Nov. 30, 1937.

K. SCHLESINGER

BRAUN TUBE

Filed Oct. 18, 1933

2,100,701

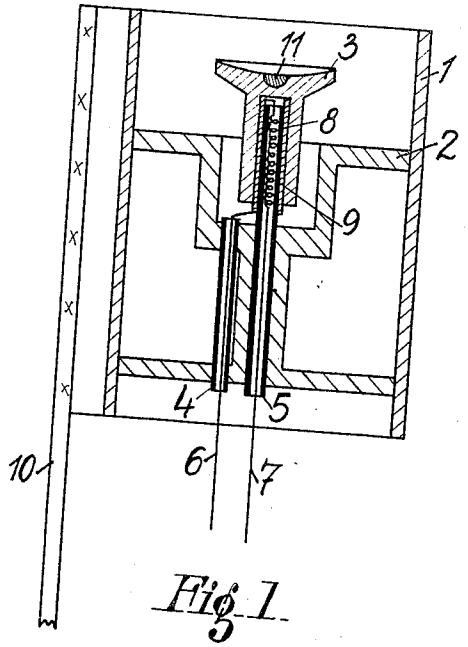

Fig. 1.

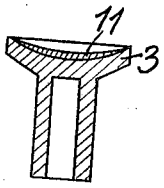

Fig. 3.

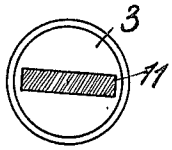

Fig. 4.

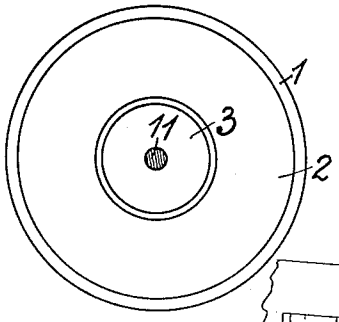

Fig. 2.

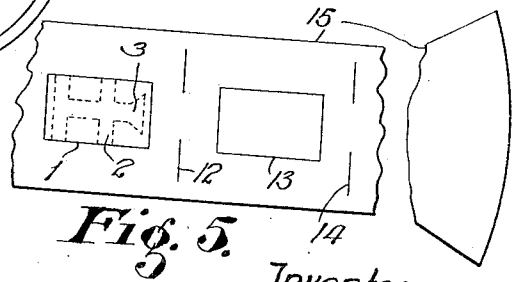

Fig. 5.

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BRAUN TUBE

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8 Claims. (Cl. 250—27.5)

It is known that the effect in connection with Braun tubes known as the lateral pull is produced by errors in the centring of the system, and more particularly by incorrect arrangement of the cathode. It has also already been proposed for overcoming this error to arrange the cathode exactly centrally in relation to the anode aperture. These known arrangements, however, have not proved to be sufficient to overcome the lateral pull defect.

The term "lateral pull defect" means a non-desired effect produced by the control electrode, which consists in that each change in the control voltage causes not only the desired change in the intensity of the cathode ray but simultaneously a non-desired change in the direction of the cathode ray which results in a non-desired displacement of the spot on the fluorescent screen.

The applicant has found that it is not the arrangement of the entire cathode with respect to the anode but the form and size of the emissive coating and its position with respect to the other electrodes and especially with respect to the control electrode which are responsible for the occurrence of this error.

According to the invention, the emissive coating is embodied and arranged symmetrically on the cathode in relation to the axis of the tube, in such fashion that the normal on all lines connecting each two corresponding points of the curve bounding the emissive layer coincides with the axis of the tube. At the same time the size of the emissive coating is such that the emission of all emissive points is covered by the electron optic.

The term "electron-optic" means one electron-optical system or a plurality of electron-optical systems which are provided in the tube for the purpose of producing on the picture receiving screen an image point representing a sharp picture either of the cathode itself or of a suitable aperture which is arranged between the cathode and the electron-optical system and acts as the proper cathode of the tube.

The electron-optical system of television tubes—which may consist, for example, of Wehnelt cylinder, preliminary or screening anode, second cylinder and after-acceleration anode, the preliminary anode being positive in relation to the Wehnelt cylinder, the second cylinder weakly negative in relation to the screening anode, and the after-acceleration anode possesses the highest positive potential occurring—possesses in practice a relatively small aperture of, for example, approximately 10°, i. e., it is not able to concentrate rays which form with the system axis an angle of more than 10°.

According, therefore, to the invention, the emissive coating is embodied in such fashion that none of the output normals possesses in relation to the axis of the tube an inclination which is greater than the aperture of the electron-optical system employed.

