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Oct. 31, 1961 J. T. McNANEY 3,007,049

APPARATUS FOR GENERATING ELECTROSTATIC IMAGES

Filed March 12, 1959 2 Sheets-Sheet 1

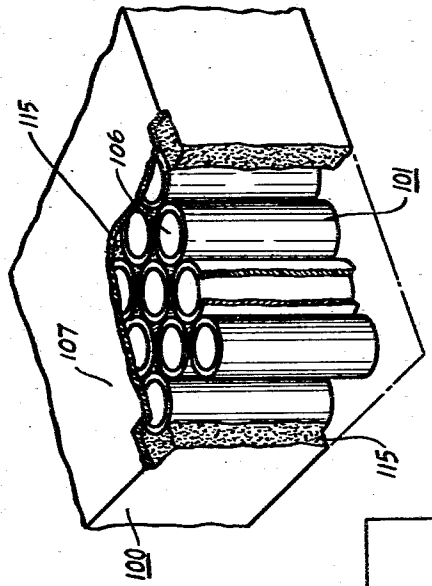


Fig. 2

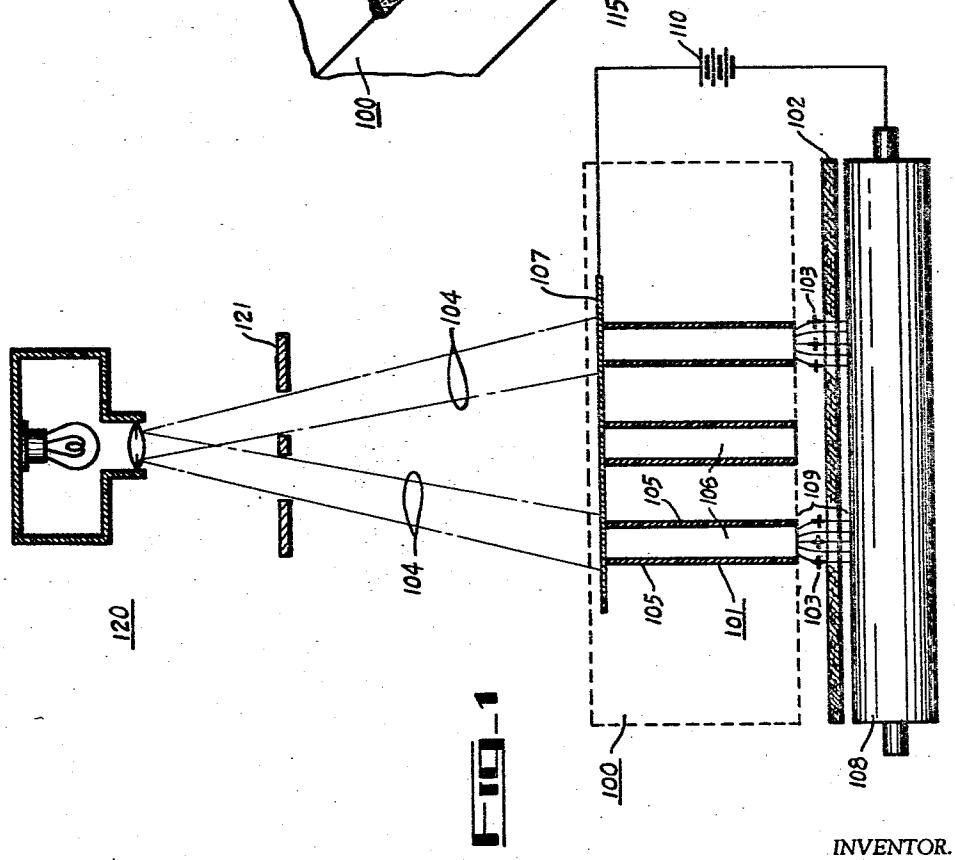


Fig. 1

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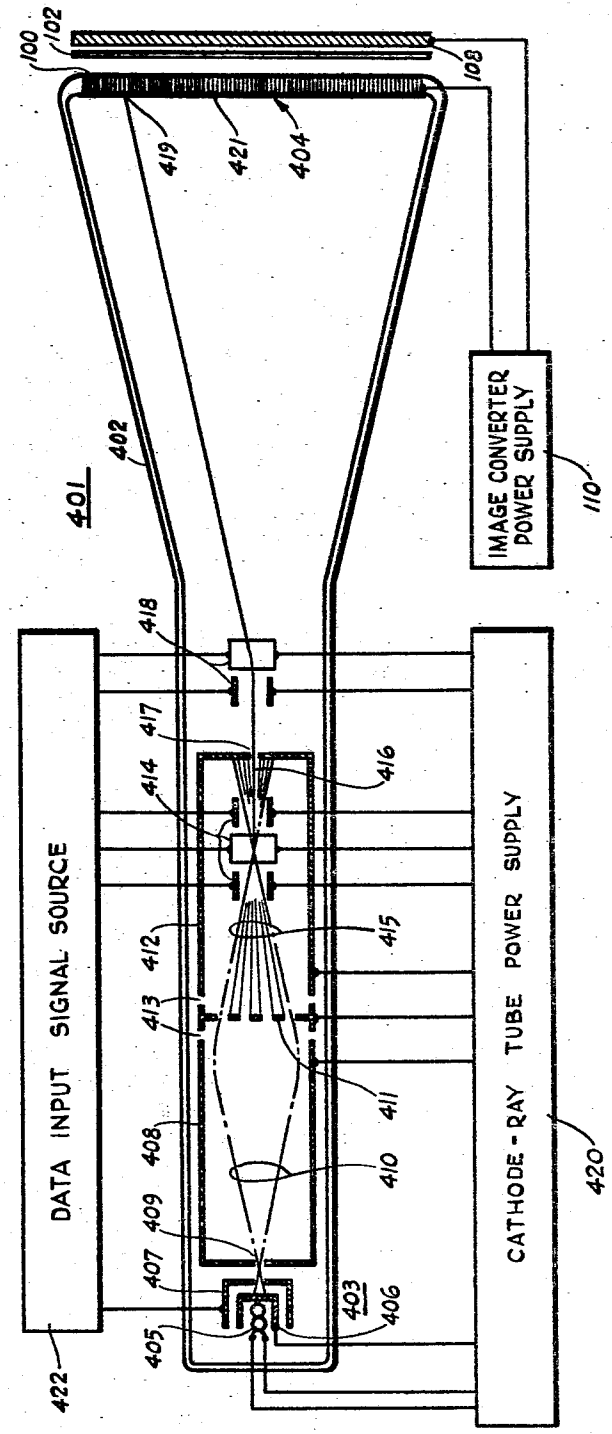


FIG. 3



FIG. 4

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APPARATUS FOR GENERATING ELECTROSTATIC IMAGES

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This invention relates to apparatus for generating electrostatic images and more particularly to apparatus for generating and recording electrostatic images from light images directly onto a recording medium.

Electrostatic image generating systems have been in use for several years. While advances in the art have been made, these systems nevertheless have characteristic limitations. They generally require highly complex input devices, intermediate storage means from which latent electrostatic images must be transferred, provisions for continually wiping and recharging the storage means, or a special relatively expensive recording medium, manufactured with a light responsive coating. Because of the complexity of these systems, it is desirable to place electrostatic images directly on a recording medium in a manner that the images may be processed to a final printed record upon the recording medium. This has advantages in eliminating the aforesaid storage means. Further it is of advantage to reproduce the light images in the form of electrostatic images on the recording medium with as high a resolution as is possible thereby obtaining clearer defined character images of smaller size.

Accordingly, it is an object of this invention to provide a new and improved apparatus for converting light images directly into electrostatic images.

It is another object of this invention to convert generated light images directly into usable electrostatic images on an inexpensive recording medium such as ordinary paper.

It is another object of this invention to convert generated light images into electrostatic images on a recording medium without the necessity of an intermediate plate or drum.

It is another object of this invention to provide apparatus for converting light images into high resolution electrostatic images on a suitable recording medium.

