

[72] Inventor **Robert G. McConnell**
Englewood, Colo.
[21] Appl. No. **772,306**
[22] Filed **Oct. 31, 1968**
[45] Patented **Jan. 11, 1972**
[73] Assignee **Honeywell Inc.**
Minneapolis, Minn.

3,133,484 5/1964 Wright 117/37 X
3,343,956 9/1967 Wright 118/637 X
3,376,133 4/1968 Roteman 117/37 X

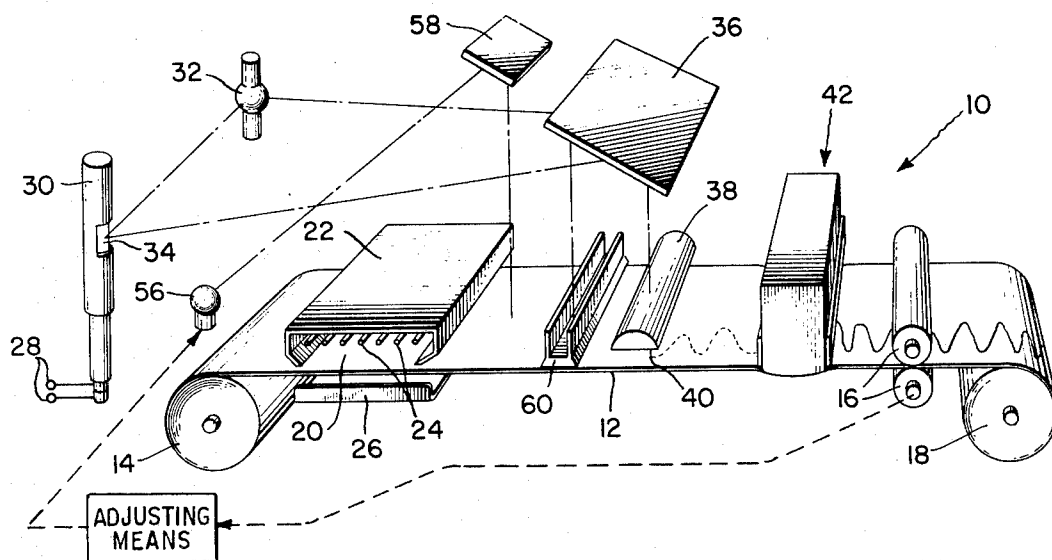
Primary Examiner—Terrell W. Fears
Assistant Examiner—Gary M. Hoffman
Attorneys—Arthur H. Swanson and Lockwood D. Burton

