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CATHODE-RAY STORAGE TUBE

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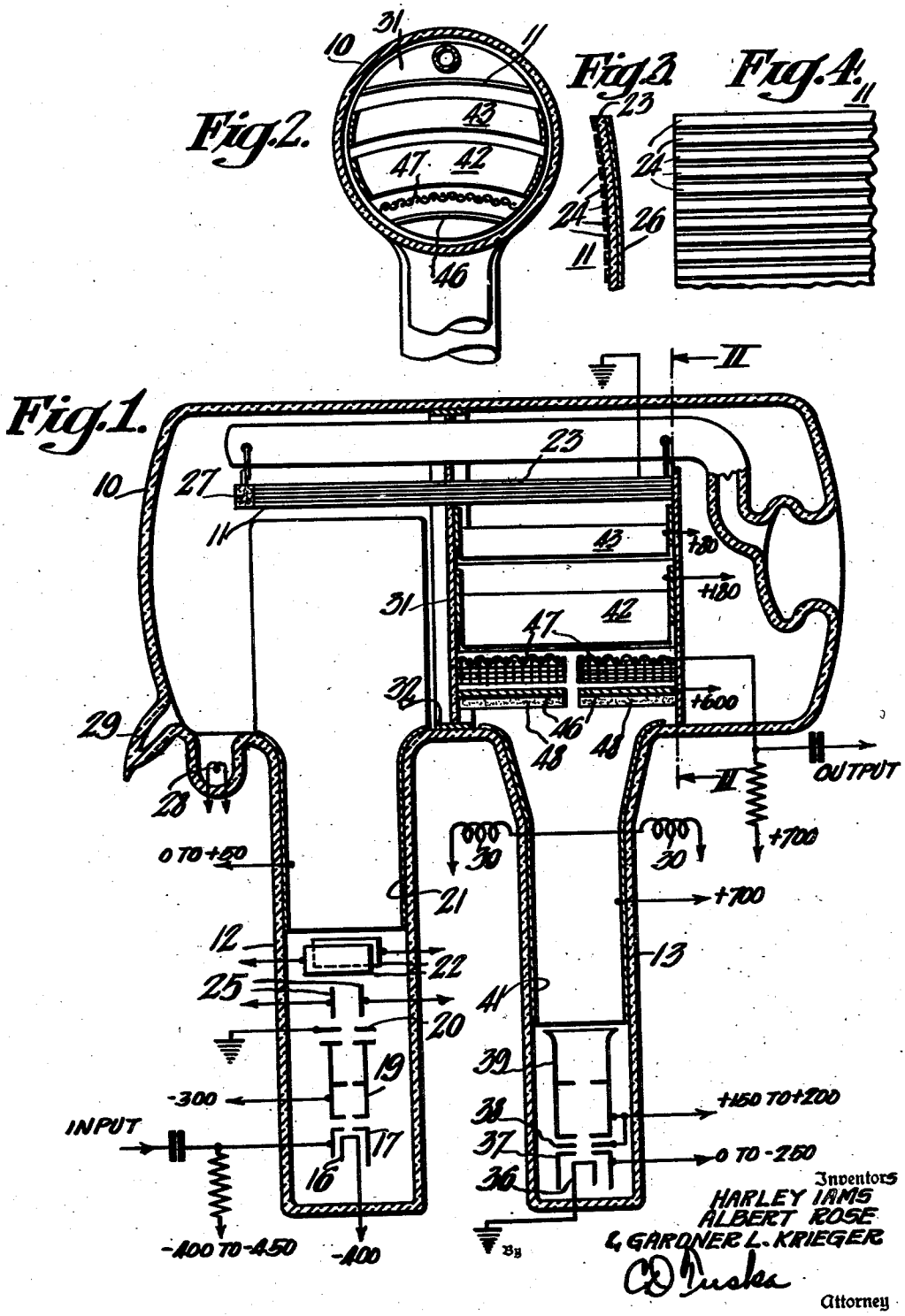

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CATHODE-RAY STORAGE TUBE

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9 Claims. (Cl. 250—150)

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Our invention relates to cathode ray tubes and particularly to tubes of the type having a signal storage screen which is scanned by a cathode ray beam. More specifically, the invention relates to signal storage tubes in which a signal is put on the storage screen by one electron beam and taken off the screen by a second electron beam.

