other electrons which leave the source at a comparatively smaller speed. Owing to the above mentioned property of the conventional electric or magnetic lenses, the common point of intersection of all of the paths of those electrons which have a high speed of emission and which owing to their high radial speed component, are emitted from the source at a great angle will be positioned a greater distance from the source than the common point of intersection of all of those paths of the electrons which have a lower initial speed. It is, however, desirable that the paths of all electrons should intersect each other in one point only.

In accordance with the invention this object is obtained by interposing in the path of the electrons a lens having a substantial spheric aberration. Such a lens has the property of refracting the rays which are farther away from the optical axis to a greater degree than those rays which are closer to the optical axis. It is therefore possible to bring the intersecting point of the paths of the electrons having a high initial speed almost to coincidence with the intersecting point of the paths of the electrons having a lower initial speed and to reduce thereby the chromatic error, accomplishing one of the principal objects of the invention.

According to investigations the spheric error will become substantial when the diameter of the electron beam in the plane of the reproducing lens is approximately one half of the diameter

of aperture of said lens or even larger. It is accordingly another object of the invention to provide the lens systems of cathode ray tubes with apertures of relatively small diameter as compared with the diameter of the electron beam.

Another object of the invention is to provide a method and means for adjusting or controlling the degree to which the chromatic error may be reduced. This is accomplished by varying the spheric error of the reproducing lens.

Another object of the invention is to adjust the spheric error to the desired degree, without changing the focal length of the entire system, by providing a plurality of coaxially mounted annular electrodes each of which has applied there- to a tension of such value as is necessary to obtain the desired spheric error.

Still another object of the invention is to provide for the above mentioned purpose a lens system, in which the electron beam passes first through a lens with small spheric error and then through a second lens having an adjustable spheric error.

With these and other objects in view as may appear hereinafter, the invention resides in certain improvements, the novel features of which will be more fully described with reference to the accompanying drawing, in which

Fig. 1 illustrates diagrammatically a Braun tube provided with a spheric non-corrected electron lens for reducing chromatic aberration.

Fig. 2 illustrates diagrammatically a modified arrangement of the spheric non-corrected lens adapted for a Braun tube similar to the one shown in Fig. 1, and

Fig. 3 illustrates diagrammatically another modified arrangement of the spheric non-corrected lens.

Referring to Fig. 1 the vessel 1 of the Braun tube contains an equipment material for the present invention a cathode 2, a control electrode 3, an electric lens 4, the diaphragm 5 and 6, and electric lens 7 and the anode 8. The cathode 2 is heated by a battery 9. A battery 10 supplies the different voltages required for the electrodes and is for this purpose shunted by a potentiometer 11 from which the various taps lead to the respective electrodes. It will be noted that the diameter  $D_1$  of the electron beam, where it passes through the lens 7, is larger than one-half of the diameter  $D_2$  of the aperture of lens 7. Other equipment which may be present in the tube is omitted from the drawing to simplify the illustration.

According to the modification illustrated in

Fig. 2, the electron lens is composed of a number of axially aligned annular electrodes 12. For the sake of clearness this assembly of electrodes only is illustrated as being most important for the present invention. The electron beam may be produced in a manner similar of that of Fig. 1 and passes as indicated by the full lines with the arrows thereon through the diaphragm 5 and into the space immediately behind the same. Then the electron beam passes through the series of axially aligned annular electrodes 12, each electrode having applied thereto a different potential taken from the potentiometer 13. The entire series of electrodes 12 constitutes a spheric non-corrected electron lens whose spheric aberrations may be adjusted by varying the potentials applied to the electrodes without changing the focal length of the entire system.

Fig. 3 illustrates in similar diagrammatic showing an embodiment of the invention in which the reproducing lens system is composed of a principal lens having a small spheric error and an additional lens having substantial spheric errors. The electron beam after having passed through the diaphragm 5, in similar manner as shown in Fig. 1, passes first through a magnetic lens 15 with small spheric aberration and then through an electric lens 14 having a considerable larger spheric error. A magnetic lens having a small spheric error is obtained, as is well known, when the coil diameter is made relatively large and the length of the coil is made relatively short. The electric current for energizing the magnetic lens 15 is supplied in known manner by a battery (not shown). The voltage for the electric lens 14, illustrated by way of example as composed of two axially aligned annular electrodes, are taken from the potentiometer 13. By varying the tap from the potentiometer the spheric error of the lens may be varied as desired within certain limits.

What we claim as our invention is:

1. The method of reducing the chromatic error of electron lenses in Braun tubes, in which the cathode ray beam composed of electrons having differential speeds passes through a spherically non-corrected electron lens having a relatively small aperture with respect to the diameter of the cathode ray beam at the point where the latter passes through the electron lens, including the step of adjusting the potential applied to said electron lens to such a value that the spherical error of the lens becomes substantial to refract the electrodes emitted at higher speed and which tend to move away from the optical axis of the cathode ray beam in such manner that their point of intersection almost coincides with the point of intersection of the other electrons emitted at lower initial speed and which travel closer along the optical axis of said cathode ray beam thereby reducing the chromatic aberration normally caused by the slower speed electrons.

2. The method of reducing the chromatic error of electron lenses in Braun tubes, in which the cathode ray beam composed of electrons having differential speeds passes through a spherically non-corrected electron lens including the step of adjusting the potential applied to said electron lens to such a value that the spherical error of the lens becomes substantial to refract the electrons emitted at higher speed and which tend to move away from the optical axis of the cathode ray beam in such manner that their point of intersection almost coincides with the point of intersection of the other electrons emitted at lower initial speed and which travel closer along the optical axis of said cathode ray beam thereby reducing the chromatic aberration normally caused by the slower speed electrons.

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