June 24, 1952 L. PENSAK 2,601,452

CATHODE-RAY STORAGE TUBE

Filed Sept. 27, 1946

Fig. 1

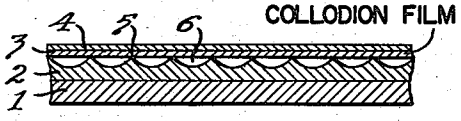


Fig. 2

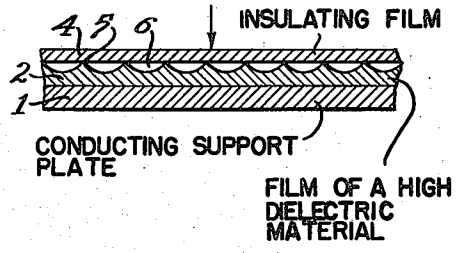
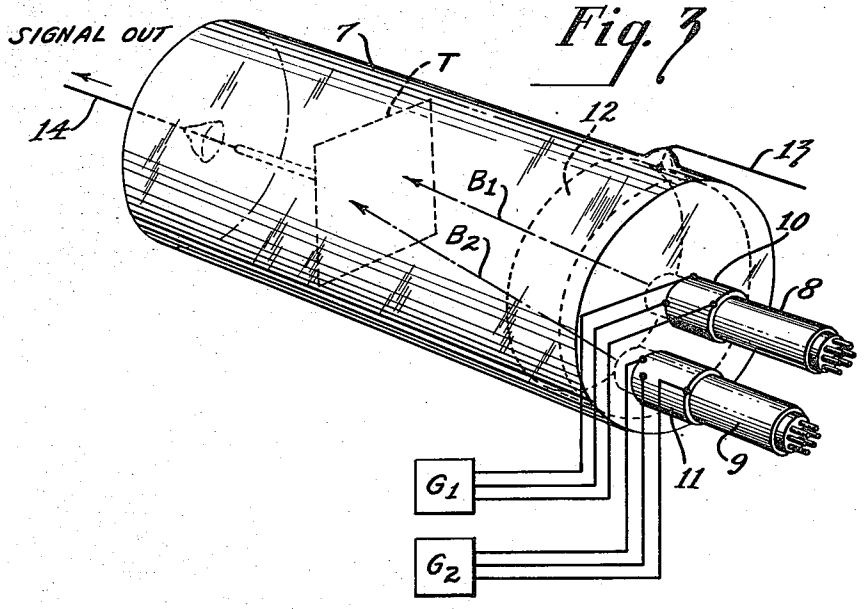


Fig. 3



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Patented June 24, 1952

2,601,452

UNITED STATES PATENT OFFICE

2,601,452

CATHODE-RAY STORAGE TUBE

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Application September 27, 1946, Serial No. 699,713

7 Claims. (Cl. 315—13)

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This invention relates to cathode ray storage tubes for use in position and direction finding and more particularly to targets for such tubes.

It is an object of this invention to provide electrical means for storing and viewing cathode ray beam traces for some time after the trace is completed as an improvement over existing methods using fluorescent materials having an appreciable afterglow.

Another object of the invention is to provide a means of viewing stored cathode ray beam traces at higher light level than is possible with fluorescent materials of the afterglow type.

Another object of the invention is to provide a means of adjusting the time of storage of such traces at will.

Another object of this invention is to provide a novel target for storage of cathode ray signals in a radar system which may be converted to visible indications in a standard television or other design tube.

Another object of the invention is to provide a signal target capable of more efficient use in storage tubes.

Another object of the invention is to provide a signal target having a layer adapted to emit secondary electrons when bombarded by the take-off beam, and to reduce the escape of secondary electrons when bombarded by the put-on beam.

Another object is to provide a signal target which emits electrons under bombardment of a beam of predetermined velocity and which will have reduced emission of electrons under bombardment of a beam of higher velocity.

Another object of the invention is to provide a target capable of storing large signal charges in one scansion of the beam which are adapted to be removed by another beam in repeated scansions thereof.

Other objects of the invention will appear in the following description with reference to the drawing, in which:

Fig. 1 is an enlarged section of a part of the improved target diagrammatically illustrating the structure of the target in an intermediate stage of construction;

Fig. 2 is a similar section illustrating the target after it has been completed; and

Fig. 3 is a perspective view of a tube embodying the invention.

Referring to Fig. 1 the target T comprises a metal plate 1 over which is laid a layer 2 of material having a high dielectric constant and several times thick enough to stop the penetration of the electrons of a 5,000 volt beam of a cathode ray tube in order to avoid leakage of electrons through to the plate 1. Material comprising titanates such as a mixture of pulverized barium and strontium titanate crystals will be found satisfactory for this purpose. The mixture may be suspended in solution and settled on the metal, dried and baked, as is well known in the art.

