

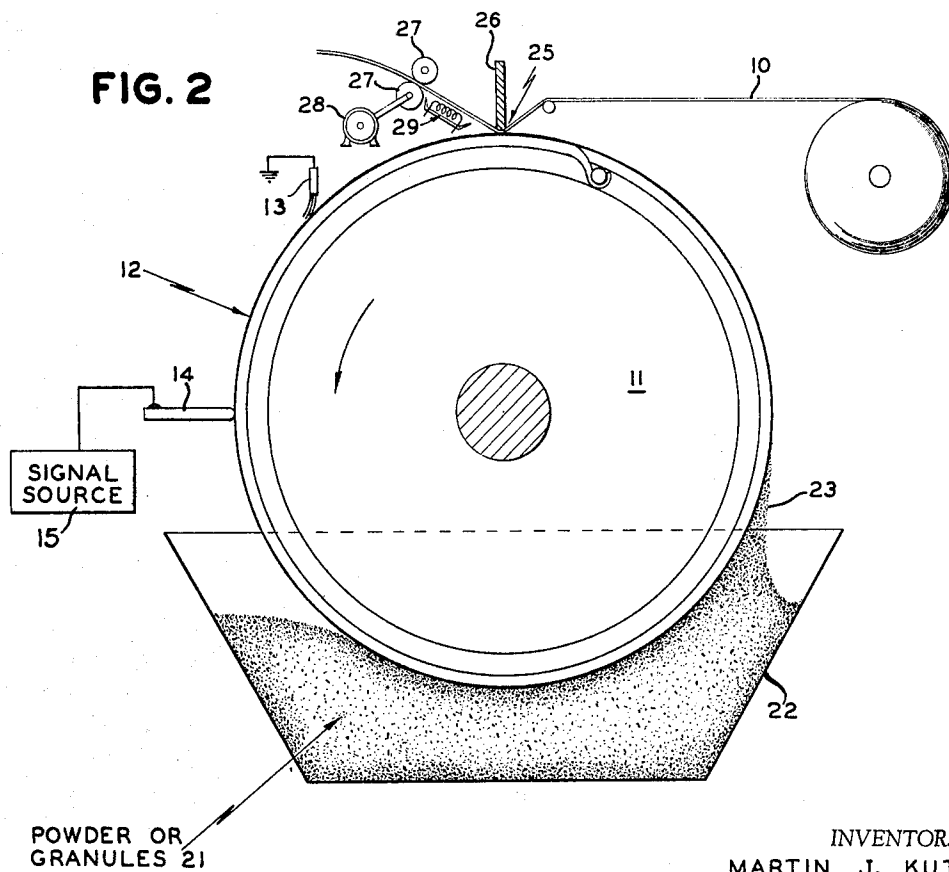
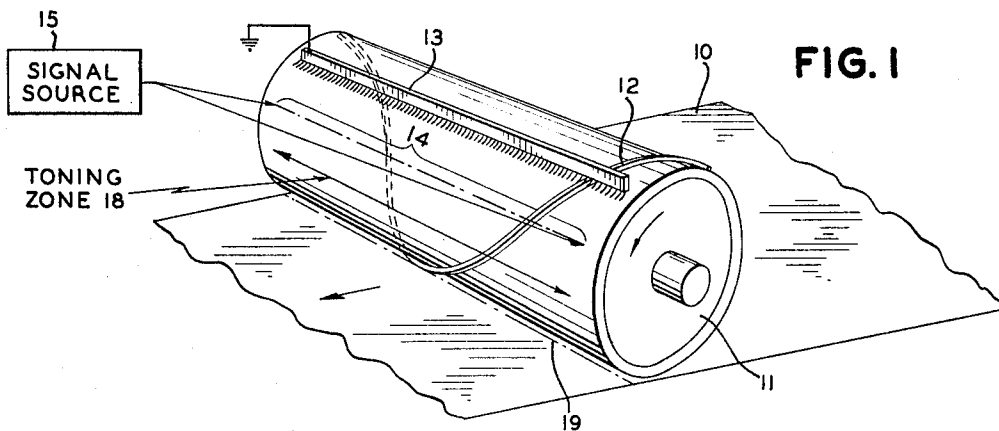
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ELECTROGRAPHIC RECORDING APPARATUS

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ELECTROGRAPHIC RECORDING APPARATUS

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9 Claims. (Cl. 346-74)

This invention relates to electrographic reproduction or recording, and more particularly to methods and apparatus utilizing electrostatic charge pattern technique for recording line-by-line on an image-receiving surface.

