March 1, 1960 R. W. HUNTER 2,927,239

INFORMATION STORAGE TUBE

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Fig. 1.

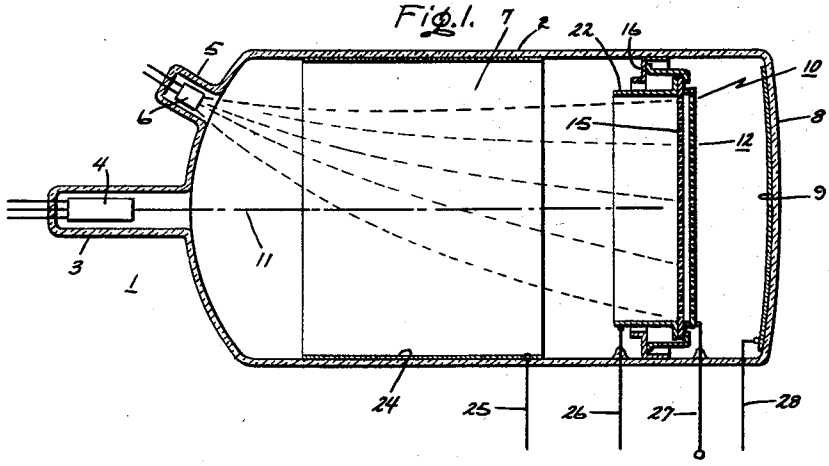



Fig. 2.

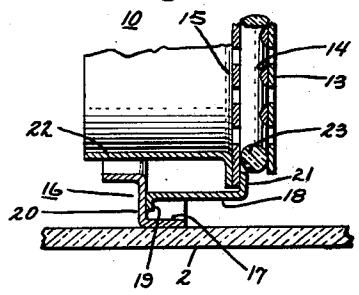
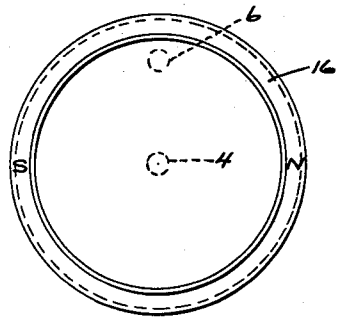



Fig. 3.

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2,927,239

# INFORMATION STORAGE TUBE

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9 Claims. (Cl. 313—155)

This invention relates to information storage tubes and more particularly to signal-to-image storage tubes.

Signal-to-image storage tubes are utilized in such applications as radar systems in which it is desired visibly to store one or more transient input signals and subsequently visibly to display such signals. In these tubes, there is conventionally provided a target electrode assembly including a fine mesh screen having a metal backing with dielectric material having secondary emission properties coated on one side thereof, and a collector screen closely spaced from the secondary emission side of the storage screen. The target electrode assembly is disposed between a phosphor viewing screen and an electron gun assembly which provides a high velocity "pencil" electron beam which is caused to scan the target electrode assembly by means of conventional deflection and focusing elements. The high velocity electron beam impinging upon the secondary emission coating on the storage screen displaces secondary electrons which are collected by the collector screen, thus leaving a positive charge on the storage screen caused by a deficiency in electrons. By modulating the voltage applied to the electron gun assembly in accordance with the incoming signal, the discrete areas of the storage screen defined by the openings therein will have different charges thereby forming a pattern or charge image on the storage screen corresponding to the input signal; this charge image will be retained on the storage screen for a substantial period of time and may be "read out" at any time during its existence. The charge image is "read out" by providing a second electron gun assembly which directs a flood of low velocity electrons onto the storage screen. These low velocity electrons pass through the openings in the storage screen in accordance with the elemental charges thereon and thus excite the phosphor viewing screen to provide a visible display of the charge image stored on the storage screen.

In order for the charge image to be faithfully reproduced on the phosphor viewing screen, it is necessary that the electrons in the flood beam impinge upon the storage screen with normal incidence; if the flood electrons do not normally impinge upon the storage screen, shading or black areas will appear on the display screen. For this reason, the flood beam electron gun has in prior signal-to-image storage tubes commonly been disposed along the axial center line of the tube with the flood electrons being collimated by conventional electron lens systems. In such tube constructions, the high velocity or writing gun has been conventionally offset from the axial center line. However, for deflection and focusing of the high velocity writing beam, it would also be desirable to dispose the writing gun along the axial center line of the tube. Obviously, the writing gun and the flood gun cannot occupy the same location along the axial center line of the tube and thus in the past, designers have accepted as a compromise location of the writing gun offset from the axial center line. Attempts have been made in the past to locate the writing gun



on the axial center line with the flood gun offset, and to focus the flood beam onto the storage screen so that the electrons have normal incidence thereto with external focusing coils and magnets, however, proper focusing of the flood beam to eliminate shading on the display screen could not be obtained with such arrangements.

