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Paley et al.

[11] **3,715,618**

[45] **Feb. 6, 1973**

[54] VIDICON VIEWED STORAGE TUBE IN WHICH THE NEWEST LINE OF INFORMATION IS DISPLAYED ON THE UPPERMOST PORTION OF THE TUBE

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[21] Appl. No.: **804,483**

[52] **U.S. Cl.** **315/10**, 313/91

[51] **Int. Cl.** **H01j 31/26**

[58] **Field of Search** 315/10; 313/91

[56] **References Cited**

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Assistant Examiner—J. M. Potenza
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[57] **ABSTRACT**

A vidicon viewed storage tube device, in which information is continuously displayed on a dark trace direct view storage tube. The tube contains a first or writing electronic gun, and a second or erase gun which removes the trace by heat impinging upon activated portions of the tube phosphor coating. A vidicon scans the storage tube in such manner that the newest line of information on the storage tube is displayed at the upper most portion of the vidicon display to provide a "passing scene" or "moving window" type of display.

2 Claims, 6 Drawing Figures

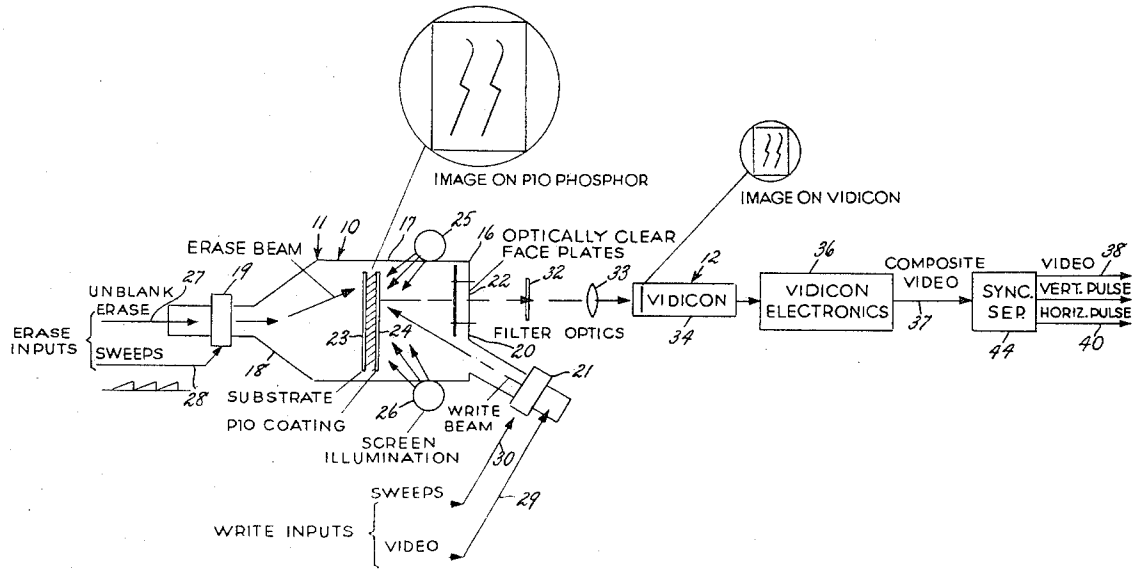


Fig. 1A

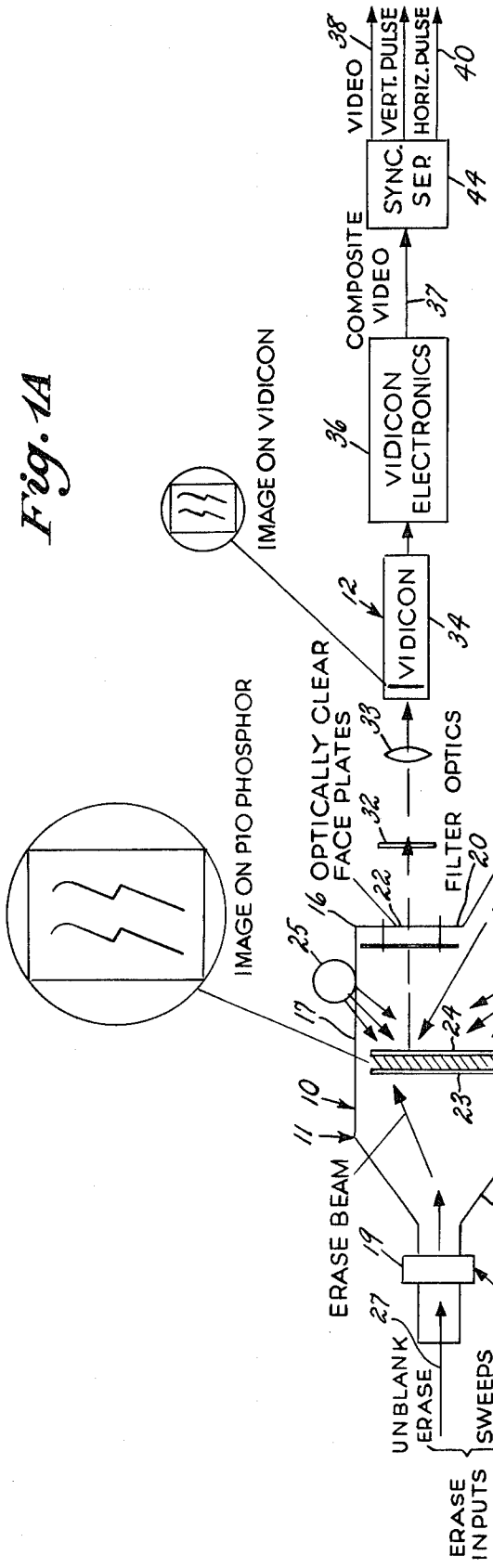


IMAGE ON P10 PHOSPHOR
IMAGE ON VIDICON
16 OPTICALLY CLEAR FACE PLATES
FILTER OPTICS
VIDICON
VIDICON ELECTRONICS
COMPOSITE VIDEO
SYNC. SEP.
VIDEO
VERT. PULSE
HORIZ. PULSE
WRITE BEAM
SCREEN ILLUMINATION
SWEEPS
VIDEO
WRITE INPUTS
ERASE BEAM
P10 COATING
SUBSTRATE
UNBLANK
ERASE
SWEEPS
ERASE INPUTS

