May 4, 1965 J. T. McNANEY 3,182,223

DATA STORAGE SYSTEM WITH LIGHT BEAM WRITE/READOUT

Filed July 5, 1960 2 Sheets-Sheet 1

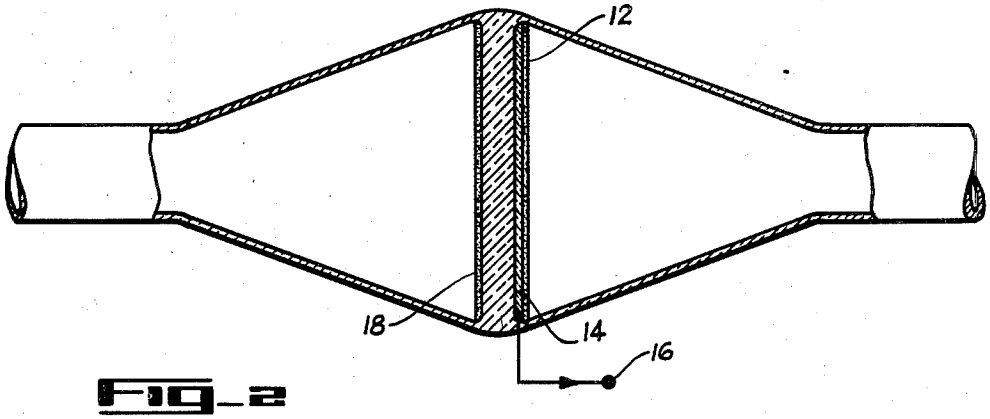

Fig_2

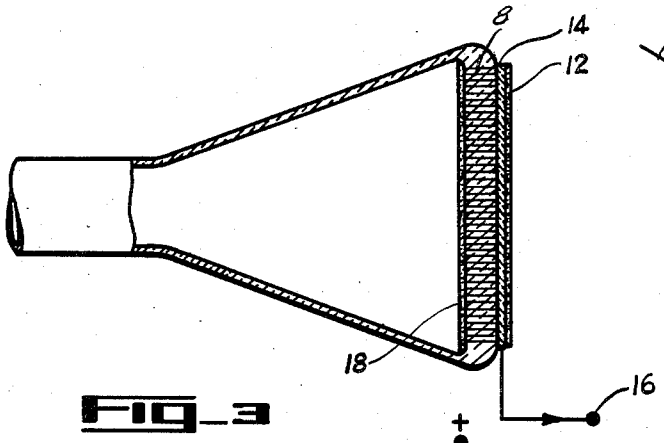

Fig_3

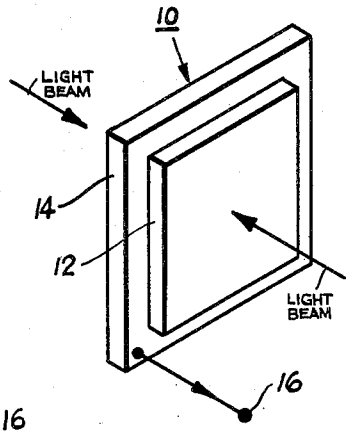

Fig_1

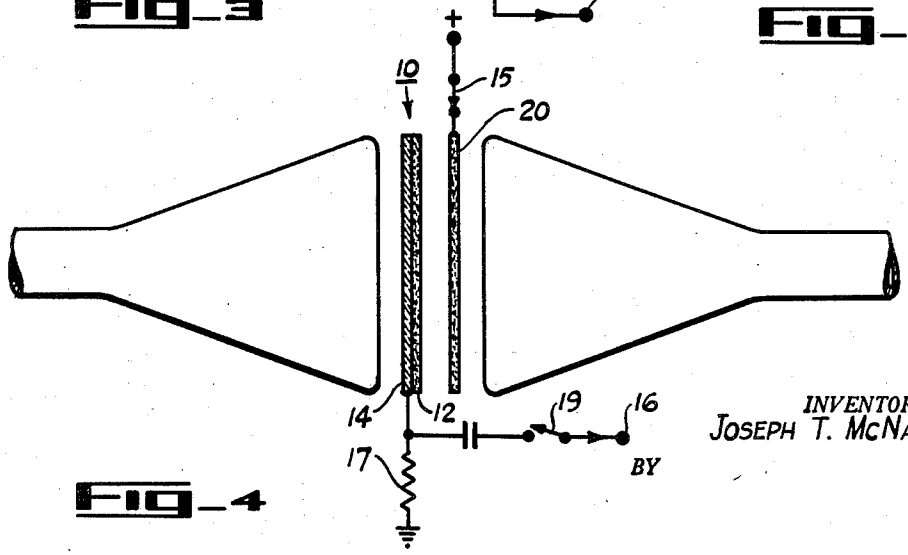

Fig_4

INVENTOR.
JOSEPH T. McNANEY.

