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STORAGE TUBE TARGET HAVING MOSAIC OF COPLANAR PHOTOCONDUCTIVE ELEMENTS AND DIELECTRIC ELEMENTS

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Fig. 1

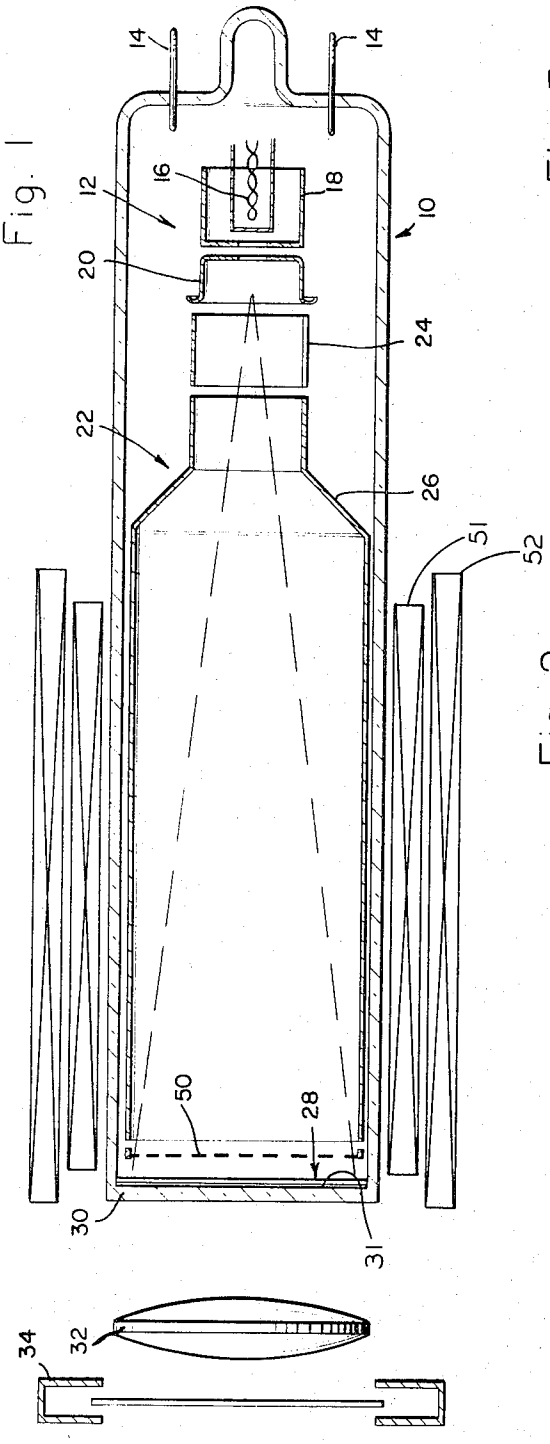


Fig. 3.

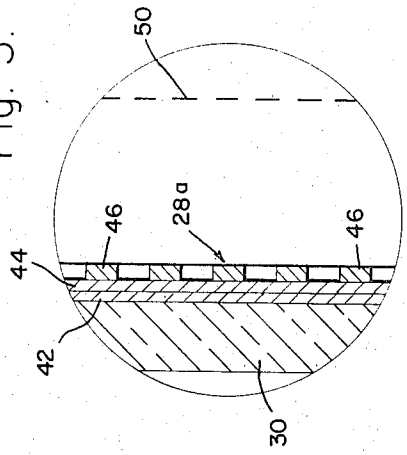
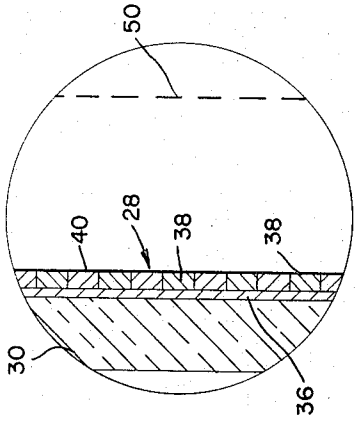


Fig. 2.



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ABSTRACT OF THE DISCLOSURE

The structure disclosed comprises a storage tube having an electron gun and a target and related equipment to control a produced electron beam. The target involves a composite of a transparent conductor associated with a transparent tube face, the conductor having a mosaic arrangement of photoconductive material and insulative material positioned thereon, the latter being capable of accepting a charge pattern during tube operation. A shutter structure is provided to expose the transparent tube face to an optical image. In operation the electron gun is arranged to flood the entire target area. Concurrently the shutter is opened to expose the transparent tube face to an optical image. The image excites the photoconductive material and a charge pattern is built up on the insulative elements directly related to the varying shades of optical illumination of the image viewed. The image thus stored on the insulative element may be reproduced by scanning the target with an electron beam in raster fashion.

The invention relates to an electron storage tube and particularly to a tube having an ability to store a viewed optical image for readout at some future time in the form of an electrical signal.

