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W. SIMM ET AL
ELECTROGRAPHIC RECORDING PROCESS WITH
CHARGING DEFLECTION
Filed Nov. 13, 1968

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FIG. 1

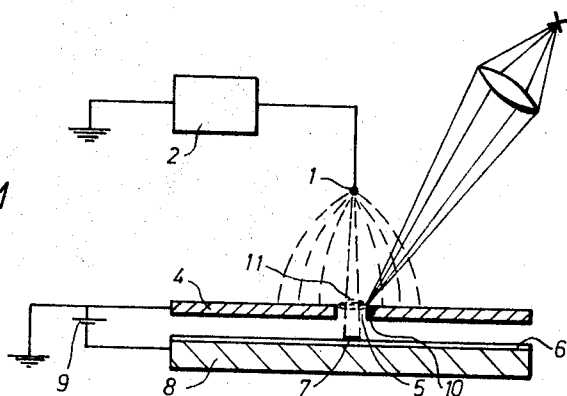


FIG. 2

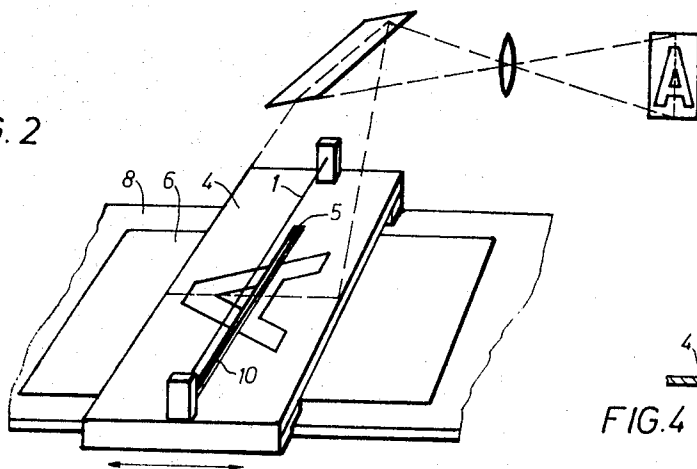


FIG. 4

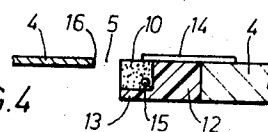


FIG. 5

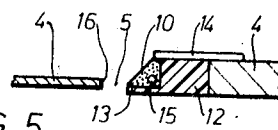


FIG. 3

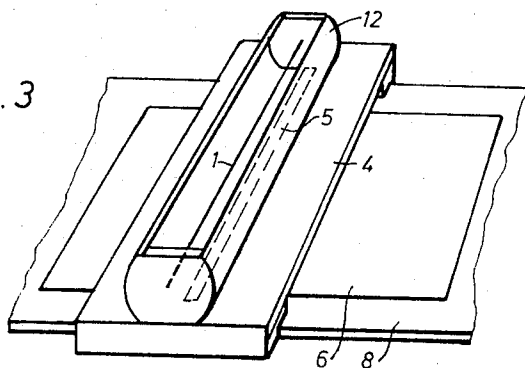
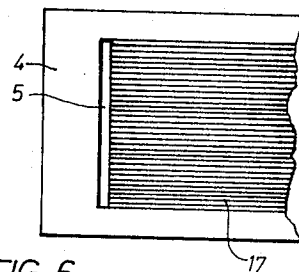


FIG. 6



INVENTORS:

WALTER SIMM, ROLF MÜLLER.
BY

Conolly and Antz
their Attorneys

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ELECTROGRAPHIC RECORDING PROCESS WITH CHARGING DEFLECTION

Walter Simm, Leverkusen, and Rudolf Müller, Deisenhofen, Germany, assignors to Agfa-Gevaert Aktiengesellschaft, Leverkusen, Germany

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7 Claims

ABSTRACT OF THE DISCLOSURE

The image-wise charging of recording materials in which a corona discharge current constant in time is directed from an electrode through a gap in a metal screen toward a recording material. The gap has along a lip a means for producing a variable electric field transversely across the gap which variable electric field is capable of deflecting the discharge current and thereby controlling the charge image production.