I have discovered unexpectedly and surprisingly that by magnetizing the metal support ring of the target electrode assembly transversely with respect to the plane of the writing and flood guns, the flood gun can be offset from the axial center line and shading or black areas on the display screen are nevertheless eliminated, thus indicating that this transverse magnetization of the support ring of the target electrode is deflecting or pulling the flood electrons into normal incidence with the storage screen. With this discovery therefore, the writing gun can be disposed along the axial center line of the tube, as desired, thereby simplifying the mounting and deflection arrangements and the flood beam from the offset flood gun can be properly collimated without requiring the use of any additional tube parts or components.

It is therefore an object of my invention to provide an improved signal-to-image storage tube.

Another object of my invention is to provide an improved signal-to-image storage tube in which the writing gun is disposed along the axial center line of the tube and the flood gun is offset from the axial center line.

Yet another object of my invention is to provide an improved signal-to-image storage tube having means for collimating a flood beam of electrons from an electron gun assembly offset from the axial center line of the tube.

A further object of my invention is to provide an improved signal-to-image storage tube having the writing gun disposed along the axial center line of the tube and the flood gun axially offset from the axial center line with the flood beam being collimated thereby to eliminate shading and black areas on the display screen without requiring the provision of any additional tube elements or components.

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, wherein:

Fig. 1 is a cross-sectional view of a signal-to-image storage tube incorporating my invention;

Fig. 2 is a fragmentary enlarged view of a part of Fig. 1 showing the mounting of the storage and collector screens on the support ring; and

Fig. 3 is an end view of the target electrode assembly support ring, viewed from the electron gun side, showing the direction of magnetic polarization to provide proper collimation of the flood beam.

Referring now to the drawing, my improved signal-to-image storage tube, generally identified as 1, includes an envelope 2, which may conventionally be formed of glass and having a neck 3 coaxial with the axial center line of the tube. An electron gun assembly 4 for providing a high velocity "pencil" beam of electrons is positioned within the neck 3, it being understood that any conventional electron gun construction may be utilized and that the specific electron gun does not form a part of this invention. The envelope 2 includes another neck 5 offset from the axial center line of the tube in which another electron gun 6 is positioned, the electron gun 6 providing a flood beam 7 of low velocity electrons. Here, again, it is to be understood that any conventional electron gun assembly may be utilized and that the specific electron gun assembly does not form a part of this invention.

The face 8 of the tube 1 remote from the electron

guns 4 and 6 has a conventional phosphor coating 9 formed on the inner surface thereof and a target electrode assembly 10 is disposed within the envelope 2 intermediate the phoshor coating 9 and the electron guns 4 and 6. The pencil beam 11 provided by the writing gun 4 is directed toward the target electrode assembly 10 and is caused to scan the target electrode assembly by means of suitable deflection means (not shown). The flood beam 7 is likewise directed toward the target electrode assembly 10 as shown.

Target electrode assembly 10 includes a storage screen 12 having a fine mesh metal backing screen 13 with dielectric material having high secondary emission properties disposed on one surface thereof, as at 14. Collector screen 15 which is also a fine mesh metal screen, is closely spaced from a secondary emission layer 14 on the side thereof toward the electron guns 4 and 6. The storage screen 12 and collector screen 13 are supported within the envelope 2 by a support ring 16 formed of magnetic material, such as Kovar, having an annular flange portion 17 sealed to the inner wall of the envelope 2. Another support ring 18 is provided having a first annular flange portion 19 secured to web portion 20 of support ring 16 and having a second annular flange portion 21 to which collector screen 15 and focusing ring 22 are secured. Storage screen 12 is in turn supported from collector screen 15 by an annular ceramic ring 23.

The inner wall of the envelope 2 may have a conventional conductive coating 24 disposed thereon forming an accelerating anode to which a suitable potential, such as +40 volts, is applied by lead 25. The collector screen 15 and the focusing ring 22 have a suitable potential, such as plus 200 volts, supplied by lead 26. The backing screen 13 has a suitable potential, such as +10 volts applied by means of lead 27 and a suitable potential, such as 10,000 volts, is applied to the display screen 9 by a lead 28.

Referring now particularly to Fig. 3, I have discovered that unexpectedly and surprisingly, by magnetizing the support ring 16 so that it is transversely polarized, as shown, with the poles lying in a plane transverse to the plane of the guns 4 and 6 and with the north pole rotated clockwise 90° from the flood gun 6, the flood beam 7 is properly collimated and impinges upon the storage screen 12 with normal incidence so that there are no objectionable shading or dark areas appearing on the display screen 9. Support ring 16 may be magnetized by bringing a strong permanent magnet adjacent the end 8 of the tube and subsequently withdrawing it. Prior to magnetization of the support ring 16, and with the flood gun 6 offset as shown in Fig. 1, as one views the display screen 9, it will be observed that the area adjacent the bottom is black thus showing that the flood beam 7 is impinging upon the storage screen 12 at too large an angle. As the permanent magnet is brought in toward the end 8 of the tube 1, it will be observed that the magnetic field forces the flood beam 7 still further down and that the bottom area of the display screen 9 becomes blacker yet. However, when the permanent magnet is removed, it is observed that the black area at the bottom of the tube disappears thus indicating that the flood beam 7 is properly collimated, i.e., the electrons in the flood beam are traveling in straight parallel paths at least adjacent the storage screen 12 so that they impinge upon the storage screen with normal incidence. It will be readily apparent that the specific target electrode assembmly shown in Figs. 1 and 2 is for illustrative purposes only and that other target electrode constructions may be advantageously employed in accordance with my invention. It will also be observed that other tube configurations may be utilized so long as there is provided a magnetic member within the tube adjacent the target electrode assembly and transversely polarized with respect to the plane of the electron guns.

