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(54) **CORONA CHARGING APPARATUS.**

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EP 0 072 862 B1

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Description

Background of the invention

The present invention relates to corona charging devices, particularly as used for discharging electrostatic images.

Corona charging devices in the form of thin conducting wires or sharp points are well known in the prior art. Illustrative U.S. Patent Nos. are Vyverberg 2,836,725; L. E. Walkup 2,879,395; P. Lee 3,358,289; Lee F. Frank 3,611,414; A. E. Jvriblis 3,623,123; P. J. McGill 3,715,762; H. Bresnik 3,765,027; and R. A. Fotland 3,961,564. Such devices are used almost exclusively in electrostatic copiers to charge photoconductors prior to exposure as well as for discharging. Standard corona discharges provide limited ion currents. Such devices as a rule achieve a maximum discharge current density on the order of 10 microamperes per square centimeter. Additionally, corona wires are small and fragile, and easily broken. Because of their high operating potentials they collect dirt and dust and must be frequently cleaned or replaced, in order to avoid fall-off of the emission current.

Corona discharges which enjoy certain advantages over standard corona apparatus are disclosed in Sarid et al. U.S. Patent No. 4,057,723. This patent discloses an apparatus for generating ions by corona discharge, comprising: an elongate conductor; a dielectric sheath extending longitudinally of said elongate conductor and interposed between the elongate conductor and a control electrode, the control electrode extending longitudinally of and being in tangential contact with the dielectric sheath; means for applying a time-varying potential applied between said elongate conductor and said control electrode in order to create a glow discharge in an air region adjacent said control electrode and dielectric sheath and means for applying an extraction potential to extract ions from said glow discharge to produce an output ion current substantially proportional to the extraction potential. Wheeler et al 4,068,284; and Sarid 4,110,614 patents disclose various corona charging devices characterised by a conductive wire coated with a thick dielectric material, in contact with or closely spaced from a further conductive member. Various geometries are disclosed in these patents, all fitting within the above general description. These devices utilize an alternating potential in order to generate a source of ions, and a DC extraction potential. The patent discloses a preferred biasing range of 2000—6000 volts, relatively high values which are required in order to obtain significant extraction currents and therefore higher charging rates. These current outputs are exponential in character, in contrast to the fairly linear outputs of the present invention. In addition, these devices are undesirably sensitive to variations in the gap width between the corona and the imaging member.

U.S. Patent No. 4,153,093 discloses ion generating apparatus which may be used for charge neutralization as well as deposition of net charge. This apparatus is superior to standard corona apparatus, but is difficult to fabricate, and does not provide the high charging rates of the present invention.

US—A—4 068 284 discloses a corona device in which an uninsulated wire is wrapped in a helical fashion, about a straight insulated wire. It is a principal object of the invention to provide charging and neutralizing devices employing corona discharges which have superior performance as compared with prior art corona devices.

Another object of the invention is to provide a corona charging device which achieves high current densities. A related object is the achievement of high charging rates. Another related object is the avoidance of high biasing potentials in providing such charging rates.

A further object of the invention is to provide a charging device having a rugged and compact structure. A related object is to provide a device having a longer operational life than is customary in corona ion generators. A further related object is the provision of corona apparatus which does not require frequent servicing.

Another object is to provide a corona charging device capable of charging or discharging a remote dielectric or photoreceptor surface to potentials within a few volts of a preselected potential.

Still another object of the invention is the avoidance of emission current fall-off as the ion generator becomes slightly dirty. A related object is the achievement of uniform emission currents. Yet another object of the invention is the provision of a corona charging device with a reliable output potential.

According to the invention there is provided an apparatus for generating ions by corona discharge comprising an elongate conductor; a dielectric sheath extending longitudinally of the elongate conductor and interposed between the elongate conductor and a control electrode, the control electrode extending longitudinally of and partially surrounding the dielectric sheath; means for applying a time-varying potential between the elongate conductor and the control electrode in order to create a glow discharge in an air region adjacent the control electrode and dielectric sheath, and means for applying an extraction potential to extract ions from the glow discharge to produce an output ion current substantially proportional to the extraction potential, wherein the control electrode contacts the dielectric sheath at more than one tangential position.

According to the invention there is also provided an apparatus for generating ions by corona discharge comprising an elongate conductor; a dielectric sheath extending longitudinally of the elongate conductor and interposed between the elongate conductor and control electrodes consisting of a pair of elongate conductive rods disposed on either side of the elongate conductor, the control electrodes extending longitudinally of the dielectric sheath, and contacting the dielectric

sheath at one tangential position; means for applying a time-varying potential between the elongate conductor and the conductive control electrodes in order to create a glow discharge in an air region adjacent the control electrodes and dielectric sheath, and means for applying an extraction potential to extract ions from the glow discharge to produce an output ion current substantially proportional to the extraction potential.

According to the invention there is also provided an apparatus for generating ions by corona discharge comprising a pair of dielectric sheathed elongate conductors extending longitudinally of the central conductive elongate control electrode; means for applying a time-varying potential between the elongate conductors and the control electrode in order to create a glow discharge in an air region adjacent the control electrode and the dielectric sheaths of the elongate conductors; and means for applying an extraction potential to extract ions from the flow discharge to produce an output ion current substantially proportional to the extraction potential; the dielectric sheaths being in contact with the control electrode at one tangential position. The apparatus of the invention may be used for corona charging and discharging by means of a time-varying potential applied between the elongate conductor and control electrode, which induces a glow discharge in an air region adjacent the control electrode and dielectric sheath. The control electrode may be maintained at ground potential for charge neutralization, and at a limiting biasing potential for corona charging. The corona charging apparatus has a linear relationship between output ion currents and a direct current ion extraction potential.

In one embodiment of the invention, the "first type", the grid electrode may comprise a one or two dimensional array of fine conductive members. In a preferred version the grid electrode comprises a fine wire mesh screen. In an alternative version, the grid comprises a parallel array of fine, closely spaced wires, transverse to the axis of the elongate conductor.

In another embodiment of the invention, the "second type", the conductive enclosure may comprise a unitary structure having a slot with the sheathed elongate conductor embedded in the slot. This unitary structure advantageously consists of a conductive beam having an essentially rectangular slot or channel. In an alternative version, the slotted conductor is replaced by a pair of conductive rods, which are mounted on each side of the dielectric-coated conductor against an insulating support.

Also, the various dimensions may be altered to modify the output ion characteristics of the corona charging and discharging device. In the first type, the most important parameter is the profile of the grid electrode, and in particular the wrap of the grid electrode over the dielectric sheathed elongate conductor. In the second type, important parameters include: the lateral separation, if any, of the sheathed conductor from the walls of the conductor; the extent of protrusion or indentation of the sheathed conductor with respect to outer surfaces of the enclosure; and the width of the conductive enclosure as compared with the diameter of the sheathed conductor. In the second type the dielectric sheathed conductor contacts the side walls of the conductor and protrudes slightly therefrom; advantageously, the conductive enclosure is only slightly broader than the width of the slot. Another important parameter in either type is the separation of the device from the surface to be charged or discharged.

