June 9, 1953 P. T. FARNSWORTH 2,641,723

TELEVISION IMAGE ANALYZING TUBE

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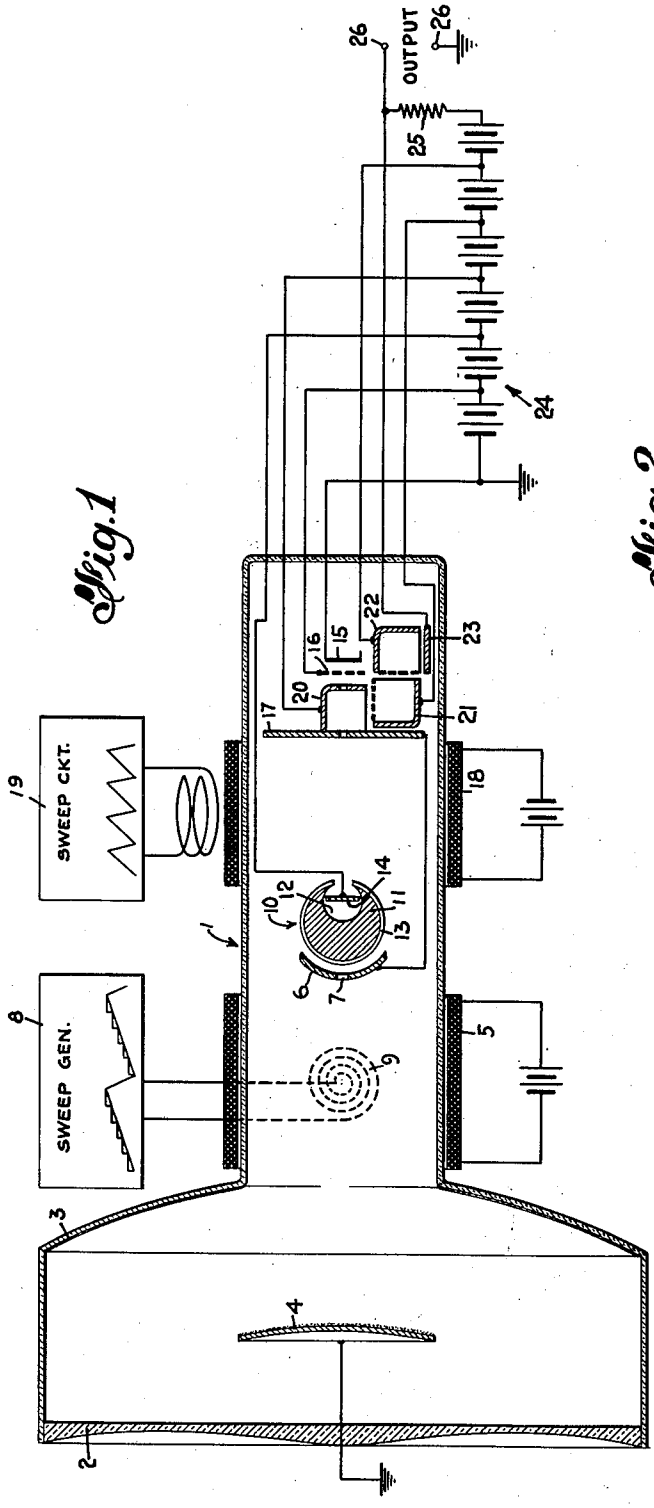

Fig. 1

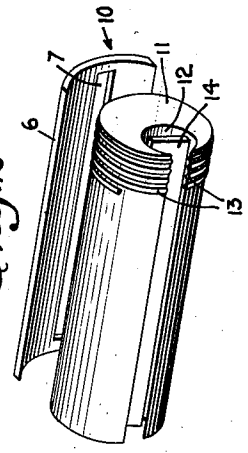

Fig. 2

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TELEVISION IMAGE ANALYZING TUBE

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7 Claims. (Cl. 313—65)

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This invention relates to television image analyzing tubes and more particularly to improvements in television transmission systems utilizing a particular form of image analyzing tube construction.

Various types of image analyzing tubes have been proposed wherein a signal representing portions of an image to be transmitted are superimposed upon a storage electrode, which may be of the mosaic type or the like. In a prior patent, Reissue No. 22,009, granted January 20, 1942, there is shown an example of the prior art type of tube known as the image dissector. In accordance with this system an image is imposed upon a photo-electric cathode producing a so called electron image. This image is scanned past a slotted opening so that one line at a time of the picture is impressed upon a storage element which may constitute a secondary emissive element aligned with the slot. The storage element takes on a charge dependent upon the emitted secondary electrons and a thermionic cathode is provided to emit further electrons which may be controlled by the voltages produced in the storage means so that an amplified line of the electron image is produced for each scanning position.

