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[54] ELECTRICAL CHARGING DEVICE

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[51] Int. Cl. G03g 15/00

[58] Field of Search 250/49.5 ZC, 49.5 TC

[56] References Cited

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[57]

ABSTRACT

Corona discharge apparatus incorporating an electrode assembly comprising needle electrode pluralities providing corona discharge at opposite sides of a longitudinal passage in the apparatus through which a chargeable member is moved. Electrodes are spaced particularly in lateral and longitudinal manner for providing a uniform electrical charge on the chargeable member.

8 Claims, 5 Drawing Figures

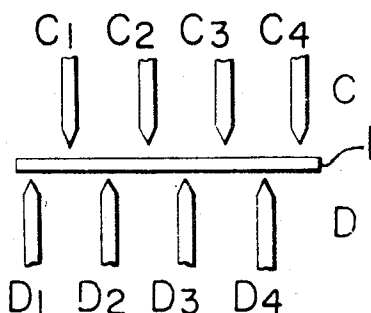


FIG. 1

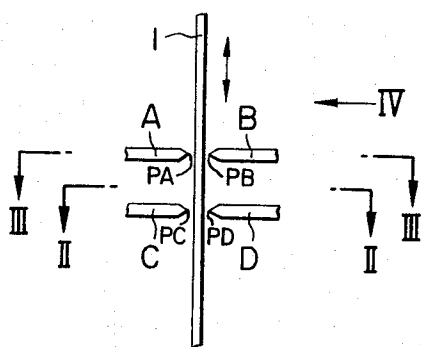


FIG. 2

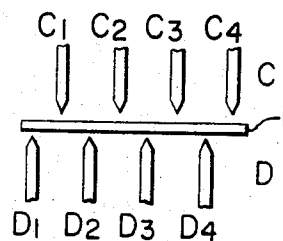


FIG. 4

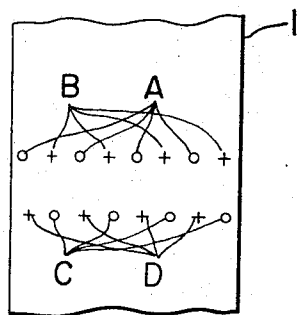


FIG. 3

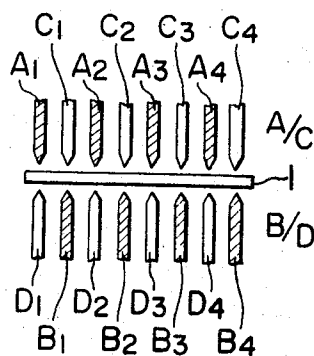
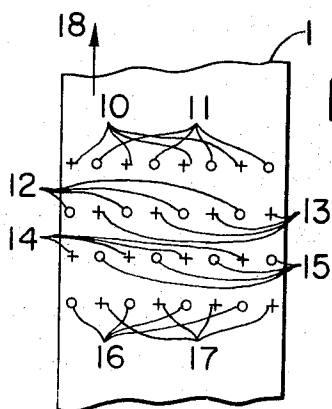


FIG. 5



ELECTRICAL CHARGING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a corona discharger for applying electric charge to photosensitive paper, foil or like material, and more particularly to a corona discharger for use in photocopying apparatus.

2. Description of the Prior Art

To electrically charge paper or foil, use is usually made of a wire electrode stretched transversely of the path of movement of the paper. The wire electrode applies electric charge to the moving paper by corona discharge.

In high speed photocopying apparatus wherein paper moves very quickly through the apparatus and accordingly moves very quickly below the corona discharge, it has been found that electric charge is not sufficiently applied to the paper to provide excellent copy.

Therefore, it has already been proposed to replace the wire electrode by a needle electrode. In this case, the needle electrodes have their tip ends juxtaposed with the paper to apply electric charge thereto. This arrangement is still insufficient, because stripes of electric charge are formed longitudinally of the fast moving paper and they clearly appear in the resulting copy. This is not remedied even if a plurality of needle electrodes are disposed one after another.

SUMMARY OF THE INVENTION

The object of the present invention is to form a corona discharge which can provide sufficiently great and especially uniform distribution of electric charge even on fast moving paper.

Such object of the present invention can be achieved by providing a number of needle electrodes, each having a voltage applied thereto, on both sides of the path of movement of the paper in such a manner that each needle electrode on one side is directed toward a gap between needle electrodes on the other side and that none of the needle electrodes on either side lies behind any other needle electrode as viewed in the direction of movement of the paper.

It has been found effective to provide at least two rows of needle electrodes on each side of the path of movement of the paper in such a manner that the needle electrodes in one row on each side are spaced transversely of the direction of movement of the paper with respect to the needle electrodes in the other row on that side and that all the needle electrodes on one side of the path of paper are directed toward gaps between the needle electrodes on the other side of the path of movement of the paper.

In another form of the present invention, the needle electrodes on both sides of the path of paper are disposed in rows spaced transversely of the direction of movement of the paper.

The rows of needle electrodes on both sides of the path of paper may conveniently be opposed to each other.

It has been found suitable that needle electrodes are disposed in two rows on each side of the path of movement of the paper in such a manner that the needle electrodes in one row are directed toward gaps with respect to the needle electrodes in the other row.

With such an arrangement, it has been found that sufficiently great and sufficiently uniform electric charge can be distributed on the surface of the paper.

The last-named embodiment shows that a relatively small number of needle electrodes can achieve the object of the present invention.

The invention will be described by way of example with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of an arrangement according to the present invention.