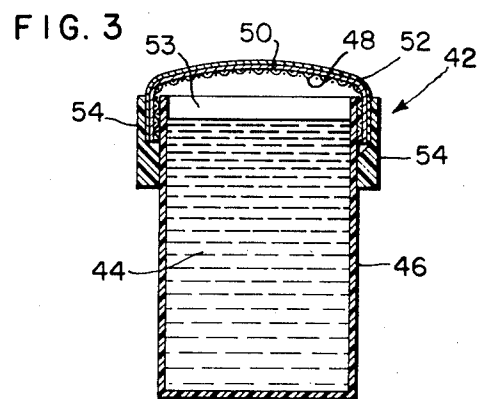
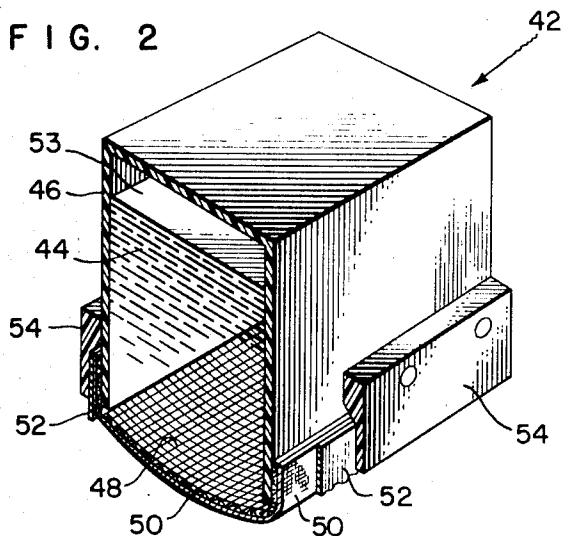
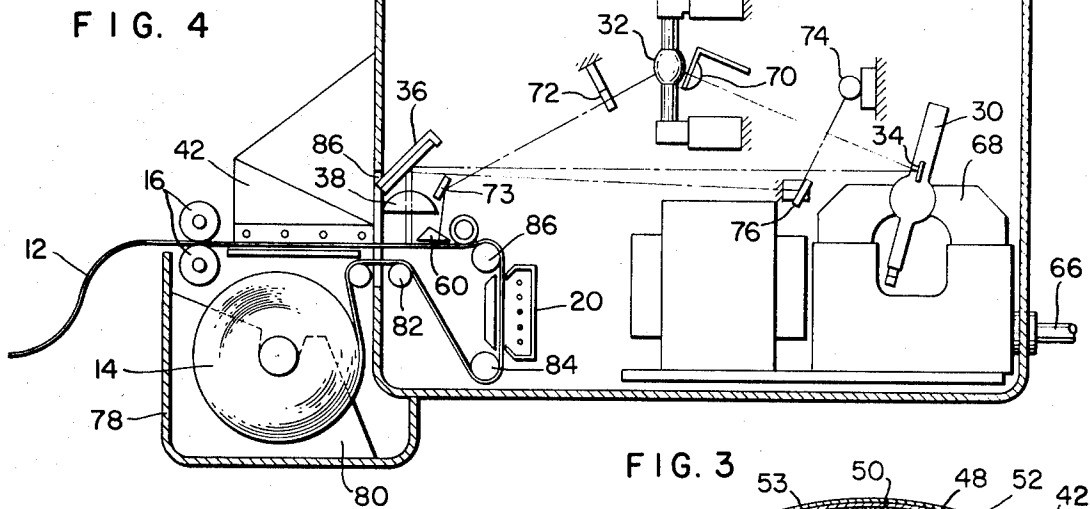
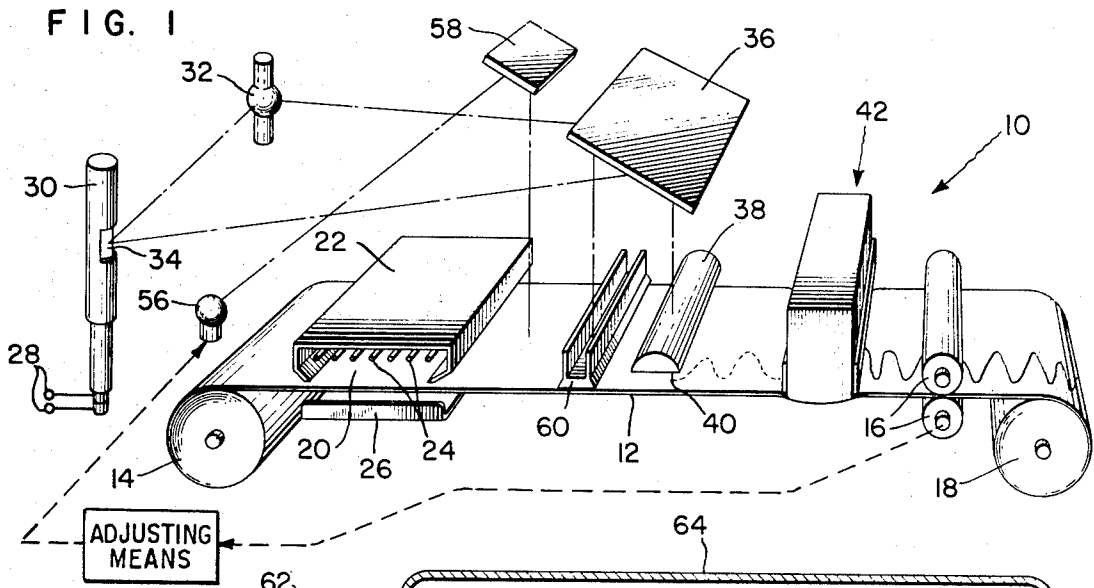
[54] **ELECTROSTATIC RECORDER**
6 Claims, 4 Drawing Figs.