In xerography or electrographic recording it is usual to form an electrostatic latent image having length and width on a receiving surface. For example a photoconductive insulating surface is charged over a definite area and then the area is selectively discharged by exposure to a pattern of activating radiation or light. The resulting electrostatic charge pattern is conventionally utilized by depositing electroscopic developer or toner material thereon through electrostatic attraction, whereby a visible image is formed corresponding to the electrostatic image. The visible image may be transferred to a second surface to form a xerographic print or may be fixed directly to the photoconductive surface.

Another method of electrographic recording forms an electrostatic image by contact rather than by projection, the electrostatic charging itself forming a pattern rather than making a pattern by dissipating a part of the uniformly charged area by light. This method may employ a scanning electrode which has moving point contact over a charge-retaining surface such as an insulating plastic. The charge pattern is formed in successive elemental areas by applying signals to the scanning element which are derived from a scanner, such as a facsimile scanner, synchronized with the operation of the charge-applying electrode. This technique is particularly useful for recording facsimile signals received over communication channels, for read-out of information that is stored in a computer or the like, and for printing labels or similar material requiring high speed reproduction particularly where the material is not repetitive in nature, i.e., where only one copy is required.

The prior electrographic techniques in use are not generally satisfactory for point recording of many elemental areas in a print of average size, or for convenient trouble-free processing of the material. Since several sequential stages of processing are required to form, develop and fix the image, the complication and time required for processing increases the possibility of failure to reproduce a record of the desired quality. In addition, the web or image-receiving surface, when it is fed successively through the several stages of processing, results in a considerable lapse of time between the reception of the signals and the production of the visible copy or printed record. This is disadvantageous in most applications of the printing or read-out method.

The object of the present invention, in general terms, is to simplify and improve electrographic apparatus utilizing contact electrostatic charging of elemental areas to build up the image or copy print in a manner analogous to that employed in facsimile scanning apparatus.

It is another object of the invention to provide an improved apparatus for electrographic reproduction or printing in which the image is formed and developed directly upon a linear charge-retaining member, which is re-used a number of times in the reproduction of a picture or image.

A more specific object of the invention is to provide signal-controlled electrographic reproduction apparatus in which the image or print is visible almost immediately

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after the application of the control or image signals to the electrographic apparatus.

Another object of the invention is to provide recording or reproduction means having a linear, preferably helical, charge-retaining member which is effective to transfer image areas line-by-line to the copy sheet or web.

A feature of the invention relates to the improvement in the art of electrographic recording in which a charge-retaining member is selectively charged, and toner or developer material is applied thereto for subsequent transfer to the image-receiving material or printing web to form a line of the recorded image. In a preferred embodiment the charge-retaining member is cyclically operated in response to a cyclic scanning process, so that the image is developed and recorded or printed substantially simultaneously with the receipt of the image signals.

According to one embodiment of the invention, a latent image of the picture or print to be reproduced is formed by charging elemental areas on a line storage element, such as a rotatable helical member of insulating, charge-retaining material. The helical charge-retaining member is movable to a position in contact with or closely spaced from the surface of the image-receiving web or sheet. The developer or electroscopic material, such as powdered toner, is applied to the helical charge-retaining member and transferred to the surface of the image receiving sheet or web during the continuous rotation of the helical member. In this manner the print or reproduction is built up line-by-line as the signals are received. Suitable means is provided for removing the latent electrostatic image on the linear charge-retaining element after the image-transfer stage and before the charging step necessary to form the latent image of the next line.

It will be evident that the apparatus according to the invention has the advantages of enhanced reliability and trouble-free operation, since the electrostatic charge pattern is toned and transferred to the image-receiving surface without appreciable delay. Furthermore the reproduction is visible almost immediately after reception of the signals representing the image to be reproduced.

Other objects and advantages of the invention will be apparent from the following description in connection with the accompanying drawings, in which

FIG. 1 is a perspective view, partially schematic, of an embodiment of the invention; and

FIG. 2 is a side elevational view illustrating the detailed construction of the apparatus shown in FIG. 1.

The invention may be practiced with apparatus constructed in various ways, one of which is shown by way of example in the drawings. Referring to the drawings, FIG. 1 illustrates an essentially diagrammatic arrangement for reproducing or printing copy upon an image-receiving web or sheet 10 of paper. A rotatable drum or cylinder 11 is shown, having on its periphery a helically formed linear element or strip 12 of charge-retaining material such as an insulating plastic. During the rotation of the cylinder 11, the outer edge of the helical element 12 contacts with or closely approaches the surface of the image-receiving material or web 10. In operation, the rotation of the cylinder 11 causes the successive elemental areas of the surface of the helical element 12 to move in succession against the surface of the web 10. On account of the shape of the element 12, the point of contact moves progressively across the width of the web 10 during rotation of the element, to provide line-by-line recording, as will be explained. The helical charge-retaining element 12 is first cleared of any existing charges, and cleaned if necessary, by contact with a grounded metallic brush 13.