BY

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DATA STORAGE SYSTEM WITH LIGHT BEAM WRITE/READOUT

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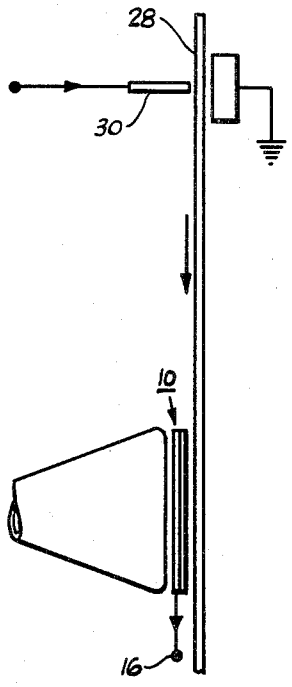

Fig_6

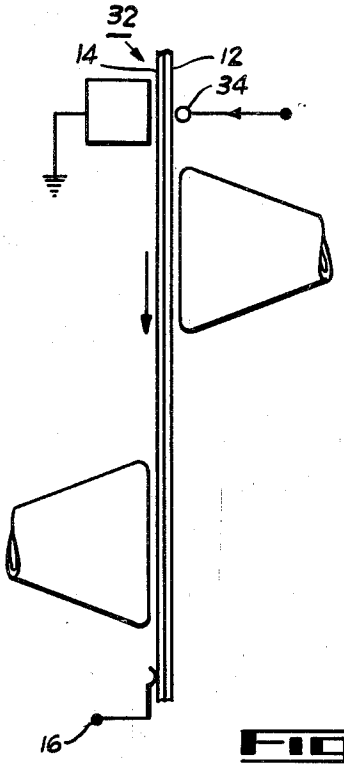

Fig_7

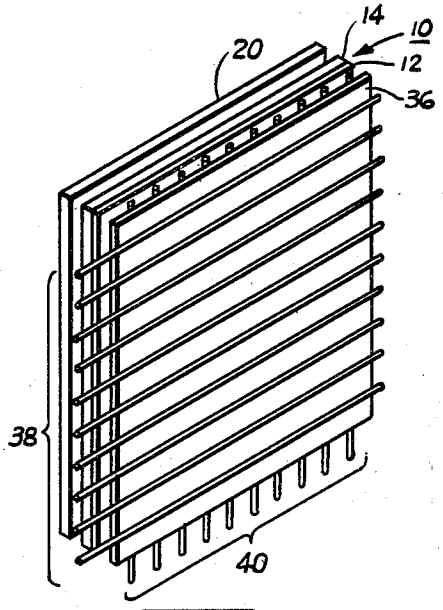

Fig_8

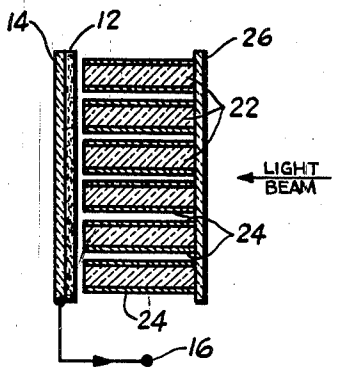

Fig_5

INVENTOR.
JOSEPH T. McNANEY.

BY

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3,182,223

DATA STORAGE SYSTEM WITH LIGHT BEAM WRITE/READOUT

Joseph T. McNaney, La Mesa, Calif., assignor to General Dynamics Corporation, Rochester, N.Y., a corporation of Delaware

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2 Claims. (Cl. 315—10)

This invention relates to a data storage system, and more particularly to one that stores data in the form of an electrical charge pattern on the surface of a photoconductor.

