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E. DREWANZ ET AL

2,089,692

CATHODE RAY TUBE

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Fig. 1.

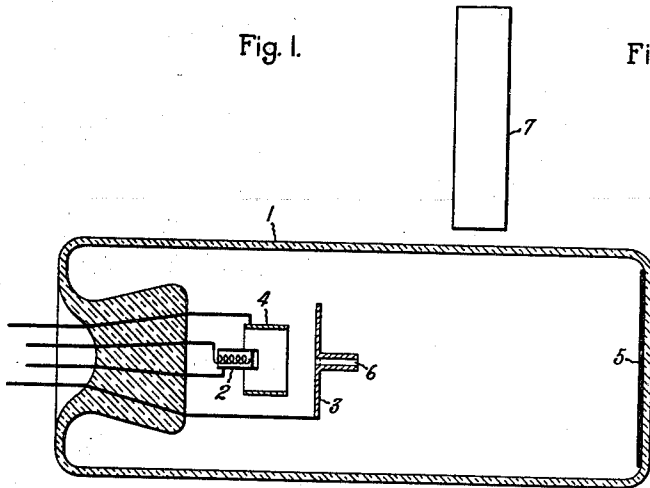


Fig. 2.

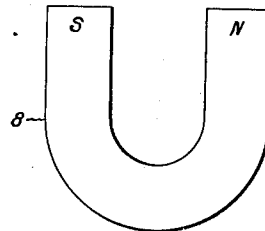
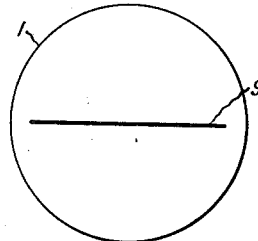
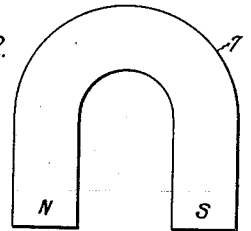


Fig. 3.

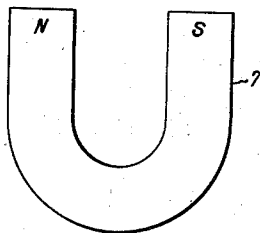
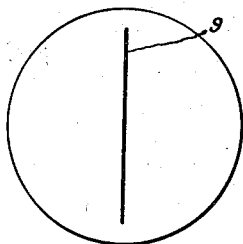
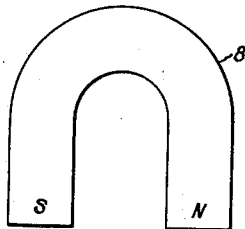


Fig. 4.

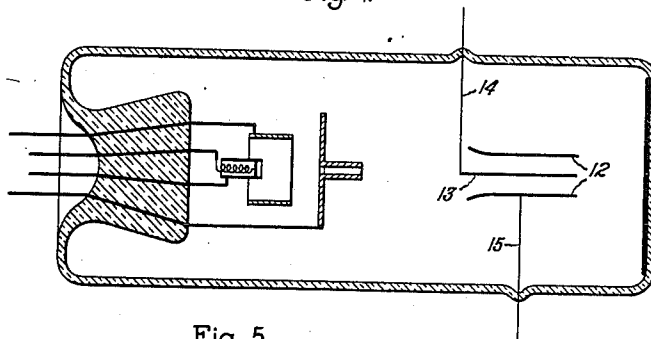
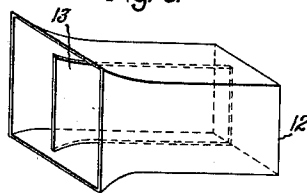


Fig. 5.



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UNITED STATES PATENT OFFICE

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CATHODE RAY TUBE

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In Germany December 9, 1931

11 Claims. (Cl. 250—27.5)

When using electron tubes for sound recording and especially for sound pictures, it is advantageous to have the image produced by the electron rays on the stream, extend to the greatest possible distance. When the fluorescent spot is elongated in this manner and suitably controlled, the screen presents narrow lines of light which vary accurately in intensity according to the microphone current. When a film is moved past the end of the cathode-ray tube, these narrow lines cause corresponding lines to appear on the film and due to their extreme narrowness, production of sound from the film will be a faithful reproduction of the original sound propagated into the microphone. The accuracy with which this reproduction is obtained depends, in part, on the degree of narrowness of the light lines.

When electrons are emanated by a filament, it is usual to focus the cathode-rays by an electrically charged cylinder of circular configuration in order to obtain maximum focusing effect. The cathode-ray stream in emerging from the cylinder or other focusing device has a circular configuration under these conditions and the problem presents itself of changing the shape of the cathode-rays from that of a circle to a line, as narrow as possible. For this purpose, various arrangements have been proposed, among which are those of a control grid having a special shape or the use of special diaphragms. In general, these prior arrangements have not given satisfactory results in that the fluorescent line produced has either been not sufficiently narrow or else has lost too high a percentage of its intensity or brightness during the conversion stage.