An object of the invention is to provide an improved tube of the above-described type.

Another object of the invention is to provide a tube of the above-described type wherein the storage elements of the storage screen each have comparatively large capacity so that they can store a substantial amount of energy when raised to a potential of only a few volts.

Still another object of the invention is to provide a tube of the above-described type which is of simple mechanical construction and which also has the desired electrical characteristics.

In one preferred embodiment of the invention the storage screen comprises capacity or storage elements formed by a large number of horizontal strips of platinum or other metal on the scanned side of the screen. Two electron guns are positioned opposite the screen and separate deflecting means are provided for deflecting each electron beam vertically across the metal strips. Thus, one beam may be utilized to put a signal on the screen and the other beam may be utilized to take the signal off the screen. By deflecting the two electron beams at different rates, the frequency of the signal may be increased or decreased as desired. By deflecting the beams in different time relations, the output signal may be delayed with respect to the input signal. Preferably, the "put-on" and "take-off" beams are high and low velocity beams, respectively.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which

Figure 1 is a plan view, partly in section, of one tube embodying the invention.

Figure2 is a view taken on the line II—II in Fig. 1, and

Figures 3 and 4 are fragmentary views, in plan and section, respectively, of the storage screen or target in the tube of Figs. 1 and 2.

Referring to the drawing, the tube comprises a highly evacuated envelope having a bulb portion 10, in which a storage screen 11 is mounted, and having two neck portions 12 and 13 in which are mounted a high velocity beam "put-on" gun and a low velocity "take-off" gun, respectively.

The high velocity and low velocity electron guns may be of well known types such as those

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employed in the high velocity beam and low velocity beam television pick-up tubes known as the iconoscope and the orthicon, respectively. In the example illustrated, the high velocity gun comprises a cathode 16, a control grid 17, a first anode 19 and a second anode 20. A collector electrode 21 is provided to collect secondary electrons from the storage screen 11. Vertical deflection of the "put-on" beam may be produced by means of a pair of deflecting plates 22. Horizontal deflecting plates 25 may be provided for a preliminary beam focusing adjustment as described hereinafter. Operating voltages that may be applied to the various tube electrodes are indicated on the drawing merely by way of example.

The storage screen 11 may be constructed in various ways. One of the preferred constructions, shown more clearly in Figs. 3 and 4, comprises a supporting sheet of mica 23 about 0.001 inch thick which has conducting strips or lines 24 extending horizontally across the screen. These strips may be formed, for example, by sputtering a conducting coating of platinum upon each side of the mica sheet and then scratching about 100 lines to the inch on the front or scanned side with a ruling machine to separate the metal into conducting lines. The metal coating 26 on the back side of the mica sheet may be used as the signal plate for taking off the signal, if desired. A strip of fluorescent material 27 may be put on an edge of the target to aid in focusing the electron beam.

A silver evaporator 28 is provided to coat the screen during the processing of the tube to make the secondary emission uniform over the whole line surface. The amount of silver introduced is too small to make the space between the lines 24 conducting. A small amount of caesium may also be supplied through a tube 29 to make sure that the ratio of secondary electrons to primary electrons is greater than unity. Since it is preferred that the screen 11 shall not be photoelectric, no oxidizing step preceding the introduction of caesium is required, as would be the case in processing a mosaic screen for an iconoscope.

The screen 11 when mounted in the tube preferably is curved to conform to the surface of a cylinder having an axis that passes through or near the centers of deflection of the two electron beams whereby the point of smallest beam diameter is always at the screen surface as the beam is deflected and whereby the beams during deflection are substantially at right angles to the screen surface where the beam strikes. The latter feature is important in the operation with a low velocity beam.

In operation, the incoming signal is applied to the control electrode 17 to modulate the intensity of the high velocity beam as it is deflected vertically across the conducting strips. The number of secondary electrons liberated from the strips exceeds the number of beam electrons and, since substantially all of the secondary electrons are drawn over to the collector electrode 21, they are not redistributed over the target. Hence, the bombarded strips 24 are given a more positive potential.