Another embodiment of the second type may include a filler at the base of the slot to prevent power loss and dielectric breakdown.

The elongate conductor may also have a variety of cross sections. In the preferred version of either type, the elongate conductor comprises a cylindrical wire. Alternatively, in the first principal type the electrode may consist of an etched foil. In a related embodiment of the invention, a variety of insulated materials, preferably inorganic, may be utilized in the dielectric sheath for the elongate conductor.

The dielectric sheathed elongate conductor and control electrode may also be coextensive structures, preferably forming a linear composite. In the first type, the grid may take a variety of transverse cross sections wherein the grid contacts or is closely spaced from the dielectric sheath at or near its outer surface. In the second type, the conductive enclosure may have a variety of cross sections, subject to the limitation that it must house the dielectric-coated elongate conductor.

In an alternative version of the first type, the corona charging apparatus may include a thin dielectric separating the conductive grid from the elongate conductor, but not completely covering the latter member. In a further alternative version of this first type, the insulating substrate may include a slot to house the dielectric sheathed conductor. In this version the dielectric sheathed conductor is embedded in the slot along its length, and the conductive grid is mounted over this member where it protrudes from the slot.

In an alternative version, a pair of dielectric-sheathed conductors straddle a central conductive rod, all mounted against an insulating board. Preferably, in this version the dielectric-sheathed conductor comprises a glass capillary lined with an inner conductive layer. In this and all versions of the second type, the invention is preferably characterized by a discharge region at or near the upper portion of a slot.

The time varying potential is advantageously a continuous wave alternating potential in the range 600 to 1500 volts peak, with a frequency in the range 60 Hz to 10 MHz. Alternatively, the varying potential may comprise a pulsed voltage. In the type for corona charging, the extraction potential preferably is on the order of tens or hundreds of volts. Both in charging and neutralizing, the device provides ion output currents

which are approximately a linear function of the extraction potential.

In a preferred utilization of the invention, the device is employed for the erasure of electrostatic images on a proximate dielectric member. Alternatively, the device may be employed for charging such a dielectric member to a prescribed voltage. In the latter case the devices of the invention provide automatic control of the charging level. In either utilization, the corona device is preferably disposed at a distance in the range 1.27×10^{-4} to 5.08×10^{-4}m (5—20 mils) from the member to be charged or discharged.

Thus, a version of the apparatus provides that the conductive enclosure comprises a conductive beam having a slot, and wherein the sheathed elongate conductor is embedded in said slot; further including an insulating base, wherein the sheathed elongate conductor is mounted against said insulating base, and wherein the conductive enclosure comprises a pair of conductive side members mounted against said insulating base.

Brief description of the drawings

Other aspects of the invention will become apparent after considering the drawings and detailed description below.

Figure 1 is a sectional view of a corona charging device in accordance with a preferred version of the first type;

Figure 2 is a plan view of the charging device of Figure 1;

Figure 3 is a sectional view of a charging device in accordance with the first type, with an alternative grid electrode profile;

Figure 4 is a sectional view of the charging device of Figure 1 deployed for charging or discharging an adjacent member;

Figure 5 is a sectional view of an alternative charging device design in accordance with the first type;

Figure 6 is a sectional view of a further charging device design in accordance with the first type;

Figure 7 is a sectional view of a charging head with an alternative corona construction in accordance with the first type;

Figure 8 is a plan view of a charging device according to the first type, with an alternative grid electrode;

Figure 9 is a perspective view of a corona charging device in accordance with a preferred version of the second type;

Figure 10 is a sectional schematic view of the corona device of Figure 9 in proximity to an imaging surface;

Figure 11 is a sectional view of the corona device of Figure 9, including actuating electronics;

Figures 12A, 12B, and 12C are partial sectional views showing various profiles of the device of the type of Figure 9, and the associated air discharge regions;

Figure 13 is a sectional view of a corona device in accordance with an alternative version;

Figure 14 is a sectional view of a corona charging device in accordance with a further alternative version; and

Figure 15 is a sectional view of a corona charging device in accordance with yet another version.

Detailed description

Reference should now be had to Figures 1—15 for a detailed description of the corona charging apparatus of the invention. Two principal types are illustrated in Figures 1 and 9; both of these types are characterized by an elongate conductor with a dielectric sheath, and a control electrode in proximity thereto. In the first type of the invention, shown generally in Figures 1—8, the control electrode takes the form of a conductive grid overlying the dielectric sheathed conductor, all mounted against an insulating support. In the second type, shown in various versions in Figures 9—15, the control electrode consists of a conductive enclosure, which defines a slot in which the dielectric sheathed conductor is placed. A characteristic feature of both corona device 10 (Figure 2) and corona device 90 (Figure 9) is that the corona electrode 11 and control electrode (respectively 17, 99) form a linear structure. The first and second types of the invention are discussed below sequentially.

In both principal types corona electrode 11 consists of a conductive wire 12 (which may consist of any suitable conductor) encased in a thick dielectric material 13. Although a dielectric-coated cylindrical wire is illustrated in the preferred types, the electrode 11 is more generally described as an elongate conductor of indeterminate cross section "a" with dielectric sheath. Figure 7 illustrates an alternative corona electrode construction in the first principal type. Corona electrode 72 comprises a thin etched electrode with dielectric encapsulation 73. The elongate conductor may rest directly in contact with the insulating support, as long as it is separated from the mesh electrode by the dielectric sheath at the surface 71.

In both principal types, the dielectric 13 should have sufficient dielectric strength to withstand high excitation potentials without dielectric breakdown. It is desirable to minimize the onset voltage, i.e. the excitation voltage at which the dielectric begins to charge. This voltage increases with thicker dielectric layers 13, and decreases with lower dielectric constants of that layer. Organic dielectrics are generally unsuitable for this application, as most such materials tend to degrade with time due to oxidizing products formed in atmospheric electrical discharges. In the preferred type, the dielectric 13 comprises a fused glass layer which is fabricated in order to minimize voids, having a thickness in the range

2.54×10^{-5}m—7.62×10^{-5}m (1—3 mils).

Other suitable materials include, for example, sintered ceramics and mica.

In the type of Figures 1—4, corona electrode 11

is placed against an insulating substrate 15. Advantageously, the electrode 11 is constrained by mesh electrode 17, but not bonded to the insulating substrate. This arrangement permits relative movement of these structures due to thermal expansion and contraction. The substrate 15 consists of insulating material of sufficient rigidity to support the coated-wire electrode 11 and mesh electrode 17.

