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M. GREEN ET AL

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IMAGE STORAGE DEVICE

Filed Aug. 2, 1965

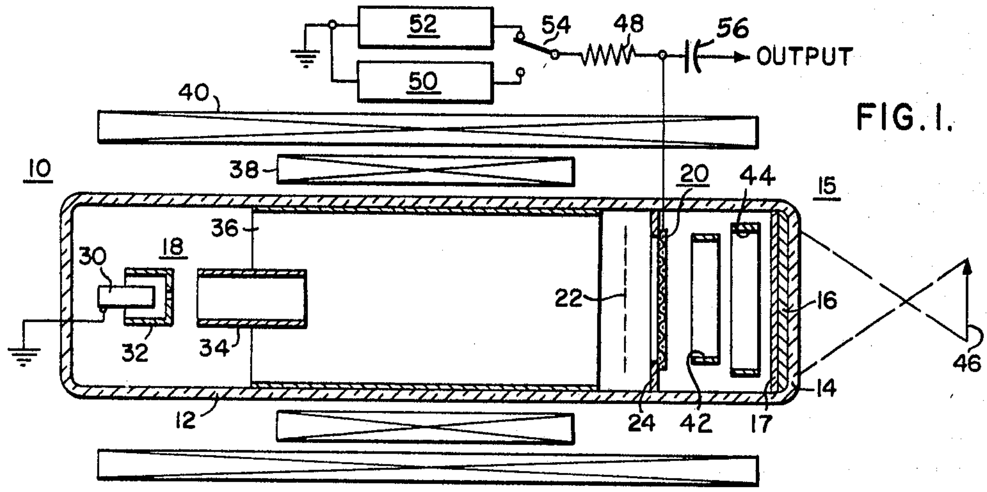

FIG. 1.

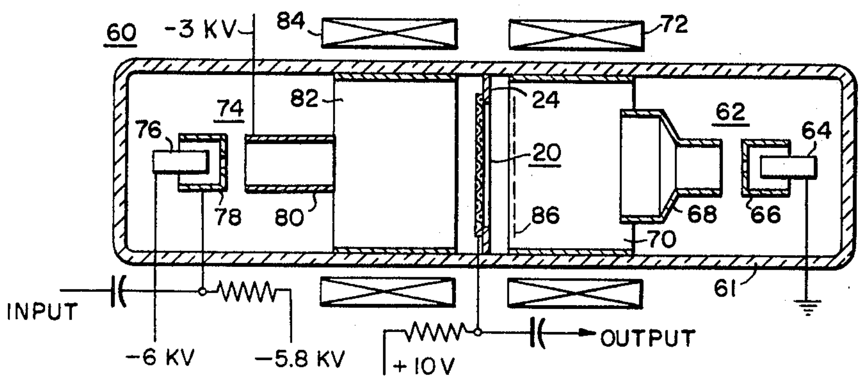

FIG. 2.

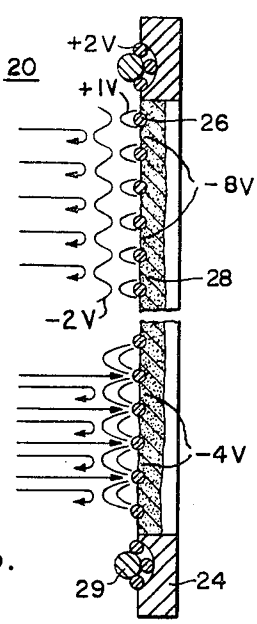

FIG. 3.

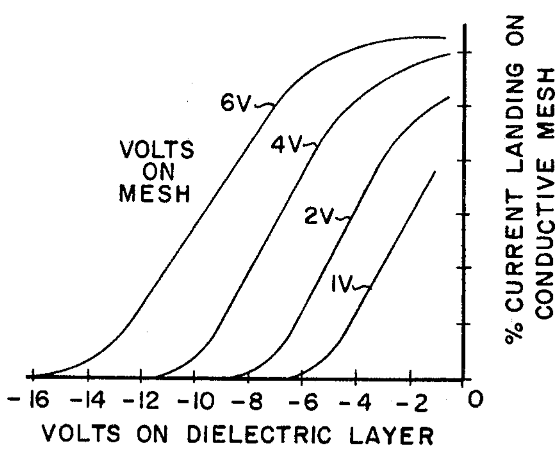

FIG. 4.