It is another object of this invention to provide apparatus capable of converting cathode-ray tube images directly into large potential electrostatic images on an ordinary paper recording medium with high resolution.

Further objects and a fuller understanding of the invention will become apparent with reference to the following description and claims, taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a schematic illustration of the operation of the invention in converting light images into electrostatic images through selective ion discharges;

FIGURE 2 is an enlarged view partly broken away, of an array of light guides arranged in a panel;

FIGURE 3 is a view of an embodiment of the invention where a cathode-ray tube is used to generate electrostatic images; and

FIGURE 4 is a cross-sectional view of a recording medium that may be used in the invention.

The general operation of the invention is illustrated schematically in FIGURE 1. An array of individual light guide units or transfer means **101** hereinafter designated an image converter **100** is arranged for spraying a dielectric recording medium **102** with a pattern of electrical charges **103** that corresponds to a pattern of light rays **104** from a light image generating means **120**. The light image generating means may take any suitable form

such as, by way of example but not limited to, printed matter illuminated by an external light source, a photographic image or a moving light beam. While the arrangement of FIGURE 1 has general application with respect to suitable light sources, it has specific application in cathode-ray tubes as will be more apparent later.

Each light guide unit **101**, shown greatly enlarged in FIGURE 1 and FIGURE 2, consists of a photoconductive coating **105** such as selenium or suitable type photoconductive material on the outer longitudinal surface of a light guide **106**. A transparent conductive layer **107** such as a coating of an oxide of tin makes electrical contact with one end of the guide units **101**. A common passive electrode **108**, which may be a conductive roller or back plate, is separated from the opposite ends of the guide units by an appropriate gap **109**. The passive electrode also serves as a support and guide for the recording medium **102**. Electrode **108** is illustrated as being spaced from recording medium **102** solely for the purposes of clarity of presentation, it being understood that recording medium **102** will be in contact with electrode **108** when electrode **108** is serving as a support. Alternatively, as shown in FIGURE 4, the recording medium may have a conductive layer **201** deposited on recording material **202** on the side opposite the gap. The conductive layer **201** may serve as the passive electrode, eliminating the need for a conductive roller or back plate. An external source of high potential **110**, connected between the transparent conductor **107** and the passive electrode **108**, supplies the energy necessary for ionization across the gap **109**. Unless it is exposed to light the photoconductive coating **105** surrounding each light guide **106** acts as an insulator across which a large voltage drop exists. The length of the photoconductor **105** must be sufficient to prevent breakdown or flashover of the large voltage drop between conductor **107** and passive electrode **108**.

In operation, incident light from a light image generating means **120** passes through an image shaping means **121** and through the transparent conductor **107** into the end of selective ones of light guides **106** along the paths **104**. Through diffraction, scattering and dispersing within the light guides **106** the light impinges on the surrounding photoconductive surface **105**. The resultant drop in photoconductive resistance because of its illumination causes a corresponding increase of current through the photoconductor **105** and places the high potential drop directly across the gap **109**. The magnitude of the external potential **110** is such that the increased potential directly across the gap causes ionization of the surrounding air or gases within the gap resulting in a current flow of ions across the gap. The ions **103** migrate under the influence of the electrical field within the gap to the surface of the recording medium **102**. Only those light activated guide units **101** can produce ionization and consequent charging of adjacent points on the recording medium **102**. The recording medium therefore receives a latent electrostatic image that corresponds to the light image impinging on the surface formed by the light receiving end of the active guide units **101**. The latent images may be developed by well-known means such as the application of charged dielectric powder to the surface of the recording medium. Powder granules cling to the oppositely charged electrostatic image to form a visible image which may be fixed by the application of heat or pressure or by other known means.

Although the gaseous and electromagnetic environment in the neighborhood of the gap **109** and the material and construction of the surface of the passive electrode **108** may be designed to favor ionization at relatively low potentials, air is normally used in the gap making it

necessary to have a high potential to cause ionization. In the present invention the length of the photoconductor and the light guide may be selectively varied to provide optimum insulation between the transparent conductor **107** and the passive electrode **108** and thus permit the utilization of high voltages without incurring flashover or insulation breakdown.