Grid electrode 17 comprises an array of elongate conductors of minute thickness as compared with the diameter of dielectric-coated electrode 11. In the preferred version of this first type, this electrode comprises a fine wire mesh screen, advantageously a screen with a mesh in the range 1180—5910 apertures m^{-1} (30—150 apertures/inch), and a wire thickness in the range 7.62×10^{-6}m to 3.048×10^{-5}m (0.3—1.2 mils). Preferably, the wire mesh screen is characterised by a high percentage of open area. The screen may consist of any well known metal or metal alloy, such as steels, stainless steels, nickel-chromium alloys, copper alloys, and aluminum alloys. The use of a fine mesh provides a desirably high density of ion generation sites, and avoids overheating at crossover points. In an alternative version, the grid electrode is fabricated by photoetching a screen pattern on a metal foil. In a further alternative version illustrated in Figure 8, grid electrode 87 consists of a parallel array of fine, closely spaced wires running perpendicular to corona electrode 11.

The grid electrode is wrapped over electrode 11, and is anchored to insulating substrate 15 at each side of electrode 11. The grid electrode 17 may describe any of a wide variety of profiles as seen from one end. In the preferred type illustrated in Figure 1, the grid electrode 17 is wrapped tightly over the apex of electrode 11, and is bonded to support 15 so as to form a roughly V-shaped profile. An alternative arrangement is shown in Figure 3, wherein the mesh 37 forms an arch over the corona electrode 11. The former profile is preferred, in that the closeness of the mesh 17 to the outer surface of dielectric 13 provides a desirably low cutoff voltage. For this reason, mesh 17 is advantageously bonded or attached to support 15 in such a manner as to tension the mesh to provide firm contact with the electrode 11.

An alternative construction 50 for a corona device 10 in accordance with the first principal type is shown in Figure 5. The insulating substrate 55 includes a slot 56 in which corona electrode 11 is fitted. The grid electrode 57 is wrapped over substrate 55 and electrode 11 as shown. This arrangement affords ease of positioning and supporting corona electrode 11.

As shown in Figure 6, the conductive core of the corona electrode need not be encased in a dielectric sheath for effective operation. In the alternative structure 60, the dielectric sheath is replaced by a thin, flexible dielectric strip 63. The elongate conductor 62 rests directly against insulating support 65, and is separated from grid electrode 67 by dielectric strip 63. The dielectric 63 may comprise, for example, mica or a thin strip of glass.

In the preferred version of the second principal type, shown at 90 in Figure 9, the corona electrode 11 is embedded in a slot 96 in a conductive beam 94. The dimensions of the various structures are chosen to provide desired operational characteristics of the device 90, as further described below. Significant features of the device in this description include the side walls 97 and base 98 of slot 96, as well as the outer surfaces 99 adjacent the slot. Figure 10 shows the corona device of Figure 9 as seen in section, in proximity to an imaging surface 20. A number of dimensions are important in describing these devices in structural terms. These include the total radius R of the corona electrode 11 and the thickness T of the dielectric layer 13; the separation G of the corona electrode from the side walls 97, if any; the width W of that portion of the beam 94 at each side of slot 96; the protrusion H of the corona electrode from slot 96 (the corona electrode 11 may be inset from the outer surface in which case H is negative); and the gap width Z between the corona device 90 and the imaging surface 20. In constructing a device 90 in accordance with the parameters, it is generally desirable that W be given a minimal value consistent with structural integrity and that H have a small positive value as compared with the magnitude of R. These preferred values provide superior performance characteristics as discussed in detail below.

The value of G must, in the embodiment of the invention, equal zero. Accordingly, a device constructed according to the exact dimensions shown in Figures 9 and 10 (where G is non-zero) does not form part of the invention.

A nomenclature listing of the reference numerals used in the figures is included at the end of this specification.

With reference to the partial sectional views of 12A—12C, the relationship between the parameter H shown in Figure 10 and the configuration of the discharge region 100 is seen with respect to a variety of profiles of device 90. In all of these profiles G=0 and W is constant. If the electrode 11 protrudes prominently from slot 96 as shown in Figure 12A, the discharge region 100 will largely encompass the outer surface 99 of beam 94. The discharge region 100 is generally determined by the Paschen limits between elongate conductor and conductive beam 94. With the discharge region 100 having the characteristics shown in Figure 12A, there will be considerable inefficiencies in the operation of the device 90 due to the loss of ions to the outer portions 99, which acts as a ground plane. This will lead to a diminishing of the ion output current. In the configuration of Figure 12B, the corona electrode 11 protrudes only slightly from the slot 96. In this case, the discharge region 100 comprises a region at the outer portion of the approximately V-shaped area defined by the side walls 97 and the dielectric 13. This area is the optimal location for the ion pool,

in that it provides a readily extractable source of ions with minimal ion current loss due to the diversion of ions. If, on the other hand, the corona electrode is embedded considerably below the upper surface 99, as shown in Figure 12C the discharge region 100 will be inset from the surface of slot 96. This will incur the disadvantages that the ions will not be easily extractable and that there will be inevitable ion current loss due to diversion to the outer portion of side walls 97.

In the preferred construction of the corona device of the second principal type, a filler is included in the inner regions of slot 96. In Figures 12A—12C an adhesive filler 95 is contained between dielectric filler 19 and base 98. The use of a filler prevents power losses due to air breakdown in these regions and reduces the risk of dielectric breakdown due to the heating in these lower regions. Such air breakdown would be similar in form to that depicted in Figures 12A—12C, but would not provide a useful source of ions. It may be seen with reference to Figures 12A—12C that a minimum value for W would be desirable in order to avoid ion current loss, and that a small positive value of H is preferred in order to provide a desirable location for the discharge region 100.

It will be appreciated that while the slot 96 of the conductive beam 94 has been shown with a generally rectangular cross section, the slot 96 alternatively may be in the form of a U-shaped channel that cradles the dielectric coating 13 of the conductive wire 12. This would allow the coated wire 12 to sit on the base of the beam without any need for packaging.

The corona electrode has to be placed in contact with the side walls 97 (i.e. G=0) in order to avoid erratic behavior in the operation of the device. This characteristic poses difficulties in the type of Figures 9—12 in keeping the dielectric-coated electrode in contact with the side walls throughout the length of the device. Figure 13 gives a sectional view of a corona device 110 in accordance with an alternative type, wherein this difficulty is overcome. In the charging device 110, the slotted conductive beam 94 of Figures 12A—12C is replaced with a pair of conductive rods 116 and 117, illustratively with a rectangular cross section. The conductive rods and dielectric-coated electrode are mounted on an insulating support block 115. Rods 116 and 117 are flexible metallic structures which may be conformed to the dielectric-coated electrode 111 throughout its length, thereby ensuring that G will be negligible for the entire length of the device.

