Dec. 6, 1938. W. HEIMANN 2,139,018

TELEVISION SCANNER CATHODE

Filed Sept. 21, 1937

Fig. 1.

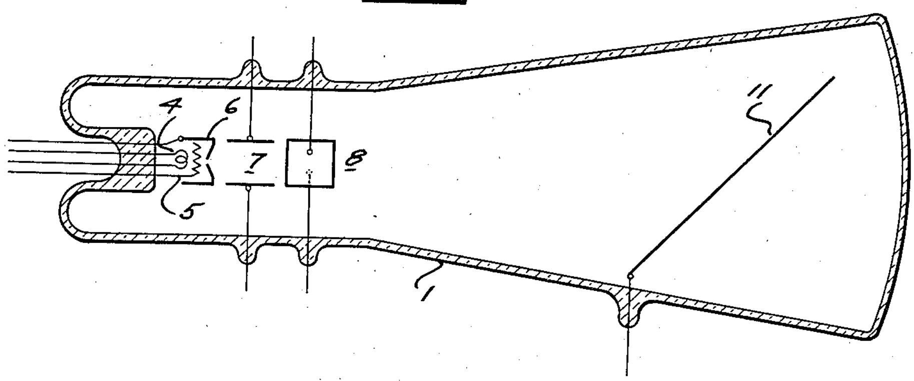


Fig. 2.

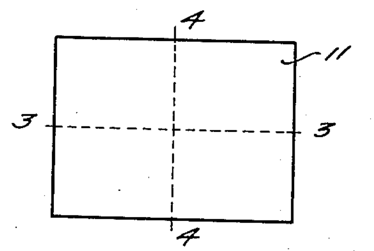


Fig. 4.

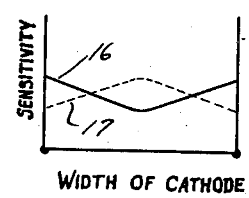


Fig. 3.

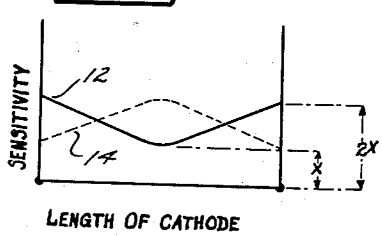
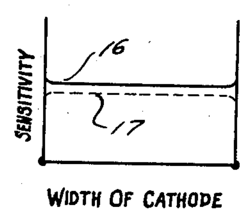


Fig. 5.



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TELEVISION SCANNER CATHODE

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4 Claims. (Cl. 250—167)

This invention relates to television scanners, and particularly to scanners of the type publicized by Vladimir K. Zworykin under the name "Iconoscope."

The efficiency of the known cathode ray beam scanner or "Iconoscope" of Zworykin, is considerably increased by increasing the beam current, which causes an increase of contrast in the image. When increasing the beam current, however, a disturbing effect in the picture appears in the form of non-uniform and unsymmetrical dark portions which extend over wide portions of the area of the image. This interference is an interfering impulse superimposed upon the picture signal, which interfering impulse consists of a series of frequencies, particularly the line and frame frequency, and is mainly caused by space charge in front of the photocathode. The space charge is presumably produced by strong secondary emission from the photocathode. It is particularly noticeable that the interference always migrates from the periphery of the cathode towards the center of the plate when increasing the beam current. Certain effects of the scanning beam, particularly the phenomena caused by the return trace and by non-linearity, furthermore often cause the interference to migrate from one side over the entire area of the cathode.

It has been proposed to reduce this interfering impulse by exterior means, such as by superimposing a corresponding compensating voltage. In practice, however, this measure is very difficult and necessitates extensive equipment. Furthermore, it has been proposed to reduce the interfering impulse by a favorable arrangement of the accelerating electrodes.

According to this invention, a further and considerable reduction or elimination of the interfering impulse is accomplished by producing a photocathode, which is non-uniform in respect to its light sensitivity and, if necessary, asymmetrical. It is particularly preferable to allow the light sensitivity to increase towards the periphery. It may also be of advantage to vary over the photocathode, according to a predetermined law, the ratio of effective photosensitive surface to the area of space between the individual photosensitive particles. This may be accomplished by either enlarging or diminishing the distances for constant size of the particles, or to make the distance between particles constant and to vary the average size of the particles at different portions of the cathode.

In the following, the object of the invention may be explained in detail with the aid of the drawing, wherein Fig. 1 is a schematic sectional view of a cathode ray tube embodying my invention. Figure 2 is a diagram of a conventional rectangular mosaic photocathode, with coordinate axes indicated thereon.

Figure 3 comprises graphs showing the variations of photosensitivity and secondary electron emissivity along said axes in accordance with this invention.

Figures 4 and 5 indicate the variations of these quantities along the vertical and horizontal axes in accordance with a modification of the invention.