Fig. 5

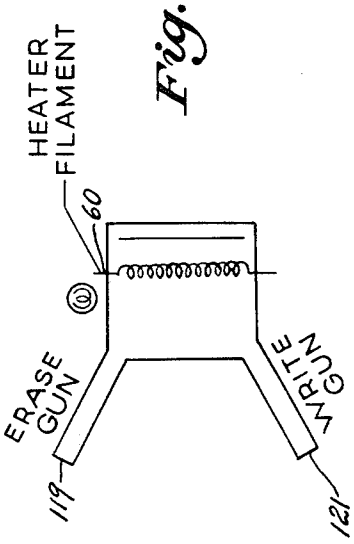

HEATER FILAMENT
ERASE GUN
WRITE GUN

Fig. 2

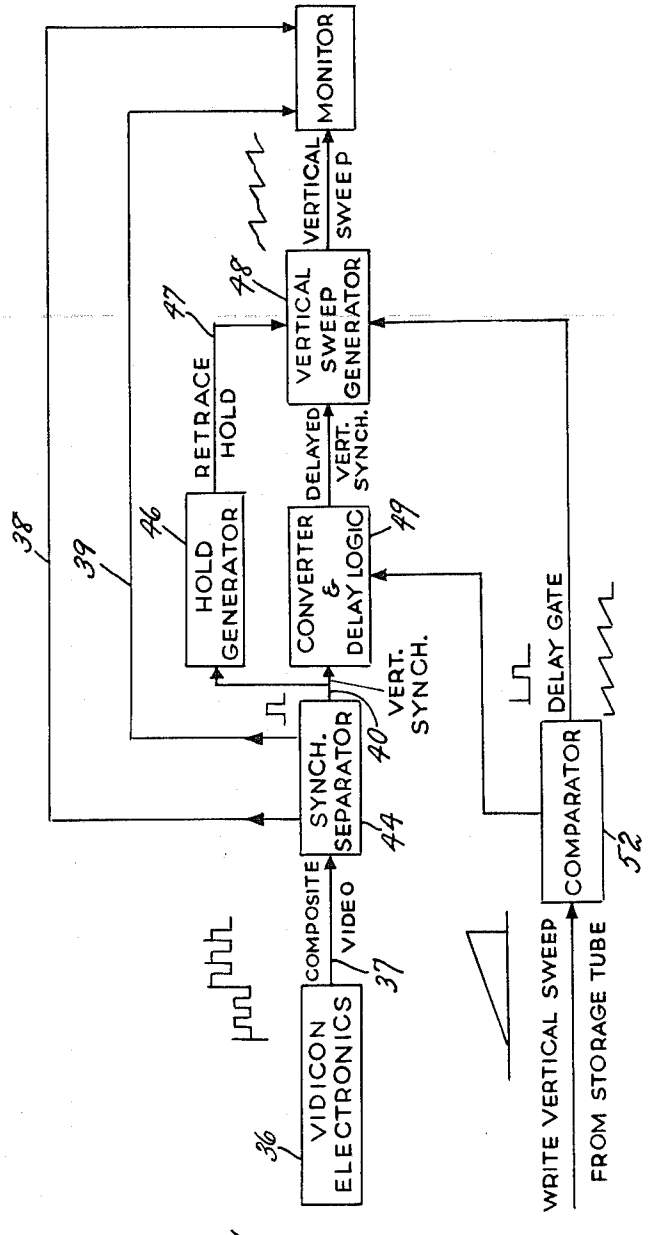

MONITOR
VERTICAL SWEEP
VERTICAL SWEEP GENERATOR
48
47
RETRACE HOLD
HOLD GENERATOR
46
DELAYED VERT. SYNCH.
CONVERTER & DELAY LOGIC
49
VERT. SYNCH.
SYNCH. SEPARATOR
40
44
38
39
COMPOSITE VIDEO
37
VIDICON ELECTRONICS
36
DELAY GATE
COMPARATOR
52
WRITE VERTICAL SWEEP
FROM STORAGE TUBE