To perform the function described above with existing storage tubes, it has been necessary heretofore to use a plurality of tubes with complicated interrelated circuitry and a common power source. Other methods to achieve this objective, i.e., the storage of an optical signal have utilized storage on magnetic tape or photographic film. These techniques patently require related equipment for recording or chemically processing the film before subsequent playback into a converted electrical signal. These devices have proven uneconomical, cumbersome, and require extensive time laps to achieve the desired result.

The subject invention functionally provides the storing of a viewed optical image utilizing a relatively small storage tube and a minimum of associated components. Generally, the device here disclosed superficially resembles a standard vidicon tube utilizing additional components, principally a lens and a shutter for capturing the viewed image and a conventional power source. Thus, complex associated equipment and circuitry of prior art arrangements is eliminated.

Particularly, the invention incorporates a storage tube which may employ an electron gun capable of producing a broad flooding electron beam which saturates the entire target without scanning. The target employed involves a unique composite of a transparent conductor associated with a glass tube face having a mosaic arrangement photoconductive material and insulative material positioned thereon. Initially, the gun is operated to flood the entire target area and concurrently, via use of a conventional shutter, the tube is exposed to an optical image which effects areas of varying degrees of illumination on the photoconductive surface in response to the varying shades of the target viewed. By balancing the intensity of optical illumination with the potential level of the flood beam, the insulative aspects of the target receive a charge level

responsive to the illumination level of the discrete segments of the impinged optical image. The flood beam may then be cut off and the shutter closed. The charge potential on the insulative material maintains, in each area thereof, a charge level related to the level of illumination on the photoconductive material adjacent to the insulative material. The charge is stored for future use.

When it is desired to transmit a signal related to the stored optical image, the electron gun is urged to scan the target area raster fashion and an output signal proportional to the charge level is created. The signal may be transmitted to a remote display tube for visual display or the output signal intelligence may be utilized in any other conventional manner.

These and other features and advantages of the invention will become apparent in the course of the following description and from an examination of the related drawing wherein:

FIGURE 1 is a schematic plan view of an electron storage tube incorporating the invention;

FIG. 2 is an enlarged view taken at circle 2 in FIG. 1 and showing, in transverse cross-section, the physical make-up of the novel storage target employed in the invention; and

FIG. 3 is a view similar to FIG. 2 and illustrating an alternate mode of storage target construction.

Describing the invention in detail and directing attention to the figures, the storage tube may comprise an envelope **10** having an electron gun indicated generally at **12** adjacent one terminal aspect thereof, and electrical leads **14**, **14** piercing the envelope **10** and being operatively connected, in a conventional manner, to the electrodes of guns **12**. Gun **12** includes a heater cathode **16** and a first electrode **18** operatively aligned with a first anode **20**. The electrode **18** and anode **20** form and accelerate the electron beam which is emitted from the cathode **16**.

A conventional electrostatic lens system is provided and is indicated generally at **22** and comprises a first electrode **24** and a second forming electrode **26**. Structures **24** and **26** are well known in the art and, by applying suitable voltages thereto, the electron beam emitted from cathode **16** may be controlled to flood the entire surface of a target **28** or alternately formed into a pencil-like beam to scan the target **28** in raster fashion as will hereinafter be described.

The front aspect **30** of the envelope **10** is a glass optically transparent segment which is aligned with a focusing lens **32** and a conventional shutter device **34**.

Attention is directed to FIG. 2 which structurally illustrates in detail a preferred structure of the target **28**. A glass segment of the envelope **10** is shown at **30** and a transparent electrical conductor **36** (sometimes called target electrode) is positioned on the inner surface thereof. The surface of the transparent conductor **36** has applied thereon in mosaic pattern individual segments of insulative material **38** and photoconductive material **40** which provides a uniform alternate pattern of discrete insulative segments and discrete photoconductive segments. Preferably the segments are constructed at a spacing of about 750 elements per inch. Both the insulative and photoconductive elements, of course, are in surface contact with the transparent conductor **36**.

An alternate mode of construction of the target is illustrated in FIG. 3. As here shown, the target **28***a* comprises a transparent electrical conductor **42** (sometimes called target electrode) positioned on the inner surface of glass **30** and a uniform non-interrupted layer of photoconductive material **44** positioned across the surface of the transparent conductor **42**. In effect, the transparent conductor and photoconductor form adjacent layers on the

surface of the glass **30**. Insulating blocks or discrete segments thereof are shown at **46**, **46** and may be provided on the inner surface of the photoconductor **44** in spaced relation to each other so as to offer spaced discrete insulative segments, again, in a number of about 750 elements per linear inch. Thus, it will be seen that in both target structures the electron gun views a target having a mosaic pattern of insulative and photoconductive segments distributed over the entire facing surface thereof. To complete the structure a collector electrode **50** is positioned adjacent the target **28** in the conventional manner.