The light guides in this invention may be a bundle or parallel multiplicity of fibers made of glass, plastic or other transparent material. Arrays of such fibers are well known in the field of fiber optics. N. S. Kapany discusses the field of fiber optics comprehensively in Appendix N (pages 553 to 579) of a book published by W. H. Freeman and Company, San Francisco, entitled "Concepts of Classical Optics," by J. Strong. As an example of one form of constructing the light guides into a unitary transfer means or image converter **100**, an enlarged view in FIGURE 2 shows an array of conductively coated glass fibers **106** welded into a panel. The fibers are bundled together along with a binder material **115** into a parallel array. The binder may initially take the form of glass frit. The assembly may then be subjected to a vitrifying temperature that converts the array into a solid block without melting the fibers **106** or disturbing the photoconductive coatings **105**. Working faces are formed by sectioning the material perpendicularly to the fiber axes. Arrays such as the one illustrated in FIGURE 2 may be composed of fibers from 5 to 50 microns in diameter, yielding a resolution capability on the order of 500 to 5000 bits per linear inch. The high ratio of photoconductive surface area to fiber aperture yields an image converter of high efficiency and light sensitivity.

It should be understood that the light guide array of the image converter **100** may have a variety of configurations such as the flat panel shown in FIGURE 2, a disk the size of a cathode-ray tube screen, a rectangle corresponding to an image frame, a section of a cylindrical or spherical surface, and the like. It may serve as an integral part of a cathode-ray tube device as hereinafter described or it may be mounted externally to such a tube, although the former application yields the higher resolution and has other specific advantages. The recording medium **102** may be a sheet or roll of ordinary paper or transparent plastic having dielectric properties, an endless belt of dielectric material, and the like. It may also be coated with a conductive layer on one side, as hereinbefore described in reference to FIGURE 4. The image converter is capable of responding to various wavelengths of light according to the spectral sensitivity of the photoconductive material. The output or writing speed is limited only by the transient characteristics of the photoconductive material and the ion discharge.

With the addition of a phosphor to the conductively coated surface **107** of a fiber array as shown in FIGure 2, an image converter arrangement **100** can form a part or all of the screen in a cathode-ray tube device, to provide a system such as shown in FIGURE 3 for obtaining a record directly from the face of a cathode-ray tube. This system has particular advantage since the image converter can be easily made to hold a vacuum, as required in cathode-ray tubes, and also higher resolution displays are obtained than would be possible if the image converter were positioned external to a cathode-ray tube screen or if other structural members were required. The particular cathode-ray tube device shown in FIGURE 3 is a shaped beam tube **401** and has in place of a conventional screen an image converter **100**. Otherwise, the tube is similar to that described in U.S. Patent No. 2,811,668. It consists of an evacuated glass envelope **402** having at one end an electron gun **403** for generating cathode rays, at the other end a screen **404** which contains an image converter **100** and intermediate the two ends means for shaping the cathode-ray beam into the form of characters, sequentially selecting various characters, and directing them to predetermined locations on the surface of the image converter.

The operation of a typical shaped beam tube so equipped is described briefly as follows. The electron gun **403** contains a heater **405** within a thermionic cathade **406**. A control grid **407** adjacent the cathode **406** is capable of varying the intensity of the electron beam. A first accelerating electrode **408** contains an aperture **409** centered on the electron beam axis. The aperture serves as an electrostatic diverging lens, spreading the electron beam **410** so as to flood a character matrix **411** as described in U.S. Patent No. 2,761,988. A second accelerating electrode **412** is separated from the first **408** by a gap **413** which serves as an electrostatic converging lens, causing the flood beam **410** to converge in the vicinity of a first set of deflection plates **414**. The character matrix **411** is a metallic plate intermediate the first accelerating electrode **408** and the first set of deflection plates **414**, and is perpendicular to the axis of the tube. It contains a plurality of etched or punched characters and thus forms the cathode-ray flood beam into a plurality of beams **415**, each with a separate and distinct cross section. The first set of deflection plates **414** is substantially symmetrical about a lateral axis of the tube, as described in U.S. Patent No. 2,811,668. This particular configuration of deflection plates yields an exit beam **416** coaxial with the tube axis. The second accelerating electrode **412** contains an exit aperture **417** centered on the tube axis which filters out all but a single character-shaped beam at a time. A second set of electrostatic deflection plates **418** intermediate the exit orifice **417** and the screen **404** directs the selected cathode-ray character beam **417** to predetermined locations **419** on the image converter **100**. A cathode-ray tube power supply **420** such as is shown in Patent No. 2,761,988 furnishes appropriate potentials to the internal elements. A coating of phosphor **421** on the image converter **100** surface which lies within the tube converts impinging cathode rays into corresponding bits of light, to which the image converter is responsive.