[52] U.S. Cl. **346/74 ES,**
117/17.5, 118/DIG. 23, 355/10, 117/37 LE
[51] Int. Cl. **G01d 15/06,**
G03g 13/10, G03g 15/10
[50] Field of Search 346/74 ES,
74 P; 355/3, 10, 17; 118/637 LX; 117/37 LX,
17.5, 93.4 A; 250/49.5; 96/1 L

[56] **References Cited**
UNITED STATES PATENTS
2,885,556 5/1959 Gundlach 346/74 X
2,986,442 5/1961 Broding 346/109 X
3,038,799 6/1962 Metcalfe et al. 117/37 X

ABSTRACT: An electrostatic recorder for recording input signals upon a recording medium having a surface coated with a conductive, electrostatically chargeable material is shown including an electrostatic charging device of the corona discharge type for evenly charging the coated surface of the recording medium. The charged surface is exposed to focused electromagnetic radiation which is transversely displaced across the recording medium for discharging the exposed portion thereof in accordance with the input signal to be recorded. The recording medium is then coated with a suspension fluid containing toner particles applied across the full surface thereof by an applicator arranged as a squeegee. The toner particles are attracted to the electrostatic charge gradient formed between the electrostatically charged surface of the recording medium and the discharged portion thereof.





INVENTOR.
ROBERT G. McCONNELL
 BY *M. McConnel*

ATTORNEY.

ELECTROSTATIC RECORDER

Subject matter disclosed but not claimed herein is disclosed and claimed in my copending divisional application Ser. No. 83,255, filed on Oct. 22, 1970.

The present invention relates to an electrostatic recorder and, more particularly, to an electrostatic recorder that is capable of recording input information upon an electrostatically charged recording medium by discharging a portion of the charged surface thereof and applying a toner thereto which is attracted to the electrostatic charge gradient formed between the discharged portion and the electrostatically charged surface of the recording medium.

The present invention may be utilized in combination with an oscillographic recorder and an adapter therefore which converts the oscillographic recorder into an electrostatic recorder as described in copending patent applications by Norman L. Stauffer, Ser. No. 772,223, filed Oct. 31, 1968, now abandoned, entitled An Adapter For Converting a Photosensitive Recorder To An Electrostatic Recorder; and by Harold J. Brikowski, Ser. No. 772,224, filed Oct. 31, 1968, now abandoned, entitled An Adapter For Converting A Photosensitive Recorder To An Electrostatic Recorder Capable of Utilizing The Original Optics.

It is well known in the recording art to utilize the principles of electrostatically charging a recording surface and applying a toner material thereto which is attracted to the electrostatic charge for establishing a mark or recording upon the surface. These devices often use a recording medium which is coated with a material that is capable of being electrostatically charged. An image is then projected upon the charged surface which discharges portions of the surface exposed to the electromagnetic energy passing through the image. A toner is applied to the surface of the electrostatically charged recording medium which adheres to the portions of the surface that retain their electrostatic charge. This form of recording has proven useful for reproducing copies of original documents where an original document is available.

It is often desirable, however, to reproduce information without an original document. For this purpose, a second type of recording device is available in which an original input signal may be recorded directly upon a recording medium. One example of this type of recording instrument is a pen recorder which utilizes a d'Arsonval galvanometer for driving the pen across the surface of the recording medium. A second form of this type of recording arrangement utilizes a d'Arsonval galvanometer to deflect a mirror which, in turn, reflects a beam of electromagnetic energy toward a recording medium sensitive to predetermined wavelengths of the electromagnetic energy. This type of recording arrangement has proven to be an acceptable means for permanently recording and immediately displaying an input signal upon a recording medium. Such an arrangement is illustrated in U.S. Pat. No. 2,580,427, by C. A. Heiland which issued Jan. 1, 1952 and is assigned to the same assignee as the present invention.

The utilization of an electrostatic recording technique within an oscillographic galvanometer of the type described in the Heiland patent has, until now, been difficult to achieve. One reason for this difficulty is caused by the fact that a reflected beam of electromagnetic energy focused upon an electrostatically charged recording medium discharges the area upon which it is focused. This results in the attraction of a toner to the charged area with none of the toner attracted to the discharged area. Such a recording produces a dark background with the recording trace displayed as a white or light line. This form of display is similar in appearance to the prior art blue prints produced with light lines and a dark blue background which have proven to be undesirable for many reasons as, for example, difficulty in ready.

