

Jan. 2, 1940.

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2,185,609

CATHODE RAY TUBE FOR TELEVISION PICTURE SCANNING

Filed Feb. 18, 1937

Fig. 1

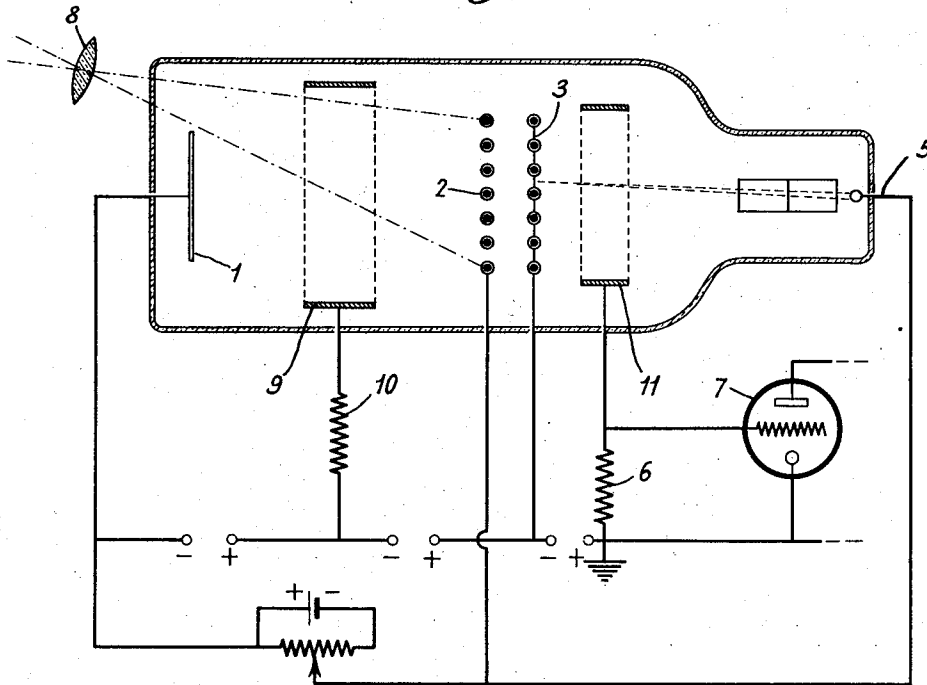


Fig. 2

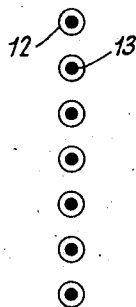
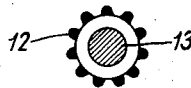


Fig. 3



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2,185,609

CATHODE RAY TUBE FOR TELEVISION PICTURE SCANNING

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Application February 18, 1937, Serial No. 126,315
In Germany February 7, 1936

3 Claims. (Cl. 250—150)

It is known in the prior art of television scanning by the aid of cathode ray tubes of the "Iconoscope" type and subsequent developments thereof to accumulate or store up the luminous action of all picture elements or units throughout the length of the scanline cycles or an appreciable portion thereof. For this purpose the photo-sensitive area or surface illuminated by the optical primary picture or pattern or a screen plate covered by the electronic pattern or image has the structure of a cellular mosaic comprising a large number (myriad) of tiny condensers. The charges which are stored up in these elementary capacities represent a potential image of the subject to be transmitted, and this image is then consecutively scanned point by point by the cathode ray pencil focussed to the size of a picture element. The cathode ray pencil in this scheme operates like a switch which is adapted to turn or direct the stored electrical charges by way of the discharge path of the tube onto the control grid of the picture signal amplifier.