The invention relates to a process for the production of charge images on insulating recording material, for example, on paper coated with synthetic resin, in which the charging current required to form the image-wise charging of the recording material is controlled by means of a control electrode.

Electrographic processes in which the charge images are produced on insulating recording coatings using electrodes shaped according to the image are already known. In another known process the charge image is produced by an electrode which consists of numerous individual elements which are arranged in the form of a raster and which are insulated from each other, these individual electrodes being employed in a combination corresponding to the print to be produced.

Processes in which image-wise charging of insulating recording materials is produced using photoconductors in a discontinuous manner are also known. In these processes, the charge is transferred from the photoconductor to the recording material across an air gap which is situated between the photoconductor which serves as charging electrode and the surface of the recording material. Jerky transmission of charges, which may cause lack of sharpness in the image, cannot be avoided under these conditions.

The disadvantages of these processes are the considerable technical complexity of a process which uses preformed electrodes and the fact that the other recording processes are not sufficiently reproducible, due to the fact that the initiation of each discharge depends to a large extent on external conditions, for example the temperature and humidity.

The latter process also has the disadvantage that the jerky discharges cause the developed image to have a patchy structure, which impairs both the power of resolution and the reproduction of half tones.

It is the object of the invention to develop a process in which imagewise charging of the recording material can be influenced continuously by a control electrode so that the above disadvantages are avoided.

An electrographic process has now been found for the production of charge images on insulating recording materials by imagewise charging of a neutral recording material or by imagewise discharge of a homogeneously precharged recording material, using a corona discharge current, which is characterised in that a corona discharge current emitted from a corona discharge which is kept constant in time, which discharge is produced from a discharge

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electrode, is used, which discharge current is directed through the gap of a metal screen onto the surface of the recording material whilst a transverse imagewise differentiated electric field is produced on a control element which is arranged on one of the lips of the gap.

According to one embodiment of the invention, the recording material is charged imagewise by a constantly maintained corona discharge current. In this process, part of the corona discharge current emitted from a discharging electrode is directed onto the surface of the recording material through a gap in a metal screen whilst a transverse electric field is produced in the gap by the electrical charging of a photoconductor strip arranged on one of the lips of the gap. This transverse field is differentiated by the imagewise exposure to light of the photoconductor strip, i.e. it is rendered permeable or impermeable to the corona discharge current, which amounts to an imagewise control of the discharge current. In addition, the potential of the photoconductor can be adjusted to the best value for image recording by means of an auxiliary electrode embedded in the photoconductor strip.

According to a further embodiment of the invention, the photoconductor strip which acts as the control element is replaced by a flat bundle of linear conductive elements over which the transverse field can be controlled by electrical signals, for example by video signals or by voltage impulses which are used for transmitting measuring values.

The invention is described in more detail below with reference to the drawings. In particular, FIG. 1 illustrates the principle of the process according to the invention on a simple embodiment given as an example.

FIG. 2 shows another embodiment of the process, which uses a sliding exposure of the photoconductor strip.

FIG. 3 shows a useful design for the discharge electrode 1.

FIGS. 4 and 5 are two cross-sections of embodiments of the control electrode given as examples for the production of the lip of a gap provided with a photoconductor.

FIG. 6 shows a control electrode which comprises numerous conductor elements instead of the photoconductor strip.

FIG. 1 illustrates the principle of the process according to the invention. A corona discharge is produced on the discharge electrode 1, which may be in the form of a thin wire or a series of metal tips, by applying a voltage from the high voltage source 2. From this discharge, a current passes over from the charge carriers to the metal screen 4, and part of the current passes through the gap 5 to the recording material 6 where a linear or band shaped charged strip 7 is produced, which depends on the form of the gap. The recording material, e.g. a paper coated with synthetic resin, is supported by the grounded metal plate 8. To facilitate the passage of the charge through the gap 5, a voltage from the voltage source 9 is applied to the screen 4 and the plate 8. The size of this voltage is calculated to provide optimum charging of the recording material 6 but without sparking over or transmission of charges from the screen to the surface of the recording material.