Spaced appropriately from the image converter **100** as in FIGURE 1 is a passive electrode **108**, which serves as one conductor in the electrostatic recording system and which may also serve as a support for a recording medium **102**. An image converter power supply **110** maintains a high potential between the transparent conductive surface of the image converter over which the phosphor is laid and the passive electrode **108**, as previously described with reference to FIGURE 1. A data input signal source **422** controls the beam intensity, the selection of characters from the matrix, and the selective deflection of character images on the image converter. An exemplary data signal input source is described fully in U.S. Patent No. 2,736,770.

Although this invention has been described with reference to a particular embodiment, it is understood that the present disclosure has been made only by way of example and that numerous configurations and changes in the type, combination and array of components may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

I claim:

1. In combination, a cathode-ray tube having an electron responsive target and means for generating and projecting an electron beam toward said target, said target including a plurality of light guide units grouped into an array, each of said guide units having transverse ends and a longitudinal outer surface extending its length with at least a portion of said surface having a coating of photoconductive material that extends substantially the length of said guide unit, means, comprising filler material positioned between each of said guide units, for welding said guide units into said array in a manner that said ends form inner and outer surfaces of said target, said inner surface of said target having a coating of electron

sensitive phosphor substantially transparent conductive means sandwiched between said inner surface and said coating of said phosphor for carrying a potential having a given magnitude, conductor means positioned in spaced relationship to said outer surface of said target for carrying a potential having a magnitude different from the potential magnitude carried by said conductive means, said light guide units being capable when illuminated by said electron beam contacting said electroluminescent material of discharging a portion of said potential difference between said conductive means and said conductor means providing an ion discharge across said space between said outer surface and said conductor means, and recording means positioned in said space for receiving an electrostatic charge in response to said ion discharge.

2. Apparatus for generating and recording electrostatic images from light images comprising in combination, a high-potential source, a pair of conducting members electrically connected to opposite terminals of said potential source, transfer means for providing an insulated path between said conductors in a first condition and for providing substantially a conducting path between said conducting members in a second condition, said transfer means being electrically connected to one of said conductors and spaced from the other of said conductors permitting an energy discharge across said space when said transfer means is in said second condition, recording means positioned in said space for receiving electrostatic charge patterns from said energy discharge, light generating means for illuminating selective portions of said transfer means, said selective portions of said transfer means being transformed from said first condition to said second condition in response to said illumination, said transfer means comprising a plurality of individual and substantially identical light guide units having longitudinal surfaces and transverse ends, at least a portion of said longitudinal surface of each of said guide units having photoconductive material extending the length of said longitudinal surface.

3. In combination, a plurality of light guide means for transferring electrical energy in response to light, each of said guide means being substantially identical and having a longitudinal surface and first and second transverse ends, at least a portion of said longitudinal surface having a coating of photoconductor material extending the length of said longitudinal surface between said ends, each of said light guide means being capable of illuminating said longitudinal surfaces in response to light being directed on said first ends, a high electrical energy source having output terminals, transparent conductive coating means electrically connected to one terminal of said energy source and to said photoconductor material at said first transverse end for supplying electrical energy to said photoconductor material and for passing light to said first transverse ends of said guide means, light generating means for projecting light displays on selective of said first ends, conductor material electrically connected to another of said energy source terminals and being positioned in spaced relation to said second ends of said guide means, and a dielectric recording means positioned between said conductor material and said second ends of said guide means for receiving an electrostatic charge when said guide means are illuminated by said light generating means.