Fig. 1B

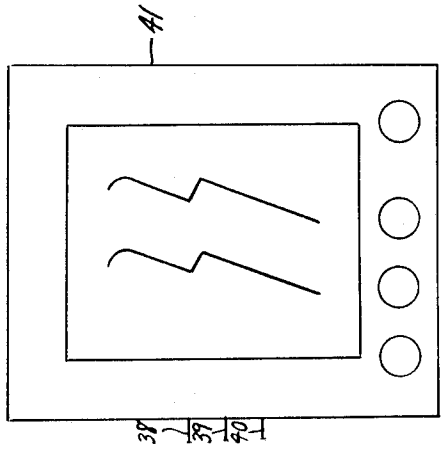

41
38
39
40

Fig. 4

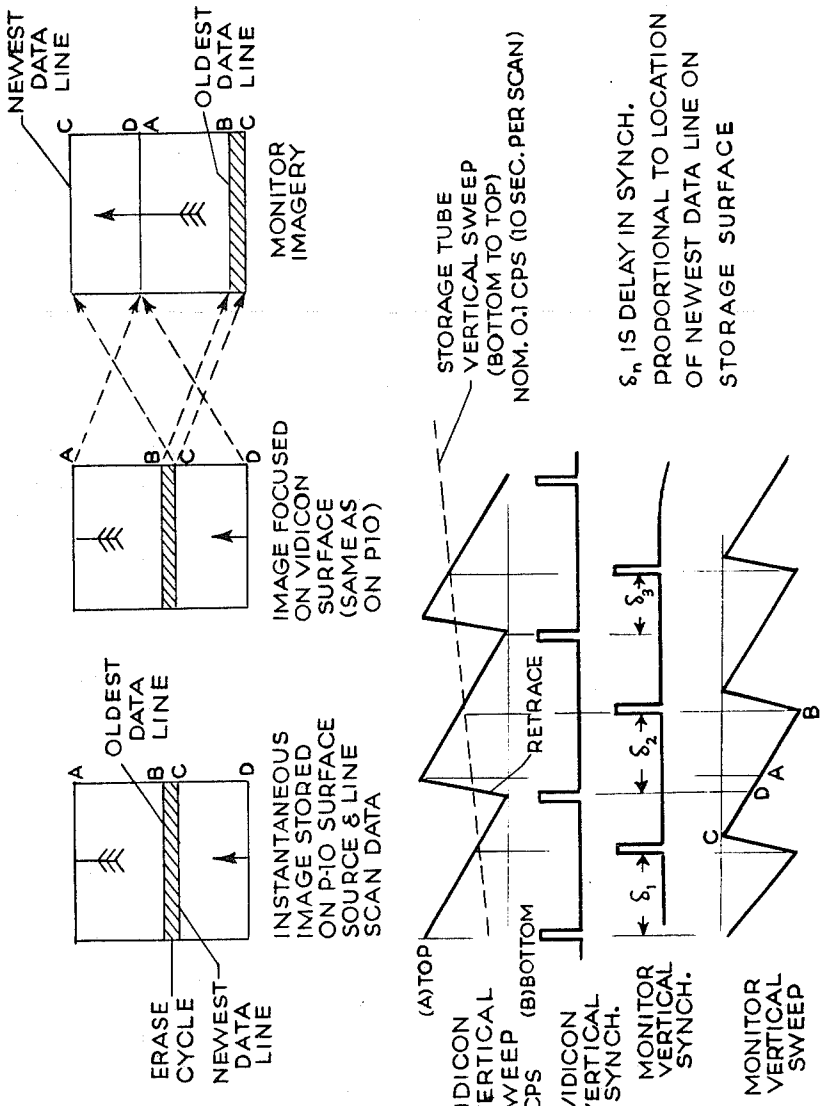
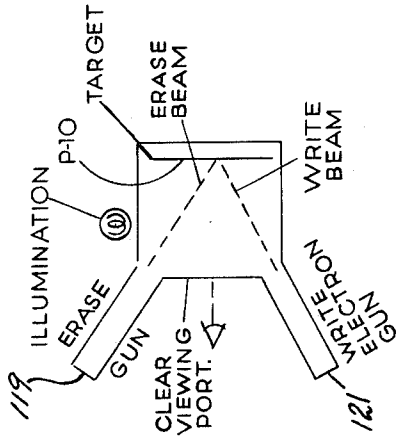

NEWEST DATA LINE
OLDEST DATA LINE
MONITOR IMAGERY
IMAGE FOCUSED ON VIDICON SURFACE (SAME AS ON P10)
INSTANTANEOUS IMAGE STORED ON P-10 SURFACE SOURCE & LINE SCAN DATA
ERASE CYCLE
NEWEST DATA LINE
STORAGE TUBE VERTICAL SWEEP (BOTTOM TO TOP) NOM. 0.1 CPS (10 SEC. PER SCAN)
δ_n IS DELAY IN SYNCH. PROPORTIONAL TO LOCATION OF NEWEST DATA LINE ON STORAGE SURFACE
RETRACE
(A) TOP
(B) BOTTOM
VIDICON VERTICAL SWEEP 60CPS
VIDICON VERTICAL SYNCH.
MONITOR VERTICAL SYNCH.
MONITOR VERTICAL SWEEP
δ_1
δ_2
δ_3

