United States Patent [19]

Wright

[11] **3,711,710**

[45] **Jan. 16, 1973**

[54] **METHOD OF AND MEANS FOR CONTROLLING CORONA EMISSION**

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[22] Filed: **Nov. 2, 1970**

[21] Appl. No.: **85,964**

[30] **Foreign Application Priority Data**

Nov. 7, 1969 Australia 63498

[52] **U.S. Cl.** .....**250/49.5 GC**, 250/49.5 ZC, 250/495 TC

[51] **Int. Cl.**.....**H01j 37/26**

[58] **Field of Search**.....250/49.5 GC, 49.5 ZC, 49.5

[56] **References Cited**

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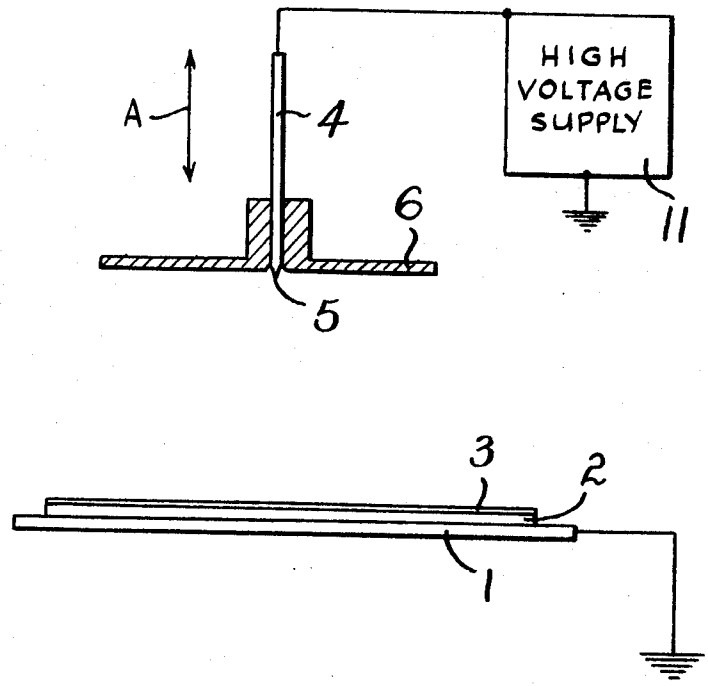
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[57] **ABSTRACT**

A method of controlling the area developed by a corona discharge which consists in providing a shield around the corona point and controlling the effect to the shield to have the focussing effect on the corona preferably by controlling the position of the electrical charge or the electrical resistivity of the shield.

4 Claims, 3 Drawing Figures



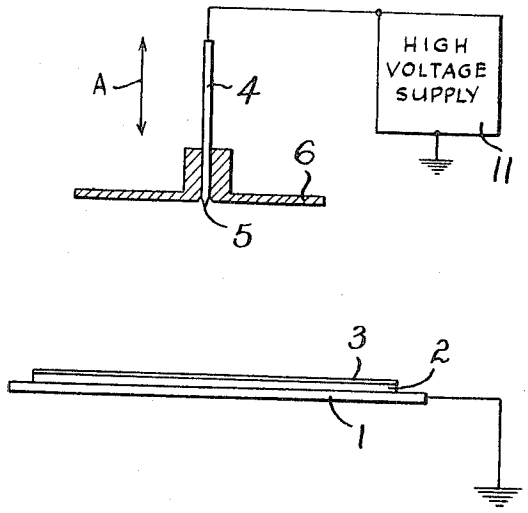


FIG 1

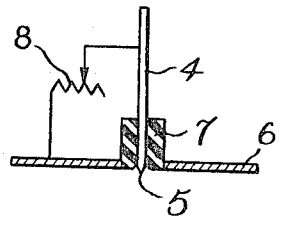


FIG 2

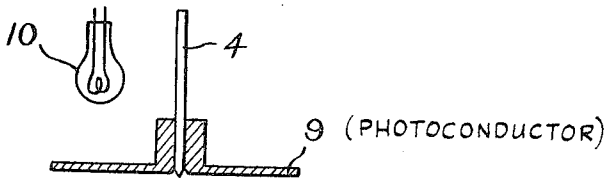


FIG 3

METHOD OF AND MEANS FOR CONTROLLING CORONA EMISSION

This invention relates to the reproduction of visual information, and is particularly applicable to signal recording and character printing processes in which an input signal is used to control in patterned form the impression of electrostatic charge on the dielectric surface of an electrographic recording member.

Various methods of recording of information on electrographic surfaces are known and such methods generally provide for the production of a pattern of electrostatic charge on the surface of the electrographic recording member. The electrographic recording member may in its simplest form comprise a paper or other relatively conducting backing member having coated on one surface thereof a thin insulator film, such as a polyester resin or the like. The charge pattern may be controlled by an input signal which controls the selection of those areas on the electrographic surface which are to be charged, and prevents charging of those areas of the electrographic surface which are required to remain uncharged. Development of the so-produced charge patterns by the use of either dry or liquid dispersed toner materials, such as those well known in the art of electrophotography, results in the production of a visual record of the information impressed as an electrostatic latent image on the electrographic recording member surface. Single point or multipoint charging means may be used, the input means providing for controlled deflection of the single point, or selection of individual points in the multipoint system. The single point system may involve the use of a stylus which is moved across the surface as is known for instance in chart recorders and the like, whereas the multipoint system is illustrated by such character printing devices as those employing a matrix of charging points, wherein the points are arranged in a closed rectangular pattern containing finite parallel rows of points which may be selectively energized to form a charge pattern corresponding to a letter of the alphabet or a number or some other desired pattern or design. Alternatively the matrix of charging points or styli may form a linear array as is common in bit recording devices.

A disadvantage of the prior art systems relates to their need to have the charging points very close to the surface being charged, and in fact in many instances it is necessary to position the charging points so that they are actually in contact with the electrographic surface. This has been necessary in prior art processes in order that charge spreading on the recording surface may be held to within acceptable limits. Contact between the points and recording surface is a disadvantage for the following reasons. Firstly, this causes wear on the points, and thus changes their geometry, which in turn affects the shape of the charge areas produced therefrom. Secondly, the contact of charging points with the electrographic surface may give rise to spurious signals, particularly in those instances in which the electrographic recording member is moved during image production. Thirdly, equipments utilizing contact or near contact charging methods need to be manufactured to conform with very small tolerances in order that they may produce accurate and uniform records of input signals.

This present invention teaches a method whereby the disadvantages of prior art processes may be overcome, in that it provides a method for restricting the zone of influence of a charging point, whereby the size of an area charged by a point electrode may be restricted to 0.010 inch diameter or less, even when the point is several inches removed from the surface being charged. Thus the present invention teaches a method for charging dielectric surfaces in patterned form which consists of placing the member to be charged on a grounded backing member with its dielectric surface spaced apart therefrom, characterized by such corona charging point being substantially surrounded by a planar shield adjustably positioned in relation to said corona charging point whereby the zone of influence of said corona discharge point on said dielectric surface may be varied in size by varying the position of said shield. In addition the size of the area of such zone influence may also be altered by varying the electrical resistivity of said shield, or by varying the contact resistivity between said corona charging point and said shield.

The diameter of the shield appears to be relatively non critical provided it is substantially in excess of the diameter of the stylus shank so that secondary emission from the shield is of insufficient strength to deposit unwanted charge on the recording surface. It will be obvious to those skilled in the art that the effect of such secondary emission may be minimized particularly where the diameter of such shield is kept to a minimum by rounding the edges thereof or by coating such edges with an insulating material.

It is known that a single point corona charging electrode, spaced apart from a grounded backing member at a sufficient distance to prevent the production of a hot spark when a high voltage power supply connected to such corona point is energized, will produce a relatively soft edged electrostatic charge on the surface of an electrographic or electrophotographic sheet placed on the grounded backing member and between such backing member and the corona charging point electrode, the diameter of such charged area being somewhat larger than the distance between the point and the grounded backing member when a negative high voltage is connected to such corona point, while the charged area produced by positive corona is usually somewhat smaller than that produced by a negative corona. If the spacing between the point and the grounded backing member is increased, the size of the charged area is also increased without improving the edge delineation of such charged area.

In accordance with the present invention a further member is provided in the charging system, such member being of selected electrical conductivity, and in addition being in a preferred embodiment substantially planar, and having a hole in the center thereof through which the tip of the corona point protrudes. The shank of the corona point electrode may touch the planar shield member in some instances, whereas in other instances there may be no direct physical contact and thus no direct electrical contact between the corona point electrode and the planar shield member. The effectiveness of the corona restriction produced by the introduction of such a shield member is influenced by the geometry of the system and the electrical re-

sistivity of the shield member. Geometrical features which influence the effectiveness of corona restriction include the distance the corona point projects through the shield, the shape of the point, and the distance between the point and the grounded backing member, while further control of the size of the corona projected area may be obtained by varying the electrical conductivity of the shield member, as well as by varying the voltage applied to the corona point.

In order that the invention may be more readily understood reference will now be made to the illustrations, in which:

FIG. 1 illustrates the embodiment in which the shield member is adjustably mounted in relation to the charging point,

FIG. 2 illustrates how the corona emission may be modulated, and

FIG. 3 shows how modulation can be carried out by a light using a photo-conductor shield.

It will be realized that these illustrations are intended to depict the principles of the invention only and are not included in the restrictive sense. In FIGS. 2 and 3 the high tension supply will be similar to that shown in FIG. 1. Corresponding parts in each figure are indicated by similar reference numerals.

Referring now to FIG. 1 in detail, a grounded conductive backing member 1 has placed thereon an electrographic recording member consisting of a relatively conductive backing 2 in contact with said grounded base 1 with a dielectric surface layer 3 on the side of said backing 2 remote from the gounded base 1. A corona charging point 4, connected to a high voltage power supply, is positioned to face the dielectric surface 3, and spaced apart from the dielectric surface. A conductive shield member 6, substantially planar on the side facing the dielectric surface 3, is adjustably mounted to the corona charging point 4, the shield member 6 may be moved up and down in response to an electrical signal to vary the size of the area on the dielectric surface 3 which is charged when high tension is applied to the corona charging point 4.

FIG. 2 shows an alternate shield construction in which the conductive shield 6 is separated from corona charging point 4 by insulator 7, and a variable resistor 8 is connected between the charging point 4 and the shield member 6 to provide the modulating control.

FIG. 3 shows a further alternate shield construction in which shield 6 is replaced with a photoconductor shield 9, the resistivity of which is modulated by varying the intensity of lamp 10. The power supply is numbered 11.

It will be realized that the shields of each of FIGS. 2 and 3 may be in addition moved in relation to the corona charging point 4 to obtain further modulation of the size of the area charged on dielectric surface 3.

The following examples will serve further to illustrate the invention.

EXAMPLE 1

A corona point charging device was constructed in which a point, radius 0.002 inch, was formed on the tapered end of a steel shaft 0.060 inch diameter, the included angle of the tapered section of the shaft being 15°. The shaft was connected to the output terminal of a high voltage power supply, arranged to supply a negative high voltage output. A backing member was positioned beneath the charging point, which backing member was connected to the ground terminal of the high voltage supply unit. Provision was made to vary the distance between the point and the backing member. In order to record the projection of the corona pattern produced when the point was energized, a sheet of electrographic paper was positioned beneath the point, with its underside in contact with the grounded backing member. After charging the electrostatic latent image was developed by immersion in a bath of liquid developer of the type used in electrophotographic document copying machines and the like.

Application of 20KV negative to the point, with the point to backing plate distance set at 1.25 inches resulted in the production of a soft edged corona discharge pattern approximately 2.25 inches diameter being produced on the sheet of electrographic paper placed on the backing member. In this instance the shield member was not used, and the edges of the charge pattern were ill defined.

A shield member was then prepared, which member consisted of a bronze disc, 1.19 inches diameter, 0.059 inch thick, substantially planar, with a central hole 0.060 inch diameter. The electrode point was pushed through the hole in the shield member and protruded 0.19 inch below the shield member. The corona pattern produced by the application of a potential of 20KV negative to the point, with the point to backing plate distance set at 1.25 inches, was 2.125 inches diameter, with a sharply defined edge.

The shield was then moved slightly to change the distance which the point protruded through the shield to 0.125 inch. The sharply defined corona pattern so produced was 1.25 inches diameter.

A further series of tests carried out with the same charging point and shield member resulted in the production of a sharply defined corona pattern 0.031 inch diameter when the point to backing member distance was set at 0.625 inch and the point protruded 0.016 inch through the shield member.

EXAMPLE 2 – 4

The following series illustrates variations in corona restriction brought about by changing the resistivity of the shield member. In each instance the applied voltage was 20 KV negative, with the charging point protruding 0.25 inch through the shield, and a shield to backing member distance of 1.50 inches.

A polyethylene shield produced a sharp edged corona pattern of 4.0 inches diameter. The volume resistivity of the of the polyethrylene was 1.6×10^{13} ohm.cm.

A cardboard shield produced a sharp edged corona pattern of 1.75 inches diameter. The volume resistivity of the cardboard was about 2.5×10^{10} ohm.cm.

A bronze shield produced a sharp edged corona pattern of 1.24 inches diameter.

EXAMPLES 5 – 6

A cardboard shield, volume resistivity 2.5×10^{10} ohm.cm with 20KV applied to a point protruding 0.5 inch through the shield, and spaced 1.50 inches above the backing member produced a charge pattern 1.50

inches diameter when a negative polarity was applied to the point, whereas the charge pattern was 1.25 inches diameter when a positive polarity was applied to the point.

It will be seen from the foregoing that the restriction of the zone of influence of a corona beam may be controlled by the provision of a shield member, and that when all other factors are kept constant, the extent of such restriction is dependent on the resistivity of the shield member, the distance the charging point protrudes through such shield member, and the distance between the charging point and the backing member.

It will be realized that the examples are illustrative of the principle of the invention only, but are indicative of the control methods available for modulating corona beams, which modulation may be achieved by moving the shield in relation to the point, varying the volume resistivity of the shield or a combination of some or all of these means. In addition the recording member may be moved to produce a continuous trace where this is desired. In addition the high voltage power supply may provide a steady DC output, or may provide an interrupted DC output of a selected frequency, or of a modulated frequency or the amplitude or frequency may be modulated, whereby the trace obtained on the recording member may be discontinued or attenuated where this is required. Thus a record of an external signal may be produced by causing such signal to provide mechanical modulation in accordance with the requirement of any or all of the variables herein disclosed.

As previously stated, the electrostatic latent image may be developed by the use of a dry electrophotographic toner material, or preferably by the use of a liquid dispersed electrophotographic toner. A liquid electrophotographic toner in dispersion in an insulating carrier liquid produces an electrophotographic liquid developer, which may be defined as an electroscopic marking material suspended in a carrier liquid, wherein the carrier liquid has a volume resistivity greater than 10^9 ohm. cm and dielectric constant less than 3, and wherein such electroscopic marking material comprises a pigment or dye or other colored particle combined with a resinous or oleoresinous or other fixing or dispersing agent, and in addition combined if necessary with a polarity control agent such as an alkyd resin or other material well known in the prior art, such combined particle forming the toner which is in suspension in the insulating carrier liquid. Such dry or liquid dispersed toner materials may be formulated and compounded to be attracted to either a positive or a negative electrostatic charge as required.

While in the foregoing reference was made to electrographic paper as the charge receptive film or recording member, it will be realized that such charge receptive film may comprise a photoinsulator and thus the recording member may be electrophotographic paper or other photoconductive printing element if desired without departing from the spirit of the herein described invention.

As a further alternative the dielectric recording member need not have a conductive backing.

I claim:

1. A method of charging a dieelectric surface of a recording member in patterned form comprising the following steps:

A. mounting a point-discharge corona discharge member in close proximity to a grounded backing member with the charging point of said discharge member directed toward but spaced from said backing member;

B. positioning a shield member in encompassing relation to said charging point of said discharge member, said shield member having a relatively large, continuous planar surface facing said backing member within a range in which the charging point of the discharge member extends beyond the plane of the shield surface by no more than a fraction of an inch;

C. positioning a recording member on said backing member with a given portion of the dielectric surface of said recording member facing said charging point;

D. energizing said corona discharge member from a high voltage power supply to generate a corona discharge between said charging point of said discharge member and said recording member;

E. adjusting the position of said shield member, relative to said charging point, within a range in which the charging point of the discharge member extends beyond the plane of the shield surface by no more than a fraction of an inch, to produce a charge area on said dielectric surface that is substantially smaller than and more sharply defined than the charge area produced by said point, at the same position and with the same energization, in the absence of said shield member;

F. and repeating steps C and D, for different portions of the dielectric surface of said recording member, to produce a pattern of sharply defined charge areas on said recording member surface.

2. A method for charging dielectric surfaces in accordance with claim 1, further characterized in that control of the size of the area charged is obtained by the step of varying the electrical resistivity of said shield.

3. A method for charging dielectric surfaces in accordance with claim 1, further characterized in that control of the size of the area charged is obtained by the step of varying the resistance between the corona charging point and the shield.

4. A method for charging dielectric surfaces in accordance with claim 1 further characterized in that the charge on the said shield is controlled by actuating a variable resistance means between the corona charging point and the shield.

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