In a second patent of the known prior art, namely, U. S. Patent No. 2,292,111, granted August 4, 1942, there is shown a second type of prior art image analyzing tube wherein lines of an electron image are selectively stored on an elongated storage electrode of the secondary emissive type and this storage electrode is then scanned in synchronism with the line images by an electron beam which produces secondary emission for providing at a target an amplified image signal.

While these prior art systems will provide a satisfactory image analyzing system it is desired to increase amplification where possible without use of excessive additional power. It is clear that in the systems as described an additional thermionic emitting cathode is required in one form of the system. In the arrangement utilizing the scanning beam and secondary emission there is not as high a degree of control of the emitted electrons as may be desired and furthermore, there exists considerable interaction between the electrons thus emitted and those emitted upon initial application of the image signals for storage purposes.

It is an object of this invention to provide an image analyzing tube of the type in which an image signal charge is formed on an elongated

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storage electrode corresponding to the lines of the picture to be analyzed and mounted within the field of influence of the charges on this element a highly secondary emissive electrode is provided which may be scanned by an electron beam to release a plurality of electrons strongly influenced by the storage charges.

In accordance with my invention I provide an image analyzing tube for transmitting the successive lines of an image signal including an elongated storage element, this storage element preferably being unbiased from external sources and carrying a group of spaced conductors. This elongated storage element is provided with an aperture on one side and mounted within the aperture is an elongated secondary emissive electrode. An electron beam source is directed toward this electrode and is provided with means for successively scanning the beam along the electrode producing discrete limited cathode sources of emitted electrons during the scansion. A large number of electrons may be emitted from the electrode at the point where the beam is striking and these electrons will be strongly influenced by the storage charges so that they will provide an amplified image signal distributed at the collector electrode. There may be provided within the tube structure an amplifier, for example, of the multiplier type, for receiving and still further amplifying the image signal currents.

The above mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic diagram partly in section of an image analyzing tube in accordance with my invention together with the operating circuits therefor; and

Fig. 2 is an enlarged perspective view showing the construction of the control element and the secondary emissive electrode of the tube of Fig. 1.

Turning now to the drawing, there is illustrated an image analyzing tube 1 shown by way of example as a so called Schmidt tube. The image to be transmitted is focussed by some well known optical system through the lens 2 to a reflecting surface and from there to a photo-emissive cathode 4. The light image focussed on cathode 4 will produce an area of electrons producing a beam having a cross-section varying in accordance with the light and shade of the picture, thus forming what is called an electron

image. A focussing coil 5 is provided around a portion of tube 1 properly to focus the electron image for application to the anode 6. In anode 6 is provided a slot aperture 7 corresponding to the width of the line to be transmitted. A first sweep generator 8 and deflection coil 9 is provided to scan the electron image past aperture 7. Thus successive image signal lines passing through aperture 7 will be impressed upon control electrode 10. Control electrode 10 is preferably made cylindrical as shown and comprises an insulating supporting element 11 which is formed with a longitudinal recess 12 on its side away from aperture 7. Mounted substantially around cylinder 11 are a plurality of open conductor rings 13 which are separate from each other with the open ends thereof extending partially over the recess 12 to provide a restricted aperture. An elongated secondary emissive electrode 14 is mounted within the recess 12 with its surface parallel with the restricted aperture between the ends of conductors 13.

An electron gun is provided within the envelope of tube 1 comprising a cathode 15, a control grid 16 and an accelerating anode 17. The beam from this electron gun is directed to impinge upon secondary emitted electrode 14 between the conductor ends. A focussing coil 18 is provided to maintain this electron beam in proper form and a second sweep circuit 19 is provided to sweep the beam from the gun along the length of secondary emissive electrode 14. The secondary electrons emitted from electrode 14 are directed toward anode 17 and follow along the exciting beam through the aperture in electrode 17 and in the electron multiplier formed by elements 20, 21 and 22 and collector electrode 23. A suitable potential controlling battery is shown at 24 for furnishing the necessary operating potentials for the various electrodes of the system. Output energy from final output electrode 23 is applied over load resistor 25 to output terminals 26.