Accordingly, it is an object of the present invention to provide an electrostatic recorder which is capable of permanently recording a dark trace upon a light background.

Another object of the present invention provides an oscillographic recorder with an electrostatic recording means.

Still another object of the invention is to provide an oscillographic recorder with an inexpensive means upon which to record input information.

Yet another object of the invention presented herein is to provide an oscillographic recorder with an electrostatic recording arrangement for immediately and permanently recording a plurality of input signals upon an economic recording medium which is capable of reproducing these signals as a permanent black trace.

A further object of the present invention is to provide an electrostatic recorder with a convenient and economical means for handling the developing agent or toner utilized thereby.

Still a further object of the present invention is to provide an electrostatic recording arrangement with a means for developing the recording medium which is easily and quickly applied thereto and does not create a problem of maintenance or handling.

Another further object of the present invention is to provide an electrostatic recorder with a liquid developing agent or toner which is attracted to the discharged portion of the electrostatically charged recording medium.

Yet a further object of the present invention is to provide a method of electrostatically recording input signals upon a recording medium which may be permanently and immediately displayed as a dark trace upon a light background.

In accomplishing these and other objects there is provided an electrostatic recording medium having a coated surface which is capable of being electrostatically charged by an electrostatic charger. The charged surface is then exposed to electromagnetic energy in response to input signals to be recorded thereon. A liquid developing agent is applied across the full surface of the coated recording medium and attracted to that area which has been discharged by the electromagnetic energy for producing a permanent and immediately visible trace upon the recording medium.

Other objects and many of the attendant advantages of the present invention will become readily apparent to those skilled in the art as a better understanding thereof is obtained by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective block diagram, schematically showing an electrostatic recorder of the present invention;

FIG. 2 is a perspective view, shown partially in section, illustrating an applicator for applying a developing agent to the electrostatic recording medium of FIG. 1;

FIG. 3 is a sectional view similar to FIG. 2 showing the applicator prior to its introduction into the electrostatic recorder of the present invention; and

FIG. 4 is an elevational view, showing the electrostatic recorder of the present invention embodied within an oscillographic recorder.

Referring now to the drawings, an electrostatic recorder is shown generally at 10, FIG. 1, having a recording medium 12 driven from a supply roller 14 through a recording area by a suitable drive means, such as pinch rollers 16. As the recording medium 12 exits the recording area, it may be allowed to fold loosely into space, a storage bin, or it may be rolled upon an optional takeup roller 18. The recording medium 12 is thus stretched between the supply roller 14 and driving means 16 in a continuous web arrangement. The recording medium may be constructed from a suitable sheet of paper having one surface thereof coated with an electrostatically chargeable material chosen from a group of suitable metallic oxides as, for example, zinc oxide.

The coated surface of a recording medium 12 is drawn under an electrostatic charging device 20 which places a uniform electrostatic charge upon the surface. The electrostatic charging device includes an insulated frame member 22 which supports a plurality of fine wires 24. The fine wires 24 traverse the full width of the recording medium 12 and are connected to a source of high-voltage DC not shown. The

wires are connected in such a way as to create a large positive or negative charge with respect to a platen member 26 which is connected to a source of reference potential, such as ground.

The electrostatically charged surface of the recording medium 12 is exposed to electromagnetic energy that is focused into a beam of energy which strikes the coated surface of the recording medium 12. The focused beam of energy causes that portion of the coated surface upon which it impinges to become electrically conductive for discharging the electrostatic charge residing thereon while leaving the remainder of the coated surface with its original uniform electrostatic charge. The input information to be recorded upon the electrostatically charged surface of the recording medium 12 is provided in the form of input signals applied to input terminals 28 of an oscillographic galvanometer 30 of the d'Arsonval type. A source of electromagnetic energy 32 is focused into a beam of energy by suitable lens means, not shown, upon a galvanometer mirror 34 which is suspended by a suitable suspension element, not shown, from the main frame of the galvanometer 30. The electromagnetic energy reflected from the galvanometer mirror 34 is then reflected from a first optical mirror 36 through a lens 38 where the beam of electromagnetic energy is focused into a recording spot 40 upon the coated surface of the recording medium 12. As indicated herein above, the focused recording spot of electromagnetic energy 40 causes the discharge of the electrostatically charged coating under the area exposed thereby. The source of electromagnetic energy may be an ultraviolet light source, such as a mercury lamp, or it may be a source of lower frequency electromagnetic energy, such as a xenon lamp.