An object of the present invention is to provide a practical means for producing a narrow fluorescent line without substantial loss of light intensity. This object is attained in brief by the use of magnetic or electrostatic fields, generically termed "electric fields" which are produced in the space between the anode and the screen by a suitable structure. The effect of the magnetic or electrostatic field on the cathode-ray stream, regardless of its original configuration, is to compress the electron beam into a narrow strip or line.

When using a magnetic field for this purpose, the field may advantageously be obtained from permanent magnets or if desired, from electromagnets excited by direct current. The magnets are preferably arranged on either side of the tube so as to constitute a four-pole system having the poles of one magnet face the opposite

poles of the other magnet. The magnet assembly is arranged with respect to the tube in such a manner that the electron beam passes perpendicularly through the center of the four-pole system. In other words, the magnets are disposed equidistantly on either side of the envelope and arranged perpendicularly thereto. It is found that under these conditions a narrow fluorescent light strip is produced, the brightness of which can be changed in the usual manner by means of an electrostatic control member. The fluorescent strip can be made extremely narrow by regulating the distance of the magnets from the envelope and the intensity of the magnetic field. The length of the strip may be shortened, if desired, as for example, when recording on a narrow sound film, by a suitable spherical or cylindrical lens system. The magnet arrangement for controlling the shape of the electron beam offers a marked advantage in that the spot can be readily adjusted into the optical axis of the recording system, by displacing the plane of the magnet structure with respect to the plane containing the axis of the electron beam.

The electrostatic method of obtaining the narrow light strip also offers certain advantages over the prior art technique, mostly from the standpoint of ease and accuracy of spot control and greater effectiveness with which the electron beam is condensed from a circular configuration to that of a line.

Physical embodiments of the invention are shown in the drawing in which Fig. 1 shows a longitudinal section of a cathode-ray tube with the magnets placed in accordance with our invention; Figs. 2 and 3 diagrammatically show various ways of applying the magnetic field; Fig. 4 illustrates the use of an electrostatic or condenser field for purposes stated hereinbefore, while Fig. 5 is an enlarged perspective view of the electric-field-producing member.

In Fig. 1, numeral 1 designates the envelope of a highly evacuated or gas-containing cathode-ray tube provided with a cathode 2, an anode 3, a focusing cylinder 4 and a fluorescent screen 5 coated on the interior of the envelope. The cathode, as illustrated, is of the indirectly heated type coated with electron-emitting material, although it will be understood that the directly heated form may also be used, if desired. The control member 4 is suitably charged for focusing purposes and is preferably positioned so as to surround the cathode, thereby constraining the electrons to the longitudinal aperture 6 con-

tained in the anode. The tube may be filled with a suitable gas such as argon or mercury vapor at well-known pressures. When an electromotive force, for example 800 volts, is applied across the anode 3 and cathode 2, a comparatively large fluorescent spot of a general circular shape normally appears on the screen and the intensity of the spot may be controlled by the potential applied to the cylinder 4, as is well known in the art.

In accordance with our invention, this normally extensive fluorescent spot is converted or condensed into a narrow light strip by the use of magnets 7, 8 which preferably are positioned exterior of the envelope in a plane intermediate the anode 3 and the screen 5, as shown. This plane preferably is perpendicular to the electron stream axis unless some special converging effect is required. As shown in Figs. 2 and 3, the magnets are symmetrically disposed with respect to the tube envelope and their unlike poles face one another. The fluorescent spot, which normally is round as it emerges from the opening 6, spreading itself out as it strikes the screen, is now constrained into a lateral strip 9 parallel to the faces of the magnets when the latter are arranged as shown in Fig. 2. When the poles of the magnets are reversed as indicated in Fig. 3, the light strip is moved through an angle of 90° and is now parallel to the longitudinal axis of the magnets. While we have shown the use of permanent magnets for this purpose, it is obvious that electromagnets energized by direct current may also be used.

Instead of using a magnetic field for contracting the fluorescent spot into a narrow line, electrostatic fields may be employed for this purpose. As shown in Figs. 4 and 5, these fields are conveniently obtained from a rectangular box member 12 made in the form of a hollow metal frame with its edges nearer the anode 3 flared outwardly, as shown. Within the box there is a center strip 13 of metal, insulatingly secured to the upper and lower sides of the box. The metal box and contained strip are rigidly mounted in any suitable manner within the envelope and positioned intermediate the anode 3 and the fluorescent screen 5. The box is positioned in alignment with the opening in the anode 3, as shown. Separate leading-in conductors 14, 15 are taken from the box and the strip respectively, to the exterior of the tube. When proper potentials are applied to the box and the strip depending chiefly on the dimensions of the box and the velocity of the cathode rays, the rays leaving the anode 3 are changed from a circular configuration into a narrow strip or line. As examples of suitable potentials which may be applied for this purpose, the center strip may have substantially the same potential as the anode 3, while the box and therefore the two side portions thereof which extend in parallel planes to the center strip, may have a potential approximately 100 volts negative with respect to the center plate and anode. It will be understood that these vertical (as shown) side plates together with the center strip constitute a double condenser and virtually divide the cathode rays into two halves in passing through the box. However, after leaving the box and impinging on the screen, the two cathode-ray streams are caused to unite and form a single straight line located in the plane of the center strip, extending perpendicular to the axis of the cathode-ray beam. The length of the line thus

