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Leibrecht

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[54] **METHOD OF REDUCING THE GENERATION OF OZONE**

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[52] **U.S. Cl.** ..... **317/4,** 317/262 A

[51] **Int. Cl.** **H01t 19/00**

[58] **Field of Search** ..... 317/4, 262 A

[56] **References Cited**

UNITED STATES PATENTS

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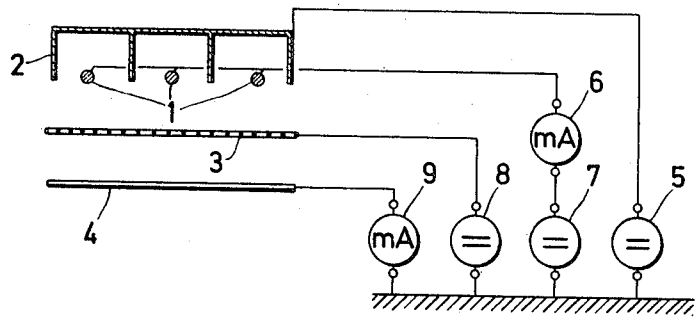
Primary Examiner—L. T. Hix

Attorney, Agent, or Firm—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

An apparatus for the reduction in the generation of ozone during the discharge of corona wires which includes the wire surrounded on three sides by a screen and on the fourth side by a surface accepting a charge with a possible grid arranged in front of the surface. The method involves connecting the screen to a voltage between that of the support of the charge accepting surface and that of the corona wire.

2 Claims, 2 Drawing Figures



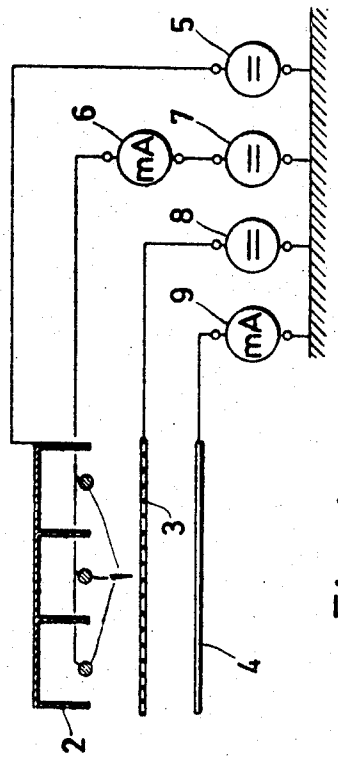
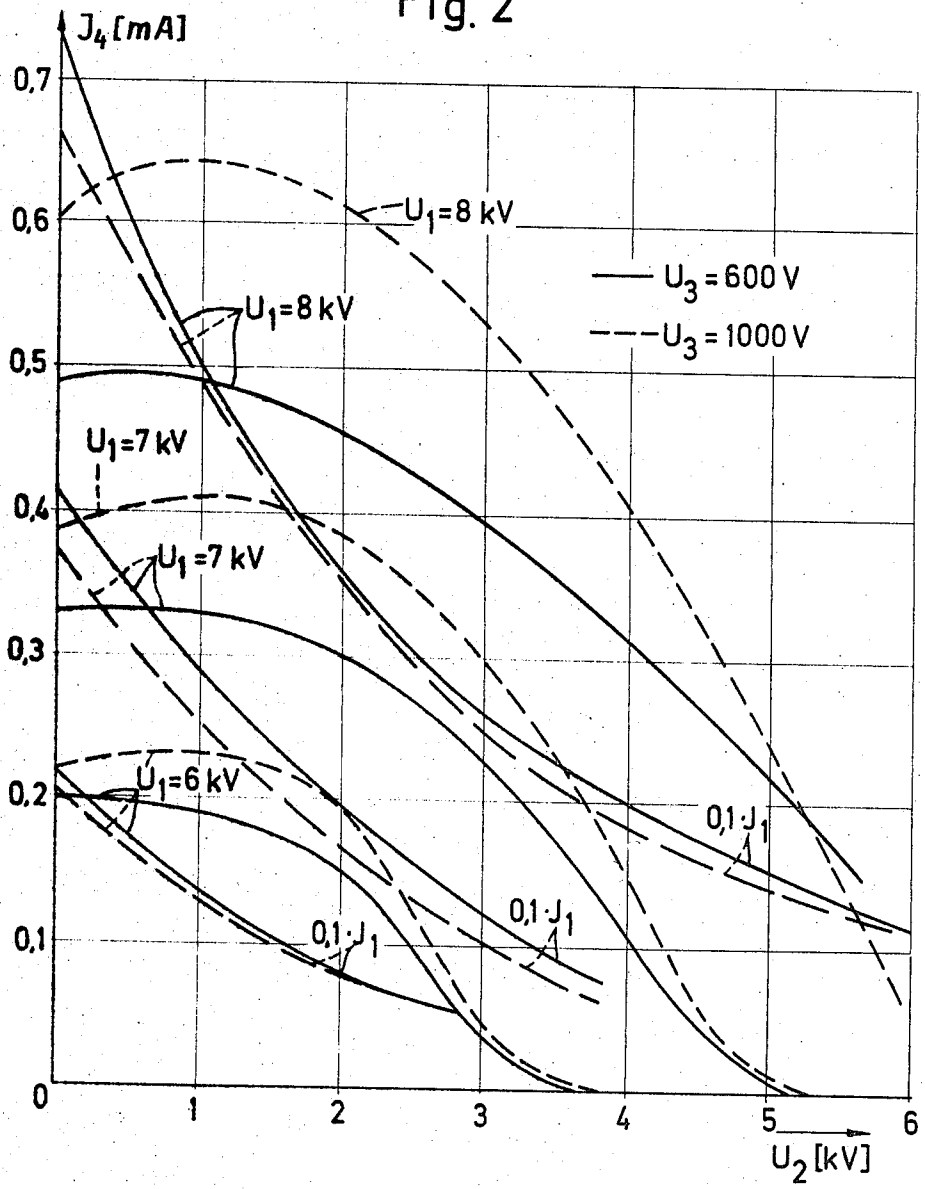