In order to record or reproduce an image on the image-receiving surface or web 10, the linear charge-retaining

element 12 is subjected to contact potentials at elemental areas along its length to form a charge pattern corresponding to the image to be reproduced. The charging of the element 12 to form a latent image thereon is illustrated diagrammatically at 14 and the charging means includes a signal source 15 which may be a facsimile scanner of the type well known in the art which generates electrical potentials along successive elemental areas of copy to be transmitted, in accordance with the variations in light and shadow of the image. One scanner of the type referred to comprises a helical scanning member that is rotated at the same speed as the receiving scanner, in this case the element 12.

After producing a latent charge pattern on charge-retaining linear element 12, the activated portion of the element 12 passes through a toning zone 18 for developing the latent image in accordance with well known xerography or electrographic technique. Many toner or developer materials have been devised and any suitable one may be employed.

The development of a visible image upon a surface bearing the latent charge image is effected by contacting the surface with a particulate coloring material, usually in the form of colored particles which will adhere to the surface. The development step usually involves the deposition of pigmented tribo-electrically charged toner particles by any desired method, for example, by magnetic brush or by creating a smoke or dust cloud of particles. The charging of the particles of toner or electroscopic material may be done by agitation of a heavy carrier with a toner, properly matched in atomic structure so as to produce the proper charge. The carrier material may be from filings or glass beads and the like. Iron filings with the Hunt toner produce a positive charge on the powder. The polarity of the charge on the developer power is opposite to that on the charged areas of the latent image. A suitable dye may be used to color the toner material, preferably a black dye. The latent image may also be colored by contacting the charged surface with a bath of developer powder, or by flowing a mixture of developer or electroscopic powder over the surface.

After a visible linear image consisting of elemental areas has been formed on the surface of the helical element 12, the rotation of the cylinder 11 carries the selectively distributed toner material to a point where it may be transferred onto the image-receiving surface 10, as schematically represented by the line 19. The toner or marking material deposited upon the image-receiving web 10 is fixed in any suitable manner, as by the application of heat. The process is a continuous one during the continuous rotation of the cylinder 11, building up the image or copy print line-by-line until the complete image has been recorded or printed.

FIG. 2 illustrates the detailed construction of apparatus embodying the principles of FIG. 1 and in which the elements 10, 11, 12, 13, 14 and 15 correspond to the elements of FIG. 1 bearing the same reference numbers. The grounded brush 13 comprising a multiplicity of flexible conducting wires is used for neutralizing the charges on the charge-retaining linear element 12 and also for removing any residue of toner adhering to said element. The charge on the element 12 may also be neutralized by a corona discharge for example. The electrode 14 for selectively charging the surface of the linear charge-retaining element 12 is shown as a metallic blade contacting the surface of said element. As the helical element 12 rotates, the straight blade 14 makes a point contact moving progressively along the length of said element. The selective charge pattern on the surface of the element 12 may also be controlled by a light source through a slit arranged in parallel with the rib 14, provided the helical charge-retaining member 12 is of a material sensitive to light, such for example as selenium. Any suitable arrangement for forming the latent image

in the form of selectively distributed charges on the surface of the charge-retaining element 12 may be employed in place of the blade or electrode 14. The length of the blade 14 parallel to the axis of the cylinder 11 is substantially equal to the length of the cylinder.

Successive elemental areas on the surface of the insulating charge-retaining helical element 12 are thus charged in accordance with the variations in the signals from the source 15, to form a latent charge pattern representing a line of the image. The rotation of the cylinder 11 carries the helical element 12 through a toning area, which as shown may consist of a bath of toner or electroscopic powder 21 in a container 22 underneath the cylinder 11. The latent linear image on the helical element 12 is thus developed into a visible linear image consisting of the selectively distributed toner particles. As pointed out above, any suitable toner or developer material may be used, the novel features of this embodiment of the invention residing in the use of a charge-retaining linear member and in the relation of such member to the toning means and to the recording or reproduction web. After the elemental areas on the charge-retaining element 12 have been developed as described, the strip 12 passes underneath the recording web or sheet 10 which is held in contact with or closely spaced from the surface of the helical element 12 at the point 25. As shown by way of example, a guide member or electrode 26 is arranged to hold the web 10 in position to effect transfer of the colored marking material 21 to the underside of the web 10 at the point 25. The electrode 26 may be maintained at a potential opposite that of the particles of marking material to facilitate the transfer of the image to the web of paper 10.

During each rotation of the cylinder 11, a line of the image is thus transferred to the image-receiving web 10 to build up the recorded copy line-by-line. The web or sheet 10 on which the image is reproduced is fed forward during the recording, as for example by feed rolls 27 driven by a motor 28 and engaging the surfaces of the web or sheet. Conventional heating means, such as an electrical heating coil 29, may be used to fix the image on the web or sheet 10.