produced is determined by the width of the center strip, hence by the distance between the upper and the lower sides of the box. While we have shown the electrostatic control member for changing the configuration of the electron beam from a circle to a line as constituting a peripherally complete box, it is obvious that one or more of the sides of the box may be left open, depending on the precise shape and thickness of the fluorescent spot desired. However, it is preferable to provide a complete box as illustrated, in order to lend ruggedness and rigidity to the structure.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electron discharge device comprising an envelope containing an electron-emitting cathode, a fluorescent screen and an anode having an opening other than rectangular, said anode being positioned between the screen and cathode, and electric means for changing the configuration of the electron beam as it leaves the anode into an extended rectangular shape as it strikes the screen.

2. An electron discharge device comprising an envelope containing an electron-emitting cathode, a fluorescent screen and an anode having an opening other than rectangular, said anode being positioned between the screen and cathode, and electric means for changing the configuration of the electron beam as it leaves the anode into an extended rectangular shape as it strikes the screen, said means including a device for producing a magnetic field between the cathode and screen.

3. An electron discharge device comprising an envelope containing an electron-emitting cathode, a fluorescent screen and an anode having an opening other than rectangular, said anode being positioned between the screen and cathode, and electric means for changing the configuration of the electron beam as it leaves the anode into an extended rectangular shape as it strikes the screen, said means including a device for producing an electrostatic field between the cathode and screen.

4. An electron discharge device comprising an envelope containing an electron-emitting cathode, an anode having a substantially round discharge opening, a fluorescent screen, and electric means positioned between the anode and screen for changing the circular configuration of the electron beam as it leaves the anode into an extended rectangular shape as it strikes the screen.

5. An electron discharge device comprising an envelope containing an electron-emitting cathode, an anode having a substantially round discharge opening, a fluorescent screen, and electrostatic means positioned between the anode and screen for changing the circular configuration of the electron beam as it leaves the anode into an extended rectangular shape as it strikes the screen.

6. An electron discharge device comprising an envelope containing an electron-emitting cathode, an anode having a substantially round discharge opening, a fluorescent screen, and magnetic means positioned between the anode and screen for changing the circular configuration of the electron beam as it leaves the anode into an extended substantially rectangular shape as it strikes the screen.

7. An electron discharge device comprising an envelope containing an electron-emitting cath-

ode, an anode having a substantially round discharge opening, a fluorescent screen, and magnetic means positioned between the anode and screen for changing the circular configuration of the electron beam as it leaves the anode into an extended substantially rectangular shape as it strikes the screen, said means including a pair of magnets arranged on opposite sides of the envelope, the poles of one magnet facing the opposite poles of the other magnet.

8. An electron discharge device comprising an envelope containing an electron-emitting cathode, an anode having a substantially round discharge opening, a fluorescent screen, and electric means positioned between the anode and screen for changing the circular configuration of the electron beam as it leaves the anode into an extended substantially rectangular shape as it strikes the screen, said means including a metal strip arranged in line with the electron stream passing between the anode and the screen and a pair of metal strips positioned on either side of the said strip, and means for applying a potential to said strips.

9. An electron discharge device comprising an envelope containing an electron-emitting cathode, an anode having a substantially round discharge opening, a fluorescent screen, and electric means positioned between the anode and screen for changing the circular configuration of the electron beam as it leaves the anode into an extended substantially rectangular shape as it strikes the screen, said means including a rectangularly shaped hollow metal member containing a metal strip arranged in line with the

electron stream passing between the anode and the screen.

10. An electron discharge device comprising an envelope containing an electron-emitting cathode, an anode having a substantially round discharge opening, a fluorescent screen, and means positioned between the anode and screen for changing the configuration of the electron beam as it leaves the anode into an extended substantially rectangular shape as it strikes the screen, said means including a rectangularly shaped hollow metal member, a metal strip insulatively supported within the member, said strip and member being arranged in line with the electron stream passing between the anode and screen, said strip adapted to be charged to a potential approximately equal to the anode potential.

11. An electron discharge device comprising an envelope containing an electron-emitting cathode, an anode having a substantially round discharge opening, a fluorescent screen, and means positioned between the anode and screen for changing the configuration of the electron beam as it leaves the anode into an extended substantially rectangular shape as it strikes the screen, said means including a rectangularly shaped hollow metal member, a metal strip insulatively supported within the member, said strip and member being arranged in line with the electron stream passing between the anode and screen, said strip adapted to be charged to a potential approximately equal to the anode potential, and said member adapted to be charged to a potential less than anode potential.

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