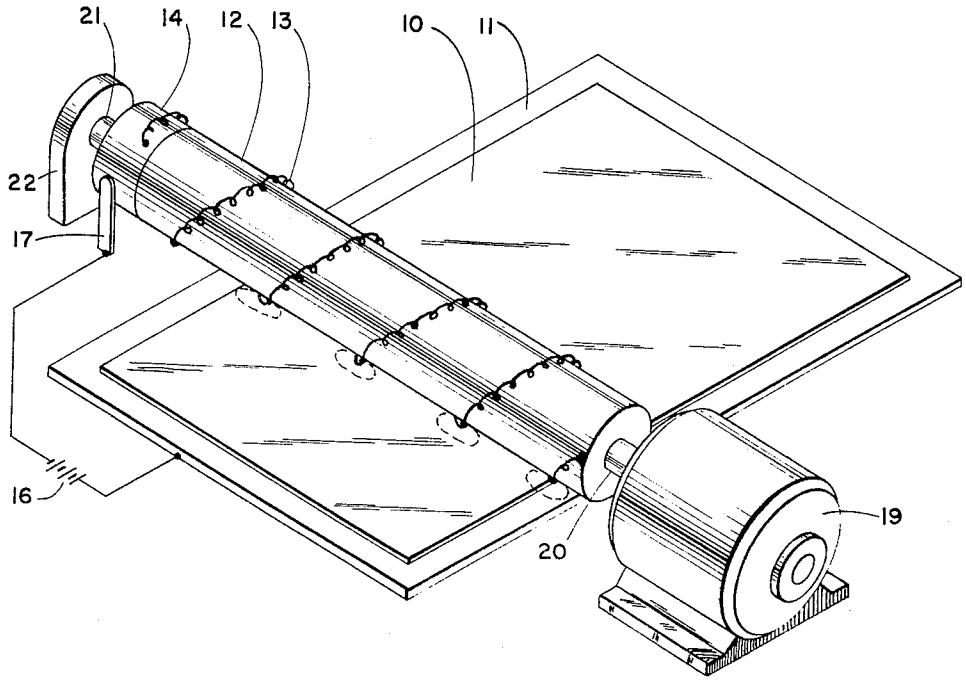
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ELECTROSTATIC CHARGING APPARATUS

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ELECTROSTATIC CHARGING APPARATUS

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This invention relates to electrography and particularly to devices for electrostatically charging the surface of an insulator. For example, in xerography the surface of a photoconductive insulating layer is uniformly electrostatically charged before exposure.

The preferred source of electric charges is an electrode or system of electrodes raised to a potential high enough to generate a corona discharge. The electrodes are normally sharp needles or fine wires. However, it has been found in practice that chargers of the above type will not charge a surface uniformly in a single pass unless a number of chargers are used in a series or tandem arrangement. This is particularly true of negatively charged wires on which corona is generated at discrete but irregularly spaced intervals. Typically, at least three chargers are necessary in a tandem arrangement for one-pass charging. One-pass charging is especially desirable when the surface being charged is that of a drum or continuous web.

One method for uniformly charging an insulating layer in a single pass is described in copending application, Serial No. 126,393, filed June 7, 1961, by James G. Jarvis and Gene H. Robinson. In their invention, a uniform charge is applied to an insulating layer, in one embodiment by means of a single helix of wire wound upon an insulating cylinder and spaced therefrom by supports.

The present invention provides a corona discharge as good as or better than that provided by such a spaced helix, and consists of a sturdier device whose manufacture is much simpler and less expensive.

It is thus an object of the present invention to provide a relatively inexpensive device which will apply a uniform electrostatic charge to the surface of an insulating layer in a single pass.

The corona generating device of the present invention consists essentially of an insulating cylinder rotatable about its axis and a bare conducting wire in the form of a small diameter helix wound upon the cylinder, the axis of this small diameter helix forming a larger diameter helix about the cylinder axis. Motor means are provided for rapidly rotating the cylinder while the wire is simultaneously energized to a corona generating potential. Such a helical-helix arrangement can be mass produced with little or no variation in their ability to produce effective, uniform corona. There is practically no variation in the distance between turns of the small helix and hence the "high" points at which the corona "spots" occur are equally spaced.