One lip of the gap 5 is covered with a strip of photoconductor 10. Owing to the relatively high dark resistance of the photoconductor, a potential is built up on the unexposed photoconductor by the charge carriers which strike it, and this potential produces an electric field transversely across the gap, as indicated by the lines of force 11. Where such a transverse field exists, the charge carriers meeting the gap are deflected sideways and taken up by the screen. Charging of the recording material 6 is thereby prevented. When the photoconductor is exposed, its conductivity is sufficient to deflect the charge carriers

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sprayed on it to the screen, and no transverse field is produced in the gap 5. Whether the recording material 6 is charged or not therefore depends on the exposure of the photoconductor 10 to light. Now only a part or several parts of the strip 10 can be reached by the exposure, with the result that linear charging on the recording material 6 is only partial, e.g. corresponding to a narrow zone passing transversely through an optical image which is exposed to direct light. The image line is then reproduced on the recording material as the line of a charge image.

As shown in FIG. 2, a stationary image projected into the plane of the gap can be scanned by the gap 5 of the screen 4 over the entire cross-section of the material 6 by shifting the screen 4 in one of the directions indicated by the arrows, and this image can then be transmitted as a charge image to the recording material 6. This charge image is then rendered visible in known manner by toning. Scanning of the optical image can also be carried out by holding the screen 4 in position but synchronously moving the projected image and the recording material 6.

To improve the spraying of the discharge electrode 1, it is advantageous to surround the electrode with a metal jacket 12 (FIG. 3) mounted on the screen 4 over the gap 5. The metal jacket is open at the top and bottom so that the gap 5 can be exposed to light from above.

The higher the resolution required of the developed film, the lower the photoconductor strip 10 should be so that conductive bridges from the edge of the photoconductor strip to the connection to the metal screen can be established even by small areas of the projected image and the charges can be removed at these points. However, the narrower the strip 10, the smaller will also be the charge on the surface of the strip in the unexposed state and hence also the controlling power of the photoconductor.

Extremely narrow photoconductor strips can, however, be used if the photoconductor strip is equipped with an additional electrode to which an auxiliary voltage can be applied by means of which the control potential can be adjusted to the desired value. Suitable embodiments of the strips are shown in FIGS. 4 and 5.

In FIG. 4, the part of the screen which carries the photoconductor is in the form of a rail 12 made of synthetic resin which forms a step at 13. The recessed part is filled with the photoconductor 10 in the form of a beam of square cross-section. The top of the beam is connected to the metal body 4 of the screen by means of a conductive cover 14 which has been painted to just before the edge of the beam 10 so that only a very narrow strip remains uncovered. The charge is carried away over this covering when the photoconductor is in the exposed condition. Supply of the charge and maintaining the potential in the dark are effected by the conductive wire 15 embedded in the photoconductor. The edge prepared in this way forms a lip of the gap 5. The second lip 16 of the gap is made of metal and is arranged opposite the free edge of the photoconductor 10.

FIG. 5 shows another embodiment of the control electrodes, in which the recess of the synthetic resin rail 12 is filled with photoconductor 10 in such a way that the cross-sectional surface is a triangle one edge of which forms the gap together with the opposite metal strip 16.

Control electrodes of the type illustrated in FIGS. 4 and 5 which are equipped with auxiliary electrodes no longer need the corona discharge current for charging them since the transverse field can be adjusted in the gap at will by means of the auxiliary electrode by applying a suitable auxiliary voltage. In this form, the control electrode is also suitable for operation with alternating current. If the auxiliary voltage used in an alternating voltage of sufficiently low frequency, e.g. 50 cycles per second, charge structures in the form of a line raster are produced on a carrier which is moved relatively to the gap, and these structures may be advantageous for exclusive development.