At the other end of the screen 11 the conducting strips are scanned by deflecting the low velocity beam vertically by means of a deflecting coil 30, for example. The electrons of this beam strike the conducting strips 24 with a velocity so low that the ratio of secondary electrons to primary or beam electrons is less than unity. According to one preferred method of operation, sufficient beam current is provided to return the conducting lines to the potential of the cathode supplying the low velocity beam. Thus the signal put on by the first beam is substantially completely "wiped off" by a single scanning of the second beam. Under certain conditions it may be desired to operate the tube with a low velocity beam of less current density so that the beam removes only a small percentage of the stored signal as it scans once across the screen. The beam current may be reduced by applying a more negative bias to the control electrode 37 referred to below. At the same time it may be desirable to reduce the amplitude of the signal that is modulating the high velocity beam.

The output signal produced by this "wiping off" may be derived from an electrode or from an electron multiplier receiving the unused electrons of the "take-off" beam as they return from the screen 11. These methods of taking off a signal from a storage screen are well known in connection with iconoscopes and orthicons. If the second method of taking off the signal is employed, the tube is provided with a mica partition 31 to prevent secondary electrons produced by the "put-on" beam from reaching the electron multiplier or collector electrode at the other side of the tube. Also, a ring electrode 32 near the partition may be provided and held at a negative potential to repel any secondary electrons that might otherwise get past the partition.

In the example illustrated, the low velocity beam electron gun comprises a cathode 36, a control electrode 37, a screen grid 38, a first anode 39 and a second anode 41. Two frame-like electrodes 42 and 43 are positioned between the second anode 41 and the screen 11 for slowing down the electrons after they leave the region of the second anode.

If the signal is to be taken off by an electron multiplier a secondary electron emissive plate 46 is provided, the plate having a slit through which the electron beam passes. A wire screen 47, also having a slit through which the beam passes, collects the electrons released from the secondary emissive plate. It will be understood that the screen 47 may be omitted and the signal taken off by the plate 46 without electron multiplication, if desired. In either case, electrons in the low-velocity beam which are not used in discharging the screen elements 24 are reflected, and may be made to strike the multiplier plate either by use of a magnetic field (not shown) at right angles to the magnetic deflection field provided by the coil 30 or by positioning the axis of the electron gun at a slight angle with respect to the perpendicular to the screen 11.

Proper focusing of the high velocity electron beam is greatly facilitated by applying a steady deflecting voltage to the deflecting plates 25 to make the beam strike the strip of fluorescent material 27. The size of the beam spot can then be observed so that the electrode voltages can readily be adjusted to obtain a spot of minimum diameter.

Proper adjustment of the vertical deflecting coils at the low velocity beam side of the tube is facilitated by applying a coating 48 of fluorescent material to the side of the plate 46 facing the electron gun. The fluorescent coating 48 makes it possible to observe whether the vertical trace of the beam is exactly vertical and whether it is centered to deflect along the slit in the plate 46 so that all of the beam will pass through the slit.

We claim as our invention:

1. A signal storage tube that comprises a storage screen comprising a multiplicity of discrete parallel conducting strips which have a secondary emissive ratio greater than unity when scanned by a high velocity beam, means for scanning transversely across said strips by a high velocity electron beam, means for collecting secondary electrons released by said beam, means for scanning transversely across said strips by a low velocity beam with the electrons striking said strips with a velocity so low that the ratio of secondary electrons to beam electrons is less than unity, means for modulating one of said beams by an input signal whereby it is stored on said screen, and means for collecting the signal removed from the screen by the other beam.

2. A signal storage tube that comprises a storage screen comprising a multiplicity of discrete parallel conducting strips which have a secondary emissive ratio greater than unity when scanned by a high velocity beam, means for scanning transversely across said strips by a high velocity electron beam, means for modulating said beam by a signal, means for collecting substantially all of the secondary electrons released by said beam, means for scanning transversely across said strips by a low velocity beam with the electrons striking said strips with a velocity so low that the ratio of secondary electrons to beam electrons is less than unity, and means for collecting the signal obtained by said low velocity beam scanning.