It is freqeuntly desired to store data, and to later read it out in the same or other forms. For example, the incoming data may be in the form of light pulses or a picture and the output may be preferred in the form of electrical impulses. At other times the input may be in the form of a P.P.I. radar display, and it may be desired that the output be a raster-type display—for producing a brighter display or multiple displays on a plurality of monitors.

It is therefore the principal object of my invention to provide an improved storage display and readout system.

The attainment of this object and others will be realized from the following specification, taken in conjunction with the drawings, in which:

FIGURE 1 illustrates the basic concept of my invention; and

FIGURES 2 through 8 show various embodiments thereof.

In FIGURE 1, which shows the basic concept of my invention, data is "written in" in the forming of an electrical charge pattern, and "read out" by a scanning light beam. To accomplish this result, I use a structure **10** that comprises a sheet **12** of photoconductive material that is in contiguous relation with a layer **14** of transparent electrically-conductive material. The data to be stored is first "written" onto photoconductor **12** in the form of a charge pattern, which is produced by means to be discussed later. As is well known, photoconductive material becomes conductive where illuminated, and I use this characteristic to "read out" the stored information by causing a light beam to impinge upon sheet **12** from either direction. The conductive illuminated area of photoconductor **12** permits the charges that form the charge pattern to leak off through the conductive areas to conductor **14**. The leakage produces, at output terminal **16**, an output signal that may be used in any desired manner.

FIGURE 2 shows an embodiment that uses a double-ended cathode ray tube having a common faceplate. In this embodiment the electron beam from the right hand cathode ray tube produces a charge pattern on photoconductive material **12** by either depositing electrons thereon, or by causing electrons to be emitted by secondary emission.

Readout is achieved by causing the electron beam in the left hand cathode ray tube to impinge on a phosphor screen **18**, the light from which permits the charge pattern to be dissipated as previously described. The light spot produced on phosphor screen **18** of the left hand tube traces out a raster comprising a series of parallel lines; and the instantaneous output signal corresponds with the position of the readout spot of light. It will be noted that in this embodiment the information is written in electrically, and read out electrically.

FIGURE 3 shows an embodiment wherein the writing and the reading are done by the same cathode ray tube. In this embodiment photoconductive material **12** is first given a uniform charge in any convenient manner. The

cathode ray tube is then energized to produce a display on phosphor screen **18**, and the light traversing optical fiber faceplate **8**—which is used for improved resolution—discharges selected areas of the photoconductor to produce a charge pattern. This pattern may be stored for as long as desired, and when it is desired to read it out, the cathode ray tube is again energized. The moving spot of light permits the charge pattern to leak off, in this way producing output signals.

The embodiment of FIGURE 4 uses two separate tubes and a structure **10** comprising a photoconductive sheet **12** and an electrically conductive layer **14**. Adjacently positioned is another transparent structure **20** for producing a uniform charge on the photoconductive material. Charging structure **20** may use corona discharge, electrostatic induction or any other suitable method. For example, to produce a corona discharge, charging switch **15** is closed. A discharge takes place between elements **20** and **12**, resistance **17** completing the circuit. During this charging interval, output switch **19** is open, so no output signal appears at output terminal **16**.

To "write in" the message, switches **15** and **19** are opened, and the right hand tube writes as previously explained. During this writing interval, part of the uniform charge on photoconductor **12** leaks off to produce a charge pattern; the leakage current passing off through resistance **17**.

In order to readout, switch **15** is opened and switch **19** is closed. Readout is produced by the left hand cathode ray tube, whose beam of light scans the photoconductive material and permits the charge pattern to leak off; the leakage through resistance **17** producing an output signal at output terminal **16**. The operation of FIGURE 4 is thus a sequential one wherein a uniform charge is first produced on photoconductor **12**, parts of the uniform charge are permitted to leak off to produce a charge pattern, and the charge pattern is then read out by another cathode ray tube.

One use for the embodiment of FIGURE 4 is to convert a P.P.I. display on one tube to signals that provide a raster-type display.