It will be apparent from the foregoing description of an embodiment of the invention that the invention provides a simple means for rapidly recording or reproducing images received in the form of electrical signals. Since the image areas are developed and fixed almost immediately after reception of the signals, the reliability is enhanced and it is possible to view the reproduction as it proceeds, which is often a great advantage. While only one embodiment of the invention has been described in detail, for the purpose of explaining the underlying principles thereof, various modifications of the form and arrangement of the linear charge-retaining element, and of the charging and developing means shown and described, may be made without departing from the scope of the invention. The term "charge-retaining element" in the specification and claims is used in the ordinary sense to refer to an element having a surface adapted to retain electric charges.

What is claimed is:

1. In electrographic recording apparatus, in combination,
 - means for supporting an image-receiving surface,
 - an elongated linear charge-retaining element of insulating material,
 - means for moving said element into juxtaposition with said image-receiving surface,
 - means for scanning said charge-retaining element from end to end and forming a latent image thereon in the form of charged areas corresponding to areas of the image to be recorded on said image-receiving surface,
 - means for supplying toner or developer to the charged areas on said linear charge-retaining element for

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transfer to the image-receiving surface, and means for causing a scanning toner transfer function in successive lines across the width of the image receiving surface.

2. In electrographic recording apparatus, in combination, 5
 - means for supporting an image-receiving surface,
 - a rotatable charge-retaining helical element of insulating material in juxtaposition with said image-receiving surface, 10
 - means for rotating said helical element,
 - an input signal circuit,
 - means including said signal circuit for forming a latent image on said helical element in the form of charged areas corresponding to areas of the image to be 15
 - recorded on said image-receiving surface, and
 - means for supplying toner or developer to the charged areas on said helical element for transfer to the image-receiving surface.
3. In electrographic recording apparatus, in combination, 20
 - means for supporting an image-receiving surface,
 - a rotatable charge-retaining helical element of insulating material,
 - means for charging predetermined areas of said charge-retaining helical element during its rotation to form a latent image of a portion of the subject-matter to be recorded, 25
 - means for supplying toner or developer to said charged areas for transfer to the image-receiving surface,
 - means to effect transfer of said toner or developer to said image-receiving surface, and 30
 - means for discharging the charged areas on said helical element during each rotation thereof.
4. In electrographic recording apparatus, in combination, 35
 - means for supporting an image-receiving surface,
 - a rotatable helical element of insulating material,
 - means for selectively charging areas of said insulating helical element, 40
 - means for rotating said helical element,
 - means for feeding said image-receiving surface adjacent said rotating charged element, and
 - means including said rotating charged element for depositing marking material on said image-receiving surface. 45
5. In electrographic recording apparatus, in combination,
 - means for supporting an image-receiving surface,
 - a rotatable charge-retaining element of helical configuration adjacent said image-receiving surface for marking on said surface, 50
 - means for charging predetermined areas of said charge-retaining element, and
 - means for depositing particulate developer or toner on said charge-retaining element for transfer to said adjacent image-receiving surface. 55

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6. In electrographic recording apparatus, in combination,
 - means for supporting an image-receiving surface,
 - means including a rotating helical charge-retaining element for marking said image-receiving surface,
 - means for forming a latent image in the form of a charge pattern on said helical element, and
 - means for toning said helical member to mark said image-receiving surface.
7. In electrographic recording apparatus, in combination,
 - a rotatable charge-retaining element of helical configuration,
 - means for supporting and feeding an image-receiving surface for successive line-by-line contact with said helical element,
 - means for applying a charge pattern to said charge-retaining element, and
 - means for supplying toner or developer to said charge-retaining element for line-by-line transfer to said image-receiving surface.
8. In electrographic recording apparatus, in combination,
 - an image-receiving sheet or web,
 - an input signal circuit,
 - a movable linear insulating charge-retaining element,
 - scanning means including said input signal circuit for forming patterns of marking particles on said linear charge-retaining element representing different lines of the image to be recorded, and
 - scanning means for transferring said patterns to said image-receiving sheet or web progressively from the beginning to the end of each line across the width of said sheet or web.
9. In electrographic recording apparatus, in combination,
 - an image-receiving sheet or web,
 - a rotatable helical charge-retaining element,
 - means for continuously rotating said element,
 - means for forming successive linear images of charged marking particles, representing lines of the image to be recorded, on said linear element, and
 - means for transferring said marking particles to said image-receiving sheet or web to form a print or copy of the image.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,283,334

November 1, 1966

Martin J. Kutik

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 6, for "facisimile" read -- facsimile --;
line 33, for "from" read -- iron --; line 36, for "power" read
-- powder --.

Signed and sealed this 5th day of September 1967.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents