

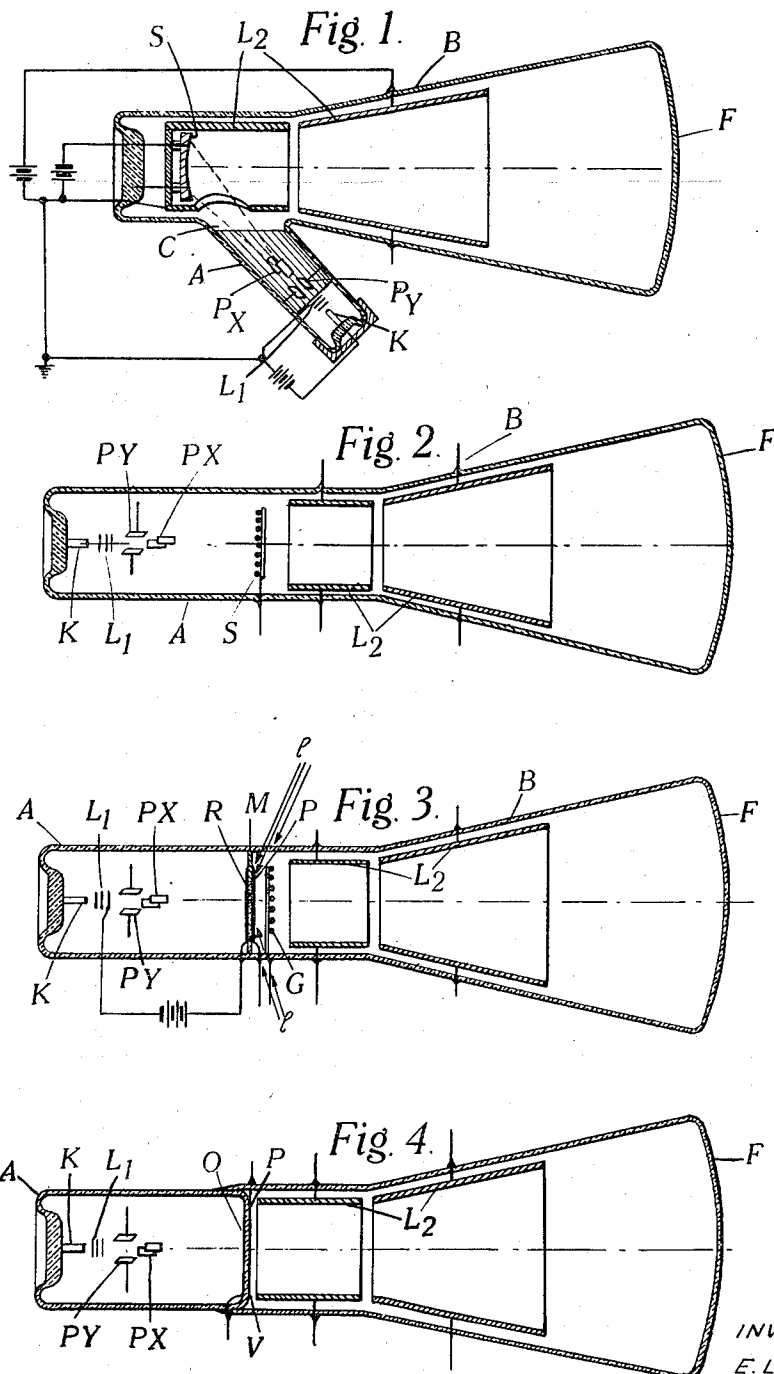
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ELECTRON DISCHARGE DEVICE

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ELECTRON DISCHARGE DEVICE

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The present invention relates to cathode ray tubes or the like, and particularly to cathode ray tubes of the kind employed in television receivers.

5 In certain cathode ray tubes, known in the art, electro-optical concentrating systems with low magnifying power and high acceleration potentials are usually employed. The fineness and brilliance of the luminous spot are thereby increased, which is desirable, but the sensitivity is reduced. One means of compensating for this drawback consists in lengthening the electronic paths but this has the result of reducing the fineness of the spot.

10 An object of the invention is to obtain in a cathode ray tube a high sensitivity of deflection and at the same time a small and brilliant luminous spot.

In accordance with one feature of the invention a tube such as a cathode ray tube is provided, having in the path of the cathode rays one or more relays, for example, electronic relays of the type having electronically or photo-electrically controlled electronic emission.

25 In accordance with a further feature of the invention, in such a tube an intermediate screen is provided in the path of the electrons emitted by the cathode this screen being arranged as a relay source of electrons. The electrons from the intermediate screen cause the formation on a main screen of a luminous image of the modulated electronic image projected on the intermediate screen.

30 In accordance with other features of the invention the said intermediate screen may consist of a complex unit mainly formed of a photo-sensitive layer arranged behind a resistant or fluorescent layer.

In accordance with other features of the invention, a cathode ray tube comprises an intermediate screen capable of producing an electronically or photo-electrically controlled electronic image either on the side explored by the cathode beam or on the opposite side.

45 In accordance with another feature of the invention, the tube electrodes are contained in a common evacuated envelope. Alternatively two enclosing vessels may be employed preferably having a common wall constituted by the intermediate screen and having different degrees of vacuum. In other cases a larger number of vessels may be desirable containing gases at various pressures or having different degrees of vacuum.

50 A cathode ray tube employing features of the invention may thus comprise a part composed of

an emitting cathode, a modulation grid, an electron gun, and a deflecting system for the cathode beam, a screen capable of emitting electrons under the influence of the incident cathode beam, and a second portion in which are means for accelerating and concentrating this new bundle of electrons and bringing it to explore a phosphorescent or similar surface capable of emitting luminous rays under the influence of said bundle.

5 In the manner described and in accordance with features of the invention, the two functions of the cathode ray tube, that is, formation of an oscillograph image and formation of a luminous image, are thus separated, the luminous image being formed by means of electrons practically entirely proceeding from a second source, the energy necessary for the formation of a luminous image only being derived from this new bundle of electrons.

10 The invention will be explained in more detail in various embodiments shown in the attached drawing in which:

Fig. 1 shows an embodiment of a cathode ray tube employing a screen capable of producing secondary electrons under the action of a primary electronic bombardment;

25 Fig. 2 represents a modification of the device of Fig. 1 in which the two electron paths are arranged in the extension of each other;

Fig. 3 shows a tube arrangement in which the intermediate screen comprises a complex unit substantially composed of a photo-sensitive surface preceded by a resistant screen; and

30 Fig. 4 represents a schematic arrangement of a tube in which the intermediate screen comprises a complex unit substantially composed of a photo-sensitive layer preceded by a fluorescent layer.

40 Fig. 1 shows a tube, for example a cathode ray oscillograph with an intermediate screen S. The tube is formed of two portions A and B. The portion A is similar to the corresponding portion of a cathode ray oscillograph of the usual type. It is a glass tube in which a high vacuum prevails and which encloses a cathode K, an electron-optical concentration or focussing system L₁ and deflection plates PX and PY.

45 The portion A communicates with the portion B in which is situated the intermediate source of electrons S which plays the part of screen for the portion A and of cathode for the portion B. Following S an electron-optical system L₂ projects the emission from S onto the final screen F. The system L₂ may consist, for example of

two electrodes, as shown, or of a metallisation of the glass sheath.

The primary cathode beam is emitted by the heated cathode K. The lens system L_1 , for which relatively low acceleration potentials of the order of 400 V. are employed, projects the primary cathode beam upon screen S. By the use of low acceleration potentials a high sensitivity of deflection by the plates PX and PY is obtained.

The incident beam in striking the screen S produces the emission of secondary electrons, the number of secondary electrons being from three to six times greater than the primary electrons, if their speed is well adapted to the nature of the screen. These secondary electrons are accelerated and concentrated in the portion B of the apparatus, so as to strike the screen F with great energy and obtain at F very brilliant luminous spots. It is possible to employ potentials of the order of 10,000 or 20,000 V. in the lens system L_2 . The only limit is that imposed by the saturation of the screen.