The recording medium 12 is then drawn under an applicator 42 which applies a liquid developing agent 44, FIG. 2, across the full width of the coated surface of the recording medium 12. The liquid developing agent or toner 44 consists of a suspension of toner particles within a nonconductive fluid. The liquid toner thus formed is known as a reversal toner premix wherein the particles contained within the mix are normally repelled by each other and the electrostatic charge upon the coated surface of the recording medium 12. Most prior art toners are attracted to the electrostatic charge of a recording medium. In the present embodiment, the toning particles are attracted to the electrostatic charge gradient formed between the uniformly charged surface of the recording medium 12 and the discharged portion thereof. Thus, a recording trace formed upon the recording medium 12, by the recording spot 40, is developed by the attraction of the toner particles to the two sides thereof for forming two thin parallel lines. These narrow parallel lines are spaced a few thousandths of an inch apart and, therefore, visual observation reveals a solid line a few thousandths of an inch thick. Examples of the toner may be obtained under the Part No. T-480 from the Plastics Coating Corporation of Massachusetts. The liquid toner may also be mixed by placing 2 to 4 percent, by volume, of the toner particles in a solution of Isopart G, manufactured by Humble Oil. It has been found that a mixture of 3 percent is desirable. The concentrated toner particles may be obtained under the Part No. C-540 from the Plastics Coating Corporation of Massachusetts.

Referring now to FIGS. 2, and 3, the applicator 42 is shown as a rectangular housing 46 having sidewalls and a top and an open bottom when in the operational position of FIG. 2. The bottom portion is covered by a screen 48 which is outwardly bowed to form a curvilinear surface. The curvilinear surface is covered with a permeable membrane 50 which may be constructed from many suitable materials; such as felt, wool, or a synthetic material containing 80 percent polyester and 20 percent polyamide. The thickness of the permeable membrane 50 has been optimized experimentally to provide a membrane which is thin enough to allow full transfer of the toner particles at the fastest speed of the recording medium 12, while being thick enough to prevent leakage of the nonconductive suspension fluid when the recording medium is stopped. A

1¼-inch width has been found suitable for proper toner application. The permeable membrane 50 is sealed by an outside disposable cover 52, shown schematically after being torn away in FIG. 2. The screen 48, permeable membrane 50, and outside disposable cover 52 are clamped to the sidewalls of the rectangular housing 46 by clamping means 54 which are illustrated as elongated bars. The elongated bar clamping means 54 may be attached to the sidewalls of the rectangular housing 46 by many suitable means, such as spot welding or riveting. The clamping means may also be formed by a four-sided frame which is press fit over the permeable membrane screen, and cover. It is anticipated that the applicator 42 may be provided as a throwaway unit wherein the outside disposable cover 52 is removed prior to placing the applicator 42 in a contiguous operating relationship across the full coated surface of the recording medium 12.

The throwaway applicator 42 is shown in FIG. 3 in its storage position prior to being utilized within the electrostatic recorder 10. A small air space 53 is left between the liquid toner 44 and the permeable membrane 50. After the disposable cover 52 is removed, the applicator 42 is inverted and placed with its permeable membrane 50 downwardly and contiguously facing the recording medium 12. The liquid toner 44 is removed from its container 46 by a squeeze action of the permeable membrane 50 against the recording medium. As this occurs, a slight vacuum is formed in the air space 53. This vacuum serves to retain the nonconductive fluid of the liquid toner within the applicator 42, especially when the recording medium 12 is not being drawn thereby. The screen 48 thus serves to support the permeable membrane 50 against the contact pressure of the recording medium and against the pressure caused by the partial vacuum created within the housing 46. While the housing 46 has been described and shown as a rectangular structure, it will be obvious that various shapes may be desirable for various mounting arrangements and the present invention is thus not intended to be limited by the rectangular showing.