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3,440,478

IMAGE STORAGE DEVICE

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U.S. Cl. 315—12 8 Claims

ABSTRACT OF THE DISCLOSURE

A scan converter tube which includes a target element incorporating a porous dielectric storage material having a density of less than 10% of the material in bulk form and in which one surface of the target facing the reading gun has conductive portions surrounding elements of a dielectric material to permit a non-destructive read-out of information written onto the target from the opposite side by a writing electron gun.

This invention relates to image storage devices and more particularly to those in which information is stored on a target element as a distribution of charges and read out by means of an electron beam.

In one well known type of image storage device, a photocathode element is positioned on one side of the target element and an electron gun is disposed on the other. The photocathode element emits in response to a light scene a corresponding electron image onto the target element; as a result, a charge pattern is established on the target element corresponding to the light scene. The electron gun positioned on the other side of the target element provides an electron beam of low velocity to scan the target element and to thereby derive an output signal corresponding to the pattern of charges distributed upon the target element.

In a second type of image storage device, a writing electron gun is substituted for the photocathode element. The information to be placed upon the target element is scanned across one surface of the target element in a given pattern to thereby provide a pattern of charges upon the target element. Due to the insulating or dielectric nature of the target element, the charge pattern remains upon the target element for an extended period of time. During this time the target element is scanned by a second beam of electrons to thereby provide an output signal corresponding to the pattern of charges. The output signals are typically produced by a different scanning pattern than that by which the charge pattern was established on the target element by the writing electron gun. This particular type of image device is commonly known as a scan converter.

It is an object of this invention to provide a new and improved image storage device.

Another object of this invention is to provide a new and improved image storage device having a high gain target element therein capable of providing many copies of the output signal from a single stored pattern.

A further object of this invention is to provide a new and improved image storage device incorporating therein a target element capable of integrating the input signal over an extended period of time and of rapidly discharging the resultant charge pattern.

Another object of this invention is to provide a new and improved image storage device having a target element therein upon which the reading and writing by electron beams can be performed simultaneously.

A still further object of this invention is to provide an image storage device having a target element therein

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of increased dimensions thereby improving the resolution of this device.

It is another object of this invention to provide a new and improved image storage device incorporating a target element in which the conduction of electrons substantially takes place within a vacuum and which, in addition, exhibits an increased stability during the reading and writing processes.

Briefly the objects of this invention are accomplished by providing an image storage device including a target element for storing a pattern of charges, means for directing an electron beam modulated with input signals onto the target element, and means for directing a second electron beam into the target element to thereby derive an output signal. More specifically, the target element includes a plurality of elements made of a porous dielectric storage material having a density of less than 10% of the material in bulk form and a conductive member for supporting the dielectric elements. Further, the elements of dielectric material and the conductive member have portions thereof which are exposed to the electron beam directed thereon to derive an output signal. In one specific embodiment of this invention, the dielectric material is disposed as by evaporation onto a fine mesh to thereby provide a target element having exposed on one side thereof portions of the electrically conductive mesh and a plurality of exposed portions of dielectric material.

In a further aspect of this invention, the target element is operated so that the side of the target element having exposed portions of dielectric and conductive material is scanned by a low velocity electron beam to establish a negative potential on the exposed portions of the dielectric material. A pattern of charges corresponding to the input signal is then disposed thereon by bombarding the target element with a beam of electrons accelerated onto the target element at a voltage sufficient to produce a secondary electron generation gain of greater than unity in the dielectric material. Due to the porous nature of the dielectric material, the electrons generated within the voids of the dielectric material are collected by the conductive material which is integrally associated with the target element to thereby drive portions of the dielectric material more positively. It is an important aspect of this invention that the portions of the dielectric material exposed to the reading electron beam are driven from a negative to a more positive, though still negative, potential; such a process allows the target element to utilize the inherently high gain of the porous dielectric material. During the readout step of this method, the exposed dielectric elements are more negative than the exposed portions of the conductive member, and as a result the reading electron beam will be attracted to the conductive member in accordance with the charges established upon the exposed dielectric portion. It is noted that the reading electron beam does not land upon the dielectric portions and as a result the charge pattern is not erased and the readout process may be repeated many times.