Fig. 3


TARGET
P-10
ERASE BEAM
WRITE BEAM
ILLUMINATION
ERASE GUN
CLEAR VIEWING PORT.
WRITRON ELECTRON GUN
119
121

VIDICON VIEWED STORAGE TUBE IN WHICH THE NEWEST LINE OF INFORMATION IS DISPLAYED ON THE UPPERMOST PORTION OF THE TUBE

This invention relates generally to the field of continuous electronic display of stored information, and more particularly to an improved dark trace direct view storage tube device having vidicon viewing means therefor, whereby the display of the storage tube device may be presented in a number of ways, including as a continuous "passing scene" or "moving window" type of display.

It is among the principal objects of the present invention to provide an improved dark trace direct view storage tube device adapted to present information continuously until erasure is desired.

Another object of the invention lies in the provision of an improved storage tube device of the class described in which information is placed upon a readable surface using a first electron gun, and subsequent erasure, when required, is selectively performed by a second electron gun.

A further object of the invention lies in the provision of improved viewing machines whereby stable or non-moving information presented by the storage tube device may be made to pass across the display elements of a vidicon TV system as a continuously moving window type display, by proper synchronization of the vidicon and storage tube.

These objects, as well as other incidental ends and advantages, will more fully appear during the progress of the following disclosure, and be pointed out in the appended claims.

In the drawing, to which reference will be made in the specification:

FIG. 1*a* and FIG. 1*b* are schematic views of an embodiment of the invention.

FIG. 2 is a schematic view showing the means for synchronizing the storage tube and vidicon elements comprising the embodiment.

FIG. 3 is a schematic view of an alternate form of the embodiment.

FIG. 4 is a schematic diagram showing the synchronization of signals between the vidicon and the monitor as a function of the position of the newest line of information on the storage surface.

FIG. 5 is a schematic view showing a second alternate form of the embodiment.

Before entering into a detailed consideration of the structural aspects of the disclosure, a brief discussion of the theory involved is believed apposite. Briefly stated, the invention includes a dark trace direct view storage tube upon which information is semi-permanently displayed to be scanned by a vidicon device for subsequent enlarged display upon a monitor cathode ray tube. The storage tube device includes means for selective electron beam erasure of the storage surface using a second electron gun which directs an electron beam to the rear of the target surface.

The utilization of potassium chloride salt as a cathode ray tube screen material, commonly called a P-10 phosphor has been known for many years. The general application has been in a direct view configuration with back lighting in which the phosphor and substrate are essentially transparent. Although this method for use of the P-10 phosphor has proven satisfactory,

some areas of improvement have been required. First, is the requirement to increase the contrast capability of the phosphor so that a high order of contrast can be achieved. Second, has been the requirement to provide a controllable selective erase capability of the storage surface, a requirement which has been difficult if not impossible to achieve in a back lighted version. Previously utilized methods for improving the contrast of the phosphor have allowed viewing of the phosphor screen from the front, that is, the written side of the target material. When the phosphor is illuminated and viewed from the written side, it is not necessary to be transparent. Therefore a reflective coating may be placed behind the phosphor material in order to reflect the light back through the phosphor for a second electron beam pass. This improves the initial brightness on the unexcited phosphor and provides a greater contrast by having a double absorption through the phosphor material. By providing a canted electron beam writing gun, provision may be made for a clear window for viewing the storage surface.

The selective erase capability is provided by controlled heat using a locally directed electron beam at the substrate side of the target. Since erasure of the storage surface is by application of electron beam heat at the substrate material, control of the location of this heat may be accomplished by supplying a second gun in the tube configuration, the electron beam of which is directed at the substrate side of the target. The impingement of the electron beam on the target causes local heating of that area and by transfer through the substrate, to the P-10 phosphor creating a local erasure. This method of erasure is rapid, highly localized by focus and deflection control of the beam, and is accomplished with a minimum effect upon adjacent areas.