The mounting arrangement of Figure 13 may be further modified by altering the spacial arrangement of the various electrodes. In the sectional view of Figure 14, a pair of dielectric-coated elongate conductors straddle a central conductive rod. Illustratively, the conductive rod comprises a thick cylindrical wire 121, and each of the dielectric-coated electrodes 122 and 126 comprise a glass capillary of rectangular cross section filled with a metallic core material. Desirably, the metallic core material is characterized by a low melting point, and has a coefficient of expansion which is compatible with that of the capillary material. As in the case of the device 110 of Figure 13, the charging device 120 is fabricated by mounting the electrodes 121, 122, and 126 on an insulating base 125 so that these electrodes closely conform to each other throughout the length of the device. The corona device 120 is actuated by applying time-varying potentials between each of the respective metallic cores 123 and 127 and the central electrode 121. Figure 15 illustrates a modified version 130 of the device of 120 of Figure 14. In corona device 130, the glass capillaries are not completely filled with a metallic core material, but are lined with an inner metallic layer of sufficient thickness to conduct the energizing current. Suitable metals for the core structures of Figures 14 and 15 include for example low melting alloys of bismuth, and indium alloys.

The corona devices of both principal types may be employed for the generation of ions both for charge neutralization and for charging a proximate dielectric surface to a predetermined potential. This is illustrated for the respective principal types in Figures 4 and 11, respectively. The former figure will be discussed for illustrative purposes, but both devices are essentially identical in operation and the discussion that follows applies to the device 90 of Figure 11 as well.

In the sectional view of Figure 4, the device 10 is employed for the generation of ions by application of a time-varying potential 23 between the elongate conductor 12 and grid electrode 17. This causes a pool of positive and negative ions to be formed in an air space in the vicinity of that portion of grid 17 which is in contact with or close proximity to dielectric 13. This phenomenon is herein termed "glow discharge". With a periodically varying potential 23, air gap breakdown occurs during each half cycle if the excitation potential exceeds approximately 1400 volts peak-to-peak, if the dielectric sheath thickness is in the range of 5.08×10^{-5}m to 7.62×10^{-5}m (two to three mils). The dielectric 13 will receive a net charge, thereby extinguishing the discharge, and preventing the direct flow of an in-phase current between grid electrode 17 and elongate conductor 12.

With the switch in position x, the ion generator 10 acts as a charge neutralizing device with respect to an electrostatic image carried on a proximate member. As seen in Figure 4, the device 10 is disposed adjacent a dielectric surface 20 having a conductive backing 25, and the mesh electrode 17 is grounded to counterelectrode 25. The electrical behavior of this device may be measured as a plot of output current, i, as a function of the voltage V between surface 20 and electrode 17. Typically, the devices of the invention are characterized by roughly linear i-V curves. It is preferable to have a low offset voltage V_0, i.e. voltage at which i=0.

If dielectric surface 20 carries any net positive or negative charge, this surface will establish an electrical field to grid electrode 17, causing the

extraction of ions of the opposite polarity from the ion pool 18. If the ion generator 10 is thus disposed for a sufficient period of time, the surface 20 will be completely neutralized. The surface 20 bears little or no residual charge under these circumstances. Another desirable feature is that of the typically high charging/discharge rates of this device.

Advantageously, the corona device 10 is disposed at a distance in the range 1.27×10^{-4} to 5.08×10^{-4}m (5—20 mils) from surface 20, most preferably around 3.81×10^{-4}m (15 mils), as measured from the outer surface of grid electrode 17. A further advantageous feature of the invention is that the offset voltage of this device is relatively insensitive to changes in gap width within this range.

With further reference to Figure 4, the device 10 may be utilized to deposit a net positive or negative charge on surface 20 when switch 21 is at position y. This places a DC bias potential 22 on grid electrode 17. With a positive bias to electrode 17, for example, a positive charge of equal magnitude will be deposited on surface 20. When operated in this mode, the corona device 10 provides automatic limiting of the charging potential.

In a preferred utilization of the corona device 10, a relative motion is provided between the device 10 and surface 20, so that the device will be adjacent to various surface areas over time. Layer 20 may comprise, for example, the surface of a rotatable drum with a dielectric or photoconductive surface. It is generally desirable to minimize variations of the gap width Z between corona device 10 and surface 20 during such relative motion. When operating in the corona charging mode during such motion, the device will generally provide a surface potential which is a fraction of the bias potential; this fraction will increase with lower surface speeds.

In the preferred type, time varying potential 23 comprises a high frequency, high voltage sinusoid. Preferably, excitation potential 23 has a magnitude in the range 1700—2500 volts peak-to-peak, most advantageously around 2000 volts peak-to-peak. Excitation potential 23 may comprise a continuous wave alternating potential, preferably of a frequency in the range 10 KHz to 1 MHz. Driving voltages at higher frequencies have been observed to cause overheating of the corona device, while lower frequency waveforms may provide inadequate output currents. A continuous wave frequency of 100 KHz provides desirably high emission currents without a serious risk of overheating device 10. Alternatively, excitation potential 23 may comprise a pulsed voltage which may be specified by the parameters of peak-to-peak voltage, repetition period, pulse width, and base frequency. The device 10 has been operated at frequencies as high as 1 MHz applied in short bursts having a duty cycle near 10 percent.

Both principal types of the invention are further illustrated in the following nonlimiting examples:

Example 1

A corona charging device of the type shown in Figure 1 was constructed as follows. The insulating support was fabricated of glass epoxy G-10 laminate. The corona electrode consisted of a 1.778×10^{-4}m (7 mil) diameter stainless steel wire having a 5.08×10^{-5}m (2 mil) thick glass coating. After layering the coated wire on the support block, a fine woven wire screen was stretched over the glass coated wire and bonded with a thermoset adhesive to the sides of the support. The screen was composed of a plain woven 2.54×10^{-5}m (1 mil) stainless steel wire, having a mesh count of 100 and an open area of approximately 90 percent. The coated wire electrode was not bonded to the support block, and was constrained only by the overlying screen.

A 100 KHz, 2000 volt continuous wave alternating potential was placed between the coated wire and the mesh electrode. The outer surface of the mesh electrode was located 3.81×10^{-4}m (15 mils) from the surface of an imaging drum having a thin photoconductive surface layer, with a capacitance of 100 picofarads per cm^2. The photoconductive surface was charged to 500 volts with a charging rate of 10^3 cm^2/sec., by imposing a 500 volt direct current potential between the mesh electrode and the drum's conductive core. This represented an average corona output current of 10 microamperes per cm. length of corona.