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The titanate layer 2 is then covered by a thin film 3 of collodion. This may be applied by immersing the target in a liquid such as water and applying a drop or so of collodion. The latter spreads out over the liquid as an extremely thin layer and upon raising the target to and above the surface the collodion is deposited on the titanium oxide as a thin film supported by the tops of the titanate crystals. A silicon dioxide film 4 (SiO_2) is next condensed from vapor onto the target. Subsequent heat treatment of a tube containing my improved target appears to liquefy the collodion film and the silicon dioxide film settles onto the peaks 5 and adheres thereto. The collodion ultimately vaporizes and is pumped out during the evacuation of the tube. The final structure of the tube is thus as shown in Fig. 2. As thus made the silica layer is in contact with the crystal peaks 5 and is spaced as at 6 from the recesses between the peaks. This is an important feature of the invention as it permits the trapping of secondary electrons in the space which leak to the silicon layer only at the peaks 5 as later explained. The peaks 5 may be close enough together so that there are several in an area the size of a focused beam spot but the percentage of the titanate area in contact with the silica at the peaks will be small.

The target T may be mounted in any way in the envelope 7 of the tube (Fig. 3) which may be similar to the well known iconoscope but it has two guns 8 and 9 instead of one. Each gun may have the well known cathode, grid and first anode (not shown). One gun, say 8, may constitute the put-on beam of a radar tube. By the term put-on beam it is meant that the incoming echo signals from distant objects are applied to the grid of the gun and the beam B_1 applies these signals to target T. The gun 9 produces the take-off beam. Electromagnetic units 10 and 11 accomplish the desired type of line and frame scansions. Each of these may comprise coils having fields at right angles to each other and to the axis of the respective

tubes. Electrostatic scanning may also be used for each gun when desired.

The deflection unit 10 is connected to a suitable source such as saw tooth generators G_1 to provide scanning of the target by the put-on beam in the pattern of radial lines starting out from the center and changing direction slowly as by rotation of the deflection yoke, one revolution taking several seconds. The deflection unit 11 is connected to a suitable source such as saw tooth generators G_2 to provide a television scan, say 30 frame scans per second. These scanning rates are illustrative of one method of operation of the tube with the novel target and, of course, other scanning types and rates may be used as may be desired.

The put-on beam may operate at 5,000 volts velocity at the target or higher. The take-off beam may operate at a lower voltage such as 1,000 volts velocity at the target. The intensity of the take-off beam is also a small fraction of that of the put-on beam B_1, varying with the time of storage desired.

In operation the electrons of the put-on beam B_1 modulated by the echo signals and having the 5,000 volt velocity are able to penetrate the silica layer 4 but are stopped by the dielectric layer 2. Any secondary electrons generated by the stopped electrons cannot escape back through the silica layer because they are of relatively low velocity. Some are collected on the inside surface of the silica layer which repels the others back to the surface of the titanate. Thus, the beam B_1 builds up a relatively heavy charge pattern over the target beneath silica layer 4. Due to the high dielectric constant of the titanate layer these charges are stored at relatively low potentials. The electrons of beam B_2 have relatively low velocity and are unable to penetrate the silica layer and therefor the secondaries produced thereby are on the outside of this layer and are collected by the ring anode 12.

It is apparent that the take-off beam, operating alone, would produce a condition of equilibrium on which the outer surface of the target would charge up to the potential of collector anode 12, and the current in conductor 13 would be constant with unity ratio of secondary to primary electrons because of the lack of collecting field. When beam B_1 puts a signal charge pattern under the silica layer 4 it lowers the potential of the silica so that the secondary electrons produced by the beam B_2 can now be collected. During each scansion of the beam B_2 a small part of the charge trapped under the silica film leaks off through the peaks 5 and is removed by secondary emission from the silica layer. It requires a multiplicity of scansions by the beam B_2 to remove the charge laid down by one scansion of beam B_1 before equilibrium is restored. Thus, the echo signals are stored by beam B_1 and are removed only by repeated scannings of beam B_2.

The output of the pick-up tube may be obtained either from the secondary electron current in conductor 13 or in conductor 14 connected to signal plate 1 of target T as will be understood by those skilled in the art. This output curent is then transmitted to a viewing cathode ray tube operating in synchronism with the take-off beam and visual signals produced thereby.

