Corona discharge devices for electrophotography, comprising means to control the flow of the ion wind (which is understood to be an air stream induced by ion flow) so as to exhaust the same through an opening other than that where the photosensitive paper is charged, and to prevent blowing of the ion wind against the paper. Alternatively means are provided for preventing the ion wind from flowing out of the charging opening.

2 Claims, 8 Drawing Figures
Fig. 2

Amount of ion wind
a > b > c

Surface potential

Amount of exposure
CORONA DISCHARGE DEVICE FOR ELECTROPHOTOGRAPHY

This invention is concerned with improvements in corona discharge devices for electrophotography. In the art of electrophotography using resin-bound zinc oxide photosensitive paper, it is a common practice to fix the dust image which is adhered upon the photosensitive paper at the stage of development following charging and imagewise exposure. In contrast to this, there has been proposed a new method also using resin-bound zinc oxide photosensitive paper, wherein the dust image formed on the photosensitive paper by development is transferred to an ordinary paper, while the resin-bound zinc oxide photosensitive paper is cleaned for repeated use. This method has a defect that the resin-bound zinc oxide photosensitive paper is degraded after being used several times and so it is limited in durability.

The major reason for the above-mentioned disadvantage is considered to be due to the fact that a so-called "ion wind" which is generated at the time of charging in the copying process is directed to the photosensitive paper. This it should be understood, is an air stream induced by ion flow.

The present invention has for its object to prevent the ion wind from blowing at the photosensitive paper so that the paper can be used many times.

The invention will now be explained in more detail with reference to the accompanying drawings, wherein FIGS. 1(a), 1(b) and 1(c) show a conventional charging device, constituting the state of the prior art, in a structural arrangement, in a schematic illustration, as well as with the wind distribution prevailing therein.

FIG. 2 is a diagram showing the relationship between the amount of ion wind in respect of the obtained surface potential and the amount of exposure.

FIGS. 3(a) and 3(b) show a first, exemplary embodiment of an improved corona discharge device according to the invention, in views similar to those of FIG. 1(a) and 1(b).

FIG. 4 is a schematic illustration of a second exemplary embodiment, in an illustration similar to that of FIG. 3(b); and

FIG. 5 shows a third embodiment, with details similar to those of FIGS. 1(b), 3(b) and 4.

In order to make this invention easily understandable, an explanation will be given first with respect to a conventional corona discharge device for electrophotography.

FIG. 1(a) shows a conventional charging device for electrophotography. Numeral 21 in the drawing is a shield plate of a U-shaped conductor and has an opening in one side 22. Insulating blocks 23a and 23b are fixed at both ends of the shield 21. Screws 24a and 24b are set into the insulating blocks 23a and 23b respectively. A corona discharging wire 25 is kept with tension at its ends between the screws 24a and 24b. Through a conductor rod 26 and the screw 24a, high voltage is supplied to initiate corona discharge.

The corona discharge device faces, as shown in FIG. 1(b), an electro-photosensitive paper 1 to effect the charging of its surface. A power supply 27 supplies high voltage to the discharging wire 25. The shield 21 and the back of the photosensitive paper 1 are grounded. While corona discharge occurs, ion wind (that is an air stream induced by ion flow) blows in the direction shown by arrow 28.

This wind is produced by the fact that ions which are generated by the corona discharge drift to collide with gas molecules which in turn move in the direction of the propelled ions. When gas flows out through the opening 22, in side air flows from outside into the less discharged area, that is, the proximity of the insulating blocks 23a and 23b, in order to balance atmospheric pressure.

Wind distribution at corona discharge is shown in FIG. 1(c). The arrows in the figure show the directions and velocities of the wind. Though ions as such are not contained in this wind, it is called an ion wind as it is produced by the ions. A fairly large amount of ozone and nascent-state oxygen are contained in this ion wind.

If resin-bound zinc oxide photosensitive paper is repeatedly used or exposed to ion wind, fog is increased on the copied image as the result of permanent degradation of said paper.