Example 2

The apparatus of Example 1 was employed as a corona discharge device by grounding the mesh electrode to the photoreceptor drum's conductive core. In this mode, the device neutralized electrostatic images at rates comparable to the charging rates of Example 1, leaving virtually no residual electrostatic image.

Example 3

The apparatus of Example 1 was modified as follows to provide a corona charging device of the type shown in Figure 7. The corona electrode was fabricated by laminating a 2.54×10^{-5}m (1 mil) stainless steel foil to the support block using a pressure sensitive adhesive, and photoetching an electrode with a line width of 2.032×10^{-4}m (8 mils). The electrode was encapsulated with a 3.81×10^{-5}m (1.5 mil) thick layer of glass by silkscreening a glass frit over the etched electrode, and sintering the glass at a high temperature to form a continuous glass coating.

This apparatus exhibited equivalent performance to the structure of Example 1, in both the charging and neutralizing modes.

Example 4

A corona charging device 90 of the type shown in Figure 9 was constructed as follows. The corona electrode consisted of a 1.778×10^{-4}m (7 mil) diameter stainless steel wire having a 5.08×10^{-5}m (2 mil) thick glass coating. The coated wire was embedded in an 2.794×10^{-5}m

(11 mil) wide, 2.54×10^{-4}m (10 mil) deep rectangular slot in a stainless steel beam of total dimensions 1.27×10^{-3}m (50 mil) wide and 1.27×10^{-3}m (50 mil) deep, after inserting adhesive filler at the bottom of the slot. This provides a beam width of 3.683×10^{-5}m (14.5 mil) on each side of the slot.

A 100 KHz, 2000 volt peak-to-peak continuous wave alternating potential was placed between the coated wire and the steel beam. The outer surface of the corona electrode was located 15 mils from the surface of an imaging drum having a thin photoconductive surface layer, with a capacitance of 100 picofarads per cm^2. The imaging drum was rotated at a surface speed of 25 cm/second relative to the corona device, and was charged to 500 volts by imposing a 1000 volt direct current potential between the steel beam and the drum's conductive core. This represented an average corona output current of 1.25 microamperes per centimeter length of corona.

Example 5

The apparatus of Example 4 was employed as a corona discharge device by grounding the mesh electrode to the photoreceptor drum's conductive core. In this mode, the device neutralized electrostatic images at rates comparable to the charging rates of Example 4, leaving virtually no residual electrostatic image.

Example 6

The apparatus of Example 4 was modified as follows to provide a corona charging device of the type shown in Figure 13. A glass-coated tungsten wire as in Example 4 was bonded to an insulating support consisting of glass epoxy G-10 laminate. Two tantalum wires of

2.54×10^{-4}m$\times2.54\times10^{-4}$m (10 mil$\times$10 mil)

square cross-sections were bonded to the base on either side of the glass-coated wire, contacting the dielectric sheath along its length.

This apparatus exhibited equivalent performance to the structure of Example 4, in both the charging and neutralizing modes.

Nomenclature

10. Corona device, first aspect, (Fig. 2)
11. Corona electrode
12. Conductive wire
13. Dielectric coating (e.g. glass)
15. Insulating substrate (e.g. plastic)
17. Control electrode
19. Dielectric filler (Figs. 12A—12C)
20. Imaging surface (Figs. 4 and 10) (e.g. plastic and imaging surface
    - R Radius of corona electrode 11
    - T Thickness of dielectric layer 13
    - G Separation of corona electrode from side walls
    - W Width of beam 94
    - H Protrusion of corona electrode from slot
    - Z Gap width between corona device
21. Switch
    - x "switch off" position
    - y "switch on" position
22. DC biasing source
23. Excitation potential
25. Conductive backing (Fig. 4)
26. Excitation potential
27. DC biasing source
30. Corona device, alternate arrangement (Fig. 3)
37. Mesh
50. Corona device alternative structure (Fig. 5)
55. Insulating substrate (e.g. plastic)
56. Slot
57. Grid electrode
60. Corona device, alternative structure (Fig. 6)
62. Elongate conductor
63. Dielectric strip
65. Insulating support (e.g. plastic)
67. Grid electrode
71. Corona electrode surface (Fig. 7)
72. Conductive wire
73. Dielectric encapsulation (e.g. plastic)
75. Insulating support (e.g. plastic)
80. Corona device, alternative structure (Fig. 8)
85. Insulating support
87. Grid electrode (Fig. 8)
90. Corona device, alternative structure (Fig. 9)
94. Conductive beam
95. Adhesive filler (Fig. 12A)
96. Slot
97. Side wall
98. Base
99. Control electrode (Figs. 9 and 12C)
100. Discharge region (Fig. 12A)
110. Corona device (Fig. 13)
111. Dielectric coated electrode
113. Dielectric coating (e.g. glass)
115. Support block (e.g. plastic)
116. Conductive rod
117. Conductive rod
120. Charging device (Fig. 14)
121. Thick cylindrical wire (electrode)
122. Dielectric coated electrode
123. Metallic core
124. Dielectric coating (e.g. glass)
125. Support block (e.g. plastic)
126. Dielectric coated electrode
127. Metallic core
128. Dielectric coating (e.g. glass)
130. Modification of device 120 (Fig. 15)
131. Cylindrical electrode
132. Dielectric coated electrode
133. Hollow metallic core
134. Dielectric coating (e.g. glass)
135. Support block (e.g. plastic)
136. Delectric coated electrode
137. Hollow metallic core
138. Dielectric coating (e.g. glass).

Claims

1. Apparatus for generating ions (10, 30, 50, 60, 80, 90) by corona discharge, comprising: an elongate conductor (12, 62, 72); a dielectric sheath (13, 63, 73) extending longitudinally of the elongate conductor and interposed between the elongate conductor and a control electrode (17, 37, 57, 67, 94), the control electrode extending longitudinally of and partially surrounding the dielectric sheath; means for applying a time-varying potential between the elongate conductor and the control electrode in order to create a glow discharge in an air region adjacent the control electrode and dielectric sheath, and means for applying an extraction potential to extract ions from the glow discharge to produce an output ion current substantially proportional to the extraction potential; wherein the control electrode contacts the dielectric sheath at more than one tangential position.

2. Apparatus as defined in claim 1, wherein said control electrode comprises a conductive grid (17; 37; 57; 67) contacting said dielectric sheath (13; 63; 73), further comprising an insulating support (15; 35; 65; 75) for the elongate conductor and dielectric sheath.

3. Apparatus as claimed in claim 2 in which the conductive grid comprises a conductive mesh electrode.

4. Apparatus as claimed in claim 3 in which the conductive mesh electrode comprises a wire mesh screen.

5. Apparatus as claimed in claim 4 in which the wire mesh screen has a mesh size in the range 1180—5910 apertures per metre (30—150 per inch).