Now, the object of this invention is a further development of the same principle for the purpose of insuring a higher efficiency or greater luminous sensitivity and response of scanning devices of the kind before described. The essential feature of the invention consists in the fact that the elementary charges of the insulated capacities are not directly charged over and impressed upon the input grid of the video or pictures signal amplifier, but are first brought to act in the scanning tube itself in the form of control potentials simultaneously at all picture elements in that they are made to influence a homogeneous electron pencil in a different manner at different points of its cross-section. This is accomplished, for instance, in this way that the meshed photo-sensitized surface in the shape of a narrow-mesh grid is interposed in the path of an electron pencil capable of penetrating across all of the openings of the mesh. To what extent this occurs from one opening to the next depends upon the local brightness or density of the image and the charges occasioned thereby. The elemental currents which are allowed to penetrate impinge upon a surface consisting of insulated anodes the number of which, like the number of mesh openings, may be equal to, or greater than, the number of picture elements, and these in turn operate as storing capacities. The incident scanning pencil focussed to a fine point will thus strike charges which have been raised in accordance with the amplification factor of the de-

scribed arrangement. As a result, the efficiency and the light response as well as the ratio between picture signal level and noise signal level are raised.

In practicing this scheme it is also possible to utilize the secondary emission on the capacitive individual anodes simultaneously struck by electrons and thus multiply, for a secondary emission ratio greater than 2, the charging effect of the controlled elementary electronic currents. For this purpose, however, a field designed to extract or absorb the secondary electrons by the provision of further auxiliary electrodes must be created.

The invention may best be described and understood by referring to the drawing, wherein:

Figure 1 shows one form of the present invention, and

Figures 2 and 3 show details of a portion of Figure 1.

Referring now to Figure 1, a perfectly homogeneous electron current issuing from cathode 1 passes through the openings of a screened photo-electric grid 2 designed in a way as shall be described in more detail further below. Each individual grid opening has a size not exceeding that of a picture element, in fact, it is preferable not to exceed a small fraction thereof in order to insure a certain average value in case of varying light sensitivity. The picture to be televised and transmitted is projected en bloc, for instance, by the aid of a lens 3 upon screen or plate 2 with the result that, by virtue of photoelectric action, in isolated positive charges accumulate at the edges of the various openings, the value of said charges varying with the brightness or density of the picture. The said charges control the electronic current penetrating through the mesh openings throughout the cross-sectional elements thereof, that is to say, at an intensity which varies with the distribution of light and dark changing locally from one point to another in the primary picture. The action is similar to that of a control grid in a standard triode amplifier tube. The anodes 3, throughout the entire cross-section of the tube, constitute equal individual or elementary capacities of a tiny size, these capacities (or anodes) being insulated from one another as well as from a core conductor (wire fabric). The number of the said capacities must be at least equal to, or greater than, the number of openings of the grid 2. To scan the charges stored up by the said anodes there is used a cathode ray pencil which is generated, as known in the prior art, by the cathode 5 and which is caused

to impinge from the rear, the said pencil being caused to move in both directions of the picture coordinate in the usual way by the action of deflector fields. The pencil switches the elementary charges contained in the constituent cells of 3 by way of auxiliary anode 11 and resistance 6 in the form of control potentials onto the grid of the video signal amplifier 7 whence the modulator means of the television transmitter is influenced in the usual way. 9 is an input anode, and 10 a protective resistance.

Fig. 2 is a small section of the grid 2, Fig. 1, drawn to an exaggerated scale. The photosensitized layer 12 is placed upon a core of oxidized metal fabric 13 so as to be insulated therefrom. The said coat or layer is produced, as well known from the earlier art, by silver plating the oxide layer, say, by the aid of cathode spatter or disintegration, bursting of the silver film to result in insulated cells, oxidation thereof, precipitation thereon of caesium, rubidium, potassium, and other vapors, followed by a suitable thermal treatment. The outcome of the treatment is shown in Fig. 3 still further enlarged. It will be seen that upon the insulating oxide envelope of 13 there are now seated distinct silver globules. The resistance between the silver cells and the conducting core fabric or texture 13 must be so chosen that a positive charge of its individual capacity, inside the time occupied by the picture scan (150th of one second) will disappear by way of the intermediary oxide layer by virtue of an equalization of opposite electricity between silver and the metallic fabric core. In order that a perfectly constant "quiescent" value may be secured for the potential of the control grid openings, recourse could be had also to the secondary emission by that, in an arrangement as shown in Fig. 1, a powerful electronic current is drawn, periodically and transiently, by suitable variations of potential applied at 2 and 3, onto the photosensitive coat of 2 with the result that secondary electrons are released thereon. The equilibrium potential (that is, when the incident primary current is equal to the outflowing secondary current) in the activated layer will then be caused instantaneously to assume a value which is a function only of the constants of the material and the definite size of the suction or extraction potential.

