Oct. 15, 1940. R. LORENZEN 2,217,758

CATHODE RAY TUBE SYSTEM

Filed July 7, 1937

FIG. 1

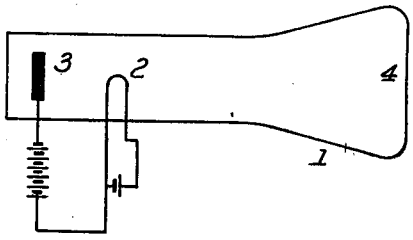


FIG. 2

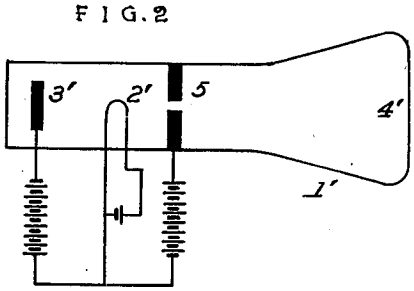


FIG. 3

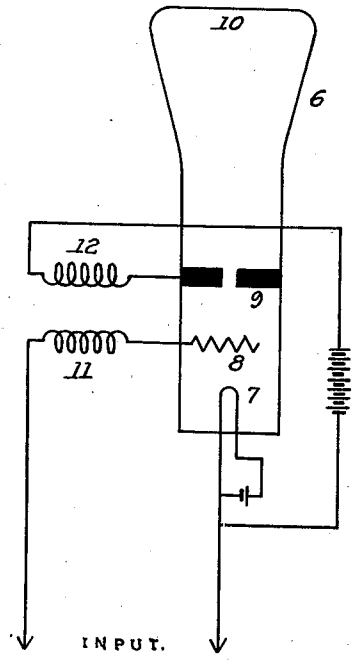
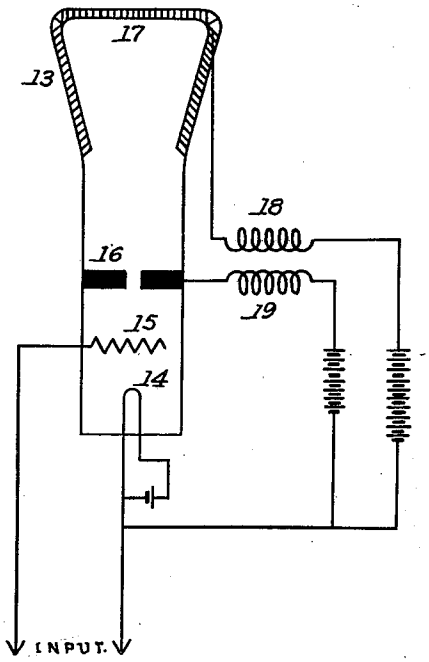


FIG. 4



INVENTOR.

Robert Lorenzen

Patented Oct. 15, 1940 2,217,758

UNITED STATES PATENT OFFICE

2,217,758

CATHODE RAY TUBE SYSTEM

Robert Lorenzen, New York, N. Y., assignor of thirty-three and one-third per cent to George H. Callaghan and thirty-three and one-third per cent to Felix Spiegel, both of New York, N. Y., and thirty-three and one-third per cent to himself

Application July 7, 1937, Serial No. 152,353

6 Claims. (Cl. 250—27)

The present invention relates to methods and means for increasing the electron beam intensity in cathode ray tubes.

One of the disadvantages of cathode ray oscillographs for television reception is the small size of image produced on the fluorescent screen of the tube. To obviate this difficulty various suggestions have been advanced whereby, by means of various optical systems, the image on the fluorescent screen is enlarged. Attempts to enlarge the picture have not been entirely successful partly because of the initially low brilliance of the fluorescent screen image, and partly because of the rapid decrease in the intensity of light as the picture is correspondingly enlarged.

Moreover, one of the desirable features of a television receiver for home use is that the pictures appearing upon the viewing screen be capable of being observed in a lighted room, so that those members of the family who are not watching the television program may attend to their respective duties without being inconvenienced by darkness. This requirement can be met only if the image appearing upon the viewing screen is of such great intensity as to counteract the effect of the room lighting.

One method of obtaining brilliant television images is to increase the intensity of the electron beam which impinges upon the fluorescent screen. The solution which immediately presents itself is to increase the potentials of the accelerating anodes. This method is subject to a great many drawbacks in virtue of the already high anode potentials in use.

One of the objects of this invention is to provide methods and means for increasing the electron beam intensity in cathode ray tubes. These methods fall into two main classifications: first, those which depend upon an electron repelling electrode, and second, those which depend upon the feed back or regenerative principle.

Another advantage of the present invention is that, when the regenerative principle is used, fewer stages of amplification are needed to build up the video modulating signal applied to the grid, thereby enabling television receivers to be more economically constructed.

Fig. 1 represents a circuit wherein a negatively charged electrode is used to repel electrons.

Fig. 2 represents the circuit of Fig. 1 when used in conjunction with a positively charged anode.

Fig. 3 represents a method of applying the regenerative principle to a cathode ray oscillograph to obtain greater modulation sensitivity and electron beam intensity.

Fig. 4 represents a method of applying the regenerative principle to a cathode ray tube having two anodes in order to obtain greater electron beam intensity.