Furthermore, it became known that ion wind has an adverse effect on the sensitivity of the photosensitive paper. FIG. 2 shows this action. In this drawing a shows the surface potential of photosensitive paper with maximum ion wind, c shows the surface potential of the paper with minimum ion wind, and b shows the surface potential of the paper with an amount of ion wind intermediate respective values a and b. The more is the amount of the ion wind, the less is the drop of the surface potential due to exposure; that is, sensitivity decreases.

The problems owing to the above effect are twofold. First, the sensitivity itself of photosensitive paper decreases. Second, a uniform image can not be obtained. That is, if there is an ion current which disturbs the ion wind near the charging and exposing parts of the copying machine, the sensitivity of the photosensitive paper would be decreased non-uniformly according to the disturbed ion wind, and, as a result, a uniform copied image is not obtained. Generally, an electrophotographic copying machine of this kind has many air current generating parts, for example developing means, cleaning means and copy paper detaching means.

Especially around the charging and exposing means air current is produced, disturbing the ion wind, by the cooling fan which is used to prevent the heat, generated by a light source for original illumination, from overheating the usual glass plate which supports the original paper. In order to prevent the untoward effects due to ion wind, it is necessary to prevent ion wind from blowing at the photosensitive paper.

This invention provides an improved corona discharge device for electrophotography which can effect the discharge without the blowing of the ion wind against photosensitive paper. FIGS. 3(a) and 3(b) show a preferred exemplary embodiment of the present invention.

A U-shaped shield 30 is made of conductive material, e.g., aluminum, and is composed of back plate 31, and right and left side plates 32a and 32b. The side plates 33a and 33b are insulating blocks that are fixed to both ends of the shield 30. At 34 is shown a corona discharge wire which is extended inside the shield 30, and 35 is a first discharge opening.

Second openings 36a and 36b are provided on the side plates 32a and 32b respectively. Outside these side plates are fixed insulating plates 37a, 37b that are made of, for example, acrylic resin, in such a manner that
they do not cover up the second openings 36a and 36b. On the other hand, the insulating plates 37a and 37b are fixed with conductive plates 38a and 38b, respectively. The plates 38a and 38b have bent ends 39a and 39b and 40a and 40b, respectively. As shown in the drawings, the bent ends 39a and 39b form diverging and rearwardly projecting baffles extending from, respectively, plates 38a and 38b. The important function of these baffles lies in preventing ion winds which flow through second openings 36a and 36b from returning exteriorly of the device. In the absence of these baffles, the ion winds would merely flow back along the outside of plates 38a and 38b and enter the first opening along the photo-sensitive paper 1 in the direction of arrow B. This would produce the same undesirable effects as the prior art structure in FIGS. 1a to 1c.

The side plates 32a, 32b the insulating plates 37a, and 37b are notched at 41a and 41b; 37a is broken away in FIG. 3(a) so that the conductive plates 38a and 38b directly face inside the box made of the shield 30 and the insulating blocks 33a, 33b.

When the above-mentioned corona discharge device is positioned, as shown in FIG. 3(b) against the photosensitive paper 1 and high voltage is supplied to the discharge wire 34 by a high voltage supply 42, corona discharge takes place. Thus the photosensitive paper is charged and at the same time ion wind is generated as explained previously.

By blowing this ion wind outwardly through the second openings 36a and 36b as shown by the arrows A in FIG. 3(b), and by making outer air to flow inwardly, through the first opening 35 as shown by the arrows B, it is possible to prevent the ion wind from blowing against the photosensitive paper 1.

In this example, in order to make the ion wind flow as stated just above, the distance from the discharge wire 34 to the photosensitive paper 1 is made larger than that from the discharge wire 34 to the back plate 31 (actually they are 10mm and 8mm, respectively).

Therefore, an electric field is created inside the device so that when the high voltage is supplied to the discharge wire 34, the ion wind flows more to the back plate 31 than to the photosensitive paper 1. In this way, the ion wind produced by the corona current is discharged through the second openings 36a and 36b.