FIG. 2 is a cross-sectional view taken along plane II—II of FIG. 1.

FIG. 3 is a cross-sectional view taken along plane III—III of FIG. 1.

FIG. 4 is a schematic view taken in the direction of arrow IV in FIG. 1 and showing the arrangement of the needle electrodes.

FIG. 5 shows a modified arrangement of the needle electrodes.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 to 4, paper 1 passes between needle electrodes, each comprising an elongated body tapering to a corona discharge point. The needle electrodes, to which a voltage is applied, emit electric charge onto the surface of the paper. In FIG. 1, there are provided four rows of needle electrodes A, B, C, D. Corona discharge points P are thereby provided, as shown, e.g., by the reference letters PA. The discharge points PA and PC of electrodes A and C are disposed in a common plane (III—III) laterally transverse to the paper passage. The discharge points PB and PD of electrodes B and D are disposed in a common plane (II—II) longitudinally spaced from the plane III—III and also laterally transverse to the paper passage. The respective rows comprise a plurality of needle electrodes A1—A4, B1—B4, C1—C4 and D1—D4 arranged in succession so as to occupy the entire width of the paper.

It is seen in FIG. 2 that needle electrodes C1—C4 are opposed to D1—D4 in such a manner that each needle electrode in one row is directed toward a gap between the needle electrodes in the opposite row.

FIG. 3 shows four rows of needle electrodes A, B, C and D. The needle electrodes in rows A and B are shown in cross section. It will be seen that the needle electrodes in rows A and D and the needle electrodes in rows C and B are respectively opposed to each other but deviated in level from each other that is, needle electrodes C and D underlie the plane of electrodes A and B in FIG. 3.

FIG. 4 schematically shows the arrangement of the needle electrodes. Cross marks represent needle electrodes D and B and circular marks represent underlying needle electrodes C and A.

FIG. 5 shows another arrangement, in which a row of needle electrodes 10 is provided on one side of the path of movement of the paper and a row of needle electrodes 11 is provided on the other side in opposed but staggered relationship with the row 10. When viewed in the direction of movement of the paper, there are rows of needle electrodes 12 and 13, the row of needle electrodes 13 being essentially opposed to the row of needle electrodes 12 but directed toward gaps between needle electrodes 12. There are further rows of needle electrodes 14 and 15, which correspond to rows of needle electrodes 16 and 17. The needle electrodes in rows 10 to 17 are disposed in such a manner that none of them lies behind any other adjacent row needle electrode as viewed in the direction of movement of the paper indicated by 18.

We claim:

1. In corona discharge apparatus having a longitudinal passage for movement therethrough of a chargeable member adapted for use in electrophotography, an assembly of electrodes each electrode therein comprising an elongated body tapering to a corona discharge point, said assembly including first and second longitudinally spaced rows of electrodes disposing their discharge points on one side of said passage and third and fourth longitudinally spaced rows of electrodes in respective facing relation to said first and to said second electrode rows and disposing their discharge points on a side of said passage opposite said one side, each of said first row electrode discharge points being spaced laterally in said apparatus from each of said third row electrode discharge points, each of said second row electrode discharge points being spaced laterally in said apparatus from each of said fourth row electrode discharge points.

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2. The invention claimed in claim 1 wherein said electrode discharge points are uniformly spaced from the electrode discharge points adjacent thereto in the same electrode row.

3. The invention claimed in claim 2 wherein said uniform electrode discharge point spacing is the same for each said electrode row.

4. In corona discharge apparatus having a longitudinal passage for movement therethrough of a chargeable member adapted for use in electrophotography, an assembly of electrodes each comprising an elongated body tapering to a corona discharge point, including:

a first plurality of $A_1, A_2, \dots A_n$ electrodes, providing a first plurality of $PA_1, PA_2, \dots PA_n$ corona discharge points disposed at a first side of said passage in a first plane laterally transverse to said passage;

a second plurality of $B_1, B_2, \dots B_n$ electrodes, providing a second plurality of $PB_1, PB_2, \dots PB_n$ corona discharge points disposed in said first plane at a second side of said passage opposite said first passage side;

a third plurality of $C_1, C_2, \dots C_n$ electrodes, providing a third plurality of $PC_1, PC_2, \dots PC_n$ corona discharge points disposed at said first passage side in a second plane longitudinally spaced from said first plane and laterally transverse to said passage; and

a fourth plurality of $D_1, D_2, \dots D_n$ electrodes, providing a

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fourth plurality of $PD_1, PD_2, \dots PD_n$ corona discharge points disposed in said second plane at said second passage side,

said first and second plurality corona discharge points being spacedly positioned in said first plane in the succession $PA_1, PB_1, PA_2, PB_2, \dots PA_n, PB_n$, said third and fourth plurality corona discharge points being spacedly positioned in said second plane in the succession $PC_1, PD_1, PC_2, PD_2, \dots PC_n, PD_n$.

5. The invention claimed in claim 4 wherein said first and third plurality corona discharge points are disposed in a third plane transverse to said first and second planes and wherein said second and fourth plurality corona discharge points are disposed in a fourth plane transverse to said first and second planes.

6. The invention claimed in claim 4 wherein the spacing between corona discharge points in the succession $PA_1, \dots PB_n$ is uniform and wherein the spacing between corona discharge points in the succession $PC_1, \dots PD_n$ is uniform.

7. The invention claimed in claim 6 wherein said uniform corona discharge point spacings are equal.

8. The invention claimed in claim 7 wherein corona discharge points PA_1 and PD_1 are both disposed in a common plane longitudinally transverse to said passage.

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