United States Patent

Simm et al.

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[54] APPARATUS FOR THE ELECTROGRAPHIC RECORDING OF CHARGE IMAGES

[72] Inventors: **Walter Simm**, Leverkusen; **Rudolf Müller**, Deisenhofen, both of Germany

[73] Assignee: **Agfa-Gevaert Aktiengesellschaft**, Leverkusen, Germany

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[30] **Foreign Application Priority Data**

July 10, 1969 Germany ..... P 19 34 890.4

[52] **U.S. Cl.** ..... **346/74 ES**, 250/49.5 GC

[51] **Int. Cl.** **G01d 15/06**

[58] **Field of Search** ..... 346/74 ES, 74 EB; 178/30; 101/DIG. 13; 250/49.5 GC, 49.5 C

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Primary Examiner—Bernard Konick
Assistant Examiner—Gary M. Hoffman
Attorney—Connolly and Hutz

[57] **ABSTRACT**

Imagewise differentiated electric charges are produced on a dielectric carrier material an apparatus for performing that production of imagewise differentiated electric charges comprising means for generating a constant corona discharge and means for controlling the amount of the corona discharge in order to obtain an imagewise differentiation.

4 Claims, 6 Drawing Figures

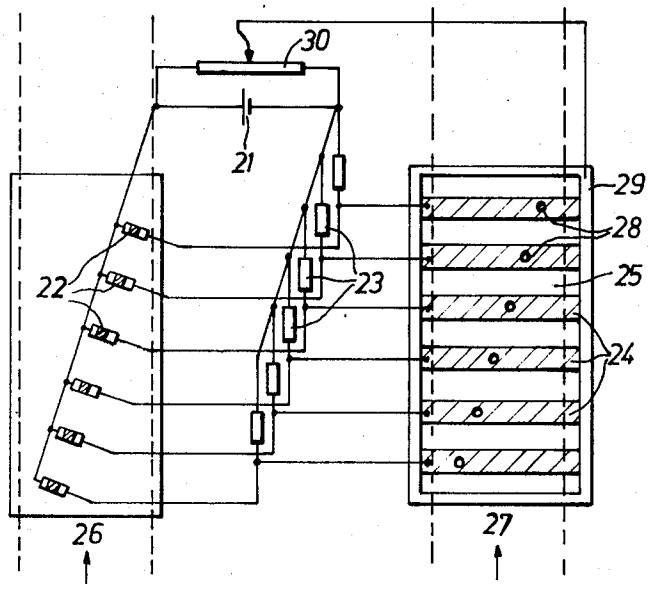


FIG. 1

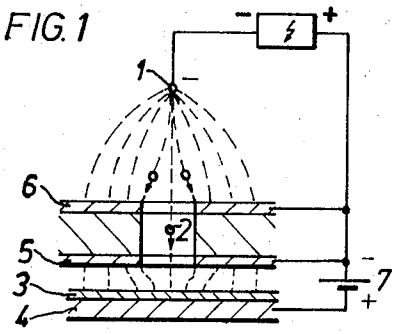


FIG. 3

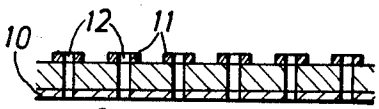


FIG. 4

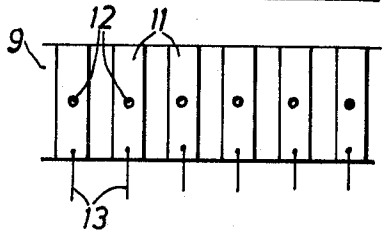


FIG. 2

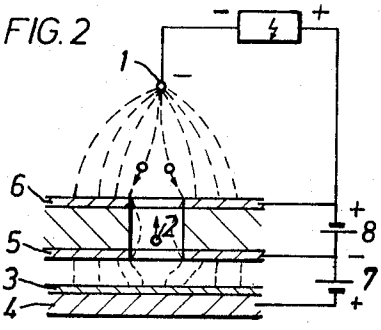


FIG. 5

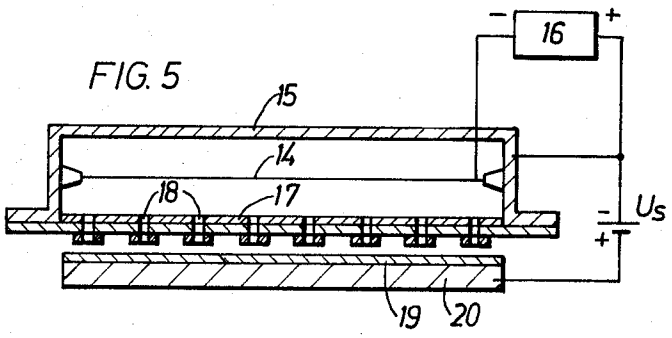
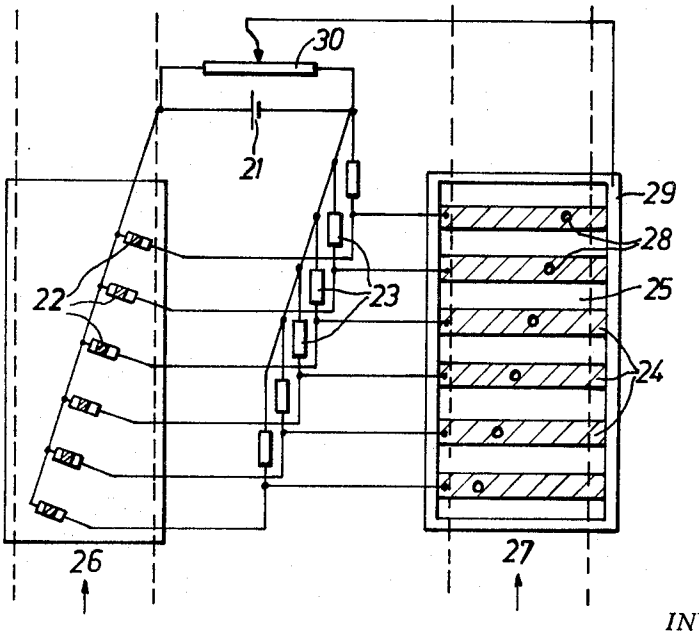


FIG. 6



INVENTORS:

WALTER SIMM, RUDOLF MÜLLER.

BY

Connolly & Hutz

APPARATUS FOR THE ELECTROGRAPHIC RECORDING OF CHARGE IMAGES

The invention relates to an apparatus for the electrographic recording of charge images on a dielectric recording material.

In known electrographic recording processes a part of the current of a corona discharge is used for imagewise controlled charging of an insulating recording material. The corona discharge is time constant and the partial current is cut off from the total current of the discharge electrode by a slotted diaphragm. Imagewise differentiated permeability of the slot to the charge current and hence also imagewise charging of the insulating support material can be achieved by means of transverse electric fields in the slot, which fields are externally controlled.

The transverse field in the slot can be produced by various means, for example by charging a photoconductive strip which is situated on one lip of the slot and which is exposed imagewise and thus receives an imagewise differentiated conductivity. Owing to the constant flow of corona current, a state of charging is then set up for a certain distribution of the bright and dark values in the area of exposure, and this charging state produces a transverse field in the slot, the permeability of this field to the corona current varying according to the exposure.

The transverse field can also be produced by providing, in place of the photoconductor strip, an arrangement of linear conductor elements which terminate at one lip of the slot and to which electric control signals can be supplied from outside.