The conductive plates 38a and 38b prevent the ion wind, blown out of the second opening, from flowing back to the first opening 35. A part of the corona current reaches the plates 38a and 38b through the openings 41a and 41b, and voltage is generated on these plates 38a and 38b. Therefore, the plates absorb floating dust by electrostatic attraction and the floating dust is prevented from attaching to the discharge wire 34.

FIG. 4 depicts another example of this invention. Numeral 60 is a discharge wire. A shield which surrounds the discharge wire 60 from three sides is composed of a back plate 61 and side plates 62a and 62b. 63 is a first opening for charging (admitting) 64a and 64b are second openings for exhausting the ion wind, 66a and 66b are plates which prevent the ion wind from flowing back, and 65 is a power supply. The plates 66a and 66b also form baffles providing the same essential function as the plates 38a and 38b in FIG. 3b.

While in the example of FIG. 3 the insulating plates 37a and 37b are fixed to the side plates 32a and 32b, in the second example no insulating plate is used. Also in this example, however, the electric field in the corona discharge device is arranged so that the ion wind is exhausted through the second openings 64a and 64b. FIG. 5 shows still another example of this invention.

In this figure, 72 is a discharge wire. A shield which surrounds the discharge wire 72 from three directions is composed of a back plate 70 and side plates 71a and 71b. 73 is a first opening for charging (introducing) 74a and 74b are second openings for exhausting the ion wind, and 75 is a duct the under-edges of which are fixed to side plates 71a and 71b. 76 is a suction fan and 77 is a high voltage supply.

In this example, by blowing out the ion wind by the suction fan 76, the ion wind is prevented from flowing through the first opening 73 for charging and blowing against the photosensitive paper 1.

The devices of the present invention, as stated previously, work extremely advantageously with resin-bound zinc oxide photosensitive paper, and in addition, they work better to prevent bad-smelling gas from being produced. It is to be recognized that the formation of such bad-smelling gas as ozone is a serious problem when a copying machine using a corona discharge device is used for a long time in a small room.

Even though the production of such gas is inherent to corona charging, it is possible to decrease the produced ozone to a certain amount by making it flow through a chemical or thermal filter.

Because the ion wind, as stated previously, blows against the photosensitive paper in a conventional corona discharge device, it is impossible to have a filter in front of the photosensitive paper. Therefore, it is quite difficult to filter the ion wind before it diffuses. Because of this there has not been any effective means to prevent the diffusion of ozone from a copying machine.

But this invention exhausts the ion wind from the second openings, it confines the passing route of the ion wind after exhaustion, and filters the ion wind before its diffusion, so it effectively solves the problem of such bad-smelling gas as ozone which is produced in a copying machine.

What is claimed is:

1. A corona discharge device for electrophotography having corona discharge electrodes for charging of a photosensitive paper spaced therefrom, comprising a plurality of plate means encompassing said electrodes on three sides thereof in a generally U-shaped arrangement, said plate means including a conductive back plate behind the electrodes and a pair of side plates flanking said electrodes extending from said back plate so as to define a first opening along the surface of said photosensitive paper facing the electrodes, second openings formed between said back plate and said pair of side plates, said side plates each including diverging and rearwardly extending elongate baffle plate means adjacent said second openings projecting in directions away from said photosensitive paper, said conductive back plate being positioned at a shorter distance from said electrodes than the distance between the latter and the photosensitive paper so as to cause an ion wind generated by an electric field within the device, upon a high voltage being supplied to said electrodes, to flow toward said back plate and through said second openings along said baffle plates, said baffle plates preventing return flow of said ion wind egressing from said second openings toward said first opening and said photosensitive paper.
2. A corona discharge device as claimed in claim 1, comprising hood means fastened to the divergent rearmost ends of said baffle plates so as to form an enclosed space therewith, said hood means having an outlet aperture; and suction fan means being positioned in said outlet aperture so as to aspirate said ion wind through said second openings.