Fig. 1

Fig. 2


J4 [mA]
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
1
2
3
4
5
6
U2 [kV]
U1=8 kV
U1=8 kV
U3 = 600 V
U3 = 1000 V
U1=7 kV
U1=7 kV
U1=6 kV
0,1·J1
0,1·J1
0,1·J1

METHOD OF REDUCING THE GENERATION OF OZONE

The present invention relates to a method of reducing the generation of ozone during the discharge of corona wires which are surrounded on three sides by a screen and on the fourth side by a surface accepting the charge and possibly also by a grid arranged in front of this surface.

Corona discharge apparatuses are used for many purposes in the electrophotographic field. Devices equipped with a control grid are used for uniformly charging the photoconductor. Further, corona devices are used for cleaning the photoconductor and for transferring the toner image onto paper.

These corona discharge devices have the serious drawback that such high energy is imparted in the electric field to the charge thus produced, that large quantities of ozone are generated. Moreover, only a small proportion of the current sprayed by the corona wire flows onto the surface accepting the charge, whereas the main portion flows to the screen. In this manner, the power-supply units are unduly stressed.

Further, an apparatus for charging a photoconductor has been described in which the corona wire is completely surrounded by a screen except for a small slot. A voltage between the voltage of the corona wire and the voltage of the photoconductor, normally earth, may be applied to this screen. Such a screen, however, causes a very poor yield of current and serves only the function performed by the grid in other charging devices, i.e., to produce uniform charging of the layer to a defined voltage. The current yield, i.e., the ratio between the amount of current collected and utilized and the amount of current emitted by the corona wire, is kept particularly low by this intermediate voltage, which is highly undesirable. It causes in particular a very extensive and very annoying production of ozone. A device of this type is described, e.g., in U.S. Pat. No. 2,817,765.

It is the object of the present invention to provide a process of the above described type in which the amount of current emitted by the corona and, consequently, the amount of ozone generated, are kept as low as possible without the portion of utilized current becoming too small.

This object is achieved by a method which is characterized in that the screen is connected to a voltage which lies between that of the charge accepting surface or its support and that of the corona wire. In corona devices of conventional structure, the voltage of the screen may amount to about one-fourth to one-half of the corona wire voltage.

As has been found, the current emitted by the corona wires may be considerably reduced by this method, without substantially diminishing the portion of current which is utilized, e.g., applied to the photoconductor.

The present invention relates further to a corona apparatus for performing the process of the invention, which comprises a combination of at least one corona wire, an electrically conductive screen which surrounds the corona wire or wires on three sides, and a grid arranged at the open side of the screen, which three units are electrically insulated from one another, and further comprises a first voltage source for the corona wire or wires, a second voltage source for the grid, and, as the

inventive feature, a third voltage source which is or may be electrically connected to the screen and whose voltage is between that of the first voltage source and the reference voltage.