The fundamental circuit employing an electron repelling electrode is shown in Fig. 1. The cathode ray oscillograph 1 contains an electron emitting cathode 2, a fluorescent screen 4, and an electrode 3 which is maintained at a negative potential with respect to the cathode 2. The electric field between cathode 2 and negatively charged electrode 3 is of such a nature as to cause the repulsion of the electrons emitted by the cathode away from electrode 3 and towards fluorescent screen 4.

Referring to Fig. 2, the cathode ray oscillograph 1′ is comprised of a cathode 2′, a fluorescent screen 4′, and also the negatively charged repelling electrode 3′ is used in conjunction with a positively charged centrally apertured anode 5. The customary accelerating effect of the positive anode 5 upon the electron stream is augmented by the repelling effect of the negative electrode 3′. Consequently, an electron beam of greater intensity is obtained than if the positively charged anode alone were used.

The principle of employing a negatively charged electrode to produce electronic repulsion may be applied to any type of vacuum tube which employs electronic emission as a principle of operation. It can, for example, be used in radio receiving and transmitting tubes in order to increase the plate current. It may also be employed in photoelectric cells for the same purpose. In particular, it may be utilized in the photoelectric type of television transmitting tubes known as electron cameras.

In the circuit shown in Fig. 3 there is shown a cathode ray oscillograph 6 which is comprised of a cathode 7, a modulating grid 8, an accelerating anode 9, and a fluorescent screen 10. An inductance coil 11 in the grid circuit is inductively coupled to an inductance coil 12 in the anode circuit. Some of the electrons which have been modulated in accordance with the video signals pass through the centrally located aperture in the anode, but others strike the anode thereby resulting in an anode current which is a function of the grid voltage. A change of potential in the grid circuit causes a greater change in the anode current than would the same potential change in the anode circuit. The tube therefore acts as an amplifier and consequently part of this amplified signal in the plate circuit can be fed back to the grid circuit by any suitable means.

Although, in Fig. 3, inductive feedback is shown, it remains within the scope of the claims to utilize any form of impedance coupling or combinations thereof to effect the regeneration irrespective of whether the impedances are external to the tube or internal as, for example, the inter-electrode impedance of the tube itself. In some cases it may be found desirable to amplify the anode current variations before feeding it back to the grid.

It is understood that although in Fig. 3 the regeneration has been shown as occurring between the anode and grid circuit that this need not be the case. For example, the grid might be replaced by any other modulating element, such as a Wehnelt cylinder, etc., the regeneration then occurring between the anode and whatever modulating electrode that is chosen.

It furthermore remains within the scope of the claims that when the tube is so constructed as to contain one or more modulating electrodes, or one or more anodes, or any combination of these that the invention applies to the obtaining of regeneration through any suitable circuit or circuits which effects such feed back with any number or combination of the aforementioned elements being used as may be found suitable. Of these innumerable circuits only one of them will be described.

In Fig. 4 the cathode ray tube 13 is comprised of a cathode 14, a modulating element 15, a first anode 16, and a conductive fluorescent screen 17 which constitutes the second anode. The variation in the first anode current, due to grid modulation, results in a greater variation in the second anode current. Part of this second anode current is fed back to the first anode by means of some form of impedance coupling, in this case by means of the inductive relationship of inductance coil 18 in the second anode circuit to the inductance coil 19 in the first anode circuit. Due to this regenerative action an electron beam of greater intensity results.

Deflecting plates or coils or any combinations thereof may be used for effecting a deflection of the electron beam.

The methods of the present invention may be used in combination if desired, that is, the principle of electron repulsion may be used in combination with the principle of regeneration.

Throughout this discussion it should be understood that the invention is not limited to cathode rays only, but that it lies within the scope of the claims to apply the various principles disclosed to any type of ray which can be electrically deflected.

Numerous modifications of the invention will be apparent to those skilled in the art, and the invention, therefore, is not to be limited except insofar as is necessitated by the prior art.

What is claimed is:

1. In a cathode ray oscillograph comprising in combination an electron emitting cathode, an intensity modulating electrode, two anodes one of which is of a higher potential than the other, an image receiving screen, and means for inductively feeding back some of the energy in the circuit of the anode of higher potential to the circuit of the anode with lower potential.

2. A cathode ray tube having a main input including in combination an image viewing screen at one end and constituting an anode, an electron emitting cathode mounted in the tube, a second anode also mounted in the tube, one of these anodes being of a higher potential than the other, a modulating grid also mounted in the tube, the cathode and the second mentioned anode being connected to the main input, two sources of independent electric energy connected respectively to one leg of the input and to the respective anodes, and means connected to said sources between such sources and the anodes for inductively feeding back some of the energy in the circuit of the anode of higher potential to the other anode.

3. A cathode ray tube including in combination an image viewing screen at one end of the tube, an electron emitting cathode mounted in the tube, a modulating grid mounted in the tube, the input being connected respectively to the cathode and grid, a plurality of anodes mounted in the tube and one of which is of a higher potential than the other, an independent source of electrical energy connected between the input to the cathode and to one of the anodes, and means interposed respectively between the grid and its input and the last source and its grid to inductively feed back some of the energy in the main circuit of the anode of higher potential to the circuit of the anode with lower potential.

4. A cathode ray tube as claimed in claim 3, wherein the latter means includes an induction means of the plural coil type.

5. A cathode ray tube as claimed in claim 3, wherein the latter means includes two inductance coils disposed inductively one to the other.

6. A cathode ray tube as claimed in claim 2 in which the latter means includes two inductance coils disposed inductively one to the other.

ROBERT LORENZEN.