4. Apparatus for generating and recording electrostatic images from light images comprising in combination, a pair of conducting members having a high potential impressed thereacross, light guide means responsive to light for providing substantially a closed potential conducting path between said conducting members in response to light, said light guide means being electrically connected to one of said conductors and spaced a distance from the other of said conductors permitting ion discharges, a dielectric recording medium positioned between said light guide means and said other conductor for receiving and retaining an electrostatic charge pattern from said space discharge, said light guide means including a plurality of individual and substantially identical light guide units having longitudinal surfaces and transverse ends, at least a portion of said longitudinal surface of each of said guide units having a coating of photoconductor material extending substantially the length of said longitudinal surface, light generating means for illuminating selective ones of said guide units, each of said guide units being capable when illuminated of transferring light throughout its length and illuminating said photoconductor throughout its length, said coating of photoconductor material having a length capable of preventing discharge of said potential across said conducting members when said guide means are in a nonilluminated condition.

5. In an apparatus for generating and recording electrostatic images from light images, a high-potential source, a pair of conducting members electrically connected to opposite terminals of said potential source, a plurality of light guides, each of said guides having a photoconductive coating for providing a portion of a conducting path between said conducting members in response to light, said coatings being electrically connected to one of said conductors and being spaced a distance from the other of said conductors permitting the transfer of space discharges across said distance, and a recording medium positioned between said light guides and said other conductor for receiving and retaining an electrostatic charge pattern from said space discharge.

6. In an apparatus for generating and recording electrostatic images from light images, a pair of electrical conductor members having a potential impressed thereacross, a light generating unit, a dielectric recording medium positioned adjacent one of said members, a plurality of light guide units adapted to discharge said potential from one of said members to the other of said members in response to light from said light generating unit by providing ion discharges to said dielectric medium over selected areas of said medium, each of said light guide units including a coating of photoconductive material, said areas of said dielectric medium receiving said ion discharges being determined by the selective ones of said light guide units being illuminated by said light generating unit, and retaining means positioned between each of said guide units for joining said guides into an array.

7. Apparatus for generating and recording electrostatic images from light images comprising in combination, a pair of electrical conductor members having a potential impressed thereacross, a light generating means for generating light images, a dielectric recording medium positioned adjacent one of said members, a plurality of light guide units adapted to discharge said potential from one of said members to the other of said members in response to light from said light generating means by providing ion discharges to said dielectric medium over selected areas of said medium, each of said light guide units including a coating of photoconductive material and said areas of said dielectric medium receiving said ion discharges being determined by the selective ones of said light guide units being illuminated by said light generating means.

8. Apparatus for generating and recording electrostatic images from light images comprising in combination, a high-potential source, a pair of electrical conductor members being capable of having a high potential from said potential source impressed thereacross, a dielectric recording medium capable of being positioned adjacent one of said members, a plurality of light guides, light generating means for illuminating selective of said light guides, each of said guides having an outer surface extending its length and transverse ends, at least a portion of said surface of each of said guides having a coating of photoconductive material that extends substantially the length of said guide, each of said light guides being capable of illuminating at least the surface of said photo-

conductive material presented to said surface of said guide when said guide is illuminated by said light generating means, said photoconductive material when illuminated being adapted to discharge a portion of said potential from one of said members to the other of said members by providing an ion discharge to said dielectric medium over selected areas of said medium, said length of said photoconductive material and said length of said guide being sufficient to prevent flashover of said high potential between said conductors when said guides are in a nonilluminated condition, and said areas of said dielectric medium receiving said ion discharge being determined by the selective ones of said light guides being illuminated by said light generating means.