6. Apparatus as claimed in claim 5 in which the wire mesh screen comprises a lattice of wires having a thickness in the range 7.62×10^{-6}m to 3.048×10^{-5}m (0.3—1.2 mils).

7. Apparatus as claimed in claim 2 in which the conductive grid comprises a metal foil etched in a mesh pattern.

8. Aparatus as claimed in any one of claims 2 to 7 in which the conductive grid comprises an array of essentially parallel conductors.

9. Apparatus as claimed in any one of claims 2 to 8 in which the dielectric sheath (63) has an arcuate lateral cross section.

10. Apparatus as claimed in any one of claims 3 to 9 in which the conductive grid (17; 37; 57; 67) is anchored against the insulating support (15; 35; 65; 75) on each side of the elongate conductor (12; 62; 72) and dielectric sheath (13; 63; 73).

11. Apparatus as claimed in any one of claims 3 to 10 in which the conductive grid (17) has a substantially inverse-V-shaped lateral cross section.

12. Apparatus as claimed in any one of claims 3 to 10 in which the conductive grid (67) has an arcuate lateral cross section.

13. Apparatus as claimed in any one of claims 2 to 12 in which the elongate conductor and dielectric sheath comprise a dielectric-coated wire.

14. Apparatus as claimed in any one of claims 2 to 13 in which the dielectric sheath has a thickness in the range of 2.54×10^{-5}m to 6.62×10^{-5}m (1—3 mils).

15. Apparatus as claimed in any one of claims 2 to 12 in which the elongate conductor and dielectric sheath comprise a conductive strip (72) contacting the insulating support (75) with an encapsulating dielectric layer (73).

16. Apparatus as claimed in any one of claims 2 to 15 in which the elongate conductor and dielectric sheath are housed in a slot in the insulating support (35), with the conductive grid (57) contacting the dielectric sheath above the slot.

17. Apparatus as claimed in claim 1 in which the control electrode defines an elongate conductive enclosure having inner walls (97, 98) surrounding the sheathed elongate conductor and further including an elongate opening (56, 96) to expose said sheathed elongate conductor.

18. Apparatus as claimed in claim 17 in which the elongate conductive enclosure comprises a conductive beam (94) having a slot, and wherein the sheathed elongate conductor is embedded in said slot.

19. Apparatus as claimed in claim 1 in which the dielectric sheath is comprised of an inorganic dielectric material.

20. Apparatus as claimed in claim 1 in which the dielectric sheath is comprised of a material selected from the class consisting of glass, mica and sintered ceramic materials.

21. Apparatus as claimed in claim 1 in which the means for applying an extraction potential is adapted to produce a direct current potential between the control electrode and a counterelectrode.

22. Apparatus as claimed in claim 21 in which the extraction potential comprises a direct current potential of a magnitude from tens to hundreds of volts.

23. Apparatus as claimed in claim 1 or claim 21 or claim 22 in which the means for applying a time-varying potential is adapted to produce a high voltage alternating potential.

24. Apparatus as claimed in claim 23 in which the time-varying potential comprises a high voltage alternating potential of a frequency in the range of 60 Hz to 4 MHz.

25. Apparatus as claimed in claim 1 in which the time-varying potential comprises a pulsed voltage.

26. Apparatus for generating ions (110) by corona discharge, comprising: an elongate conductor (112); a dielectric sheath (13) extending longitudinally of the elongate conductor and interposed between the elongate conductor and control electrodes consisting of a pair of elongate conductive rods (116, 117) disposed on either side of the elongate conductor, the rods extending longitudinally of the dielectric sheath and contacting the dielectric sheath at one tangential position; means for applying a time-varying potential between the elongate conductor and the conductive rods in order to create a glow discharge in an

air region adjacent the control electrodes and dielectric sheath, and means for applying an extraction potential to extract ions from the glow discharge to produce an output ion current substantially proportional to the extraction potential.

27. Apparatus as claimed in claim 26 including an insulating base (115), the pair of elongate conductive rods (116; 117) being mounted against the insulating base, and the sheathed elongate conductor (111) also being mounted against the base.

28. Apparatus for generating ions (120, 130) by corona discharge, comprising a pair of dielectric sheathed elongate conductors (123, 127; 133, 137) extending longitudinally of a central conductive elongate control electrode (121, 131) means for applying a time-varying potential between the elongate conductors and the control electrode in order to create a glow discharge in an air region adjacent the control electrode and the dielectric sheaths of the elongate conductors, and means for applying an extraction potential to extract ions from the glow discharge to produce an output ion current substantially proportional to the extraction potential; the dielectric sheaths being in contact with the control electrode at one tangential position.

29. Apparatus as claimed in claim 28 in which each of the elongate conductors (133, 137) comprises a glass capillary tube (134, 138) with a conductive inner lining.

30. Apparatus as claimed in claim 28 in which each of the elongate conductors (123, 127) comprises a glass capillary tube (124, 128) with a solid conductive core (123, 127).

31. Apparatus as claimed in claim 30 in which the core (123, 127) comprises one of the low-melting alloys of bismuth, or indium alloy.

Patentansprüche

1. Vorrichtung zur Erzeugung von Ionen (10, 30, 50, 60, 80, 90) durch Koronaentladung, enthaltend: einen länglichen Leiter (12, 62, 72); eine dielektrische Abdeckung (13, 62, 73), die sich in Längsrichtung auf dem länglichen Leiter erstreckt und zwischen dem länglichen Leiter und einer Steuerelektrode (17, 37, 57, 67, 94) angeordnet ist, wobei sich die Steuerelektrode längs der dielektrischen Abdeckung und teilweise um sie herum erstreckt; eine Einrichtung zum Anlegen eines zeitlich sich ändernden Potentials zwischen dem länglichen Leiter und der Steuerelektrode, um eine Glimmentladung in einem der Steuerelektrode und der dielektrischen Abdekkung benachbarten Luftraum hervorzurufen; und eine Einrichtung zum Anlegen eines Absaugpotentials zum Extrahieren von Ionen aus der Glimmentladung, um einen zu dem Absaugpotential proportionalen Ausgangsionenstrom zu erzeugen; wobei die Steuerelektrode mit der dielektrischen Abdeckung an mehr als einer tangentialen Position in Kontakt ist.

2. Vorrichtung nach Anspruch 1, wobei die Steuerelektrode ein mit der dielektrischen Abdekkung (13; 63; 73) in Kontakt stehendes leitendes Gitter (17; 37; 57; 67) und ferner ein Isolierstützelement (15; 35; 65; 75) für den länglichen Leiter und die elektrische Abdeckung aufweist.