Further objects and advantages of the invention will become apparent as the following description proceeds and features of novelty which characterize the invention will be pointed out in particularity in the claims annexed hereto and forming a part of this specification.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which:

FIGURE 1 is an elevational view in section, schematically representing an image storage device in accordance with the teachings of this invention;

FIG. 2 is an elevational view in section, schematically representing an alternative embodiment of an image storage device in accordance with the teachings of this invention;

FIG. 3 is an enlarged elevational view in section illustrating the storage target element as utilized in the devices for FIGURES 1 and 2; and

FIG. 4 is a graphical representation of the conditions upon the target element during the operation of the device shown in FIG. 1.

Referring to the drawings and in detail to FIG. 1, there is illustrated an image storage device **10** incorporating the teachings of our invention. The image storage device **10** comprises an envelope **12** including a face plate **14** enclosing one end of the envelope **12** and made of a suitable material transmissive to the desired scene radiation. A photocathode element **15** including a layer **17** of a suitable photoemissive material sensitive to the input radiations (such as cesium antimony for a visible light input) and a light transmissive layer **16** of electrically conductive material is provided on the inner surface of the face plate **14**. An electron gun **18** is provided at the opposite end of the envelope **12** for generating and forming a pencil-type electron beam which is directed onto a storage target element or electrode **20**. The storage target element **20** is positioned between the electron gun **18** and the photocathode element **15**. Between the storage target element **20** and the photocathode element **15**, there is provided a plurality of electrodes illustrated as **42** and **44** with suitable potential provided thereon for accelerating and focusing the photoelectrons emitted from the photocathode element **15** onto the storage target element **20**. Positioned between the storage target element **20** and the electron gun **18**, there is provided a grid member **22** made of a suitable electrically conductive material such as nickel which is located at a distance of about .125 inch from the surface of the storage target element **20**.

The electron gun **18** is of any suitable type for producing a low velocity pencil-like electron beam to be scanned over the surface of the storage target element **20**. The electron gun **18** may consist of a cathode element **30**, a control grid **32** and an accelerating grid **34**. The gun electrodes **30**, **32**, and **34** along with an anode electrode **36**, which may be a coating of electrically conductive material disposed upon the interior surface of the envelope **12**, provide a focused electron beam which is directed onto the storage target element **20**. Deflection means **38** illustrated as an electromagnetic coil is provided about the envelope **12** for deflection of the electron beam and by application of suitable currents, scans the electron beam over the surface of the target element **20** in a conventional manner. A focusing means illustrated as an electromagnetic coil **40** is also provided about the envelope **12** to provide additional focusing of electron beam from the electron gun **18** onto the storage target element **20** as well as for focusing the electron beam emitted from the photocathode element **15** onto the other side of the storage target element **20**.

Referring now to FIG. 3, a detailed structure of the storage target element **20** is shown. The storage target element **20** is supported upon a ring **24** made of a suitable material such as Kovar alloy (Westinghouse Electric Corporation trademark for an alloy of nickel, iron and cobalt). Further, the storage target element **20** is comprised of a very fine mesh **26** which is made of a suitable electrically conductive material such as copper or nickel and which is secured to the ring **24** by an annular support member **29** which may be spot welded to the ring **24**. The mesh **26** may be of the woven type or be made from a solid sheet which has been etched to provide a perforate structure. In an illustrative embodiment of the target element **20**, the mesh **26** has at least 750 holes per inch and an open area of from 50 to 60%. A mesh of these parameters has a wire diameter in the order of 6 microns. A layer **28** of a material exhibiting secondary emission properties is then deposited directly onto the mesh **26**. Suitable materials which exhibit this property include potassium chloride, barium fluoride, sodium bromide, and magnesium oxide.

The layer **28** is of a spongy or porous consistency having a density of less than 10% of the density of the storage material in its normal state. The porous layer **28** is formed by the evaporation of the secondary emissive material onto the mesh **26**. The material to be deposited is heated to its evaporation temperature in the presence of an inert atmosphere, for example helium or argon. The evaporation takes place at a distance in the order of a few inches in an atmospheric pressure of about .5 to 5 millimeters of mercury. It is an important aspect of this invention as will be explained later that portions or elements of the dielectric material are disposed in the interstices of the mesh **26**. Further, these portions of the dielectric material and portions of the mesh **26** present exposed surfaces which are disposed substantially in the same plane. During the evaporation, particles of the dielectric material, though smaller than the holes in the mesh, will deposit and grow sideways from the wires of the mesh **26** to thereby cover the entire area of the mesh and provide a continuous layer of the dielectric material. Further, those portions of the conductive mesh **26** directly abutting a back-plate will not be coated with the dielectric material in accordance with the teachings of this invention.