The quality of the images obtained, however, is defective because distortions occur due to slight shifting of the drawn lines and variations in the width of the lines recorded as electrostatic image in dependence upon the direction of movement of the recording support relative to the recording electrode. Another disadvantage of the process lies in the technical difficulty of making a slot of comparatively great length so uniform in width that the permeability to charge carriers will be exactly the same at every point for a given electrode voltage.

It is an object of the invention to provide an apparatus for the electrographic recording of charge images which comprises control elements by which the disadvantages mentioned above are obviated.

An apparatus for the imagewise charging of dielectric recording supports has now been found comprising a discharge device for producing a corona discharge which does not vary with time and means for imagewise control of the charging current, a diaphragm being arranged in front of the discharge instrument in order to control the charging current, which diaphragm consists of an insulating plate perforated by a plurality of apertures, the surface of the plate facing the discharge instrument having a continuous conductive coating applied to it while the surface facing the dielectric recording material is subdivided into fields which are insulated from each other, each field having one aperture associated with it. The fields are preferably arranged in narrow parallel stripes along which a control signal can be supplied. The apertures are preferably arranged in a row. Apertures of this kind are accurately reproducible in any number by simple technical means.

In the recording device, the corona electrode is arranged in front of the diaphragm in such a way that the continuous conductive coating faces the electrode. The fields on the other side of the diaphragm, which receive the control voltage, are thus protected from disturbing influences of the corona discharge.

FIG. 1 illustrates diagrammatically the passage of the charging current through one of the apertures in the diaphragm when no voltage is applied to the control electrodes. FIG. 2 shows the blocking effect of the electric field in the aperture when a voltage is applied to the electrodes. FIGS. 3 and 4 show an arrangement of a series of the control elements. FIG. 5 shows all the essential components of the apparatus necessary to make a recording. FIG. 6 shows recording apparatus for use in the transmission of images.

According to FIG. 1, part of the corona current of the discharge electrode 1 passes through the aperture 2 of the diaphragm to reach the insulating surface 3 of the recording material, where a charge is produced in the form of a very small circular area. The recording material is situated on the conductive support 4 which is adjusted to be at a higher potential than the conductive layers 5 and 6 of the diaphragm by means of a source of voltage 7 with positive suction voltage U_{St} .A large part of the corona current is previously taken up by the layer 6 and to a smaller extent by the layer 5 and is therefore not available for charging the recording material. The insulating surface 3 receives only the charge carriers from the central part of the aperture 2, so that the charged circular area is smaller than the cross-sectional area of the aper-ture in the diaphragm.

