

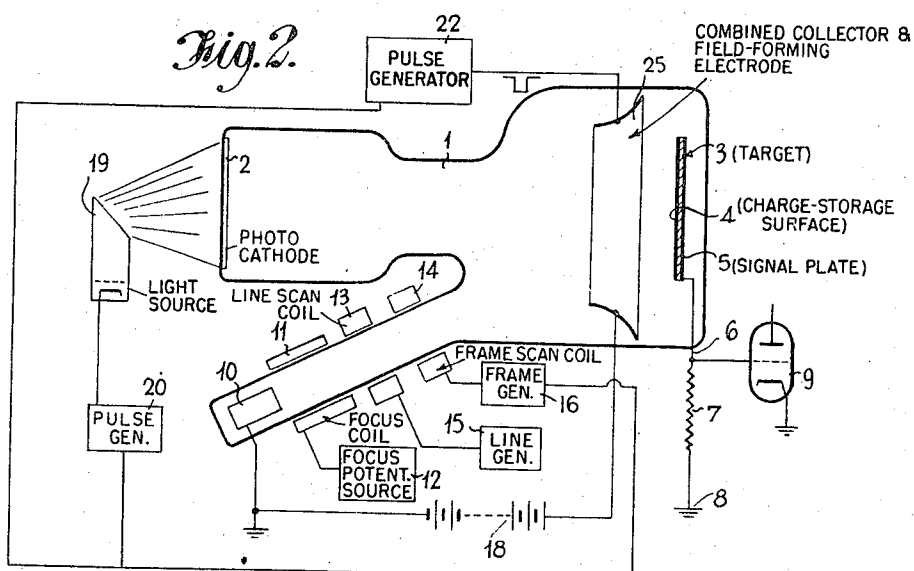
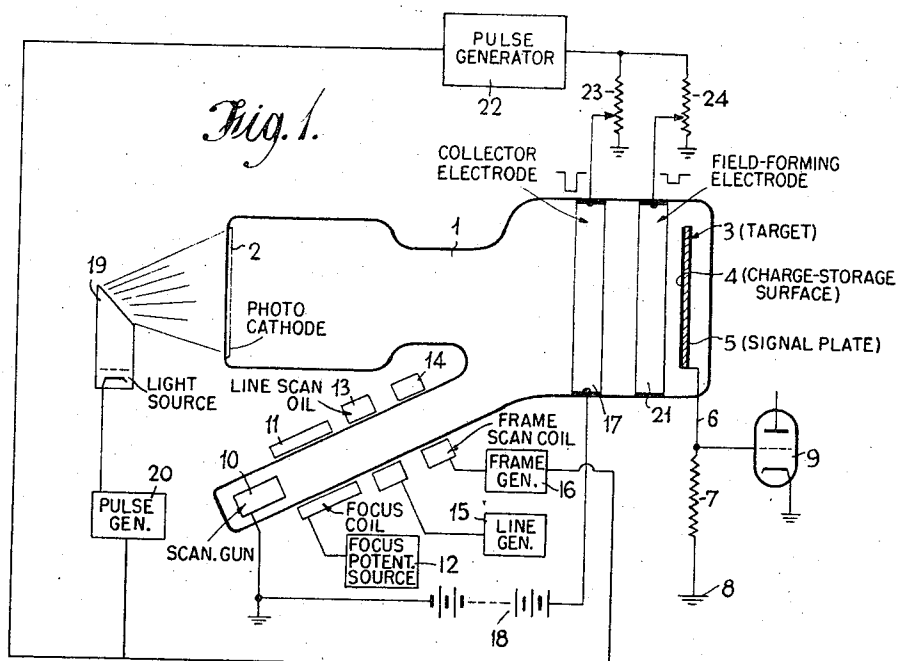
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VIDEO STORAGE TUBES

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VIDEO STORAGE TUBES

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The present invention relates to television pick-up tube arrangements incorporating a video storage tube of the kind employing high-velocity electron scanning, such as those of the type known as "iconoscopes" and "image iconoscopes" and to a method of operating the same for producing a video signal whereby an improved performance is obtained.