In an illustrative embodiment of the storage target element **20**, the mesh **26** has from 750 to 1000 holes per inch and an open area from 50 to 60%. Further, the particles of dielectric material have a diameter in a range of 1 to 2 microns and the layer **28** has a density in the range of from 1 to 2% of the bulk density of the material being deposited and a total thickness of from 5 to 40 microns. One of the significant properties of the target element **20** is that gains in the order of 100 have been readily achieved by elements that have been constructed in accordance with the above description.

Further as shown in FIG. 1, an external connection is made from the conductive mesh **26** of the target element **20** to an impedance **48** which is in turn connected to a switching means **54**. Alternatively, the switching means **54** may be connected through either of the potential sources **50** and **52** to ground. As will be explained later, an output signal may be derived across the impedance **48** and directed through a capacitance **56**.

The opeartion of the image storage device **10** as shown in FIG. 1 requires the performance of a three-part cycle. The three steps of this cycle include (1) erasing and/or priming, (2) a writing step, and (3) a reading step;

(1) *Priming*

During the first step of operating the image storage device **10**, the conductive mesh **26** of the storage target elementment **20** is set at a potential with respect to that of the cathode element **30** of approximately 10 volts positive. This is accomplished by connecting the conductive mesh **26** to the potential source **52** as by the switching means **54** (i.e. position 1). Electrons emitted form the cathode element **30**, which is connected to ground, are accelerated by the voltage placed upon the conductive mesh **26** and drive the surface of the porous layer **28** exposed to the electrons emitted by the cathode element **30** to the potential of the cathode element **30** (i.e. ground potential).

(2) *Writing*

After the target element **20** has been primed, the switching means **54** is disposed in a second position where the conductive mesh **26** of the target element **20** is connected to the potential source **50** which is approximately 2 volts positive with respect to ground. It may be understood that due to the capacitive action between the conductive mesh **26** and the surface of the porous layer **28** that the surface of the layer **28** disposed in the interstices of the mesh **28** is set at approximately —8 volts with respect to ground. Next, the radiation emitted from a scene **46** is focused upon the photocathods element **15** and photoelectrons are emitted from each portion of the coating **16** corresponding to the amount of light directed thereon. The photoelectrons are focused as by electrodes **42** and **44** and are accelerated with a sufficient high energy of about 5 to 10 kev. onto the target element **20**. The acceleration voltage is of such a value that substantially all the primary electrons from the photocathode element **15** completely penetrate the porous layer **28** but do not substantially pass on through the structure. The primary electrons from the photocathode element **15** create a number of low energy electrons within the voids of the layer **28** orders of magnitude higher than the number of incident or primary electrons. The number of secondary electrons generated is about 200 for each primary electron incident upon the target element **20**.

The secondary electrons generated within the layer **28** are attracted by the positive potential applied to the conductive mesh **26**. It is an important aspect of this invention that the conduction of electrons through the layer **28** takes place through the voids of the porous layer **28** to the mesh **26** which is an integral part of the storage target element **20**. This type of electron conduction is known as secondary electron conduction (SEC) in contradistinction to the electron conduction taking place through the solid portions of a material. As a result, portions of the layer **28** suffer a net loss of electrons and the surface of the layer **28** disposed within the interstices of the mesh **26** will be driven positively with respect to those surfaces which have not been so bombarded. After the photoelectrons emitted by the coating **16** have been accumulated and integrated for a sufficient period of time upon the storage target element **20**, a pattern of charges will appear upon the surface of the porous layer facing the electron gun **18** which corresponds to the scene **46** as focused upon the photocathode element **15**.

In this illustrative method of operation, those portions of the layer **28** which have been bombarded with photoelectrons will be charged in a positive direction, though still negative with respect to ground, to a potential of approximately 4 volts negative. Those portions of the layer **28** which had not been bombarded with photoelectrons will remain at a potential of approximately 8 volts negative with respect to ground. It may be understood that the intensity of the photoelectron bombardment emitted from the photocathode element **15** will vary as to the intensity of the light focused upon the element **15**. In turn, the level of charge placed upon the layer **28** will correspond to the intensity of the incident photoelectrons; as a result, various portions of the layer **28** may vary between 8 volts negative and 4 volts negative depending on the intensity of the incident photoelectrons.

