NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF:

April 5, 1971

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General
Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned
U.S. Patents in STAR

In accordance with the procedures contained in the Code GP to Code USI memorandum on this subject, dated June 8, 1970, the attached NASA-owned U.S. patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,431,460

Corporate Source : Radio Corporation of America

Supplementary Corporate Source :

NASA Patent Case No.: XNP-06028

Please note that this patent covers an invention made by an employee of a NASA contractor. Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words ". . . with respect to an invention of. . . ."

Gayle Parker

Enclosure:
Copy of Patent

FACILITY FORM 602

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March 4, 1969 JAMES E. WEBB 3,431,460
ADMINISTRATOR OF THE NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION
METHOD OF ERASING TARGET MATERIAL OF A VIDICON TUBE OR THE LIKE
Filed June 27, 1967

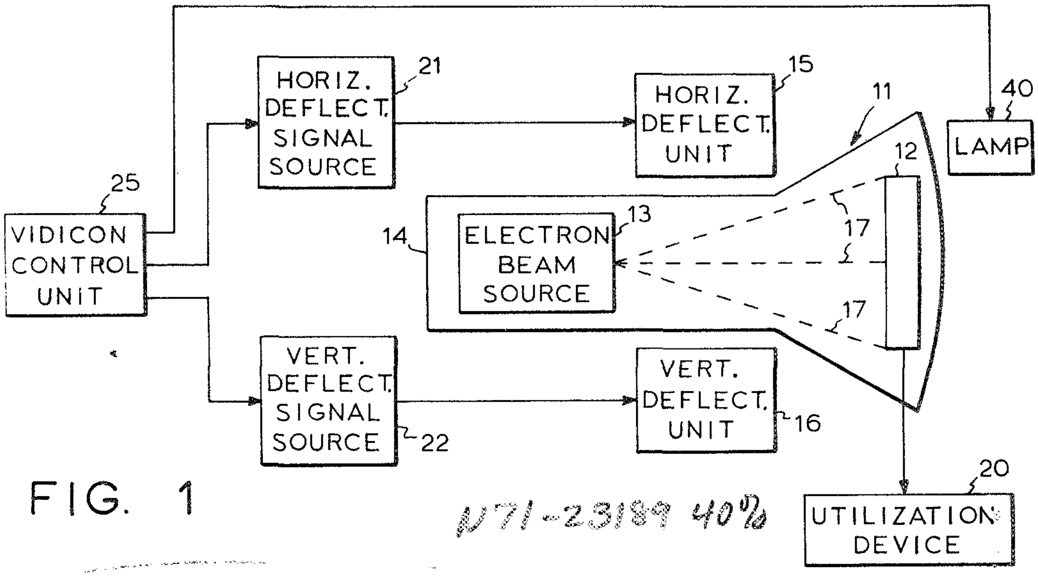

FIG. 1

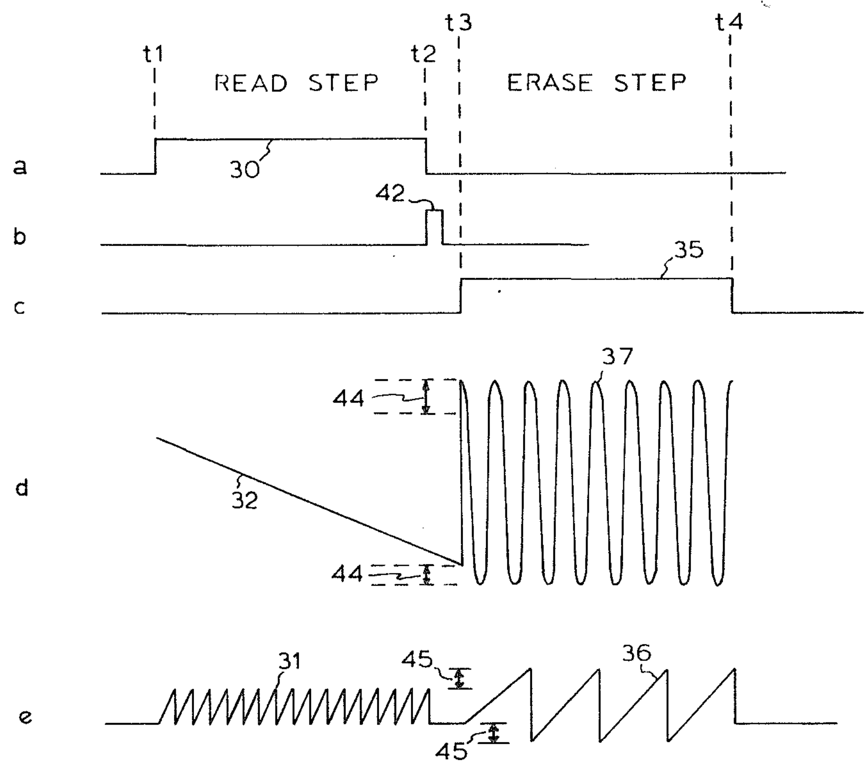

FIG. 2

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United States Patent Office

3,431,460
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3,431,460

METHOD OF ERASING TARGET MATERIAL OF A VIDICON TUBE OR THE LIKE

James E. Webb, Administrator of the National Aeronautics and Space Administration with respect to an invention of James John Hawley, Cranbury, N.J.