Tubes of this kind essentially comprise a target having a storage surface backed by an electrode termed "a signal plate," the storage surface being capable of carrying a charge pattern corresponding to the point-by-point brightness values of a light image focused on the tube. In the case of tubes of the image iconoscope type, the storage surface is secondary-emitting and the tube has a photo-cathode upon which the light image is focused and which, in response thereto, releases photo-electrons which are accelerated and focused on to the storage surface of the target to form the charge pattern by secondary emission from the storage surface. In the case of tubes of the iconoscope type, the storage surface is a photo-sensitive mosaic upon which the light image is focused to form the charge pattern by photo-emission from the storage surface. In either case, the charge pattern on the storage surface is evaluated by a high-velocity scanning beam of electrons the effect of which is to generate a train of signal pulses in the signal plate which constitute the output video signal of the tube. A collector electrode arranged in the tube near the storage surface collects electrons emitted from the storage surface under the action of the incident photo-electrons, in the case of the image iconoscope, or the incident light in the case of the iconoscope, and under the action of the scanning beam. In the normal operation of such tubes, the storage surface is restored at each scanning operation to an equilibrium potential from which the charge storage process starts at each point of the storage surface in accordance with the light value of the corresponding point of the light image. High-velocity electron scanning as employed in such tubes promotes the emission of secondary electrons from the storage surface in excess of unity ratio to the number of primary bombarding electrons and under these conditions the storage surface assumes an equilibrium potential approximating to the operating potential of the collector electrode.

Such video storage tubes suffer from a number of disadvantages and in particular low storage efficiency, generation of spurious signals, production of the visible effect known as "flare" in the reconstituted pictures, and lack of average brightness components in the generated video signal.

It has previously been proposed to minimize the effects of the above-mentioned disadvantages by providing a method and apparatus for producing a video signal utilizing a video storage tube of the kind described in which the operating point of the storage surface is modified. This was effected by submitting the storage surface of the tube, periodically during the flyback periods of the scanning beam and preferably during the frame-flyback

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periods, to the simultaneous and combined actions of an electron irradiation, causing the storage surface to emit electrons, and of a field causing the emitted electrons to return to the storage surface so as to cause the storage surface to be charged negatively relatively to its normal equilibrium potential, that is, to the normal collector potential, whereby the equilibrium potential or average equilibrium potential of the storage surface was changed from that which it would normally attain during the flyback periods, thus modifying the operating point of the tube. In particular, with a tube of the image iconoscope type this prior proposal suggested the irradiation of the storage surface with a pulse of high-velocity diffuse electrons to cause the surface to emit secondary electrons, the pulse of irradiating electrons being generated for example by illuminating the ordinary photo-cathode of the tube with a pulse of diffuse light. In the case of tubes of the normal iconoscope type, the suggestion was to bombard the photo-sensitive storage surface thereof directly with a pulse of diffuse electrons in order to obtain the required potential shift. With both kinds of tube, the required field for returning the emitted electrons to the storage surface was obtained by means applying either a suitable negative voltage pulse to the collector electrode or a positive pulse to the signal plate while the irradiation of the storage surface was proceeding. These proposals are contained in United States Letters Patent No. 2,651,674, filed May 8, 1950, in the name of Richard Theile and entitled "Television Transmission From Intermittent Film By Means of Pulsed Pick-Up Tube" and United States Letters Patent No. 2,733,292, filed May 8, 1950, in the names of John E. Cope and Richard Theile and entitled "System for Correcting the Equilibrium Potential of Storage Tubes." In these proposals it was also arranged that both the electron irradiation pulses and the voltage pulse should be of the same duration and should not be of longer duration than the flyback period during which they are applied. If necessary, blanking pulses were simultaneously applied to a signal amplifier connected to the output of the tube in order to avoid overloading and transient effects.

Although successful in many directions, tubes of the improved kind, mentioned above, do, however, suffer from the disadvantage of a non-uniform accumulation of the charge in the flooding period which is particularly manifested at the centre of the charge storage surface which accumulates most of the charge, this accumulation appearing as a shaded background in the centre of the viewed picture. This effect has been understood to be caused by the secondary emission process involved since, as the field between the signal plate and the collector electrode of the tube is not uniform, the slow secondaries being returned are deflected by the non-uniformity of the field in such a manner as to accumulate most charge at the centre of the screen.

The present invention is more specifically concerned with remedying this disadvantage in tubes of the improved kind referred to.

According to the invention, there is provided a television pick-up tube arrangement of the kind referred to, comprising means for modifying the field between the storage surface and the collector electrode to render said field uniform and thereby effect the re-distribution of the secondary electrons over the storage surface in a substantially even manner. This may be effected either by dividing the collector electrode into a plurality of discrete sections and applying negative voltage pulses of differing amplitude to the various sections, or by shaping and/or disposing the collector electrode so as to produce an appropriate field between the signal plate and the collector electrode.