The driving means 16 draws the recording medium 12 under the applicator 42 and out of the recording area established between the electrostatic charging device 20 and the applicator 42. In the electrostatic recorder 10 of the present invention, it is therefore necessary to prevent ambient radiation from exposing and discharging the recording medium 12 within the recording area by suitable radiation proofing means. In other areas, however, the recording medium may be exposed to ambient radiation without causing harmful effects. After the recording medium exits the recording area, it may be placed in a suitable storage bin or rolled upon the takeup roller 18.

In the present embodiment, it is anticipated to provide the driving means 16 with a multispeed prime mover, not shown, which will be capable of drawing the recording medium 12 through the recording area at various adjustable speeds. As the speed of the recording medium is adjusted to traverse the electrostatic charging device 20 at a higher linear speed, the amount of electrostatic charge applied to the coated surface of the recording medium 12 is substantially reduced. As the electrostatic charge is reduced, the electrostatic charge gradient between the charged and discharged areas on the surface of the recording medium is also reduced. This, in turn, reduces the attraction of the toner particles within the liquid toner 44 to the electrostatic charge gradient, thereby reducing the intensity of the dark recording trace formed upon the recording medium 12. Thus, the intensity of the recording trace upon the recording medium 12 will vary proportionally with linear speed unless a suitable compensating means is provided.

The compensating means is provided in the present invention by a second source of electromagnetic energy 56 whose intensity is inversely adjustable in proportion to the adjustable linear speed of the recording means 12. Electromagnetic energy from the second source is focused upon a mirror 58 and reflected therefrom upon the coated electrostatically charged

surface of the recording medium 12 for modulating the electrostatic charge thereon. The intensity of the electromagnetic source 56 is adjusted to its lowest intensity level at the highest linear speed of the recording medium and adjusted to its highest intensity level at the lowest linear speed of the recording medium for providing a charge modulation of the recording medium by reducing the electrostatic charge accumulated on the coated surface thereof at lower speeds. Such an adjustment could also be obtained by adjusting the DC voltage between the fine wires 24 and the platen 26. However, it has been found that this type of adjustment is not suitably accurate for obtaining the desired continuity of trace intensity at the various linear speeds of the recording medium 12.

The electromagnetic source 32 is also focused directly upon the first optical mirror 36 and reflected therefrom through a grid-forming optical lens 60. This lens is provided with suitable apertures therein for forming a series of parallel lines upon the recording medium by exposing the recording medium to electromagnetic energy passing therethrough. To provide a series of transverse lines upon the recording medium, a flashed tube, 74 (FIG. 4), whose timing sequence is tied to the adjustable linear speed of the recording medium 12 is provided. Each flash or discharge of the tube focuses electromagnetic energy through a suitable optical system for recording a series of transverse lines upon the recording medium 12.

In operation, the recording medium 12 is drawn through the recording area by the driving means 16. The coated surface of the recording medium 12 is charged by the electrostatic charging device 20 and then exposed to a focused beam of electromagnetic energy which forms a recording spot 40 thereon. The spot is transversely displaced across the surface of the recording medium 12 by the influence of an input signal applied to the input terminals 28 of the galvanometer 30. Electromagnetic energy forming the recording spot discharges the recording medium and produces an electrostatic charge gradient on each side of the locally discharged area. The applicator 42, which contiguously contacts the full width of the coated surface of the recording medium 12, applies a liquid toner thereto by the squeegeeing action of the permeable membrane 50 against the coated surface. The toner particles suspended within the nonconductive fluid of the liquid toner are mutually repelled from each other and from the electrostatic charge upon the coated surface. The areas of electrostatic charge gradient adjacent the localized discharge portion of the recording medium attract the toner particles through the permeable membrane 50 for forming a permanent, immediately visible recording thereon. The nonconductive fluid which wet the coated surface of the recording medium dries rapidly, completely in approximately 10 seconds, to fix the permanent recording upon the recording medium without requiring additional heat or toner fixing agent.