If the potentials are arranged as shown in FIG. 2 vary, charging of the recording material does not take place. In addition to the positive suction voltage U_{St} between the layer 6 and the support 4 there exists a control voltage U_{St} across the layers 5 and 6, which is taken from an additional voltage source 8. This voltage produces a blocking field in-side the aperture 2, which prevents the passage of the charge carriers. In this case, all the charge carriers emitted from the discharge electrode 1 are received by the layer 6. The control voltage U_{St} which causes complete blocking of the aperture 2 may, for example, be between 50 and 100 V. The thickness of the diaphragm may be 0.1 mm to about 1 mm. If smaller control voltages U_{St} are applied which are less than the value required for complete blocking, partial permeability occurs, first in the center part of the aperture 2. The charged surface on the recording material will therefore be smaller than when no voltage is applied to the layers 5 and 6. Unilateral deflection of the charging current does not occur.

FIGS. 3 (side view) and 4 (top plan view) show a considerable portion of an apertured diaphragm comprising a row of control elements and apertures. The insulating plate 9 is covered on its undersurface with a conductive layer 10, e.g. a layer of copper. On the top surface, the layer is subdivided into individual strips 11 which are insulated from each other and each one of which is perforated by an aperture 12 which is smaller in diameter than the width of the strips. The width of the strips may, for example, be 0.5 mm and the diameter of the apertures 0.1 to 0.4 mm. To each strip is connected a lead 13 by which an electric signal for the image recording can be supplied. This electrode enables individual lines or image lines to be recorded in an arrangement according to FIG. 5, in which FIG. 3 is turned upside-down.

According to FIG. 5, the charging current is produced by a corona discharge by the electrical discharge wire 14 which is suspended by insulating attachments in a metal casing 15 and which communicates with a high voltage source 16. The apertured diaphragm 17 forms the lower wall of the casing, through which a plurality of partial current pass from the corona discharge to the recording material 19 through the aperture 18. The suction voltage U_S is applied to the conductive support 20. The leads for supplying the control voltage U_{St} to the individual conductor strips are not shown in the drawing. Line charges are applied to the insulating surface by uniformly moving the recording support 19 relatively to the apertured diaphragm 17. The line density can be increased by placing the row of apertures obliquely to the direction of movement of the recording support. A greater line density can, of course, also be achieved by arranging several apertured diaphragms behind each other, the position of the diaphragms to each other being then so arranged that the lines of one row of apertures are drawn in the gaps between the lines of the other row of apertures.

The apparatus described combines high sensitivity with the ability to produce distortion free recordings regardless of the direction of movement of the recording material. Another advantage of the apparatus is that the recordings can be produced with a relatively great distance between diaphragm and recording material, e.g. 1 mm, with the result that the quality of the image is less affected by irregularities in the recording material.

FIG. 6 illustrates the use of the recording apparatus for the transmission of images. According to the circuit diagram in FIG. 6 the control voltage for the recording apparatus is produced by a source of voltage 21 in combination with photoconductive cells 22 and working resistances 23. The voltage drop across the working resistances varies with varying exposure of the photoconductive cells to light, hence the passage of the charging current at each control electrode 24 of the diaphragm 25 is controlled. The photoconductive cells can be exposed, for example, in contact with a transparent film which has been blackened imagewise and which has a source of light arranged behind it. Furthermore, a photographic image may be projected on an arrangement of such photoconductive cells or transmitted via photoconductors. If the original image moves along the path 26 in the direction of the arrow indicated in FIG. 6 over the row of photoconductive cells which are arranged obliquely to the direction of movement, then the image can be scanned line by line by the different photoconductive cells. The variations in voltage thus produced across the working resistances 23 are transmitted as a charge image composed of lines to the recording strip 27 which is moved in the same way as the original image. To achieve this, the apertures 28 in the diaphragm 25 must be arranged in the same way as the row of photoconductive cells 22. To adjust the operating range of the electrodes, the voltage for the continuous, conductive layer 29 of the diaphragm 25 is taken from the voltage course 21 by means of the potentiometer tap 30.

The recording material used is conductive paper with an insulating plastics coating, e.g. of polyester, polystyrene, polyethylene, etc. The image can be rendered visible by means of electrophotographic developers of known type.

WHAT WE CLAIM IS:

1. An apparatus for the production of imagewise differentiated electric charge on a dielectric carrier material, comprising means for the production of a constant corona discharge and means for controlling the amount of the corona discharge reaching the carrier material which control means comprises an insulating plate pierced by a number of holes, the surface of the plate facing the corona discharge being coated with a continuous conductive coating, the other side being discontinuously coated with a conductive layer to provide a number of separate control elements which are electrically insulated from each other, each of the said elements being associated with and surrounding a hole, and also comprising means for the application of control voltages to the said elements.

2. An apparatus as claimed in claim 1 in which the holes in the plate are arranged in a straight line.

3. An apparatus as claimed in claim 1 in which the control elements are a series of parallel strips.

4. An apparatus as claimed in claim 1 in which means are provided for moving the carrier material relative to the control means.

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