The embodiment of FIGURE 5 shows another method of producing a charge pattern. This embodiment uses optical fibers **22** that are coated with sleeves **24** of photoconductive material. When light enters selected fibers, their circumjacent photoconductive sleeves are illuminated, and the resultant low electrical resistance permits a potential applied to transparent electrical coating **26** to appear at the other end of the photoconductive sleeve. There a corona discharge is produced, and this results in a charge pattern being produced on photoconductive material **12**. Alternatively, a uniform charge may be produced, and the corona discharge from the optical fibers used to produce the charge pattern by selective neutralization. The charge pattern may be read out by a cathode ray tube or a scanning beam of light, and an output signal is obtained as previously described. In this embodiment writing and readout are performed by light.

Referring now to FIG. 6, there is shown an embodiment of my invention wherein a moving strip **28** of material has the characteristic that a charge pattern produced on its surface will remain there for a desired period of time. To produce this charge pattern, I use a series of aligned charging elements **30**, such as wires or pins. Potentials applied to selected elements will produce a discharge between the selected pin and the grounded electrode; the discharge resulting in a charge pattern on the surface of material **28**. As material **28** moves downward as indicated by the arrow, the charge pattern passes in front of structure **10** that comprises a sheet of photoconductive material and a layer of transparent conduc-

tive material, as previously described. In the embodiment of FIGURE 6, the readout spot of light originates at the faceplate of a cathode ray tube, and produces output signals that correspond with the position of the light.

In the embodiment of FIGURE 7, the storage strip **32** comprises a sheet **12** of photoconductive material and a layer **14** of transparent electrically conductive material in a contiguous relationship. A transversely positioned corona producing element or wire **34** provides the photoconductive surface with a uniform electrical charge. As the uniformly charged strip passes in front of the first cathode ray tube, light therefrom causes selective areas of the photoconductive material to become conductive, and selected charges leak off through the transparent electrically conductive material **14**. As the storage strip moves beyond the first cathode ray tube, its surface therefore contains a charge pattern which may be picture, characters, codes or any other desired pattern. As this charge pattern passes in front of the second cathode ray tube, the light beam thereof reads out the information by illuminating the photoconductive material; and the charge pattern therefore leaks off, thus producing an output signal.

The embodiment of FIGURE 8 comprises a structure **10** that includes a photoconductor **12** and a transparent electrical conductor **14**. A charge producing element **20** operates as previously described to produce a uniform charge on the surface of photoconductor **12**. Light impinges on photoconductor **12**, to permit leakage of charges from selective areas, thus producing a charge pattern as previously described.

In order to read out the stored data, I use a sheet **36** of electroluminescent material, which has sets **38** and **40** of crossed grids sandwiched to the sides thereof. By suitably energizing selected crossed grids, a potential is applied across a small area of the electroluminescent material, in this way producing movable spots of light that permit the charge pattern to produce output signals as previously described. In this way, an electroluminescent structure is used for the readout.

The particular embodiment of the invention illustrated and described herein is illustrative only and the invention includes such other modifications and equivalents as may readily appear to those skilled in the art, within the scope of the appended claims.

I claim:

1. In combination, a single sheet of electrically insulating photoconductive material capable of maintaining a charge pattern on a surface thereof, means including a charging structure for producing a uniform distribution of electrons on said surface of said sheet, an electrically conductive layer positioned contiguously with said sheet,

output impedance means connected to said electrically conductive layer, output terminal means disposed across said output impedance means, charge pattern producing means for exposing selected areas of said photoconductive sheet to input information to render said selected areas electrically conductive, said electrons leaking off from said selected exposed areas through said conductive layer and said output impedance means for establishing an electrical charge image on said sheet, means for scanning said surface of said sheet with light information to remove said electrical charge image from said sheet, said output impedance means accommodating an electron flow accompanying the removal of said charge image for providing an output signal voltage at said output terminal means, said charge pattern producing means, and said means for scanning being embodied within a single cathode ray tube.

2. An information handling system comprising, a composite two-sheet information storage plate consisting essentially of a transparent electrically conductive sheet and a sheet of photoconductive material having an exposed side and a side in contact with said transparent electrically conductive sheet, means for producing an electrostatic image on the exposed side of said sheet of photoconductive material which electrostatic image is stored thereon, a load circuit for manifesting current changes therethrough, means for coupling said load circuit to said transparent electrically conductive sheet, and means for sweeping said sheet of photoconductive material with a beam of light to cause current to flow through said load circuit representative of said electrostatic image.

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DAVID G. REDINBAUGH, *Primary Examiner.*

RALPH G. NILSON, ROY LAKE, *Examiners.*