The invention and its objects and advantages will be fully undersood from the following description when read in connection with the accompanying drawing in which:

The figure is a partly schematic perspective view of the preferred form of the invention.

The drawing shows a metal plate **11** on which the photoconductive insulating sheet **10**, or other sheet to be charged is supported. Means (not shown) may be provided for moving the plate **11** under the corona discharge

mechanism or it may be moved by hand. Prior systems required the plate to be moved back and forth several times to provide adequate uniform charging, but the present invention is so efficient that only a single pass is needed. The corona generating device consists of a cylinder **12** of good insulating material, such as polymethylmethacrylate, conveniently of approximately one inch in diameter and as long as may be necessary. The wire **13**, preferably stainless steel of 0.004-inch diameter, in the form of a spring or small helix approximately one-eighth inch in diameter and stretched to a pitch of approximately one-eighth inch is spirally wound on the cylinder **12** whereby the axis of the spring or small diameter helix forms a second helix about the axis of the cylinder **12**. Wire having a diameter of 0.004 inch requires a potential of approximately 10,000 to 12,000 volts to produce useful corona.

One end of the wire **13** is anchored to a conducting slip ring **14**, which in turn is mounted on one end of the cylinder **12**. The other end of the wire **13** is anchored directly to the other end of the cylinder **12**. The slip ring **14** is connected to one terminal of a voltage source **16** through metal spring brush **17**. The other terminal of the voltage source **16** is connected to the metal plate **11**.

The cylinder is rotated by an electric motor **19** attached to one end of the cylinder **12** by a shaft **20**. The shaft **21** at the other end of cylinder **12** is supported in a suitable bearing **22**. The cylinder is rotated at speeds of the order of 100 to 1000 r.p.m.

The corona generating sites tend to concentrate at the points of the helix nearer the plate **11**. As shown in the drawing, a row of charging areas is created by the wire **13** along the plate **11** and along any sheet **10** laid upon the plate **11**. The sheet **10** to be charged moves under this row of charging areas. Due to the rapid rotation of the cylinder **12**, the sheet is subjected to a myriad of moving corona discharge areas. The charging areas are large enough and the rotation of the cylinder is fast enough that the paths of the charging areas overlap one another. Thus, uniform charging can be accomplished in a single pass. This is contrasted with the relatively small number of stationary discharge areas when stationary corona producing devices are used.

It is to be understood that the wire **13** need not necessarily be in the form of a small diameter helix of circular cross-section but may have, for example, a helix of triangular cross-section. The wire in that case may be wound upon the cylinder in such a manner that the base of the triangle is adjacent the surface of cylinder and the apex opposite this base faces outward. However, the simple circular cross-section helix is more satisfactory in practice.

Although the arrangement shown in the drawing is the preferred embodiment of the present invention, any other arrangement, such as discussed above, wherein the wire may be wound directly on the surface of the cylinder **12** and a portion of the wire will be self-supported at a distance spaced from the surface of the cylinder is contemplated as falling within the scope of the present invention.

Having described the preferred embodiment of my invention, I wish to point out that it is not limited to this specific structure, but is of the scope of the appended claims.

What is claimed is:

1. Corona charging apparatus comprising an insulating cylinder rotatable about its axis, a conducting bare wire

formed as a relatively small diameter helix having a substantially circular or polygonal cross-section spirally wound on said cylinder, the axis of said small diameter helix forming a relatively large diameter helix about said cylinder axis, and electric potential means connected to said wire for generating a corona discharge.

2. Apparatus according to claim 1 in which said wire is stainless steel having a diameter of 0.004 inch.

3. Apparatus according to claim 2 in which said small diameter helix has a pitch of at least one-eighth inch.

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