To describe the operation, assume initially that the structure is positioned to view a desired optical image. The gun **12** is operated to flood the entire target area with electrons. The collector mesh is provided with a potential several hundred volts above the cathode and the target electrode **36** has a potential applied thereto several volts more positive than the collector **50**. The optical image is focused on the glass surface **30** and transmitted to the photoconductor by opening the shutter **34** and allowing the image to be focused by lens **32**. By experimental determination, to obtain appropriate voltage ranges, the brightness of the image and flood beam current are adjusted relative to each other so that the flood electrons maintain the photoconductive surface near the collector mesh potential in those areas of the image having the lowest illumination intensity. In those areas of highest illumination intensity the potential at the photoconductive surface will reach an equilibrium level near the potential of the target electrode such that the number of electrons impinged by the flood beam is equal to the number of electrons conducted through the photoconductor to the electrode **36**. Areas of illumination intensity intermediate the minimum and maximum values noted will seek corresponding equilibrium potentials which range between the collector and target electrode potentials.

Obviously, the insulative segments **38** will lose electrons as a result of secondary emission and the photoconductive surface acts as a collector for secondary electrons emitted therefrom. Therefore, each area of the insulative surface will assume the approximate relative potential of the adjacent areas of photoconductive surface. It is noted again that the potential level of each discrete segment of photoconductive surface is directly related to the degree of illumination of the optical image thereon. Patently, the insulator surface, therefore, cannot rise above the potential of the surrounding photoconductor surface. Otherwise, secondary emitted electrons would encounter a retarding field which would return them to the insulator. Nor will the insulator surface remain at a potential below that of the surrounding photoconductor surface because the flood electrons charge each segment of insulator surface, by secondary emission, in a positive direction until the emission of secondary electrons is prevented. In this matter, it will be apparent that a charge pattern is produced across each discrete segment of insulator material which has a potential which corresponds to the illumination level of the image on the adjacent photoconductive surface.

The electron beam may now be turned off and the shutter **34** closed. Nothing occurs to change the charge pattern across the insulator surface and hence it remains stored thereon for future use. When not in use the voltage potential across the photoconductor collapses but the potential of the photoconductor is not being relied upon for storage.

Conventional deflection coil **51** and focusing coil **52** surround the envelope **10**. During readout, they are conventionally used to form and focus the pencil-like readout beam and to control scan the surface of target **28** raster fashion.

At a desired time an output signal may be created directly related to the viewed image. In one mode the image pattern may be destructively read out. This provides a high intensity output for a short time period. To accomplish destructive readout, the target electrode **36** has a potential applied thereto which is greater than the cathode potential to the same degree which it exceeded the collector mesh potential during the writing operation. The electron gun scans the target raster fashion and an output signal is created directly related to the charge on the insulative segment.

To non-destructively read out the stored image the target electrode **36** is operated at a potential that will maintain the insulator segments **38** at a level below the cathode potential. This may be accomplished by maintaining the target electrode at a potential slightly above the cathode potential with the insulative segments at a potential slightly below the cathode potential. Again, the electron gun **12** scans the target raster fashion and an output signal is generated directly related to the charge potential stored on the insulative segments. Before or during readout, whether destructive or non-destructive, the target may be illuminated without causing the stored image to be lost thereby. Illumination during the reading operation may enhance the output signal by preventing charges from building up on the photoconductor surface.

The invention thus provides a storage tube having the capacity to optically receive a visual image, store the image by the creation of appropriate electrical potentials on insulative segments of a storage target and at some subsequent time provide a signal output directly related to the viewed image. Minimum equipment is required to capture and store the image, i.e., tubes, lens, shutter and power source (batteries). The readout mode of operation requires, in addition to the tubes, conventional deflection and focus coils with the usual circuitry and power supply.

The invention as shown is by way of illustration and may be modified in many respects all within the scope of the appended claims.

What is claimed is:

1. In a tube arrangement for storing an optically viewed image,

an evacuated envelope,

an electron gun at one end of the envelope,

a transparent viewing segment at the other end of the envelope,

said segment having a target on the inner surface thereof,

said target comprising a collector electrode portion uniformly distributed over the entire surface of said viewing segment,

said electrode portion being transparent,

a mosaic pattern of discrete photoconductive and insulative elements to form discrete islands arranged substantially in the same plane and distributed over the inner surface of said electrode portion when viewed from the gun,

said elements being electrically connected to the portion,

means to create an electron beam emanating from the gun and flooding the entire target with electrons,

and optical shutter means for momentarily exposing said viewing segment to an optical image concurrently with flooding the target with electrons and thereby create a stored charge pattern on the insulative elements,

the charge on each discrete insulative element being directly related to the intensity of illumination of that portion of the viewed image optically impinged on the adjacent portion of the viewing segment.

2. A tube arrangement for storing an optically viewed image according to claim **1**,

wherein the created stored charge pattern on the insulative elements is of varying intensity levels, the current of said flooding electron beam being controlled to maintain the photoconductive elements in

those areas of lowest intensity illumination close to the potential of said collector electrode portion.

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