The preferred embodiment comprises the division of

the collector electrode into a plurality of sections, and applying to the several sections negative voltage pulses of differing amplitudes, and in carrying this embodiment of the invention into effect, the collector electrode sections may be connected to a common pulse generator through a voltage-dividing arrangement so adjusted as to produce a plurality of output pulses of differing amplitudes.

In a preferred arrangement, the collector electrode is divided into two sections, and the voltage divider may comprise a pair of resistors having differing values connected in parallel to the output of a pulse generator arranged to produce a negative pulse of adjustable amplitude whereby negative pulses of differing but constant amplitudes are provided to the sections of the collector electrode.

Preferably the resistors are variable resistors so that the amplitudes of the negative pulses applied to the appropriate sections of the collector electrode may be varied at will to give more positive control.

If desired, one or more of the collector electrodes may be fed with a slightly positive pulse to produce a control, the effect of which can be precisely and easily graduated.

In a modification, instead of sub-dividing the collector electrode, that electrode may have its normal shape and/or disposition varied to bring about the effects required. For example, the collector electrode, which is normally in the form of an annular ring, formed from strip material, may be formed from material having a non-planar section arranged to produce fields in conjunction with a signal plate that evens out the electron flow in the space between the two electrodes.

Alternatively, the collector electrode ring or a portion thereof may be arranged as a section of a cone so as to produce field effects calculated to influence the redistribution of the secondary electrons in the manner aforementioned.

If desired all these expedients mentioned may be provided together.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which show two specific embodiments thereof by way of example and in which

Fig. 1 shows a tube having a divided collector electrode, and

Fig. 2 shows a tube having a single collector electrode suitably shaped so as to produce field effects calculated to influence the redistribution of the secondary electrons in a substantially even manner over the surface of the charge storage plate.

In Fig. 1, the pick-up tube comprises an evacuated glass envelope 1 having a photo-cathode 2 at one end thereof and a target 3 at the other end thereof comprising a charge-storage surface 4 and a signal plate 5, which latter is connected by a lead 6 to a load resistance 7 grounded at 8, the output of the tube being taken across said resistance 7 and amplified in a suitable amplifier, such as tube 9.

The charge-storage surface 4 is arranged to be scanned by means of an electron gun schematically illustrated at 10, the beam from the gun 10 being focussed by focus coil 11 connected to a suitable source of potential schematically illustrated at 12, suitable deflection coils for the beam being shown at 13 and 14 for causing the beam to scan in horizontal and vertical directions in known manner. The deflection coils 13, 14 are connected to appropriate waveform generators 15, 16 in accordance with known practice. The source 12 and the generators 15 and 16 are of a type very well-known in the art and therefore need not be described here.

As is usual in such tubes, a collector electrode is provided at 17 and this electrode is held at a positive potential with respect to the cathode 10, as schematically illustrated by potential source 18. The collector elec-

trode collects the secondary electrons emitted from the charge storage surface 4 under the influence of the light image from the photo-cathode 2.

In the prior proposal employing the negative pulsing technique referred to above, means are provided for periodically pulsing the photocathode 2 with diffuse light from a light source during the frame flyback period and simultaneously with this pulsing the collector electrode is provided with a negative pulse so that a field is produced to cause the electrons emitted from the storage surface to be returned thereto to charge the storage surface negatively relatively to its normal equilibrium potential, that is to the normal collector potential, whereby the equilibrium potential or average equilibrium potential of the storage surface is changed from that which it would normally attain during the flyback periods thus modifying the operating point of the tube.

A similar arrangement is illustrated in Fig. 1 in which there is shown schematically a light source 19 which is arranged to be pulsed on by a pulse generator 20 during the frame flyback period of the tube for producing the effect mentioned above. According to the first embodiment of the present invention, the collector is divided into two discrete sections and both the main collector electrode 17 and the subsidiary collector electrode 21 are given negative pulses during the frame flyback period, the pulses being supplied from pulse generator 22. In order to re-distribute the secondary electrons emitted by the storage surface over the surface in a substantially even manner, the amplitudes of the negative pulses applied to the main collector electrode 17 and the subsidiary collector electrode 21 are different and this may be arranged by providing variable resistors 23, 24 in the lead from the pulse generator 22 and taking connections from the electrode 17 and 21 to these resistors so that the amplitude of the separate pulses may be varied at will. The necessary synchronous relationship between generators 16, 20 and 22 is schematically illustrated by showing said generators joined together in the drawing.

It will be understood that the pulse generators 20 and 22 are connected in circuit with the vertical deflection generator 16 so that the pulses to the light source 19 and to the electrodes 17 and 21 are produced during the frame flyback period as required, but these circuit connections are not shown on the drawings so as to reduce complication thereof.