Filed June 27, 1967, Ser. No. 649,356
U.S. Cl. 315—26 8 Claims
Int. Cl. H01j 29/70

ABSTRACT OF THE DISCLOSURE

A method and means for shortening the time required to erase target material of a storage tube which retains a spatial charge density pattern for a relatively long time. After reading a pattern on the target material, the material is exposed to a uniform light to rapidly discharge the target material and remove the original pattern. Thereafter, the beam is deflected at rates outside the system's readout bandwidth. Consequently, the material is recharged for subsequent exposure in a relatively short time with a pattern which does not affect the tube's readout system.

ORIGIN OF THE INVENTION

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85–568 (72 Stat. 435; 42 USC 2457).

BACKGROUND OF THE INVENTION

(1) *Field of the invention*

This invention relates to display and storage devices and, more particularly, to a new method of operating a storage tube in which an electron beam is employed to scan a spatial charge density pattern, and means therefor.

(2) *Description of the prior art*

Various storage devices are presently known for providing electrical signals which represent patterns, formed on the devices. Among such devices, is one known as a vidicon tube. Briefly, a vidicon tube is a camera tube in which a spatial charge density pattern is formed on the surface of a photoconductive target material, exposed to a desired light pattern to be displayed thereon. Such a step may be thought of as the exposure step. Thereafter, the surface of the target material is scanned by an electron beam, usually of low velocity electrons, to provide signals which represent the pattern to which the target material was exposed. The latter phase of operation may be defined as the read step or cycle.

In some applications, it is desirable to scan the exposed target material at a slow rate to obtain higher pattern resolution or a lower read cycle bandwidth, resulting in a relatively long read step. When slow scanning is required, the target material is chosen to be of a type capable of retaining the spatial charge density pattern for a relatively long time to insure that it remains unaffected during the long read step. Such materials are well known in the art.

One basic disadvantage of such a target material is the relatively long time required for erasing the pattern from the material, before it can be exposed once more to a new pattern. This is particularly undesirable when long read steps are required, but the time available between read steps is quite limited.

Various techniques have been attempted to uniformly charge the target material, i.e. erase the previous pattern on the target material and prepare it for subsequent exposure in a sufficiently short time. However, the results

have not been sufficiently satisfactory. The major unsatisfactory feature when employing such techniques is a large residual image of approximately 15% left on the target material after the erase step. Moreover, rapid erase scanning which reduced the original residual image, produced an unwanted spatial charge density pattern which also was objectionable.

OBJECTS AND SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a new method for operating a vidicon tube or the like.

Another object is to provide a new method for preparing a vidicon tube or the like for exposure to a pattern to be displayed thereon.

Yet another object is to provide, in combination with a vidicon tube or the like, means for erasing the tube's target material.

A further object is the provision of a novel method of erasing the pattern on a vidicon tube or the like, after it has been scanned, to prepare the tube for subsequent exposure in a relatively short time.

Still a further object is to provide a new method of erasing, in less time than by other methods, the pattern on a vidicon tube or the like, having a target material scannable to read the pattern thereon during a relatively long period.

These and other objects of the invention are achieved by controlling the deflection of the electron beam of the vidicon tube, during an erase step, between one read step and a subsequent exposure step, so that after the erase step, the residual image left on the target material is less than 5%.

Briefly, after the pattern is read from the target material, by scanning the electron beam over the surface of the target material, the tube is switched to an erase step. During this step, the target material is first exposed to a uniform source of light. This light tends to rapidly discharge all portions of the target material and hence aids in removing the original pattern. Thereafter, the electron beam is deflected at rates which put a spatial charge density on the target, which is above the response of the readout electronic circuitry forming part of the vidicon tube system. Alternatively stated, the beam is deflected at rates during the erase step which form a spatial charge density pattern outside the system's readout bandwidth. The rates of deflection of the beam, during the erase steps, are such that (1) the target material is recharged in a relatively short time, and (2) the pattern left on the target by the erase scan is beyond the system's readout bandwidth.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention will best be understood from the following description when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a block diagram of a vidicon tube and associated circuitry required to practice the invention; and

FIGURE 2 is a diagram of waveforms useful in explaining the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is now made to FIGURE 1 which is a simplified block diagram of a vidicon tube and one arrangement of associated circuitry required to practice the method of the invention. Reference numeral **11** generally designates a conventional vidicon tube, which, as is appreciated by those familiar with the art, includes a target material **12**, and a source of an electron beam **13**, enclosed in the tube's envelope **14**. Also, a deflection arrangement is used to control or deflect the beam from source 13 over the surface of target material 12.