3. Vorrichtung nach Anspruch 2, bei der das Leitergitter eine leitende Maschenelektrode aufweist.

4. Vorrichtung nach Anspruch 3, bei der die leitende Maschenelektrode ein Drahtmaschensieb aufweist.

5. Vorrichtung nach Anspruch 4, bei der das Drahtmaschensieb eine Maschenauslegung im Bereich von 1180—6910 Öffnungen pro Meter (30—150 pro Inch) hat.

6. Vorrichtung nach Anspruch 5, bei der das Drahtmaschensieb ein Gitterwerk aus Drähten einer Dicke im Bereich von $7{,}62\times10^{-6}$m bis $3{,}048\times10^{-5}$m (0,3—1,1 mils) aufweist.

7. Vorrichtung nach Anspruch 2, bei der das leitende Gitter eine in einem Maschenmuster geätzte Metallfolie aufweist.

8. Vorrichtung nach einem der Ansprüche 2 bis 7, bei der das leitende Gitter eine Anordnung von im wesentlichen zueinander parallelen Leitern aufweist.

9. Vorrichtung nach einem der Ansprüche 2 bis 8, bei der die dielektrische Abdeckung (63) einen bogenförmigen seitlichen Querschnitt aufweist.

10. Vorrichtung nach einem der Ansprüche 3 bis 9, bei der das leitende Gitter (17; 37; 57; 67) auf jeder Seite des länglichen Leiters (12; 62; 72) und der dielektrischen Abdeckung (13; 63; 73) mit dem Isoslationsstützelement (15; 35; 65; 75) verankert ist.

11. Vorrichtung nach einem der Ansprüche 3 bis 10, bei der das leitende Gitter (17) einen im wesentlichen umgekehrt-V-förmigen seitlichen Querschnitt aufweist.

12. Vorrichtung nach einem der Ansprüche 3 bis 10, bei der das leitende Gitter (67) einen bogenförmigen seitlichen Querschnitt aufweist.

13. Vorrichtung nach einem der Ansprüche 2 bis 12, bei der der längliche Leiter und die dielektrische Abdeckung einen mit einem Dielektrikum überzogenen Draht aufweisen.

14. Vorrichtung nach einem der Ansprüche 2 bis 13, bei der die dielektrische Abdeckung eine Dicke in einem Bereich von $2{,}54\times10^{-5}$m bis $6{,}62\times10^{-5}$m (1—3 mils) aufweist.

15. Vorrichtung nach einem der Ansprüche 2 bis 12, bei der der längliche Leiter und die dielektrische Abdeckung einen mit dem Isolationsstützelement (75) in Kontakt stehenden leitenden Streifen (72) mit einer ihn einschließenden dielektrischen Schicht (73) aufweisen.

16. Vorrichtung nach einem der Ansprüche 2 bis 15, bei der der längliche Leiter und die dielektrische Abdeckung in einem Schlitz in dem Isolationsstützelement (35) angeordnet sind, wobei das leitende Gitter (57) mit der dielektrischen Umhüllen über dem Schlitz in Kontakt steht.

17. Vorrichtung nach Anspruch 1, bei der die Steuerelektrode ein längliche leitende Hülle mit Innenwänden (97, 98) definiert, die den umhüllten länglichen Leiter umfaßt, und zudem eine längli-

che Öffnung (56, 96) aufweist, um den umhüllten länglichen Leiter freizulegen.

18. Vorrichtung nach Anspruch 17, bei der die Längliche leitende Hülle einen leitenden Balken (94) mit einem Schlitz aufweist, und wobei der umhüllte längliche Leiter in diesen Schlitz eingebettet ist.

19. Vorrichtung nach Anspruch 1, bei der die dielektrische Abdeckung aus anorganischem dielektrischen Material besteht.

20. Vorrichtung nach Anspruch 1, bei der die dielektrische Abdeckung aus einer aus der Glas, Glimmer und Sinterkeramikmaterial umfassenden Klasse ausgewählten Substanz besteht.

21. Vorrichtung nach Anspruch 1, bei der die Einrichtung zum Anlegen des Absaugpotentials dazu geeignet ist, ein Gleichstrompotential zwischen der Steuerelektrode und einer Gegenelektrode zu erzeugen.

22. Vorrichtung nach Anspruch 21, bei der das Absaugpotential ein Gleichstrompotential mit einer Größenordnung von mehreren zehn bis mehreren Hundert Volt umfaßt.

23. Vorrichtung nach Anspruch 1 oder 21 oder 22, bei der die Einrichtung zum Anlegen eines zeitlich sich ändernden Potentials dazu geeignet ist, ein Hochspannungswechselpotential zu erzeugen.

24. Vorrichtung nach Anspruch 23, bei der das zeitlich sich ändernde Potential ein Hochspannungswechselpotential einer Frequenz im Bereich von 60 Hz bis 4 MHz umfaßt.

25. Vorrichtung nach Anspruch 1, bei der das zeitlich sich ändernde Potential eine Impulsspannung aufweist.

26. Vorrichtung zum Erzeugen von Ionen (110) durch Koronaentladung, enthaltend: einen länglichen Leiter (112); eine dielektrische Abdeckung (113), die sich in Längsrichtung von dem länglichen Leiter erstreckt und zwischen dem länglichen Leiter und Steuerelektroden, die aus einem Paar länglicher leitender Stäbe (116, 117) bestehen und auf jeder Seite des länglichen Leiteres angeordnet sind, eingebracht ist, wobei die sich die Stäbe in Längsrichtung auf der dielektrischen Abdeckung erstrecken und an einer tangentialen Position mit der dielektrischen Abdekkung in Kontakt sind; eine Einrichtung zum Anlegen eines zeitlich sich ändernden Potentials zwischen dem länglichen Leiter und den leitenden Stäben, um eine Glimmentladung in einem den Steuerelektroden und der dielektrischen Abdeckung benachbarten Luftraum hervorzurufen; eine Einrichtung zum Anlegen eines Absaugpotentials zum Extrahieren von Ionen aus der Glimmentladung, um einen zu dem Absaugpotential proportionalen Ausgangsionenstrom zu erzeugen.

27. Vorrichtung nach Anspruch 26, welche eine Isolationsbasis (115), das Paar an der Isolationsbasis angebrachte längliche leitende Stangen (116, 117) umfaßt und wobei auch der umhüllte längliche Leiter (111) an der Isolationsbasis angebracht ist.

28. Vorrichtung zur Erzeugung von Ionen (120, 130) durch Koronaentladung, enthaltend: eine Paar dielektrisch umhüllter länglichen Leiter (123, 127; 133, 137), die sich in Längsrichtung auf einer zentralen leitenden länglichen Steuerelektrode (121, 131) erstreckt; eine Einrichtung zum Anlegen eines zeitlich sich ändernden Potentials zwischen den länglichen Leitern und der Steuerelektrode, um eine Glimmentladung in einem der Steuerelektrode und den dielektrischen Abdekkungen der länglichen Leiter benachbarten Luftraum hervorzurufen; eine Einrichtung zum Anlegen eines Absaugpotentials zum Extrahieren von Ionen aus der Glimmentladung, um einen zu dem Absaugpotential proportionalen Ausgangsionenstrom zu erzeugen; wobei deer dielektrischen Abdeckungen an einer tangentialen Position mit der Steuerelektrode in Kontakt sind.

