

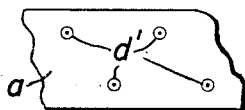
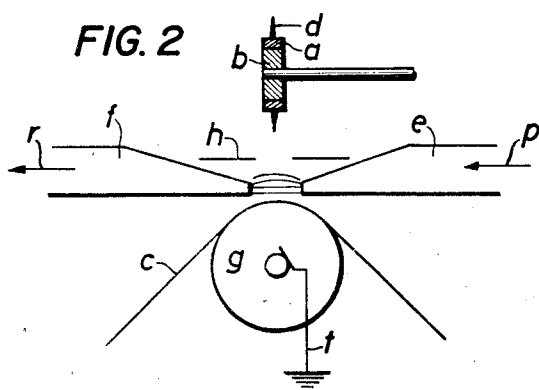
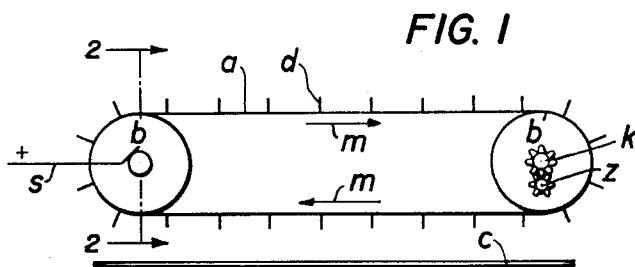
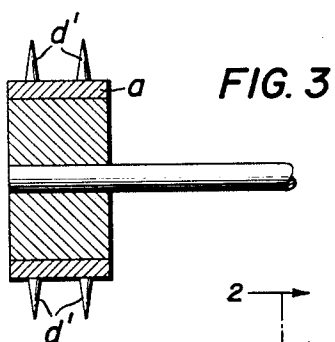
Feb. 16, 1965

W. SIMM

3,169,886

APPARATUS FOR THE ELECTROPHOTOGRAPHIC PRODUCTION OF IMAGES

Filed Nov. 15, 1960



INVENTOR.
WALTER SIMM

BY
Burgess, Linklater & Sprung
ATTORNEYS

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3,169,886 APPARATUS FOR THE ELECTROPHOTOGRAPHIC PRODUCTION OF IMAGES

Walter Simm, Opladen, Germany, assignor to Farbenfabriken Bayer Aktiengesellschaft, Leverkusen, Germany, a corporation of Germany

Filed Nov. 15, 1960, Ser. No. 69,402

Claims priority, application Germany, Nov. 18, 1959,
F 29,879

6 Claims. (Cl. 118—637)

The invention relates to an apparatus for the electrophotographic production of images on light-sensitive semiconductor layers, in which first of all a latent conductivity image is produced by exposure to light, which image is developed by transfer of a coloured aerosol in the stationary electrical field of a corona discharge. By using for this purpose an electrode arrangement consisting of a pointed electrode on which the corona discharge occurs and an opposed plate-like electrode, on which the semiconductor layer or a support with the semi-conductor layer is located, it is only possible to develop an image of a certain size, as the intensity of the electrical field over the plate decreases very rapidly with increasing distance away from the point directly opposite the pointed electrode. Owing to the decreasing field intensity, the colouring also becomes proportionately weaker away from this point. The region on the image surface in which the colouring is still sufficiently strong and uniform can perhaps be extended by increasing the spacing between the electrode point and the plate. Nevertheless, this modification necessitates a substantially greater electrode voltage and requires substantially more space for the arrangement, so that a practical limit is very soon reached.

If an attempt is made to increase the region of satisfactory colouring by simultaneous use of several discharge electrodes in the form of points or wires positioned at a small distance from the plate, it is found that the discharge zones are mutually disturbed so that when colouring of the layer by the aerosol is effected, lattice-like structures are formed which completely distort the image.

An additional difficulty in the development of relatively large areas or surfaces is that the aerosol cannot be distributed with sufficient uniformity over spaces of any desired size.

The said difficulties are obviated according to the invention by positioning the discharge electrode on a movable holder device and guiding it at constant speed over that surface of the semi-conductor layer which is to be developed. By such a movement parallel to the semi-conductor layer, each spot of the surface can come at least once into very close proximity to the discharge electrode. As a result of the electrode being repeatedly moved over the surface at equal time intervals, the discharge field can be extended to a large area with a relatively small electrode distance so that the development of images on large surfaces becomes possible. A considerable advantage associated with the use of a moving electrode arrangement is that a plurality of discharge points, each with a corona discharge, can be simultaneously employed, since lattice formation does not occur with the development of the image because of the movement. The use of a plurality of such electrode points enables the ion stream to be substantially strengthened and the development time shortened. For the development of images of large area an arrangement which has proved to be practicable is for the electrode points to be arranged in a row and to be moved along this row at a constant speed, the semi-conductor layer being advanced also at a constant speed, at right-angles to the direction of movement of the points, in order to obtain a uniform development of the image over the entire surface.

The invention is further described in reference to the accompanying drawing, wherein embodiments of the invention are schematically represented. In the drawing:

FIG. 1 is an elevation view of apparatus according to the invention, showing the discharge electrodes mounted on an endless belt, in side elevation;

FIG. 2 is an elevation view of apparatus according to the invention, including the equipment shown in FIG. 1, and showing the discharge electrode endless belt in FIG. 1 as the same is seen along line 2—2 in FIG. 1;

FIG. 3 is a showing of an alternative construction for the endless belt discharge electrode, the showing in this figure corresponding to the showing of the endless belt discharge electrode in FIG. 2; and

FIG. 4 is a top plan view of a portion of the endless belt discharge electrode shown in FIG. 3.

One embodiment of the arrangement according to the invention is shown diagrammatically and by way of example in the drawing. A continuous metal chain *a* fitted with metal points is, for example, used as discharge electrode (FIG. 1), the said chain being guided over two sprocket wheels *b*, *b'*. The sprocket wheel *b'*, is provided with a gear *k* and the gear is driven by drive gear *l*, to impart motion in the direction indicated by the arrows *m* to the endless discharge electrode *a*. The extended portion of the chain lies parallel to the semi-conductor layer *c*. The points *d* extend outwardly and upon voltage being applied each separately produces a corona discharge. The chain is set in motion by means of electric motor driving one of the sprocket wheels through the gearing *l*, *k*, so that the electrode points may move at a velocity of a few centimetres per second to a few metres per second relative to the semi-conductor layer. In order to widen the discharge zones, the points can also be staggered relatively to one another.

A staggered arrangement for the electrodes is indicated in FIG. 3 and FIG. 4, wherein the electrodes *d'* of the discharge electrode endless belt or chain *a* are staggered as is indicated in these figures.

The aerosol is injected into the discharge field from a slotted nozzle *e* as is indicated by the arrow *p* (FIG. 2) parallel to the semi-conductor layer or at a slight inclination to the plane of the layer and is taken up again by a second slotted nozzle *f*, which is connected to a suction device which draws off aerosol in the direction indicated by the arrow *r*. The nozzles are positioned opposite each other at a distance of a few millimetres to a few centimetres (for example 1 cm.) so that an aerosol mist of a few millimetres, in thickness for example of 5 mm. is formed between them, the width of the aerosol mist corresponding to the width of the slot in the nozzle.

Power is supplied to the discharge electrodes *d* from the supply *s* which is in electrical connection with the sprocket wheel *b*, and metal roller *g* for the semi-conductor layer is grounded by connection *t*.

The support with the semi-conducting layer, for example paper with zinc oxide, is guided over a rotating, earthed metal roller *g*, which serves as counter-electrode. Thus, the semi-conducting layer is moved through the path of the discharge from the corona discharge electrode. As a result of the paper being moved at right-angles to the direction of travel of the electrode points, a surface is developed which can cover an unlimited length of the paper strip over the selected width (slot length).

By the use of this arrangement, the development zone is confined to a narrow space which is very advantageous from the point of view of equipment and because of the short electrode distance made possible by the arrangement it is possible to work with relatively low voltages of a few kilovolts so that insulation is substantially simplified.

Strong distortions of the discharge field are caused by the rims of the nozzles *e* and *f*, which are connected to earth potential, and this results in irregularities in the colouring. Such distortions occur when the nozzles are made of insulating material, because a conductive film is formed in time because of moistening by the aerosol. These disturbances are avoided according to the invention by the provision of a slotted diaphragm *h* of insulating material which is arranged above the aerosol mist between the discharge electrode and the roller. By means of this diaphragm, the stream of ions is focused and the aerosol deposition is limited to a specific zone between the nozzles. Furthermore, protection against flash-over is obtained by the rims of the nozzles being covered by the diaphragm. The width of the diaphragm slot must be larger than the width of the discharge electrode and smaller than the spacing of the nozzle rims.

By suitable nozzle setting and flow velocity, the aerosol stream is advantageously so guided that the dye-stuff particles stream past the semi-conductor layer just above the surface thereof when the discharge electrode is without voltage and are directed on to the layer and produce the colouring of the exposed areas by the stream of ions and the electric field only when the voltage is switched on.

I claim:

1. In an apparatus for the electro-photographic reproduction of images having corona discharge electrode means, transfer means for passing a semi-conductor layer having a latent conductivity image thereon to travel past said electrode means, the semi-conductor layer upon such travel passing through the path of discharge from the electrode means, and means disposed intermediate the electrode means and the transfer means for injecting an aerosol developer into the path of discharge from the electrode means, the improvement which comprises said electrode means being mounted for movement transverse to the direction of travel of the semi-conductor layer, means for moving said electrode means transversely to the direction of travel of the semi-conductor layer as the same is past, and shielding means disposed intermediate the corona discharge means and said injector means for shielding the injecting means from the corona discharge, said shielding means terminating short of the path of the discharge from the electrode means to the semi-conducting layer permitting passage of the corona discharge from the electrode means to the semi-conducting layer.

2. Improvement according to claim 1, wherein said aerosol injecting means comprises an aerosol discharge nozzle disposed on one side of the path of discharge from the electrode means, and an aerosol suction nozzle spaced from the discharge nozzle and disposed on the other side of said path, said shielding means comprising a slotted diaphragm having the slot thereof disposed for passage of the discharge therethrough along said path, the slot being narrowed than the spacing of the nozzles and portions of the diaphragm adjacent the slot overlying the nozzles.

3. Improvement according to claim 1 in which said means for passing said semi-conductor layer includes a grounded roller for the passage of said layer thereover positioned opposite said electrode means and in which said electrode means are movable parallel to said roller axis.

4. Improvement according to claim 1 in which said electrode means includes a multiple number of pointed electrodes positioned in an endlessly moving conveyor.

5. Improvement according to claim 4 in which said pointed electrodes are staggered laterally relative to each other on said conveyor.

6. Improvement according to claim 1, and including a semi-conductor bearing a later conductivity image mounted on said means for passing such layer past the electrode means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,169,886

February 16, 1965

Walter Simm

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 4, line 9, for "narrowed" read -- narrower --;
line 25, for "later" read -- latent --.

Signed and sealed this 13th day of July 1965.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents

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