It will now be seen that I have provided an improved signal-to-image storage tube construction in which the writing gun may now be desirably disposed along the axial center line of the tube thereby simplifying mounting, deflection and focusing, and with the flood gun being offset from the axial center line with its flood beam properly collimated without requiring the use of any external coils, magnets or devices and, in fact, no tube components other than those already provided in conventional tubes.

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 is claimed is:

1. A signal-to-image storage tube comprising: an envelope; target electrode means in said envelope; first electron gun means in said envelope for directing a writing electron beam toward said target electrode means; second electron gun means in said envelope for directing a flood electron beam toward said target electrode means; and annular magnet means within said envelope and adjacent said target electrode means for collimating said flood electron beam, said magnet means being transversely polarized.

2. A signal-to-image storage tube comprising: an envelope; target electrode means in said envelope; first electron gun means in said envelope for directing a writing electron beam toward said target electrode means; second electron gun means in said envelope for directing a flood electron beam toward said target electrode means; and an annular permanent magnet within said envelope and adjacent said target electrode means for collimating said flood electron beam, said magnet being transversely polarized.

3. A signal-to-image storage tube comprising: an envelope; target electrode means in said envelope; first electron gun means in said envelope for directing a writing electron beam toward said target electrode means; second electron gun means in said envelope for directing a flood electron beam toward said target electrode means; and annular magnet means within said envelope and closely spaced from said target electrode means on the side thereof toward said gun means for collimating said flood electron-beam, said magnet means being transversely polarized.

4. A signal-to-image storage tube comprising: an envelope; target electrode means in said envelope; first electron gun means in said envelope and disposed along the axial center line thereof for directing a writing electron beam toward said target electrode means; second electron gun means in said envelope and offset from said axial center line thereof for directing a flood electron beam toward said target electrode means; and an annular permanent magnet within said envelope and closely spaced from said target electrode means on the side thereof toward said gun means for collimating said flood electron beam, said magnet being polarized transversely to the plane defined by said gun means.

5. A signal-to-image storage tube comprising: an envelope; a target electrode in said envelope; a support ring formed of magnetic material for supporting said target electrode from the inner wall of said envelope; first electron gun means in said envelope for directing a writing electron beam toward said target electrode; and second electron gun means in said envelope for directing a flood electron beam toward said target electrode; said support ring being magnetized with transverse polarization for collimating said flood electron beam.

6. A signal-to-image storage tube comprising: an envelope; a target electrode in said envelope; a support ring formed of magnetic material for supporting said target electrode from the inner wall of said envelope; first electron gun means in said envelope and disposed along the axial center line thereof for directing a writing electron beam toward said target electrode; and second

electron gun means in said envelope and offset from said axial center line thereof for directing a flood electron beam toward said target electrode; said support ring being magnetized with transverse polarization for collimating said flood electron beam.

7. A signal-to-image storage tube comprising: an envelope; target electrode means in said envelope; first electron gun means in said envelope and disposed along the axial center line thereof for directing a writing electron beam toward said target electrode means; second electron gun means in said envelope and offset from said axial center line thereof for directing a flood electron beam toward said target electrode means; and annular magnet means within said envelope and adjacent said target electrode means for collimating said flood electron beam, said magnet means being transversely polarized in a plane at right angles to the plane of said gun means with the north pole thereof being 90° clockwise from said second gun means.

8. A signal-to-image storage tube comprising: an envelope; a target electrode in said envelope; a support ring formed of magnetic material for supporting said target electrode from the inner wall of said envelope; first electron gun means in said envelope and disposed along the axial center line thereof for directing a writing electron beam toward said target electrode; and second electron gun means in said envelope and offset from said axial center line thereof for directing a flood electron beam toward said target electrode; said support ring being magnetized with polarization in a transverse plane at right angles to the plane of said gun means with the



north pole thereof being 90° clockwise from said second gun means.

9. A signal-to-image storage tube comprising: an envelope; a target electrode screen in said envelope; first electron gun means in said envelope and disposed along the axial center line thereof for directing a writing electron beam toward said target electrode; second electron gun means in said envelope and offset from said axial center line thereof for directing a flood electron beam toward said target electrode; a collector screen in said envelope closely spaced from said target electrode screen on the side thereof toward said gun means; a support ring formed of magnetic material in said envelope and secured to the inner wall thereof; and means for supporting said target electrode screen and collector screen from said support ring; said support ring being disposed in a plane parallel with the plane of said target electrode and collector screens and closely spaced therefrom on the side toward said guns, said support ring having an inside diameter larger than the effective diameter of said target electrode and collector screens; said support ring being magnetized with polarization in a transverse plane at right angles to the plane of said gun means with the north pole thereof being 90° clockwise from said second gun means.

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