It has been found to be particularly convenient to select the curvature of the emissive coating with consideration to the curvature possessed by the level "0" shortly before reaching the surface of the cathode, viz., to select the curvature of the emissive surface to be equal to or greater than the curvature of the said level in the stated position.

The term "level '0'" means the curved plane connecting all of the points in the vicinity of the cathode, the potential of which is zero. The position and the curvature of this plane is defined by the potentials of the cathode and of the control electrode and by the arrangement of these electrodes with respect to one another and to the anode. The position and curvature of the lever "0" changes in correspondence with the changes of the control potential applied to the control electrode in such a way, that it moves the more in the direction to the cathode surface the more positive the control electrode becomes, until at last it coincides with the emissive surface.

By adopting the measure according to the invention when producing cathodes it is possible to produce tubes, which are absolutely free of lateral pull, and in which lateral pull does not take place even when the cathode has become partially aged.

A form of embodiment of the cathode according to the invention is illustrated by way of example in the drawing, in which

Fig. 1 is a section through the complete cathode arrangement.

Fig. 2 is a plan view of the same arrangement, whilst in

Fig. 3 there is shown a particular form of embodiment of the cathode member, and in

Fig. 4 a plan view of this member.

Fig. 5 is a diagrammatic sectional elevation of a cathode ray tube comprising a cathode arrangement according to the invention.

In the drawing 1 is the Wehnelt cylinder, which is centered in such fashion by means of the holder 10 that its axis coincides with the axis of the tube. In this Wehnelt cylinder there is fitted a pot 2, which serves for exact centring of the cathode system in the Wehnelt cylinder, and

accordingly (said Wehnelt cylinder being exactly centralized with respect to the tube axis and therefore also with respect to the other electrodes) in the Braun tube. The leads 6 and 7 for the filament 8 are passed through tubes 4 and 5 composed of ceramic material. The tube 5 carries at its upper end projecting out of the pot a nickel tube 9, which acts as return line for the heating current and carries the metallic, preferably nickel cathode member 3. The sleeve-like cathode member 3 is made in the form of a hollow reflector at its upper, preferably widened end, the centre of curvature being disposed on the axis of the tube between the centre point of the anode (12 in Fig. 5) and the surface bounding the cathode member vertically to the axis of the tube. The emissive substance, for example an alkaline earth oxide or a mixture of alkaline earth metal oxides and alkaline earth metals, may be applied to the surface of the hollow reflector by painting or the like. It has been found, however, that in this manner exact confinement of the emissive surface is not to be obtained. According, therefore, to the invention, the surface in the hollow reflector intended for reception of the emissive substance is produced by corning, engraving, milling or the like, and the recess formed in this fashion is filled out with the emissive substance. After the filling in and drying of the emissive substance the surface, if necessary, may again be polished, so that the emissive substance itself forms part of the hollow reflector, and is contained solely in the recesses provided for the same, which recesses possess an exactly pre-determined form. In this manner it is possible to give the emissive surface an exactly defined predetermined shape.

It is particularly convenient to produce in the surface of the hollow-reflector, for example by milling, an elongated slot, which may possess, for example, the dimensions of .5–1 mm. in width and 2–3 mm. in length, and the greatest extension of which is disposed vertically to the line direction. When employing cathodes of this nature it is possible to produce points of corresponding rod-like form, which for the first time permit of the production of a line screen, the single lines of which are disposed in close proximity to one another without intermediate spacings.

A cathode of this type is illustrated in Figs. 3 and 4. The emissive substance is provided in the preliminarily engraved or milled slot 11, in such fashion that the emissive surface possesses the requisite curvature according to the invention, and that no additional emissive centres of any kind are present outside of this emissive surface.

In the form of embodiment according to Fig. 1 the emissive substance is represented as grain point 11.

The embodiment of the cathode with the massive metallic cathode body 3 according to the invention prevents in reliable fashion a variation in the form of the emissive surface upon the assembly. Owing to the fact that thicker emissive coatings—which represent a greater reserve—are employed, a partial burning out of the emissive surface and accordingly a variation in the effective surface in operation will be safely avoided for a period of several thousand hours.

In Fig. 5 the following additional references are used: 13 for the second cylinder, 14 for the after-acceleration anode, and 15 for the envelope of the cathode ray tube. No specific shapes or arrangement of the individual elements are to be read on this merely diagrammatic showing.

Naturally it is possible to secure the cathode member 3 also in other fashion. The essential feature is that this cathode body be of such a stable kind that it cannot be distorted either upon the assembly or in operation or otherwise vary its form.