Since the take-off beam B_2 is of low intensity the fractional removal of the signal charges will produce outgoing signals during a multiplicity of scansions and therefore a bright image may be built up on the viewing tube during the charge removal. Due to "burning" and other characteristics of phosphors especially those with afterglow, greater luminosity may be obtained at the screen of the kinescope when the signals are applied a fractional part at each rapid scansion rather than when applied all at one slow scansion. Therefore, my improvement permits one to pick up radar type signals and transmit them to a receiver with better illumination on the screen of the kinescope. Since the phosphorescence of a screen decays rapidly in, or substantially in, an exponential manner, applying the full strength of the signal at each scan causes an objectionable flicker with slow scanning rates used in radar systems. More rapid scanning with utilization of only a small part of the charge per scansion eliminates this flicker.

The time for removing the charge from the target is subject to variation as may be desired by varying the intensity of the take-off beam.

It will be apparent that the signal output of conductor 14 can be amplified to operate in existing television equipment for projecting bright pictures of the incoming signals to any desired size in a Teleran or other system. It is also feasible to make the target act simultaneously as a photocathode by proper activation. This permits one to project optical pictures of maps and other printed information thereon to superpose a charge image on the echo signals charge image in a radar system.

While certain specific embodiments have been illustrated and described, it will be understood that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

What I claim as new is:

1. A target for cathode ray tubes comprising a conducting plate, a titanate layer on the conducting plate having a thickness sufficient to be impervious to electrons having velocities below a predetermined value, a layer of silica on the titanate layer that is pervious to electrons having velocities above a predetermined value lower than the first value.

2. A target for cathode ray tubes comprising a conducting layer, a layer of titanium oxide on the conducting layer having a thickness sufficient to be impervious to electrons having velocities below a predetermined value, a layer of silica on the layer of titanium oxide that is pervious to electrons having velocities above a predetermined value lower than the first value.

3. A cathode ray tube comprising, an evacuated envelope containing a target comprising a conducting plate, a layer of insulating material impervious to electron bombardment, said insulating layer having one surface against said plate and having a multiplicity of closely spaced peaks on its other surface, a layer of insulating material pervious to electron velocities above a predetermined value resting on said peaks and spaced from the hollows therebetween, means for scanning a beam of electrons over said target having sufficient electron velocities above said predetermined value to penetrate said last mentioned layer and means for scanning a beam of electrons over said target having insufficient electron velocities to penetrate the last mentioned layer, means providing a greater scanning rate for the second mentioned electron beam than the first mentioned beam.

4. A cathode ray tube comprising an electron gun for producing a beam of electrons having velocities above a predetermined value, an electron gun for producing a beam of electrons having velocities below said value, a target positioned in the path of said beams comprising a dielectric layer of a material and thickness pervious to the electrons of the first-mentioned beam and impervious to those of the second-mentioned beam and a dielectric layer having a multiplicity of peaks engaging the surface of the first-mentioned layer remote from the gun, said last-mentioned layer being impervious to electron bombardment and a conducting layer on the surface of the last-mentioned dielectric layer opposite said peaks, field producing means for scanning the first-mentioned beam over said target at a predetermined rate, field producing means for scanning the second-mentioned beam over said target at a greater rate, and an electrode for collecting secondary electrons emitted from said target.

5. A target electrode for a cathode ray tube comprising, a conducting layer, a layer of insulation on one face of said conducting layer, said insulation layer being impervious to electron bombardment, and a layer of silica on the surface of said insulation layer, said silica layer having a thickness pervious to electrons having velocities above a predetermined value.

6. A cathode ray tube comprising, electron gun means for producing a modulated beam of electrons having a velocity above a predetermined value, a second electron gun means for producing a beam of electrons having velocities below said value, a target electrode positioned in the paths of said electron beams, said target electrode including a conducting layer, a layer of insulation on the surface of said conducting layer, said insulation layer being impervious to

electron bombardment from said electron gun, a layer of silica on the surface of said insulation layer, said silica layer having a thickness pervious only to electrons having velocities above said predetermined value.

7. A signal storage device comprising, an electron gun means for producing a first beam of electrons having velocities above a predetermined value, electron gun means for producing a second beam of electrons having velocities below said predetermined value, a target electrode including a supporting plate positioned in the paths of said electron beams, a layer of insulation on the surface of said target plate facing said electron gun means, said insulation layer being of a material and thickness impervious to electron bombardment from said electron guns, a second layer of silica on the surface of said first layer, said silica layer being of a material and thickness pervious to electrons having velocities above said predetermined value, means for scanning said electron beams over said target surface, and a collecting electrode for collecting the secondary electrons emitted from said target surface.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,164,961	Strubig	July 4, 1939
2,195,489	Iams	Apr. 2, 1940
2,250,721	Moller et al.	July 29, 1941
2,277,007	Von Ardenne	Mar. 17, 1942
2,372,903	Lynch	Apr. 3, 1945
2,481,458	Wertz	Sept. 6, 1949