The present invention and the advantages thereof will be described more in detail by reference to the drawing in which,

FIG. 1 is a diagrammatic representation of the apparatus according to the invention, and

FIG. 2 is a diagram of the currents measured.

FIG. 1 shows a sectional view of a corona discharge apparatus in which the actually utilized current is measured as a function of the screen voltage. The apparatus comprises three corona wires **1** of 50 μ thick tungsten which are surrounded on three sides by a screen **2.** A grid **3** is arranged beneath the corona wires, and under the grid **3** there is a collector electrode **4.**

The screen **2** is connected to an adjustable voltage source **5,** the corona wires are connected over a milliammeter **6** to a voltage source **7,** the grid **3** is connected to a voltage source **8,** and the collector electrode is connected over a milliammeter **9** to ground.

The currents measured are shown in FIG. **2.** The hyperbolalike curves **0.1.** I_1 represent the currents of the corona wires **1** as measured by the milliammeter **6.** For the sake of clarity, these curves are drawn as multiplied by **0.1.** It can be seen that the current emitted by the corona device decreases rapidly with a decrease in the voltage U_2 of the screen. At a screen voltage of only −2,200 V, the current I_1 of the corona has dropped to less than half of its original value. It was found, however, that the current I_4, measured on the collector electrode **4,** first increases slightly, as compared with the current produced with the screen grounded when a voltage is applied to the screen **2,** and that in the case of a corona wire voltage of −8 kV and a grid voltage of −1,000 V it reaches its original value at a screen voltage U_2 of −2,200 V. This means that in this case the current yield, i.e., the ratio between the current which is collected and utilized, and the current emitted by the corona device, was improved by a factor of more than 2. Consequently, the generation of ozone was reduced by this factor.

Similar results were obtained when using other corona voltages and other grid voltages. This also can be seen from FIG. **2.** The curves drawn in broken lines were obtained by using a grid voltage U_3 of −1,000 V., and the solid line curves were obtained by using a grid voltage U_3 of −600 V. It is evident from all the curves, that a screen voltage in the range of one-fourth to one-half of the voltage at the corona wire causes a considerable improvement of the current yield and thus substantially and advantagesouly reduces the generation of ozone.

Although not wishing to be so bound it is assumed that this phenomenon occurs as follows:

The potential of the screen causes a modification in the intensity of the field at the surface of the corona wire **2,** especially in the sector facing the screen. This change in the intensity of the field causes the substantial decrease of the current actually emitted by the wires **1,** which can be seen from the hyperbola-like curves **0.1.** I_1. With regard to the current I_4 arriving at the electrode **4,** this phenomenon is superimposed by an effect which is due to the higher potential of the screen and causes part of the charges emitted by the corona wire **1** in the direction of the screen to be de-

flected and sent to the collector electrode **4.** In spite of the reduced corona current, the collected current I_4 can thus increase initially and drops substantially only after the field intensity in the sector facing the collector electrode, and with it the emission, decreases to such an extent that the deflecting effect of the screen potential is overcome.

The exact shape of the curves is dependent on the geometrical arrangement of the corona apparatus, the voltage of the corona wires, and the voltage of the grid. In all cases, however, the curve representing the current emitted by the corona wire will start at an acute angle from the ordinate and will rapidly decline with increasing screen potential, whereas the current curve of the collector electrode starts substantially horizontally from the ordinate and declines with increasing screen voltage only after the current at the corona wire has already dropped to half of its original value.

In addition to the reduced generation of ozone in such charging devices, the method of the present invention has the considerable advantage that it increases the yield. Thus, charging devices of simpler construction and power-supply units of smaller size may be used.

What is claimed is:

1. Corona discharge apparatus comprising,

a. at least one corona wire,

b. an electrically conductive screen which surrounds the corona wire or wires on three sides,

c. a grid arranged between a photoconductor layer and the fourth, open, side of the screen, with the corona wires, the screen, and the grid being electrically insulated from each other,

d. a first voltage source for the corona wire or wires,

e. a second voltage source for the grid, and

f. a third voltage source for the screen, the voltage of the latter lying between the voltage of the first voltage source and that of a photoconductor support.

2. Corona discharge apparatus according to claim **1,** in which the corona wires consist of 50 μ thick tungsten wire, the first voltage source supplies from −6 to −8 kV, the second voltage source supplies between −600 and −1,000 V, and the third voltage source supplies about −2 kV.

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