Referring to FIG. 4, the electrostatic recorder of the present invention is embodied within a multitrace oscillographic recorder 62. The oscillographic recorder 62 includes the main housing 64 having a suitable connection for electric power 66. A plurality of galvanometers 30 are located within a galvanometer bank formed by permanent magnets 68. A source of electromagnetic energy 32 is focused through a collector lens 70 upon the galvanometer mirror 34 and reflected therefrom toward the first optical mirror 36. The electromagnetic energy reflects from the optical mirror 36 through the lens 38 onto the coated surface of the recording medium 12. The electromagnetic energy from the source 32 is also focused through a grid filter 72 onto the first grid mirror 73 where it is reflected for focusing through the grid-forming optical lens 60 for forming parallel grid lines upon the recording medium 12. A photo flash tube 74 is arranged to focus its radiant energy upon a mirror 76 which reflects the light toward the first optical mirror 36 and through the lens 38 to the recording medium 12 for providing transverse grid lines thereon. While only one galvanometer 30 is shown, it will be obvious that a plurality of galvanometers may be utilized within the multitrace oscillographic recorder 62 as illustrated in the Heiland patent referred to hereinabove.

The multitrace oscillographic recorder 62 illustrates an oscillographic recorder which normally utilizes a recording medium that is ultrasensitive to a predetermined wavelength of electromagnetic energy. This ultrasensitive recording medium becomes damaged when exposed to excessive amounts of ambient radiation. The present invention may be utilized within an adapter for converting the prior art oscillographic galvanometer to a recording device which is capable of recording upon the more economical electrostatically coated recording medium. A magazine 78 attaches to the lower front surface of the oscillographic recorder 62 for housing the supply roller 14 and a supply of the electrostatic recording medium 12. The supply roller 14 is mounted on a suitable mounting frame 80 which facilitates the rotational motion thereof as a recording medium 12 is unwound therefrom. The recording medium 12 passes over a plurality of rollers 82, wraps 180° around a guide roller 84 and passes under the electrostatic charging device 20. As the recording medium exits the electrostatic charging device 20, it passes over a second guide roller 86 and through the recording area where the electromagnetic energy is focused upon the electrostatically charged surface thereof by the lens 38. The recording medium 12 is then drawn under the applicator 42 by the driving means 16. It will be observed in FIG. 4 that the applicator is specially formed for providing visual access through a suitable filter 86 to the recording area. This arrangement allows the operator of the oscillographic recorder 62 to adjust the location of the recording spot 40 and the grid lines upon the recording medium 12. The filter is shown to pass only those wavelengths of electromagnetic radiation which will not discharge the electrostatically charged coated surface of the recording medium 12.

Thus, there has been provided an electrostatic recorder which is capable of recording a plurality of input signals upon an electrostatically charged recording medium in response to the input signals to be recorded thereby. The focused beam of electromagnetic energy causes the discharge of portions of the electrostatically charged surface for providing an electrostatic charge gradient which attracts toner particles thereto as the recording medium is drawn under the applicator. As the applicator applies the liquid toner, the toner particles therein are fixed to the recording medium by the drying action of the nonconductive suspension fluid for immediately and permanently displaying the plurality of input signals thereon.

Obviously, many modifications and variations of the present invention will become apparent to those skilled in the art in the light of the above teaching; and, therefore, it should be understood that the present invention is intended to be limited only by the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An electrostatic recorder for recording an input signal, comprising:

55 a recording web having one surface thereof coated with a metallic oxide capable of being electrostatically charged; electrostatic charging means arranged adjacent said recording web for electrostatically charging said coated surface; a source of electromagnetic energy;

60 means responsive to said input signal for focusing said electromagnetic energy upon said coated surface for removing said electrostatic charge therefrom in response to said input signal thus creating an electrostatic charge gradient between said electrostatically charged portion of said coated surface and the portion of said coated surface from which said electrostatic charge is removed;

65 a liquid suspension containing toner particles, said toner particles being repelled by an electrostatic charge and attracted by an electrostatic charge gradient; and

70 applicator means contacting said recording web across the full coated surface thereof for applying said liquid suspension containing said toner particles to said areas of said electrostatic charge gradient upon said recording web coated surface thus immediately and permanently recording said input signal thereon, said applicator means in-

cluding a container having an opening covered with a permeable membrane arranged for contacting said recording web across the full width of the coated surface thereof, means for sealing said permeable membrane over said container opening thus retaining said suspension containing toner particles within said container under a partial vacuum, and screen means for supporting said permeable membrane against the urging of said partial vacuum and for forming said permeable membrane against the full width of the coated surface of said recording web, whereby said electrostatic charge gradient upon the coated surface of said recording web draws said toner particles through said permeable membrane against the urging of said partial vacuum.