Erasure of stored information on the P-10 phosphor by use of the heat created by an electron beam can also be accomplished on the phosphor side of the target. In this case, the general phenomena of erasure at the center of the beam with "darkening" at the edges can be observed. This darkening at the edges of the beam can be eliminated by movement of the beam in a raster scan. In this case, by proper control of sweep speed and scan speed, the dark edges at the leading edge of the scan (in the direction of progression of the scan) are removed by the next scan line, while the trailing dark edge fades due to the rapid decay condition caused by the temperature of the P-10 phosphor which remains high in that area due to the previous erase scan line. A very effective raster erase can be achieved in this manner with less beam power required than in the case where the erase beam is directed at the substrate side of the target.

The mechanism for creating the necessary erase beam current in the above case may be by either time sharing the writing beam or by providing a second electron gun directed at the phosphor side of the target.

The structure described hereinabove has application as a direct view cathode ray tube storage device with selective erasure. It provides a high contrast storage image with the ability for selective erasure and refreshment of various areas of the target. The stored image may be viewed by a television device such as a vidicon in order to obtain larger sized images and for certain

applications to obtain images other than the stationary image formed in the storage surface. The use of a vidicon to scan the storage surface and to display the stored information through a closed circuit television link to a relatively larger monitor overcomes the restriction on small size screens and the somewhat inconvenient viewing angle required in the direct view mode.

A typical application for the above structure is in the display of line scan data obtained from aircraft which has downward or sideward looking sensors such as infra red or radar. In these applications, it is desirable to have the display present a moving window or passing scene type of presentation to the observer or operator. The use of the closed circuit television to read out the stored image can be made to provide this mode of display in the following manner.

The vidicon through its optics chain has focused upon its photo-sensitive surface the stationary stored image from the storage tube. The image on the storage tube is being continuously refreshed on an essentially line by line basis. By control of the synchronization signals between the vidicon and the monitor as a function of the position of the newest line of information on the storage surface, condition may be created whereby the monitor always has the newest line of information presented at the top edge of the monitor. The synchronization signals are slipped in phase as a function of the position of the newest data line. In this manner, the imagery appears to pass in front of the viewer on the monitor screen and appears to the viewer as if a window were available in the aircraft. The sense of the display is similar to a rolling picture on a domestic television set with the exception that the speed of the rolling and its position is synchronized with the data being stored on the display surface of the storage tube. The black synchronization timing bars which would appear on the monitor due to the vertical retrace of the vidicon may be eliminated by causing the vertical sweep of the monitor to dwell for a period of time corresponding to the vertical synchronization in the vidicon.

With the foregoing discussion in mind, reference may be made to FIG. 1*a* of the drawing, in which, the device, generally indicated by reference character **10** comprises broadly: a storage tube element **11** and a vidicon element **12**.

The storage tube element **11** includes a tube envelope **16** having a main cylindrical portion **17** and a tapered portion **18** supporting an erase electron gun **19**. Positioned at an opposite end of the main cylindrical portion **17** is a planar wall **20** mounting an angularly disposed writing gun **21**. Disposed above the gun **21** is an optically clear face plate **22** permitting the viewing of a planar substrate **23** supported by the envelope **16**.

The substrate **23** is coated with a dark trace direct view storage material which may be erased by the application of heat, such as a potassium chloride salt of the type described hereinabove, indicated by reference character **24**, and so positioned as to lie within the range of upper and lower screen illumination means **25** and **26**, respectively. This material may be erased by application of heat.

The erase gun **19** functions to cast an electron beam on the rear surface of the substrate **23** whereby the heat may penetrate the same to locally erase stored traces on the coating **24**. The erase gun inputs include an unblank erase (a negative video signal) indicated by reference character **27**, and a sweep raster **28**. The oppositely disposed writing gun **21** has a similar video input **29** and a raster sweep input **30**.