It is noted that by first establishing the surface of a layer **28** at a negative potential and driving this surface progressively positive, that the inherent gain of the target element **20** is utilized to establish the pattern of charges upon the layer **28**. This has particular significance where this type of target element is used in conjunction with a photocathode element. Normally, photocathode elements emit a lower intensity beam of electrons and, as a result, the use of this target element is necessary to achieve a sensitive device for detecting radiation emitted by the scene **46**.

(3) *Reading*

After a charge pattern has been disposed upon the surface of the porous layer **28**, the image storage device **10** is set to derive an output signal. This may be accomplished by disposing the switching means **54** in its second position so that the electrically conductive mesh **26** is connected through the impedance **48** through the potential source **50** of approximately 2 volts positive with respect to ground. As explained above, there has been established upon the surface of the layer **28** a pattern of charges whose potential varies between 4 volts negative and 8 volts negative with respect ground in accordance with scene **46**. As shown in FIGURE 3, equal potential surfaces are distributed from the surface of the dielectric storage layer **28** in accordance with this pattern of charges. It is understood that the charge of 8 volts negative stored upon the layer **28** represents an absence of a signal or a "black" input signal being stored upon the target element **20**, whereas a charge of 4 volts negative represents a "white" input signal.

As can be seen in FIG. 3, the negative equal potential surfaces emanating from the layer **28** tend to cut down the area through which electrons emitted from the electron gun **18** can be directed onto the conductive mesh **26**. As portions of the layer **28** of dielectric material are driven more negatively, the equal potential surfaces spread and overlap to further prevent the landing of electrons upon the conductive mesh **26**. In the instance where a more positive charge (i.e., 4 volts negative) had been disposed upon the layer **28**, the negative equal potential surfaces are so distributed from the surface of layer **28** to form passageways to the exposed portions of the mesh **26**.

In order to obtain an output signal, the electrons emitted by the cathode element **30** are focused and accelerated as by electrodes **34** and **36** and are deflected as by means **38** across the surface of the storage target element **20**. As explained above, a portion of the electron beam emitted by the electron gun **18** is allowed to land upon the conductive mesh **26** to thereby provide an output signal across the impedance **48**. As the portions of the layer **28** are driven more negatively, the reading beam landing on the conductive mesh is correspondingly decreased. Thus, where there has been established a charge distribution of 4 volts negative with respect to ground, a relatively large proportion of the electrons will be allowed to pass through the equal potential surfaces and be collected by the conductive mesh **26**. As portions of layers **28** are charged more negatively, more electrons will be prevented from passing to the conductive mesh **26** and relatively smaller current signals will be derived. Referring now to FIG. 4, there is shown a series of graphs indicating the percentage of electron beam current collected by the mesh **26** as a function of the potential disposed upon the dielectric layer **28** with respect to ground (i.e., the potential of the cathode element), and the potential established upon the conductive mesh **26** with respect to ground (i.e., the potential of the cathode element). In the exemplary method of operation where a potential of 2 volts positive with respect to ground has been established on the conductive mesh **28**, FIG. 4 indicates that only a few percent of the electrons emitted by the cathode element **30** will penetrate through the equal potential surfaces to the conductive mesh **26** in those regions of layer **28** where there has been established a charge of 8 volts negative. On the other hand, where there has been established a more positive charge upon the layer **28**, an increasing percentage of electrons will be received by the mesh **28**. Thus, the reading beam current directed upon the mesh **28** is inversely related to the negative voltage charge established upon the layer **28** and directly related to the intensity of the electron image generated by the photocathode element **25** and the radiation emitted by the scene **46**.

It is a significant aspect of this invention that an output signal is derived without erasing the pattern of charges established upon the porous layer **28** of the storage target element **20**. As noted above, the output signal is derived as the conductive mesh **28** collects electrons and a potential is developed across the impedance **48**. It is specifically noted that the surface of the porous layer **28** is established at a negative potential whereas the conductive mesh **26** is set at a positive potential to attract the electrons. Therefore, the electrons emitted by the cathode element **30** cannot land upon the surface of the layer **28** while it is disposed negatively and are in turn collected upon the positively disposed conductive mesh **26**. If the low energy electrons emitted by the cathode element **30** landed upon the surface of the layer **28**, the surface of this layer as explained above with regard to the priming of the target element **20** would be established at the potential of the cathode element **30** and a pattern of charges would thereby be erased. However, the surface of the porous layer **28** is disposed at a negative potential thereby preventing the bombardment of electrons and allowing a multicopy readout from the storage type element **20**.