9. Apparatus for generating and recording electrostatic images from light images comprising in combination, a pair of electrical conductor members having a potential impressed thereacross, a light generating means for generating light images, a dielectric recording medium positioned adjacent one of said members, a plurality of light guide units having longitudinal surfaces adapted to discharge said potential from one of said members to the other of said members in response to light from said light generating means by providing ion discharges to said dielectric medium over selected areas of said medium, each of said guide units including a coating of photoconductive material along said longitudinal surfaces, means between each of said guide units and fixed to said longitudinal surfaces for securing said guides into a unitary array, and said areas of said dielectric medium receiving said ion discharge being determined by the selective ones of said light guide units being illuminated by said light images of said light generating means.

10. Apparatus for generating and recording electrostatic images from light images comprising in combination, a pair of electrical conductor members having a potential impressed thereacross, a dielectric recording medium positioned adjacent one of said members, a plurality of light guides, light generating means for illuminating selective of said light guides, each of said guides having an outer surface extending its length and transverse ends, at least a portion of said surface of each of said guides between said ends having a coating of photoconductive material, each of said guides being capable of illuminating at least the surface of said photoconductive material presented to said surface of said guide when said guide is illuminated by said light generating means, said photoconductive material when illuminated being adapted to discharge a portion of said potential from one of said members to the other of said members by providing ion discharges to said dielectric medium over selected areas of said medium, and said areas of said dielectric medium receiving said ion discharges being determined by the selective ones of said light guides being illuminated by said light generating means.

11. Apparatus for generating and recording electrostatic images from light images comprising in combination, a high-potential electrical energy source, a pair of electrical conductor members being capable of having a high potential from said potential source impressed thereacross, a dielectric recording medium positioned adjacent one of said members, a plurality of light guides, light generating means for illuminating selective of said light guides, each of said guides having a longitudinal outer surface extending its length and transverse ends, said guides being grouped in an array with said longitudinal surfaces being substantially parallel, said longitudinal surface of each of said guides having a coating of photoconductive material that extends substantially the length of said guide, each of said light guides being capable of illuminating at least the surface of said photoconductive material presented to said surface of said guide when said guide is illuminated by said light projection means, said photoconductive material when illuminated being adapted to discharge electrical energy from said source of said members to the other of said members by providing an ion discharge to said dielectric medium over selected areas of said medium, the length of said photoconductive material and the length of said guide being sufficient to prevent flashover of said electrical energy between said conductors when said guides are in a nonilluminated condition, said areas of said dielectric medium receiving said ion discharge being determined by the selective ones of said guides being illuminated by said light generating means, and means positioned between each of said guides and secured to said photoconductive material for grouping said guides into a unitary array.

12. In an apparatus for generating electrostatic images from light images, a pair of conducting members whereby potentials may be applied to said members by connecting them to opposite terminals of a potential source, a plurality of light guides having ends, each of said guides having a photoconductive coating whereby said coatings may provide a conducting path between said conducting members in response to light, one end of each of said coatings being electrically connected to one of said conductors and the other end of said coatings being spaced a distance from the other of said conductors permitting the transfer of space discharges across said distance.

13. Apparatus for generating and recording electrostatic images from light images comprising in combination, a cathode-ray tube having an electron responsive target and means for generating and projecting an electron beam toward said target, said target including a plurality of light guide units grouped into an array, each of said guide units having transverse ends and a longitudinal outer surface extending its length with at least a portion of said surface having a coating of photoconductive material that extends substantially the length of said guide unit, means filling the space between said guide units and secured to said outer surfaces for securing said guide units into said array in a manner that said ends form inner and outer surfaces of said target, said inner surface of said target having a coating of electroluminescent material and a coating of transparent conductive material sandwiched between said inner surface and said coating of said electroluminescent material, a conductor being positioned in spaced relationship to said outer surface of said target, a high potential source, said source being capable of being connected across said transparent conductive coating and said conductor, a dielectric recording medium capable of being transported through said space between said outer surface of said screen and said conductor, said light guide units being capable of illuminating at least the surface of said photoconductive material presented to light within said guide and for discharging a portion of said potential from said conductive coating to said conductor providing an ion discharge through said dielectric medium in response to light generated by said electroluminescent coating when contacted by said electron beam, said length of said photoconductive material and said length of said guide units being sufficient to prevent flashover of said high potential between said conductive coating and said conductor when said guide units are in a nonilluminated condition.