In an electromagnetic type tube, the arrangement consists of horizontal and vertical deflection coils, while deflection plates are used in an electrostatic type tube. In FIGURE 1, numerals 15 and 16 represent horizontal and vertical deflection units respectively. These may comprise either electromagnetic or electrostatic type deflection means. Also, in FIGURE 1 the electron beam is represented by dashed lines 17 to indicate that the beam is deflectable over the entire surface of the target material 12. Deflecting signals are supplied to units 15 and 16 from sources 21 and 22 to control the rate and manner of the beam's deflection.

In operation, when the target material is exposed to a light pattern from any conventional source, such as a cathode ray tube or lens image, a charge density pattern is created on the surface thereon. Thereafter, the target surface is scanned or read by deflecting the electron beam over the surface; the resulting currents or signals from the target material 12 are supplied to a utilization device 20. Such a conventional arrangement is shown and described in U.S. Patent No. 3,078,342.

As herebefore indicated, the teachings of the present application are particularly applicable for use with a vidicon tube, employing a target material which is capable of maintaining a spatial charge density pattern for a relatively long period, so that it may be scanned or read over a relatively long interval without degradation in the spatial charge density. Such materials, however, maintain the charge pattern after being scanned or read out once, so that a relatively long erase period, consisting of several readout scans, must elapse before subsequent exposure.

In accordance with the teachings of the invention, sources 21 and 22 are controlled by a vidicon control unit 25 in a manner whereby in the read cycle or step, the beam is deflected in any conventional way to scan the target material 12. The deflection may consist of a conventional TV multiline deflection pattern. However, unlike prior are methods, in accordance with this invention, after the read step and during an erase step, the sources 21 and 22 cause units 15 and 16 to deflect the beam at selected frequencies so that (1) the useful target area can be rapidly and uniformly charged and (2) that any charge pattern put on the target by this charging is outside the system's readout bandwidth. Thus, the tube is ready for subsequent exposure in a relatively short time period. The frequencies are chosen so that the residual charge density pattern is outside the system's useful readout bandwidth. Consequently, the effect of the residual pattern on subsequent readout of a subsequently exposed pattern is minimized.

The teachings of the invention may best be exemplified and further explained in conjunction with FIGURE 2, which is a multiline diagram of waveforms of deflection signals supplied during exemplary read and erase steps. In FIGURE 2, pulse 30 defines a read step between times *t1* and *t2*. During this interval, unit 25 controls sources 21 and 22 to provide deflection signals as diagrammed in lines *e* and *d*, and designated by numerals 31 and 32 respectively. That is, source 22 is controlled to provide signal 32 which may be thought of as a sawtooth wave to deflect beam 17 in a uniform manner in the vertical direction, such as from near the top of material 12 to near the bottom thereof. At the same time, source 21 is controlled to provide signals 31, which are shown to have sawtooth shapes at a selected frequency *f*. During each cycle of *f*, the beam is deflected from one end to the other to scan or read a strip or line of the surface target material.

The frequency *f* is chosen so that during the interval *t2*–*t1*, the entire target surface is read in an integer number of lines. In one arrangement, during a read cycle or step of 2.56 seconds, the frequency *f* was 450 c.p.s. so that the surface was read out in 1152 lines. Such a readout scanning pattern is similar to a conventional multiline TV scanning raster.

Thereafter, to shorten the time of the erase step or cycle, represented by a pulse 35 (line *c*) between times *t3* and *t4*, the sources 21 and 22 are controlled to provide deflection signals 36 and 37 respectively. The frequencies of signals 36 and 37 are chosen to be outside the system's bandwidth. In one arrangement, this is accomplished by having the vertical deflection signals 37, of a sine wave supplied at a frequency of 15 kilocycles (kc.), while the sawtooth-shaped signals 36 were supplied at a frequency of 25 c.p.s. As a result, during each cycle of a horizontal deflection signal 36, as the beam is deflected horizontally across the target material surface, the beam is also deflected vertically 600 times across the target surface to result in a uniform charge density on the target material surface.

With deflection frequencies as stated, the erase period *t4*–*t3* can be reduced to less than the time generally required for erasing. It is important that (1) no frequency coherence should exist between the vertical signals 37 and the horizontal signals 36, and (2) that the end of the erase signal 35 coincide with the end of a horizontal sawtooth cycle of signal 36.