Further, in order to achieve the nondestructive readout, the exposed surfaces of the conductive mesh **26** and the layer **28** of dielectric material should be substantially the same plane. More specifically, these surfaces should not be displaced from each other more than one-half the width of the portions of dielectric material disposed in the interstices of the mesh **26**. If this condition is substantially not met, the electrons emitted from the electron gun **18** will not be efficiently collected by the mesh **26** and a distorted attenuated output signal will be derived.

Referring now to FIG. 2 there is shown an illustrative embodiment of an image storage tube **60** which has a particular application as a scan converter. More specifically, the image storage tube **60** includes an enclosed tubular envelope **61** having disposed therein at one end a reading electron gun **62** comprised of a cathode element **64**, a control electrode **66** and an accelerating electrode **68** and an anode element **70** which may be formed as a coating upon the interior surface of the envelope **61**. There is disposed at the other end of the envelope **61** a writing electron gun **74** including a cathode element **76**, a control electrode **78**, an accelerating electrode **80** and an anode element **82** which may be disposed as a coating upon the interior surface of the envelope **61**. A storage target element **20** as described above with regard to FIG. 3 is disposed between the reading and writing electron guns **62** and **74**. More specifically, the exposed portions of the conductive mesh **26** are disposed toward the reading electron gun **62**. Further, a grid member **86** is disposed in a spaced relationship from the storage target element **20** in order to normalize the path of the electrons emitted by the cathode element **64** as they land upon the surface of the storage target element **20**. A deflection means **72** shown as an electromagnetic coil **72** is disposed about the envelope **61** so as to deflect electron beams emitted by the reading electron gun **62** across the surface of each storage target element **20**. In a similar manner, a deflection means **84** shown as an electromagnetic coil is disposed about the envelope **61** in order to deflect the electron beam as emitted by the cathode element **76** across the opposite surface of the storage target element **20**.

In a typical mode of operation, a beam of electrons emitted by the cathode element **76** of the writing electron gun **74** is accelerated with approximately 6 kev. onto the surface of storage target element **20**. An input signal is disposed upon the control electrode **78** to thereby modulate the writing electron beam which is scanned by means **84** over the surface of the storage target element **20** in a typical television pattern. As a result, secondary electrons are generated within the voids of the porous layer **28** and are conducted to the conductive mesh **26**. A positive voltage of approximately 10 volts is applied to conductive mesh **26** to attract the generated secondary electrons. Due to the aggregate loss of electrons, portions of the surface of the porous layer **28** are drawn towards the potential of the conductive mesh **26**. Depending upon the intensity of the electron beam emitted by the cathode element **76**, the surface of the porous layer **28** will have a pattern of positive charges corresponding to the input signal disposed upon the control electrode **78**.

In order to derive an output signal, the reading electron beam as emitted from the cathode element **64** is scanned over the surface of the storage target element **20** as by means **72**. As the reading electron beam is attracted to the more positively charge portion of the porous layer **28** the incident reading electron beam tends to charge the surface **20** toward the potential of the cathode element **64** or ground potential. As a result, a charge is induced across a minute portion of the porous layer **28** to the conductive mesh **26** to provide an output seignal which is proportional to the potential stored upon the surface of the porous layer **28**. In this manner, an output signal may be derived representing the pattern of charges disposed upon the storage target element **20** by the writing electron gun **74** and at the same time, the pattern of charges is erased as the surface of the porous layer **28** is driven towards the cathode or ground potential. Due to this capability of rapid erasure, the writing electron beam may be secanned across the storage target element **20** at one scan rate or pattern whereas the reading electron beam may be scanned at a second rate or pattern which is different from the first.