The concentration effect which is capable of being obtained with the assistance of the cathode arrangement according to the invention is so considerable that it is possible, particularly when employing the Braun tube for oscillographic purposes, to dispense with Wehnelt cylinder, or to link up the Wehnelt cylinder with zero potential and employ the same solely as light screen.

I claim:

1. In a Braun tube in combination with a picture receiving screen and an electro-static electron optical system having an aperture angle of at least 10 degrees: a structural unit producing a bundle of cathode rays, the angle of inclination of which with respect to the tube axis does not exceed 10 degrees for the purpose of causing the electron optical system to collect all of the electrons produced by said unit for forming one sharp image on the image screen, said structural unit comprising an indirectly heated cathode body, a highly emissive surface covering a partial area of the surface of the cathode body facing the electron optical system, said structural unit further comprising a control electrode, said highly emissive surface being disposed symmetrically with respect to said control electrode.

2. In a Braun tube in combination with a picture receiving screen and an electro-static electron optical system having an aperture angle of at least 10 degrees: a structural unit producing a bundle of cathode rays, the angle of inclination of which with respect to the tube axis does not exceed 10 degrees for the purpose of causing the electron optical system to collect all of the electrons produced by said unit for forming one sharp image on the image screen, said structural unit comprising an indirectly heated cathode body, a highly emissive layer disposed in a recess occupying a partial area of the surface of the cathode body facing the electron optical system, said structural unit further comprising a control electrode, said highly emissive surface being disposed symmetrically with respect to said control electrode.

3. In a Braun tube in combination with a picture receiving screen and an electro-static electron optical system having an aperture angle of at least 10 degrees: a structural unit producing a bundle of cathode rays, the angle of inclination of which with respect to the tube axis does not exceed 10 degrees for the purpose of causing the electron optical system to collect all of the electrons produced by said unit for forming one sharp image on the image screen, said structural unit comprising an indirectly heated cathode body, the surface of said cathode body facing the electron optical system being curved, a highly emissive surface covering a partial area of the surface of the cathode body facing the electron optical system, said structural unit further comprising a control electrode, said highly emissive surface being disposed symmetrically with respect to said control electrode.

4. In a Braun tube in combination with a picture receiving screen and an electro-static electron optical system having an aperture angle of at least 10 degrees: a structural unit producing

a bundle of cathode rays, the angle of inclination of which with respect to the tube axis does not exceed 10 degrees for the purpose of causing the electron optical system to collect all of the electrons produced by said unit for forming one sharp image on the image screen, said structural unit comprising an indirectly heated cathode body, a highly emissive layer of at least $\frac{2}{10}$ millimetre thickness disposed in a recess occupying a partial area of the surface of the cathode body facing the electron optical system, said structural unit further comprising a control electrode, said highly emissive surface being disposed symmetrically with respect to said control electrode.

5. In a Braun tube in combination with a picture receiving screen and an electro-static electron optical system having an aperture angle of at least 10 degrees: a structural unit producing a bundle of cathode rays, the angle of inclination of which with respect to the tube axis does not exceed 10 degrees for the purpose of causing the electron optical system to collect all of the electrons produced by said unit for forming one sharp image on the image screen, said structural unit comprising an indirectly heated body, the surface of said cathode body facing the electron optical system being curved, a highly emissive layer disposed in a recess occupying a partial area of the surface of the cathode body facing the electron optical system, said structural unit further comprising a control electrode, said highly emissive surface being disposed symmetrically with respect to said control electrode.

6. In a Braun tube in combination with a picture receiving screen and an electro-static electron optical system having an aperture angle of at least 10 degrees: a structural unit producing a bundle of cathode rays, the angle of inclination of which with respect to the tube axis does not exceed 10 degrees for the purpose of causing the electron optical system to collect all of the electrons produced by said unit for forming one sharp image on the image screen, said structural unit comprising an indirectly heated cathode body, a highly emissive surface covering a partial area of the surface of the cathode body facing the electron optical system, said structural unit further comprising a control cylinder, a metallic cathode holder tightly fitting into said control cylinder, said cathode body being mounted on and insulated from said cathode holder, said highly emissive surface being disposed symmetrically with respect to said control electrode.

7. An indirectly heated cathode comprising a heater element, an equipotential body mounted near said heater element, part of said equipotential body being a mirror surface hollow member, the surface of the hollow member having a recess, and a highly emissive substance disposed in said recess.

8. An indirectly heated cathode comprising a heater element, an equipotential body mounted near said heater element, part of said equipotential body being a mirror surface hollow member, the surface of the hollow member having a recess, and a highly emissive substance disposed in said recess, the surface of the emissive subtance forming together with the non-emissive parts of the hollow member a uniform concave surface.

KURT SCHLESINGER.