In certain applications, the storage tube element **11** may be directly viewed through the plate **22**, depending upon the nature of the information stored. For most applications, it is more convenient to view the information by means of the vidicon element **12**, which will not only provide an enlarged image, but allow the information to be presented serially as described hereinabove. This mode of viewing has an inherent advantage, in that there is no problem of a fading image being viewed by the vidicon, so that the storage may be presented as often and as long as necessary. In addition, since the coupling between the storage tube and the vidicon is solely optical, a low noise level is also possible.

Overlying the plate **22** is a contrast filter **32**, and an optical lens **33** which projects an image into the vidicon camera mechanism **34**. The vidicon electronics, generally indicated by reference character **36** will produce a composite video output **37** which is fed to sync signal separating means whereby the video signal **38** is separated from vertical and horizontal pulses **39** and **40**, respectively which control the image on the monitor **41**.

Referring to FIG. **2** in the drawing, as has been mentioned, it is desirable in many instances to present the display as a "moving window" or "passing scene." This procedure involves modifying the vertical signal by suitable delay so that the display will commence on the upper edge of the monitor with the most recent data line. Accordingly, the synchronization signal separator **44** connects the video signal and horizontal pulse directly to the monitor, and the vertical synchronization pulse is split, so that one portion of the same triggers a hold generator **46**, the output **47** of which is fed to a vertical sweep generator **48**. Another portion of the vertical signal is fed to a converter and delay logic system **49**, the output of which is also fed to the vertical sweep generator. A closed loop, including a comparator **52**, which receives the output of the vertical sweep generator and compares it with the vertical sweep from the writing gun of the storage tube, serves as a delay gate operating on the delay logic circuitry **49**. The hold generator serves to eliminate the black synchronizing timing bars referred to hereinabove caused by the vertical retrace of the vidicon. Referring to FIG. **4**, it will be observed that a phase shift is obtained with respect to the monitor vertical synchronization which is proportional to the location of the newest data line on the storage surface.

Referring now to FIG. **3**, which illustrates an alternate form of the embodiment, parts corresponding to those of the principal form have been designated by corresponding reference characters with the additional prefix **I**.

The alternate form differs from the principal form in the location of the erase electron gun **119** to the same side of the substrate as the writing gun **121**, a construction which is particularly useful when dealing with compact space limitations.

Turning now to the second alternate form of the embodiment, illustrated in FIG. 5, parts corresponding to those of the principal form have been designated by corresponding reference characters with the additional prefix 2.

The form illustrated in FIG. 5 differs from the form shown in FIG. 3 in the provision of a heater filament disposed within the tube envelope which may be selectively actuated to provide total erasure of the coated substrate, as distinguished from the selective local erasure which is the function of the erase gun **219**. The heater filament **60** may be of annular configuration, and positioned adjacent the border areas of the substrate, so that radiant heat may inpinge directly thereon when total erasure is required.

We claim:

1. A dark trace direct view storage tube comprising: a tube envelope including a tube face, substrate means supported by said envelope disposed behind said face, a heat-erasable cathode ray tube, screen material coating said substrate means, electron beam means within said envelope for locally activating said screen material, said last mentioned means having an angularly disposed neck communicating with said tube face to impinge a beam on a first surface of said substrate, heat-generating means within said envelope on opposite sides of said substrate for erasing previously activated traces forming said coating material, said envelope including a optically clear viewing port overlying said first surface of said substrate, whereby an activated trace may be viewed, said last mentioned means including means for displaying traces observes on said storage tube, such that the most recently entered data is presented at a predetermined edge of aid cathode ray tube; and television camera means for viewing said substrate coating and displaying observed traces upon a cathode ray tube.

2. Structure in accordance with claim **1**, in which said last mentioned means includes means for generating a phase shift in the vertical raster signal which is proportional to the location of the newest data line on the substrate means.

* * * * *