In Fig. 2, the arrangement is generally the same as in Fig. 1, and therefore like parts are shown with like reference numerals. However, instead of providing a main collector electrode 17 and a subsidiary collector electrode 21, a single collector electrode 25 is shown which is of annular form and located in front of the charge storage surface 4 and is specially shaped with a flared surface facing towards the storage surface so as to produce a field in the vicinity of the charge storage surface so as to influence electrostatically the re-distribution of the secondary electrons in a substantially even manner over the charge storage surface. The actual shape of this collector electrode 25 may take several forms, and apart from the shape shown it may, for example, be arranged as a section of a cone.

It will be apparent that although the invention has been particularly described in connection with tubes of the image iconoscope type, yet nevertheless it can equally well be applied to other high-velocity-scanned storage type tubes such as normal iconoscopes.

I claim:

1. A television pick-up tube arrangement of the kind having a pick-up tube of the charge-storage type employing high-velocity scanning of an insulated charge-storage surface, and a collector electrode to collect secondary electrons emitted by said charge-storage surface during said scanning, and in which periodically during the flyback periods of the scanning beam and preferably during the frame flyback periods said charge-storage surface is

submitted to the simultaneous and combined actions of an electron irradiation causing said storage surface to emit electrons and of a field causing the emitted electrons to return to said storage surface so as to cause said storage surface to be charged negatively relatively to its normal equilibrium potential, characterized by the provision of field-modifying electrode means located adjacent and in front of said charge-storage surface rendering the field between said storage surface and said collector electrode substantially uniform to effect the redistribution of the secondary electrons over the storage surface in a substantially even manner.

2. A television pick-up tube arrangement as claimed in claim 1 in which said field-modifying electrode means and said collector electrode are combined into one structural element of substantially annular form arranged round the inside walls of the tube and which is flared outwardly towards the said charge-storage surface.

3. A television pick-up tube arrangement of the kind having a pick-up tube of the charge-storage type employing high-velocity scanning of an insulated charge-storage surface, and a collector electrode to collect secondary electrons emitted by said charge-storage surface during said scanning, and in which periodically during the fly-back periods of the scanning beam and preferably during the frame flyback periods said charge-storage surface is submitted to the simultaneous and combined actions of an electron irradiation causing said storage surface to emit electrons and of a field causing the emitted electrons to return to said storage surface so as to cause said storage surface to be charged negatively relatively to its normal equilibrium potential, characterised in that said collector electrode comprises a plurality of discrete sections, and in that means are provided for applying negative voltage pulses of differing amplitude to the various sections, so as to effect a substantially even redistribution of secondary electrons over said storage surface.

4. An arrangement as claimed in claim 3, in which said collector electrode has two sections, both of annular form and arranged in axially-spaced relationship around the inside walls of the tube on the side of the charge storage surface that is scanned by the scanning beam.

5. An arrangement as claimed in claim 4, and comprising further a negative pulse generator, means for connecting said collector electrode sections to said generator and a resistor in each of said connecting means, said resistors having different values.

6. An arrangement as claimed in claim 4 and comprising further a negative pulse generator, means for connecting said collector electrode sections to said generator, and a variable resistor in each of said connecting means.

7. Television pick-up tube apparatus of the kind comprising a television pick-up tube of the high-velocity-scanned image iconoscope type that has a photo-cathode and an insulated charge-storage surface between which is arranged a collector electrode, and means for illuminating said photo-cathode with a pulse of diffuse light during the frame flyback periods of operation of said tube, characterized in that said collector electrode comprises two discrete portions and in that means are provided for applying to said portions of said collector electrode negative pulses of differing amplitude also during said frame flyback periods.

8. Television pick-up tube apparatus of the kind comprising a television pick-up tube of the high-velocity-scanned image iconoscope type that has a photo-cathode and an insulated charge-storage surface between which is arranged a collector electrode, a diffuse light source located outside said tube for illumination of said photo-cathode, and a pulse generator connected to said light source for pulsing said light source "on" during the frame-flyback periods of operation of said tube, characterised in that said collector electrode comprises two discrete portions, in that two resistors of different values are located outside said tube connected respectively by one of their ends to said collector electrode portions, and in that a generator of negative pulses is connected commonly to the other ends of said resistors, said generator being operative to supply negative pulses to said collector electrode portions via said resistors during only the said frame flyback periods.

9. Television pick-up tube apparatus as claimed in claim 8, in which said resistors are variable resistors.

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