In Fig. 1 there has been disclosed in somewhat schematic form a cathode ray device of the type previously referred to, such a tube comprising an envelope **1** which houses the necessary electrodes including a source of electrons **4**, a grid or control electrode **5**, an anode **6**, deflecting plates **7** and **8**, and a photocathode **11**, all arranged in conventional manner well known in the art. The present invention relates particularly to improvements in the photocathode electrode which is sometimes referred to as a mosaic cathode by reason of the fact that its surface is composed of minute globules photosensitized so as to render them responsive to the effects of light.

Figure 2 shows a mosaic cathode **11** of rectangular shape. The cathode comprises a photo mosaic which may be produced in any desirable manner, as has become well known in the art. In the usual photosensitive layers, the basic silver layer, comprising droplets of silver condensed on an insulating plate, is oxidized, and the photosensitivity as well as the secondary emission ratio depends on the degree of oxidation. Experience has shown that the photosensitivity varies in opposite sense to the secondary emission ratio, whereby the secondary emission ratio increases with increasing degree of oxidation while the photosensitivity decreases. If the periphery of the plate has been subjected to a stronger degree of oxidation, the interfering impulses will be especially great. Thus, according to the invention, the center of the photocathode is subjected to stronger oxidation than the periphery and in such a ratio that a reduction or elimination of the interfering impulses is gained.

Figure 3 shows the photosensitivity along the line **3—3** of the mosaic plate. Normally, a straight horizontal line would be obtained. According to the invention, however, the photosensitivity follows the line **12** and the secondary emission ratio the line **14**. The variation of these values along the line **4—4** is shown in Figure 4, where the photosensitivity follows the line 16 and the secondary emission ratio the line 17.

Such a distribution of the sensitivity is, for instance, accomplished by locally controlling the oxidizing process. Oxidation is accomplished by passing a current from an auxiliary electrode to the cathode in an atmosphere of oxygen at low pressure, causing a glow discharge, and the degree of oxidation is a function of the intensity of the glow and the time during which it is applied. If, for instance, the oxidation is made in a glow discharge which is produced between an auxiliary electrode disposed on one side of the mica plate and an anode, it is possible to oxidize the center more strongly than the periphery by suitable choice of the vapor pressure or by choosing a suitable shape for the auxiliary electrode or both. Whereas an approximately homogeneous oxidation takes place at a vapor pressure of 0.01 millimeter Hg, the oxidation at vapor pressure of the order of several thousandths millimeter Hg is influenced in such a manner that the desired distribution of sensitivity is obtained.

It is possible to let the positive ions impact substantially only the center portion of the plate. Thus, with a point auxiliary electrode apposed to the center of the plate, and the plate mounted temporarily or permanently in an oxygen filled envelope on the pump, the discharge glow at the higher pressure mentioned will be sensibly uniform over the whole cathode area, but as the pressure is further reduced the glow will concentrate at the center of the cathode, producing the heaviest oxidation at this spot, and the distribution of sensitivity shown in Figures 3 and 4 will be closely approximated.

To produce other patterns the auxiliary electrode may be disposed at the periphery of the mosaic cathode, or only at different parts of the periphery. By enlarging or decreasing the distance, the oxidation process can be influenced considerably.

The distribution of sensitivity shown in Figures 3 and 4 only serves as an example. A somewhat different distribution is shown in Figure 5, whereby the photosensitivity is to remain constant along the line 4—4. The distribution of sensitivity over the plate is, therefore, different for the two coordinates. Such a distribution may be produced by means of a linear or knife-edged electrode apposed to the center of the plate. It may also be asymmetrical and increase only on one side. Also, the actual difference in sensitivity between portions of highest and lowest sensitivity may vary within wide limits. The ratio of about X:2X shown in the drawing, however, is sufficient to cause a reduction of the interfering impulse. The desired distribution of sensitivity is applicable to cathode ray scanners with one-sided as well as double-sided mosaic plates.

While control of sensitivity is preferably obtained by the control of oxidation, as above described, it may also be accomplished in considerable degree by regulating the deposit of silver on the insulating plate 11. This is sometimes done by masking off parts of the plate, but it may also be accomplished by evaporating the silver onto the plate from a point sufficiently near so that there is an appreciable difference in distance from that point to the different parts of the plate, the heavier deposit occurring at the nearer points, the size of droplets of condensed silver, or their density of distribution, or both, being increased by increased proximity to the point of evaporation. These latter factors can also be varied in some degree, as is well known, by the gas pressure and the speed at which evaporaton takes place.

The final sensitization of the cathode, by admitting caesium or other photosensitive material, is carried on in accordance with usual practice.

I claim:

1. The method of forming a photosensitive cathode which comprises depositing a silver mosaic upon an insulating plate, oxidizing said silver mosaic in a glow discharge in an atmosphere of rarefied oxygen at a pressure of the order of thousandths of a millimeter of mercury and then sensitizing the surface of said plate with an alkali metal.

2. A photocathode having a coating of photosensitive material varying in sensitivity in accordance with a predetermined pattern.

3. A photocathode having a coating of photosensitive material, the photosensitivity of which increases from the center of the cathode toward its periphery.

4. A photocathode having a coating of photosensitive material varying uniformly in photosensitivity along one axis from the center of said cathode to its periphery.

WALTER HEIMANN.