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Control of the charge current can also be achieved if, instead of preparing the photoconductor on a lip of the gap, linear conductors 17 are arranged on the gap 5 of the screen 4 in FIG. 6, across which voltage impulses or control voltages can be applied for image recording. This control electrode may be, for example, in the form of a flat bundle of wires or metal coatings on synthetic resin similar to printed circuit. Connection to a scanning device can be established over comparatively large distances through the conductor elements, for example to allow the transmission and recording of images or measuring values.

In the apparatus described in FIGS. 1 to 6, the width of the gap is a few tenths of a millimetre, preferably 0.2 to 0.5 mm. The distance of the screen 4 from the surface of the recording material 6 amounts to a few millimetres, preferably 1 to 2 mm. The control voltages at the edges of the gap is in the region of 0 to 1000 v., preferably 0 to 300 v. The voltage between screen 4 and the support 8 is adjusted to the optimum value such that interfering transmission of charge from the screen to the surface of the carrier does not occur. It is in the region of a few k-volts. The corona discharge on the discharge electrode 1 is produced in a known manner, the voltage being adjusted to the optimum value according to the geometrical relationships of the arrangement.

The process according to the invention can, of course, also be used for imagewise discharging of a homogeneously precharged recording material, the corona discharge current causing either imagewise neutralisation of the charges already present or an additional imagewise charging of the recording material with a charge of opposite sign.

The process according to the invention has considerable advantages over the conventional processes, consisting inter alia in that images can be recorded with simple electrode arrangements and the desired effect is achieved with minimum expenditure in apparatus. Furthermore, paper which does not have a perfectly flat surface can be used as the recording material since the quality of the recording is substantially unaffected by the distance of the control electrodes from the surface of the recording material. This opens up the possibility of obtaining superimposed development of several separated images in different colours since one insulating toner which has been applied to the paper does not impair a second imagewise charging. The distance of the electrodes can always be kept sufficiently large that any toner image already present will not be wiped out. Other advantages lie in the operational reliability of the process and the possibility of the continuous application of image charges.

What is claimed is:

1. An electrographic process for the production of charge images on insulating recording material by imagewise charging of a neutral recording material, or by imagewise discharging of a homogeneously precharged recording material, using a corona discharge current, comprising the steps of producing a corona discharge from a discharge electrode, said corona discharge being constant in time, directing the corona discharge to a surface of a recording material positioned to receive said discharge current, passing said corona discharge current to said surface through a metal screen interpositioned between said discharge electrode and said recording material surface passing the current through an elongated gap defined in the screen, producing an electric field transversely across the gap by a lamellar electrode at one longitudinal side of the gap deflecting the discharge current by said electric field provided from said lamellar electrode by varying potentials in said strip and producing a control of the charge image production on the recording material surface.

2. A process according to claim 1 wherein said transverse field is supplied by applying a potential to a conductive strip at one longitudinal side of said gap.

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3. A process as claimed in claim 1 in which said transverse field is produced across said gap by applying a potential to several linear conductors terminating at said gap.

4. The process of claim 1 wherein said transverse field is supplied by applying an insulating photoconductive material on one longitudinal side of said gap, said photoconductive material holding the charge on its insulating surface thereby establishing said field, and wherein the photoconductive material is exposed to a light image to remove the transverse field allowing charges to be deposited on the recording material surface.

5. The process according to claim 4 wherein potential is applied to a conductor embedded in the photoconductive material to maintain the transverse field.

6. A process according to claim 1, characterised in that a voltage which is lower than the breakdown voltage of the air layer between screen and recording material is applied between the metal screen and the conductive support of the recording material.

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7. A process according to claim 1, characterised in that the recording material on the one hand and the screen and the discharge electrode on the other hand are moved relatively to each other during the recording process.

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GEORGE F. LESMES, Primary Examiner

J. C. COOPER III, Assistant Examiner

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