It is a significant aspect of this embodiment of the invention that the reading and writing operations may be conducted simultaneously with each other. It is noted that due to the high inherent gain (i.e., at least ten) of the storage target element **20** that the current collected by the conductive mesh **26** due to the capacitive discharge of the charge pattern under the bombardment of the reading electron beam is in the order of several magnitudes larger than the electron beam current originating from the cathode element **76**. Thus, the output signal is primarily related to the reading beam current and is substantially independent of the writing electron beam current. It may be understood, as explained above, that in the illustrative target element described above that 100 secondary electrons are generated for each incident writing electron emitted by the cathode element **76** and that the pattern of charge established upon the porous layer **28** and the resultant output current are a function of the increased gain due to the porous nature of the target element **20**.

As described in the copending application Ser. No. 241,641, entitled "Tube With Highly Porous Target," now U.S. Patent 3,213,316, by Goetze and Boerio and assigned to the assignee of this invention, there has been discovered under certain circumstances an instability in the porous type of target element which may lead to destruction of the target element. More specifically, as explained above, the incident primary electrons bombard the porous target element to thereby generate a number of secondary electrons within the target element for each incident primary electron. As the porous layer of the storage target element is driven positively, it is possible that some of the secondary electrons may be emitted from the surface of the storage target element opposite that surface upon which the writing electron beams fall. The emitted secondary electrons tend to be attracted by the positive potentials applied to various electrodes on the reading side of the target element. Due to the additional loss of electrons, the surface of the target element is driven more positively and may assume the potential of the aforementioned electrodes. Typically, these electrodes are maintained at several hundred volts positive with respect to the target elements and may drive the target element to a potential at which the internal field created within the target element physically destroys this element. However, due to the arrangement of the target element of this invention and its placement within the storage device, secondary electrons are substantially prevented from escaping from the target element and no transmission secondary electron emission takes place. This is principally due to the fact that the voltage applied to the conductive mesh establishes potential surfaces which retard the escape of secondary electrons from the target element.

Further, due to the porous nature of the above-described target element, the image storage device may write and also erase the pattern of charges upon the target element with but a single scan of the reading electron beam across surfaces of the storage target element. The capability of quickly writing and erasing is due to the nature of the electron conduction that takes place within the porous layer of the storage target element; specifically, the electrons are conducted through the voids of the porous layer as opposed to solid state conduction which is inherently slower.

While there has been shown and described what are presently considered to be the preferred embodiments of this invention, modifications thereto will readily occur to those skilled in the art. It is not desired, therefore, that the invention be limited to the specific arrangements shown and described, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

We claim:

1. An electron discharge device comprising a storage target electrode, said storage target electrode including a plurality of storage elements of a porous material having a density of less than 10% of said material in bulk form, and an electrically conductive member, said storage target electrode having at least one surface with portions of said storage elements and said member exposed; means for directing a writing electron beam modulated with a signal upon said storage target electrode to generate within said storage elements secondary electrons to thereby establish a charge pattern whose distribution is determined in accordance with said signal; and means for directing a reading electron beam upon said one surface of said storage target element to derive an output signal corresponding to said pattern of charges.

2. An electron discharge device comprising a storage target electrode, said storage target electrode including a plurality of elements made of a porous material having a density less than 10% of the material in bulk form, said material exhibiting the property of generating electrons within said elements in response to electron bombardment and conducting electrons through the voids of said porous material, and an electrically conductive member, said elements and said member each presenting upon one surface of said storage target electrode exposed areas substantially disposed in a plane; means for directing a writing electron beam modulated with a signal at said storage target electrode to generate within said elements secondary electrons which are collected by said conductive member to establish a charge pattern whose distribution is determined in accordance with said signal; and means for directing a reading electron beam upon said one surface to derive an output signal corresponding to said charge pattern.

3. An electron discharge device comprising a storage target electrode, said storage target electrode including a mesh of an electrically conductive material, and a porous material having a density of less than 10% of said material in bulk form deposited in the interstices of said mesh, said material having the property of generating secondary electrons within said porous material in response to electron bombardment and of conducting electrons through the voids of said porous material, said storage target electrode having at least one surface thereof with exposed portions of said mesh and said porous material disposed substantially in a plane; means for directing a writing electron beam modulated with input signals upon said storage target electrode to generate within said porous material secondary electrons which are collected by said mesh to establish a pattern of charges whose distribution is determined in accordance with said input signals; and means for directing a reading electron beam toward said one surface to said storage target electrode to derive output signals corresponding to said pattern of charges.