In some applications, it may be desired to operate control unit 25 (FIGURE 1) to activate a lamp 40 (FIGURE 1) in order to uniformly illuminate the surface of the target material prior to the erase scan step. A lamp-activating pulse is designated in FIGURE 2 by numeral 42.

It should be appreciated that the actual frequencies of the deflection signals during the erase step are dependent on the actual target material and the system's bandwidth. For example, in one application, it has been found that an erase frequency of 5 kc. of the vertical deflection signals and an erase frequency of 450 c.p.s. of the horizontal sawtooth signal put a charge pattern on the target which was within the system's bandwidth. However, with a horizontal signal frequency of 25 c.p.s. and a vertical sine wave signal frequency of 15 kc., the spatial density charge pattern was placed beyond the resolution capabilities of the system, placing the components of the erase frequencies beyond the bandpass of the video amplifier, conventionally employed with a vidicon tube.

The various circuits in FIGURE 1 are shown in block form since it should be appreciated that different circuits may be employed to control the frequencies of the signals, supplied to deflection units 15 and 16 during the read and erase steps. Similarly, different signal control devices may be utilized in implementing control unit 25.

From experience with vidicon tubes in which the erase technique herebefore described has been employed, it has been found that some image degradation occurs at the periphery or edge of the surface of the target material, particularly when erase lamps are used. Such image degradiation manifests itself by a short and abrupt white discontinuity. Such degradation may be eliminated by overscanning the surface of the target material.

Overscanning may be conveniently accomplished by increasing the amplitudes of the horizontal and vertical deflection signals during the erase step to about 120% of their amplitudes during readout, while the centers of the signals are assumed to be held constant. These increased amplitudes of signals 37 and 36, with respect to signals 32 and 31, are diagrammed in lines *d* and *e* of FIGURE 2, by arrows 44 and 45, respectively.

There has accordingly been shown and described herein a novel method of erasing the target material of a vidicon tube in order to minimize the time required before the material may again be exposed to a pattern after a prior pattern has been read therefrom. It is appreciated that those familiar with the art may make modifications and/or substitute equivalents in the arrangements as shown without departing from the spirit of the invention. Therefore, all such modifications and/or equivalents are deemed to fall within the scope of the invention as claimed in the appended claims.

What is claimed is:

1. In a method of operating a vidicon tube wherein a pattern is represented as a spatial charge density pattern on a target material, said pattern being read by scanning the target material with an electron beam, the improvement comprising:

erasing the charge density pattern from said material after the pattern is read therefrom by deflecting said electron beam over said material with signals at frequencies which are outside the readout bandwidth of electronic circuitry associated with said tube.

2. The improvement as recited in claim 1 wherein said target material is scanned during a read step by deflecting the electron beam with a plurality of sawtooth-shaped deflection signals of a first frequency, each sawtooth-shaped signal causing said beam to be deflected in a first direction from one side of the surface of said target material to an opposite side, and a single deflection signal, causing said beam to be deflected in a second direction perpendicular to said first direction by deflection signals at a second frequency and in said first direction by deflection signals at a third frequency, with said second and third frequencies being outside the readout bandwidth of the circuitry associated with said tube.

3. The improvement as recited in claim 2 in which said second frequency is in the order of at least 10 times the first frequency, and said third frequency is less than one-tenth of said first frequency.

4. The improvement as recited in claim 2 wherein the amplitudes of the signals at said third frequency are in the order of 120% of the amplitudes of the signals at said first frequency, and the amplitudes of the signals at said second frequency are in the order of 120% of the single vertical deflection signal at said read step.

5. The improvement as recited in claim 4 in which said second frequency is in the order of at least 10 times the first frequency, and said third frequency is less than one-tenth of said first frequency.

6. The method of operating a vidicon tube in which a spatial charge density pattern is formed on the surface of a target material thereof, the steps comprising:

reading the charge density pattern during a readout cycle by deflecting an electron beam over the surface in a first predetermined scanning pattern; and

erasing the residual charge pattern in said target material by deflecting the electron beam over said surface at frequencies which put a spatial charge density pattern on the target material that is higher than the largest spatial density to which said tube can respond in the readout cycle.

7. The method as recited in claim 6 wherein said surface is read out by deflecting the beam thereon in a plurality of substantially parallel lines, said beam being deflected for erasing said residual charge pattern at frequencies whereby the beam is deflected over the entire useful height of said surface a preselected number of times as the beam is repeatedly deflected horizontally from one side of the surface to the other.

8. The method as recited in claim 7 in which the signals deflecting the beam to erase said residual charge pattern cause the beam to be deflected over dimensions exceeding the dimensions of the surface of said useful target material.

References Cited

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U.S. Cl. X.R.

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