It will be apparent from the structure as defined above that line by line scanning of the electron image will produce successive storage effects on storage electrode 10. For any one signal line storage thereon, charges will be developed across the aperture between the ends of conductors 13 by reason of these conductors. As the electron beam is scanned along secondary emissive electrode 14 electrons will be emitted and will tend to travel along the beam toward the anode 17. However, the amplitude of current passing back to the anode electrode 17 will depend in a large part on the charges stored in the conductors 13 of the elongated control electrode 10. Because of the large emission of the secondary electrons due to the beam striking electrode 14 an amplified signal corresponding to points of the image to be analyzed will be impressed upon target 17 and the electron amplifier for final transmission. It will be realised that the beam in scanning along the secondary electrode produces in effect a virtual cathode of limited area for each point of impingement. An effective control grid is produced by the stored charges on electrode 10 so that in effect there is provided an amplifying triode which produces an amplified signal energy. The intensity of the stream admitted to the multiplier is considerably stronger than could be obtained from image analyzers known to the art. In addition, the photo electric emission from the photo cathode elements will be directed to each of the floating grid wire conductors for a period longer than emission from a single elemental area of the cathode as used in the conventional dissector.

Thus because of the longer period of control and the greater degree of amplification a much smaller number of stages of electron multiplication are required in the amplifier to achieve the desired value of signal. Accordingly, a greatly improved signal-to-noise ratio results.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention.

What I claim is:

1. An image analyzing tube for transmitting successive lines of an image signal comprising an elongated control storage element, signal means to establish successive voltage charges along said control element corresponding with the image signal lines, an elongated secondary emissive electrode mounted in the field of influence of said control element and shielded from said signal means, an electron beam source directed toward said electrode, means for successively scanning said beam along said secondary emissive electrode to release secondary electrons whereby a cathode source under the influence of said field of influence is provided and means for collecting said released secondary electrons.

2. A system according to claim 1, wherein said elongated control storage element comprises a cylindrical element having an opening along one side thereof, and a plurality of separate conductors mounted along the length thereof and extending over a part of said opening, said secondary emissive electrode being mounted within said opening behind said conductors.

3. In an image analyzing tube of the type wherein an electron image is scanned past an elongated control storage element to provide thereon successive distributed voltage charges corresponding with lines of an image, and an electron beam is linearly scanned along the length of said element for each of said successive distributed voltage charges, an arrangement for producing image signals corresponding to desired picture signals comprising a secondary emissive electrode mounted within the field of influence of said elongated control electrode and in the path of scan of said electron beam, and means for collecting secondary electrons emitted from said electrode.

4. An image analyzing tube according to claim 3, wherein said elongated control storage element comprises a cylindrical element having an opening along one side thereof and a plurality of separate conductors mounted along the length thereof and extending over a part of said opening, said secondary emissive electrode being mounted within said opening behind said conductors.

5. An image analyzing tube comprising a storage element mounted to receive and store said image line signals, said element having an opening along its length and provided with separate conductors mounted along its length and extending over a part of said opening, an elongated secondary emissive electrode mounted within said opening adjacent said conductors, an electron beam source directed toward said electrode, a scanning means for successively scanning said beam over said electrode to release secondary electrons within the field of influence of said stored image line signals, and a collector for collecting said released secondary

electrons to provide successive amplified image line signals.

6. An image analyzing tube comprising means for producing an electron image, a first anode provided with a slot aperture positioned to extend across the face of said electron image, a scanning means for scanning said image signals past said aperture to provide successive image line signals, an elongated storage element mounted adjacent said slotted aperture successively to receive and store said image line signals, said element having an opening along its length facing away from said aperture and being provided with separate conductors mounted along its length and extending over a part of said opening, an elongated secondary emissive electrode mounted within said opening adjacent said conductors, an electron beam source directed toward said electrode, a second scanning means for successively scanning said beam over said electrode to release secondary electrons within the field of influence of said stored image line signals, and a collector for collecting said released secondary electrons to provide successive amplified image line signals.

7. An image analyzing tube comprising a photo emissive cathode, means for focussing a light image onto said cathode, a first anode provided with a slot aperture positioned to extend across the image signals emitted from said cathode, a scanning means for scanning

said image signals past said aperture to provide successive image line signals, a cylindrical storage element mounted adjacent said slotted aperture successively to receive and store said image line signals, said element having an opening along its length facing away from said aperture and being provided with separate conductors mounted along its length and extending over a part of said opening, an elongated secondary emissive electrode mounted within said opening adjacent said conductors, an electron beam source directed toward said electrode, a second scanning means for successively scanning said beam over said electrode to release secondary electrons within the field of influence of said stored image line signals, and a collector for collecting said released secondary electrons to provide successive amplified image line signals.

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2,303,930	Gray	Dec. 1, 1942