4. An image tube for storing an input signal corresponding to a viewed scene and repetitively providing an output signal corresponding to said input signal, said image tube comprising a storage target electrode including

a mesh of an electrically conductive material, and a porous material having a density of less than 10% of said porous material in bulk form deposited in the interstices of said mesh, said material having the property of generating secondary electrons within said porous material in response to electron bombardment and of conducting electrons through the voids of said material, said storage target electrode having a surface with exposed portions of said material and said mesh disposed substantially in a plane; a photocathode element for directing an electron image in accordance with said scene upon said storage target electrode to generate within said porous material secondary electrons which are collected by said mesh to establish a charge pattern whose distribution is determined in accordance with said electron image; and an electron gun for repetitively scanning an electron beam upon said surface of said storage target electrode to derive said output signal corresponding to said charge pattern.

5. A scan converter tube comprising a storage target electrode, said storage target electrode including a mesh of an electrically conductive material and a porous material having a density of less than 10% of said porous material in bulk form deposited in the interstices of said mesh, said porous material having the property of generating secondary electrons within said porous material in response to electron bombardment and of conducting electrons through the voids of said porous material, said storage target electrode having at least one surface with exposed portions of said porous material and said mesh disposed substantially in a plane; an electron gun for directing an electron beam modulated with input signals upon said storage target electrode to generate within said porous materal secondary electrons which are collected by said mesh to establish a pattern of charges whose distribution is determined in accordance with said input signals; and a second electron gun disposed on the opposite side of said storage target electrode for directing an electron beam upon said one surface of said storage target electrode to derive an output signal corresponding to said pattern of charges.

6. The method of operating an image storage device of the type having an integral target electrode comprising a plurality of storage elements of a material having the property of generating secondary electrons within said material in response to electron bombardment and of conducting electrons through the voids of said material, and a conductive member, said target electrode having at least one surface with portions of said storage elements and said member exposed; said method comprising the steps of directing high energy electrons modulated with input signals into said elements to produce secondary electrons, collecting said secondary electrons by said member to provide a pattern of charges corresponding to said input signals on said storage elements, setting said surface of said storage elements and said member respectively at first and second potentials, said first potential being more negative than said second potential, directing low energy electrons toward said one surface of said target electrode from a source of electrons disposed at a potential between said first and second potentials, and collecting a portion of said low energy electrons with said member to provide an output signal corresponding to said pattern of charges while maintaining said pattern of charges upon said storage elements.

7. The method of operating an image storage device of the type having a target electrode comprising a mesh of an electrically conductive material and a porous material having a density less than 10% of the density of said porous material in bulk form, said porous material having the property of generating secondary electrons within said porous material in response to an electron bombardment and of conducting said electrons through the voids of said porous material, said target electrode having at least one surface with exposed portions of said porous material and said mesh disposed substantially in a plane, said method comprising the steps of establishing a first potential on said one surface of said target electrode, directing a flow of electrons modulated with input signals with sufficient energy to penetrate into said material to produce secondary electrons therein, conducting said secondary electrons through the voids of said porous material and collecting said secondary electrons upon said mesh to provide a pattern of charges corresponding to said input signals on said porous material, applying a second potential to said mesh to thereby establish said exposed portions of said material at a third potential, said third potential being more negative than said second potential, directing an electron beam onto said one surface of said target element from a source of electrons disposed at a fourth potential set between said second and third potentials, and collecting a portion of said second electron beam upon said mesh to provide an output signal while maintaining said pattern of charges upon said porous material.

8. The method of repetitively providing an output signal from an image storage tube including a target electrode having a plurality of storage elements of a porous material having the property of generating secondary electrons within said porous material in response to electron bombardment and of conducting electrons through the voids of said porous material, and a conductive member, said target element having at least one surface with portions of said storage elements, and conductive member

exposed in a plane; said method comprising the steps of directing into said target electrode a first beam of electrons modulated with input signals with sufficient energy to penetrate into said porous material and to generate secondary electrons, attracting said secondary electrons through the voids of said porous material and collecting said secondary electrons by said member to provide a pattern of charges corresponding to said input signals on said storage elements, establishing first and second potentials respectively upon said one surface of said storage elements and said member, said first potential being more negative than said second potential, repeatedly scanning said one surface of said target electrode with a second beam of electrons from a source disposed at a third potential intermediate said first and second potentials, and collecting a portion of said second electron beam upon said member to provide a repetitive output signal corresponding to said pattern of charges while maintaining said pattern of charges upon said target electrode.

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