The cathode 1, the photoelectric grid 2, and the anode mosaic 3 operate in a manner similar to the operation of a triode in which the photoelectric grid 2 functions as the control electrode. The electrons which originate at the cathode 1 are accelerated toward the anode 3 and the number of electrons which reach the anode 3 depends upon the potential which appears on the control electrode or photoelectric grid 2. The anode 3 is not laterally conductive as is conventionally the case, but is composed of a plurality of minute elements on a conducting mesh 13. The number of electrons which reach individual elements of the anode 3, therefore, depends upon the charge of the corresponding photoelectric elements at the grid structure 2. This grid structure may be maintained at cathode potential or may be maintained at a potential slightly negative with respect to the cathode by reason of the source of current and potentiometer which connect the cathode and the control electrode 2 externally of the tube. The charge which appears on the individual elements of the anode structure 3 then depends upon the intensity of the light image which is projected upon the

photoelectric grid 2 through the optical system 8. When the anode structure 3 is scanned by the cathode ray beam, picture signals may then be derived from the anode 11 and will represent the optical picture projected upon the photoelectric grid 2.

Inasmuch as in the case of a television scanning tube of the kind hereinbefore described, an amplifier action is being utilized it follows that recourse could also be had to all such means and ways as are known in the modern amplifier art, say, the addition of other grids, special means designed to shape the electrical fields, the use of secondary emission, the creation of virtual cathodes, etc. The circuit scheme shown in Fig. 1 roughly would correspond to that of a space-charge grid type of tube in which, by suitable choice of the potentials of cathode 1, the accelerator electrode 9 and the photosensitive grid 2, electron accumulation placed directly in front of 2 and acting as a "virtual cathode" would be created. The arrangement according to this invention could be carried into practice also in such a form that the photoelectric grid 2 is made to operate like the grid of a "plation". The source of electrons 1 is then located between a photoelectric signal screen or plate which takes the place of grid 2 and upon which the incident or projected optical image or pattern sets up a corresponding distribution of the control potential, and the anode mosaic 3 which is posteriorly scanned by the cathode ray pencil. In this instance, 2 should have a structure similar to 3. In other words, the conducting material resulting in photoelectric emission upon the face where the light rays impinge, while acting posteriorly as a control pole, fills all the way from one face to the other the openings of a metallic core fabric resembling a framework in structure, after the latter has been completely coated with an insulating layer.

It is also possible to use the arrangement in Fig. 1 in this manner that the insulated outer layer of grid 2 (the activated silver particles 12, Fig. 3) is not called upon itself to give off photoelectrons by the incidence of picture rays, but absorbs such photo-electrons as originated from a separate photo-cathode, and these, by the aid of electronic lenses are in turn "imaged" upon 2 in the manner of an electronic microscope. In this instance, 2 may be simpler in design; for instance, it may consist of a fine-mesh aluminum wire gauze having an oxidized surface. Aluminum oxide (alumina) is capable of storing, for a comparatively long time, in the form of insulated space charges, such electrons as may impinge thereon. These space-charges, by means of the varying potentials occasioned thereby, exercise a control action upon a stream of electrons passing across the openings of the grid, and the said stream of electrons thereupon impinges upon the elementary anodes of the anode mosaic 3.