The screen F may be formed of phosphorescent substances or of metallic layers brought to incandescence by the electrons coming from screen S. An oscillograph is thus provided which is both very brilliant and very sensitive.

In accordance with the absolute dimension desired on the screen F, the lens system L_2 which forms the image of S on F may have an enlargement greater than equal to or smaller than 1. In general the enlargement concerned is not the absolute dimension of the spot but what may be called the "relative fineness" of the apparatus, that is to say, the ratio of the diameter of the spot to the total useful diameter of the screen. This relative fineness varies for existing cathode ray tubes between $\frac{1}{200}$ and $\frac{1}{500}$.

The relative fineness is obviously the same on F and on S (if we neglect the deviations from sphericity of the objective L_2).

Relative fineness of the above-mentioned order may be effected on the screen S by employing relatively low potentials for the optic L_1 if we make do with beams transporting a small number of electrons.

It is known in effect that the influence of the electron lens systems on the path of the electrons depends exclusively on the ratio of the potentials of the electrodes and not on their absolute value.

Thus, theoretically one might choose a very low final potential. In practice, however, if the potential of the first anode in the vicinity of the cathode becomes too low, the space charges play a predominant part, as well as the chromatic aberrations, that is to say, the influence of the initial speeds of electrons leaving the cathode; moreover, the intensity of the beam decreases.

With an electron lens system L_1 of the type which is common practice at the present time, formed of a first lens in the vicinity of the cathode K which gives a virtual image of the latter situated behind the cathode, and of a second lens which projects on S the virtual image of K, it is possible to obtain relative fineness of the order of magnitude of $\frac{1}{500}$ and better with acceleration potentials of 300 to 400 V. if one manages with currents of the order of 15 to 30.

Thus the "relative fineness" of the apparatus can be maintained by reducing the intensity of the beam in the portion A.

This fineness can be further increased if very great sensitivity is not required. Thus, it is possible to reduce the distance between the second lens of the lens system L_1 and the screen S and

then both the sensitivity and the diameter of the spot on S are reduced in proportion.

In other words, the apparatus can, as desired, give either a great brilliance with a great sensitivity of deviation and an ordinary fineness, or a great brilliance with a great fineness and an ordinary sensitivity of deviation.

Referring now to Fig. 2, the electron emitting system and the electron optical system are identical to those of Fig. 1 but the paths of the electrons emitted by the cathode K and those emitted by the intermediary screen S are in the extension of each other. The glass envelope can then be of the form usual in cathode ray tubes. The intermediate electron-emitter screen S consists of a metallic grid on which has been deposited a suitable substance which can emit electrons under the action of the primary electron bombardment. An electron objective lens similar to that of the arrangement of Fig. 1 is also arranged as shown in order to accelerate and concentrate the electron flux in its path to the fluorescent screen F.

Fig. 3 shows another embodiment of a cathode ray tube in accordance with certain features of the invention. In this drawing the electron-optical system may also be identical with those of Figs. 1 and 2. The intermediate screen consists of a photosensitive layer P preceded by a resistant layer R, a thin plate M of insulating material such as mica being interposed between the two layers. The resistant layer R is brought to a uniform potential slightly more positive than that of the anode of the electron lens system and, consequently, can be connected to said anode. Alternatively it may be connected to a metallisation of the portion A of the tube. Such a metallisation is shown at C in the tube of Fig. 1 and is given a potential equal to or slightly more positive than that of the anode. The photosensitive layer P receives from the side a constant illumination, as indicated by the arrows P (ρ). In front of the photo-sensitive layer is a grid G on which is normally applied a slightly negative potential with respect to the potential of the photosensitive layer. There is a continuous weak emission of the photo-sensitive layer but the grid maintains the emitted electrons in the space between it and the photosensitive layer.

When the incident cathode beam strikes the layer R, the transverse resistance of which is high, a displacement current begins in the condenser formed by the element of R and the corresponding element of the layer P. This current corresponds to a difference of the potential in a negative sense, which liberates the photoelectrons which are to the front of the layer P.