14. In combination, a potential source, a pair of conducting members positioned in spaced relationship and having a large-magnitude potential from said potential source impressed across said members, transfer means for providing a conducting path between said conducting members in response to light, said transfer means being electrically connected to one of said conductors and spaced a distance from the other of said conductors permitting space discharges across said space, recording means positioned between said transfer means and said other conductor for receiving and retaining an electrostatic charge pattern in response to said space discharge, said transfer means including a plurality of individual and substantially identical light guide units having longi-

tudinal surfaces and transverse ends, at least a portion of said longitudinal surface of each of said guide units having a coating of photoconductor material extending the length of said longitudinal surface, light projection means for illuminating selective ones of said guide units, each of said guide units being capable when illuminated of transferring light throughout its length and illuminating said photoconductor throughout its length.

15. In combination, a plurality of light guide means for transferring electrical potential in response to light, each of said guide means having a longitudinal surface and first and second transverse ends, at least a portion of said longitudinal surface having a coating of photoconductor material extending the length of said longitudinal surface between said ends, a large-potential source having output terminals, said first transverse ends having a transparent conductive coating means electrically connected to one terminal of said source for supplying electrical energy to said photoconductor material and for transmitting light to said guide means, conductor means electrically connected to another of said energy source terminals positioned adjacent said second end of said guide means for providing substantially a closed electrical path through said guide means, a dielectric recording medium secured to said conductor means and positioned adjacent said second ends of said guide means for receiving an electrostatic charge when said guide means are illuminated by said light projection means.

16. A light guide having a longitudinal surface; a photoconductive coating positioned on said surface whereby light escaping from said guide illuminates said coating, and reduces the electrical resistance thereof; a first conductive electrode connected to a point of said coating; a second conductive electrode spaced from another point of said coating to provide a gap, said gap containing an ionizable gas; a source of potential connected between said first and second conductive electrodes; and a recording medium capable of accepting and retaining an electrostatic charge upon its surface, said recording medium being located within said gap and spaced from said other point of said coating, said potential being of sufficient magnitude to create an ionic discharge across said gap whereby said potential when applied across said gap causes an ionic discharge to said recording medium through said gas.

17. A plurality of light guides each having ends and longitudinal surfaces; a sleeve of photoconductive material positioned on each of said surfaces whereby when light traverses selected light guides, it illuminates the sleeves associated with said selected guides and reduces their resistance; a first electrode connected to the first end of each said sleeve; a source of potential having two terminals; a connection between said first electrode and one of said terminals; a second electrode spaced from the other ends of said sleeves to provide an airgap; and a recording medium capable of accepting and retaining an electrostatic charge upon said recording medium located within said airgap, and being spaced from said other ends of said sleeves; a connection between said second electrode and said other terminal whereby the reduced resistance of said photoconductive sleeve permits said potential to be applied across said airgap.

18. The combination of claim 5 including means permitting the transfer of space charges across said distance to selected areas of said recording medium.

19. The combination of claim 18 wherein selected said areas are seqentially charged.

20. In an apparatus for generating and recording electrostatic images from light images, a high potential source, first and second conductors, means for connecting said conductors to different terminals of said source, light responsive switch means having one surface connected to said first conductor, the other surface being spaced apart from said second conductor to provide a gap, said gap containing an ionizable gas, said switch means being responsive to said light information for selectively connecting said first conductor to corresponding areas of said other surface to thereby selectively create electrostatic fields across said gap in accordance with light information projected upon said one surface, a recording medium capable of accepting and retaining electrostatic charges on a surface thereof, said recording medium being located within said gap and spaced relationship with respect to said other surfaces of said switch means, a source of light images and means for projecting said light images on said one surface of said light responsive switch means, said source of potential being of a magnitude sufficient to create an ionic discharge across said gap to thereby selectively create ionic discharges to said recording medium within said gap in accordance with said light information.

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