Oct. 5, 1937. M. KNOLL 2,094,606

CATHODE RAY TUBE

Filed July 26, 1934

Fig. 1

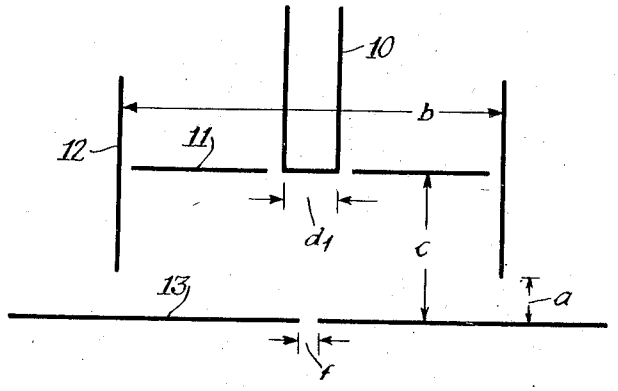
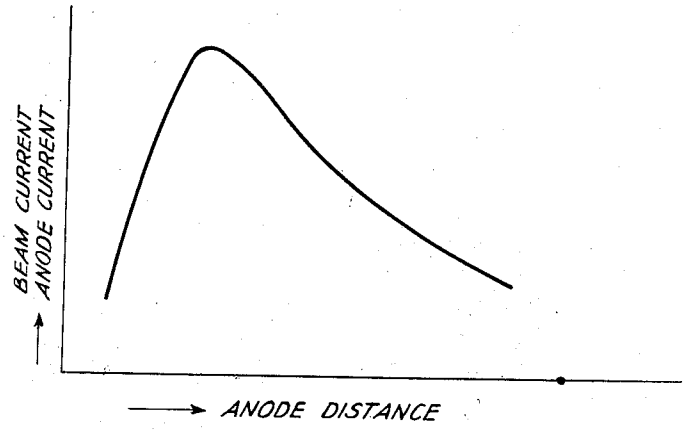


Fig. 2



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CATHODE RAY TUBE

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3 Claims. (Cl. 250—27.5)

The invention relates to a cathode ray tube suitable for receiving television transmissions. These tubes have a control cylinder surrounding the cathode, and to which the so-called picture modulation voltage is applied, i. e., that voltage which determines the luminosity of the luminous spot on the screen of the tube.

The invention is based upon the teaching that such control cylinder together with an oppositely disposed positive electrode can be considered an electrical lens, whose focal distance, at low input velocity of the electrons, lies in the direct vicinity of the control cylinder, namely between the latter and the positive electrode. It was found from tests, that in the focus produced in front of the control cylinder, the cathode beam has a very small diameter, practically only a fraction of a millimeter. In accordance with the invention, the diameter of the control cylinder and its distance from the anode, as well as the cathode will be so dimensioned, that the anode opening lies in the focal distance of the control cylinder. This entails the advantage that the electron current emitted by the cathode nearly completely passes through the anode opening and is intercepted by the anode shutter to a very small extent only. The anode opening can hereby be made so small that a very small fluorescent spot is produced on the fluorescent screen of the tube, when the anode opening is reproduced on the fluorescent screen in the known manner by means of a collector coil.

The embodiment of the invention already practically tested, will be described in the following and it is schematically represented in the drawing in which Fig. 1 shows schematically one embodiment of my invention, and Fig. 2 shows a graph illustrative of the principle of my invention.

In Fig. 1, 10 signifies a cathode, 11 is a disk which may have applied thereto the potential of the cathode 10, or the potential of the control cylinder 12, or any other potential therebetween. 13 designates an anode shutter, whose opening is in the axis of the control cylinder 12. The diameter b of the control cylinder was in the mentioned experiment 10 mm., the distance a of its edge opposite the anode shutter from the latter was 2 mm., and the distance c between the anode and cathode was 6 mm. The control cylinder 12 had a negative potential of 150 volts against the cathode, the anode 13 a positive potential of 2000 volts against the cathode. The diameter of the emitting cathode surface d_1 was 4 mm., the opening f of the anode was only 0.6 mm. Under these conditions, it was observed that an electron current of 2 ma. passed through the anode opening f, while the anode shutter 13 received a current of less than 0.2 ma.

This result is next insofar remarkable in that it proves that electrons radiated by a cathode placed within a control cylinder actually pass at one place through a negligibly small cross section, which can be designated as focal point of the arrangement. A further proof for the presence of such a focal point will be noted from the results of tests one of which is shown in Fig. 2. In this figure there is plotted in dependence upon the distance a, the relation of the ray current to the anode current (i. e., the proportion between the current passing through the anode opening and the current received by the anode shutter). As can be seen, the proportion between ray current and anode current has an optimum at a definite distance of the control cylinder from the anode. This signifies moreover that for other values for the distance between control cylinder and anode, the anode opening is not in the focal point of the cathode ray beam, but is rather more or less outside this point, and that therefore this opening gives in this case passage to only a small part of the current emitted from the cathode.

The result explained of Fig. 1 is also insofar remarkable in that it shows, that by suitably dimensioning of the control cylinder etc., the current emitted from a comparatively large surface of the cathode can pass nearly completely through an opening f which is extremely small in comparison with the cathode. Since the specific emission of the cathode, i. e., the electron current emitted from a square millimeter of the cathode surface, cannot further be increased without shortening the life of the cathode, the above is of great importance, and also for the reason that for producing a small luminescent spot on the screen of the tube, small anode openings are of advantage.

Having thus described the invention, what I claim is:

1. In a cathode ray tube, the combination of a cathode having an electron emitting surface, an apertured disk shield electrode concentric to said cathode and lying in the same plane as the emitting surface of the cathode, a cylindrical focusing electrode coaxial with and surrounding said cathode and shield, and an accelerating annular anode coaxial with the aforesaid electrodes and placed in register with said cathode.

2. In a cathode ray tube, the combination of a cathode having an electron emitting surface,

an annular shield electrode, said electrode lying in the same plane as the emitting surface of the cathode, a cylindrical focusing electrode, and an annular accelerating electrode, all of said electrodes being coaxial with said cathode, said accelerating electrode being positioned at the focal distance of the cylindrical focusing electrode under optimum operating conditions.

3. The combination of a cathode having an electron emitting surface, an apertured disk shield electrode, said electrode lying in the same plane as the emitting surface of the cathode, a cylindrical focusing electrode, and an apertured accelerating anode, the ratio of the square of diameters of the emitting cathode and aperture in the accelerating anode being of the order $d_1^2/f^2=K$, where d_1 is the diameter of the cathode, f is the diameter of the aperture and K any integer greater than 1.

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