3. A signal storage tube that comprises a storage screen comprising a multiplicity of parallel conducting strips, means comprising an electron gun for scanning transversely across said strips, means for modulating said beam by a signal, means comprising a second electron gun for scanning transversely across a different portion of said strips, and means for collecting the signal obtained by said last beam scanning, said screen being curved to conform substantially to the surface of a cylinder having its axis passing through the centers of deflection of said beams, the conducting strips being substantially parallel to said axis.

4. The invention according to claim 3 wherein there is a strip of fluorescent material on said screen at right angles to said strips and at one side of the screen area scanned by a beam during operation of the tube, and means for deflecting the high velocity beam to make it strike said fluorescent material whereby the beam spot may be observed to facilitate beam focusing.

5. A signal storage tube that comprises a storage screen comprising a multiplicity of parallel conducting strips, means comprising an electron gun for deflecting a high velocity electron beam transversely across said strips, means for modulating said beam by a signal, means comprising an electron gun for scanning transversely across a different portion of said strips, means for collecting the signal obtained by said last beam scanning, said screen being curved to conform substantially to the surface of a cylinder having its axis passing through the centers of deflection of said beams, the conducting strips being parallel to said axis, and a strip of fluorescent material on said storage screen transverse to said conducting strips in a region that is not struck by an electron beam during the tube operation, and means for deflecting and holding said high velocity beam upon said fluorescent strip to facilitate focusing of the beam.

6. A storage tube that comprises a storage screen comprising a multiplicity of discrete secondary electron emissive capacity elements, means for scanning transversely across said elements by a high velocity electron beam, means for modulating said beam by an input signal whereby the signal is stored on said screen, means for scanning transversely across said elements by a low velocity beam having sufficient current density to remove substantially all the stored signal from said screen, and means for collecting the signal obtained by said last scanning.

7. A signal storage tube that comprises a storage screen comprising a multiplicity of parallel conducting strips, means comprising an electron gun for deflecting a high velocity electron beam transversely across said strips, means for modulating said beam by a signal, means comprising an electron gun for deflecting a low velocity electron beam transversely across a different portion of said strips, means for collecting the signal obtained by said last beam scanning, said low velocity beam having sufficient current density to remove the stored signal completely from said screen, said screen being curved to conform substantially to the surface of a cylinder having its axis passing through the centers of deflection of said beams, the conducting strips being substantially parallel to said axis.

8. A signal storage tube having a bulb portion and two neck portions, a storage screen located in said bulb portion, said screen comprising a multiplicity of parallel conducting strips which, at one end of the bulb portion, have a secondary emissive ratio greater than unity when scanned by a high velocity beam, means in one of said neck portions for scanning transversely across said strips by a high velocity electron beam, means for collecting secondary electrons released by said beam, means in the other of said neck portions for scanning transversely across said strips at the other end of the bulb portion by a low velocity beam with the electrons striking said strips with a velocity so low that the ratio of secondary electrons to beam electrons is less than unity, a partition separating the two end portions of the bulb portion, means for modulating one of said beams by an input signal whereby it is stored on said screen, and means for collecting the signal removed from the screen by the other beam.

9. A signal storage tube having a bulb portion and two neck portions, a storage screen located in said bulb portion, said screen comprising a multiplicity of parallel conducting strips which, at one end of the bulb portion, have a secondary emissive ratio greater than unity when scanned by a high velocity beam, means in one of said neck portions for scanning transversely across said strips by a high velocity electron beam, means for collecting the secondary electrons released by said beam, means in the other of said neck portions for scanning transversely across said strips at the other end of the bulb portion by a low velocity beam with the electrons striking said strips with a velocity so low that the ratio of secondary electrons to beam electrons is less than unity, a partition separating the two end portions of the bulb portion, means for modulating said high velocity beam by an input signal whereby it is stored on said screen, and means for collecting the signal removed from the screen by the low velocity beam, said low velocity beam having sufficient current density to remove the stored signal completely from the storage screen.

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