The electron current thus controlled may be emitted from a distinct source in the shape of a homogeneous pencil or beam of charge carriers which fill up the entire image cross-section simultaneously and uniformly. However, it is also possible to work in such a way that electrode 1, Fig. 1, as a result of photoelectric activation, turns into a source of electrons when irradiated by luminous energy. In this case one would preferably operate in such a way that during a fraction of the picture scan period the optical image of the televised subject is made to fall upon 1 and that the photoelectrons which are emitted

are drawn off by the electrode 9 and are sharply focussed and projected, in the form of an electron pattern, upon the mesh 2 if the electrode potential has been suitably chosen (electron microscope). If the said mesh or network, as above indicated, consists of oxidized aluminum or equivalent substance, it will absorb or extract from the electron pattern isolated space charges the size of which will be a function of the distribution of light and dark contrasts. As a consequence, the various openings of 2 will become subject to the action of corresponding control potentials (make-ready or preparation interval). During the balance of the picture scan period, the cathode 1 is illuminated very brightly from an auxiliary source of light, being incidentally caused to yield a definite and powerful electronic current which will homogeneously and uniformly fill the entire cross-section of the frame. This current is no longer focussed upon 2, but by virtue of a suitable variation of the electrode potential it is focussed upon the anode mosaic 3. By virtue of variations of control action produced by the variable charges of the elementary openings of 2 upon the electronic stream flowing therethrough there will then flow, per unit of time, to the elementary anodes of 3 a volume of electricity which varies in accordance with the picture brightness (or the contrast between light and dark). The charge pattern stored up on 3 inside the available length of time is then evaluated by the cathode ray beam as hereinbefore outlined.

What I claim is:

1. A cathode ray tube comprising an envelope, an electron emitting surface in one end of the envelope adapted to produce a flooding stream of electrons, an electron gun structure in the other end of the envelope adapted to produce a concentrated beam of electrons, an electron permeable grid structure intermediate the ends of the envelope upon which a light image is adapted to be projected, said grid structure comprising a plurality of insulated elementary light responsive elements, a mosaic electrode positioned between said grid structure and said electron gun structure comprising a plurality of insulated elements capable of accumulating an electrical charge in accordance with the electrons collected from the flooding stream as determined by the light values projected on the elements of said grid structure, the electron beam being adapted to scan each

element of said mosaic electrode according to a predetermined pattern whereby the charge on each element of the mosaic as produced by the collected electrons from the emitting surface may be removed to produce a series of picture signals.

2. A cathode ray tube comprising an envelope, means in one end of the envelope adapted to produce a flooding stream of electrons, a light responsive electron permeable grid structure upon which a light image is adapted to be projected positioned intermediate the ends of the envelope comprising a plurality of insulated elementary light responsive elements, a mosaic electrode structure positioned adjacent to and parallel with said grid structure and comprising a plurality of insulated elements adapted to assume an electrical charge from the flooding electrons in accordance with the modulation of the flooding stream of electrons as produced by the light values projected on corresponding elements of said grid structure, and means in the other end of the envelope adapted to systematically scan said mosaic electrode structure to produce a series of picture signals.

3. An electron discharge tube comprising an elongated envelope, means in one end of said envelope for producing a stream of electrons of substantially cross-sectional area and having substantially uniform intensity over the entire cross-sectional area, means for accelerating the stream of electrons toward the center of the envelope, an electron permeable grid structure positioned in the path of the electrons, said structure comprising a plurality of insulated elementary light responsive elements adapted to receive a light image whereby a charge image may be produced on the grid structure, an electrode positioned adjacent to and parallel with said grid structure comprising a plurality of insulated elementary condenser elements, the condenser elements of said electrode being adapted to assume an electrical charge from the stream of electrons in accordance with the modulation of the stream of electrons as produced by the charge image on the grid structure, means in the other end of the envelope adapted to produce a concentrated beam of electrons for scanning said electrode to remove the charges on the individual condenser elements, and means to receive the series of charges so removed.

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