2. An electrostatic recorder for recording an input signal, comprising:
 - a recording web having one surface thereof coated with a metallic oxide capable of being electrostatically charged; electrostatic charging means arranged adjacent said recording web for electrostatically charging said coated surface; a source of electromagnetic energy; means responsive to said input signal for focusing said electromagnetic energy upon said coated surface for removing said electrostatic charge therefrom in response to said input signal thus creating an electrostatic charge gradient between said electrostatically charged portion of said coated surface and the portion of said coated surface from which said electrostatic charge is removed;
 - a liquid suspension containing toner particles, said toner particles being repelled by an electrostatic charge and attracted by an electrostatic charge gradient;
 - applicator means contacting said recording web across the full coated surface thereof for applying said liquid suspension containing said toner particles to said areas of said electrostatic charge gradient upon said recording web coated surface thus immediately and permanently recording said input signal thereon;
 - driving means arranged for driving said recording web across said electrostatic charging means at various selectable linear speeds;
 - a second source of electromagnetic energy arranged for preexposing said coated surface of said recording web after it has been electrostatically charged; and
 - means for adjusting said second source of electromagnetic energy as said recording web speed is selectably varied for creating a constant electrostatic charge upon said coated surface of said recording web regardless of the linear speed thereof, thereby creating a constant recording intensity upon said recording web.
3. An electrostatic recorder for recording input information comprising
 - means for moving through said recorder a recording medium having a surface capable of being electrostatically charged,
 - a source of recording energy,
 - means for producing on said surface an electrostatic charge pattern representing said input information and including means for directing energy from said source onto said surface in accordance with said input information and means for subjecting said surface to an electrostatic charging effect

- fect for charging said surface,
 - a second source of energy arranged so that its energy is directed onto said surface to reach the latter after it has been subjected to said charging effect for controlling the charge on said surface,
 - means for adjusting said second source of energy in accordance with the speed of movement of said medium for making the charge on said surface constant and independent of said speed, and
 - toner applicator means for applying toner particles to said pattern to produce an immediately visible and permanent trace on said surface representing said input information, said second source of energy and said adjusting means causing the intensity of said trace to be independent of said speed.
4. An electrostatic recorder for recording input information comprising
 - means for moving through said recorder a recording medium having a surface capable of being electrostatically charged,
 - a source of recording energy,
 - means for producing on said surface an electrostatic charge pattern representing said input information and including means for directing energy from said source onto said surface in accordance with said input information and means for subjecting said surface to an electrostatic charging effect,
 - toner applicator means comprising a container provided with an opening and a permeable membrane, said membrane having a dimension which is at least equal to the width of said surface and covering and closing said opening to contain within said container a quantity of a liquid toner consisting of a suspension of toner particles within a liquid, said particles being attractable to a charge pattern on said surface, said opening constituting the only opening into said container and said membrane sealing said container to maintain a partial vacuum in an air space above said liquid toner to regulate the passage thereof through said membrane, and
 - means for mounting said applicator relative to said moving medium with said membrane contacting said surface which bears said charge pattern and extending across the full width of said surface, across the direction of motion thereof, to apply said liquid toner thereto through said membrane by the squeegeeing action of said membrane against said surface as the latter is moved past said membrane by said moving means, thereby to apply said particles to said pattern to produce an immediately visible and permanent trace on said surface representing said input information.
 5. Apparatus as specified in claim 4, wherein said applicator means includes screen means mounted on said container behind said membrane and supporting the latter against the urging of said vacuum for forming said membrane into good contact with said surface across the full width thereof.
 6. An electrostatic recorder as claimed in claim 4, wherein: said permeable membrane is a material selected from the group consisting of felt, wool, or 20 percent polyamide and 80 percent polyester.

* * * * *