The normally constant illumination of the layer P may if desired be made variable to provide for modulation of the intensity of the luminous spot on the screen F. This method of modulation may be employed to supplement the normal grid modulation around the cathode to obtain special effects such as the control or augmentation of contrast between black and white in a television image.

The plate M can be employed to separate the tube into two distinct spaces in which different suitable degrees of vacuum can be established; more particularly it is possible to introduce in the portion A inert gases under low pressure to permit a better concentration of the primary beam. Risks of deterioration of the cathode by

bombardment of positive ions are not thereby incurred, since the potentials employed are relatively low in this part of the tube.

Fig. 4 shows another tube employing an intermediate screen consisting of a photo-sensitive layer P preceded by a fluorescent layer O explored by the cathode beam proceeding from the usual electron-optical system. Between the photo-sensitive and fluorescent layers is a very thin transparent wall V of glass or other suitable substance, whose thickness is not sufficient to permit the short luminous rays to spread out or to disperse during their transit between the two layers.

The invention is not limited to the embodiments described hereinbefore by way of example and the invention is capable of numerous applications within the scope of the appended claims. For example, the relay or repeating arrangement which may be provided in the path of the electron rays may be of various types adapted to the desired end. These relays may be associated with electron-optical systems or other devices permitting their operation to be facilitated.

What is claimed is:

1. Cathode ray tube comprising in combination means for forming and directing an electron beam, a layer of resistance material disposed transversely of the electron beam, a layer of photo-sensitive material having its parts in capacitative relation to corresponding parts of said layer of resistance material means for illuminating said photo-sensitive layer, a fluorescent screen and a space-charge grid between said photo-sensitive layer and said fluorescent screen.

2. Cathode ray tube according to claim 1 including a tubular electrode disposed between said space-charge grid and said fluorescent screen and having its axis normal to said photo-sensitive layer.

3. A cathode ray tube for setting up a television image upon a first fluorescent screen comprising means for modulating an electron beam according to received signals, a second fluorescent screen, means for deflecting said beam to scan an area of said second fluorescent screen, a photo-sensitive screen operatively associated with said second fluorescent screen for generating secondary electrons proportional, over each element

of the scanned area, to the intensity of the electron beam and means for directing the secondary electrons upon said first fluorescent screen.

4. A cathode ray tube according to claim 3 wherein a grid is provided for maintaining a space charge adjacent to said photo-sensitive screen.

5. A cathode ray tube comprising means for producing and deflecting an electron beam, a plate of insulating material having on one side a control screen energized by said beam, and on the other side a layer of photo-sensitive material operatively associated with said screen for generating secondary electrons proportional to the intensity of the electron beam, a fluorescent screen, and means for directing the secondary electrons upon said fluorescent screen.

6. A cathode ray tube comprising in combination a first sealed vessel, and a second sealed vessel evacuated to different degrees, a plate of insulating material having on one surface a control screen adapted to produce electron controlling impulses responsive to the impingement thereon of an electron beam, means in said first vessel for producing and deflecting an electron beam to scan an area of said screen, a layer of photo-sensitive material in said second vessel on the opposite surface of said plate operatively associated with said control screen for generating secondary electrons proportional, over each element of the scanned area, to the intensity of the electron beam, a fluorescent screen in said second vessel, and means for directing the secondary electrons upon said fluorescent screen.

7. A cathode ray tube comprising a source of cathode rays, a first fluorescent screen, a second fluorescent screen between said source and said first fluorescent screen and a photo-sensitive screen between said first and second fluorescent screens and adjacent to the second screen for producing a secondary stream of cathode rays for activating said first fluorescent screen in accordance with fluorescence of said second fluorescent screen produced by cathode rays from said source.

8. A cathode ray tube in accordance with claim 7 wherein a grid is positioned between said photo-sensitive screen and said first fluorescent screen for maintaining a space-charge adjacent said photo-sensitive screen.

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