29. Vorrichtung nach Anspruch 28, bei der jeder der länglichen Leiter (133, 137) ein Kapillarröhrchen (134, 138) aus Glas mit einer leitenden inneren Beschichtung aufweist.

30. Vorrichtung nach Anspruch 28, bei der jeder der länglichen Leiter (123, 127) ein Kapillarröhrchen (124, 128) aus Glas mit einem festen leitenden Kern (123, 127) aufweist.

31. Vorrichtung nach Anspruch 30, bei der der Kern (123, 127) eine der niedrigschmelzenden Legierungen aus Wismut oder eine Indiumlegierung aufweist.

Revendications

1. Appareil pour générer des ions (10, 30, 50, 60, 80, 90) par décharge corona, comportant: un conducteur (12, 62, 72) de forme allongée; une gaine diélectrique (13, 63, 73) qui s'étend dans le sens longitudinal du conducteur de forme allongée et qui s'interpose entre le conducteur de forme allongée et une électrode de commande (17, 37, 57, 67, 94), l'électrode de commande s'étendant dans le sens longitudinal de la gaine diélectrique et entourant partiellement cette gaine; des moyens pour appliquer un potentiel, variable en fonction du temps, entre le conducteur de forme allongée et l'électrode de commande pour créer une décharge lumineuse dans la région de l'air voisine de l'électrode de commande et de la gaine diélectrique, ainsi que des moyens pour appliquer un potentiel d'extraction pour extraire de la décharge lumineuse des ions pour produire un courant ionique de sortie sensiblement proportionnel au potentiel d'extraction; étant précisé que l'électrode de commande est au contact de la gaine diélectrique en plus d'une position tangentielle.

2. Appareil selon la revendication 1, dans lequel ladite électrode de commande est constituée d'une grille conductrice (17; 37; 57; 67) venant en contact avec ladite gaine diélectrique (13; 63; 73), et comportant en outre un support isolant (15; 35; 65; 75) pour le conducteur de forme allongée et pour la gaine diélectrique.

3. Appareil selon la revendication 2, dans lequel la grille conductrice est constituée d'une électrode conductrice présentant des mailles.

4. Appareil selon la revendication 3, dans lequel

l'électrode conductrice comportant des mailles est constitué d'une toile en fil métallique présentant des mailles.

5. Appareil selon la revendication 4, dans lequel la toile en fil métallique présentant des mailles a une dimension de mailles sur la plage 1180—5910 ouvertures par mètre (30—150 par pouces).

6. Appareil selon la revendication 5, dans lequel la toile en fil métallique présentant des mailles est constituée d'un treillis de fils métalliques d'une épaisseur allant de 7.62×10^{-6}m à 3.048×10^{-5}m (0.3—1.2 mils).

7. Appareil selon la revendication 2 dans lequel la grille conductrice est constituée d'une feuille de métal attaquée selon ne configuration maillée.

8. Appareil selon l'une quelconque des revendications 2 à 7 dans lequel la grille conductrice est constituée d'une distribution de conducteurs essentiellement parallèles.

9. Appareil selon l'une quelconque des revendications 2 à 8, dans lequel la gaine diélectrique (73) a une section latérale en forme d'arc.

10. Appareil selon l'une quelconque des revendications 3 à 9, dans lequel la grille conductrice (17; 37; 57; 67) est attachée contre le support isolant (15; 35; 65; 75) de chaque côté du conducteur de forme allongée (12; 62; 72) et de la gaine diélectrique (13; 63; 73).

11. Appareil selon l'une quelconque des revendications 3 à 10 dans lequel la grille conductrice a une section latérale sensiblement en forme de V renversé.

12. Appareil selon l'une quelconque des revendications 3 à 10, dans lequel la grille conductrice (67) a une section latérale en forme d'arc.

13. Appareil selon l'une quelconque des revendications 2 à 12, dans lequel le conducteur de forme allongée et la gaine diélectrique sont constitués d'une tige métallique gainée de matériau diélectriqué.

14. Appareil selon l'une quelconque des revendications 2 à 13, dans lequel la gaine diélectrique a une épaisseur allant de 2.54×10^{-5}m à 6.62×10^{-5}m (1—3 mils).

15. Appareil selon l'une quelconque des revendications 2 à 12, dans lequel le conducteur de forme allongée et la gaine diélectrique sont constitués d'un ruban conducteur (72) qui vient en contact du support (isolant (75) et qui est encapsulé dans une couche diélectrique (73).

16. Appareil selon l'une quelconque des revendications 2 à 15, dans lequel le conducteur de forme allongée et la gaine diélectrique sont logés dans une rainure prévue dans le support isolant (35), la grille conductrice (57) venant au contact de la gaine diélectrique au-dessus de la rainure.

17. Appareil selon la revendication 1, dans lequel l'électrode de commande définit une enceinte conductrice de forme allongée dont les parois intérieures (97, 98) entourent le conducteur de forme allongée, gainé, et qui présente en outre une ouverture allongée (56, 96) pour y placer ledit conducteur de forme allongée, gainé.

18. Appareil selon la revendication 17, dans lequel l'enceinte conductrice de forme allongée est constituée d'un barreau conducteur (94) présentant une rainure, et dans lequel le conducteur de forme allongée, gainé est enrobé dans ladite rainure.

19. Appareil selon la revendication 1, dans lequel la gaine diélectrique est constituée d'un matériau diélectrique inorganique.

20. Appareil selon la revendication 1, dans lequel la gaine diélectrique est constituée d'un matériau choisi dans la classe constituée du verre, du mica et de matériaux céramiques frittés.

21. Appareil selon la revendication 1, dans lequel les moyens prévus pour appliquer un potentiel d'extraction sont conçus pour produire un potentiel de courant continu entre l'électrode de commande et une contre-électrode.

22. Appareil selon la revendication 21, dans lequel le potentiel d'extraction est constitué d'un potentiel de courant continu dont la valeur va de quelques dizaines à quelques centaines de volts.

23. Appareil selon la revendication 1 ou la revendication 21 ou la revendication 22, dans lequel les moyens prévus pour appliquer un potentiel variable en fonction du temps sont conçus pour produire un potentiel alternatif de tension élevée.

24. Appareil selon la revendication 23 dans lequel le potentiel variable en fonction du temps est constitué d'un potentiel alternatif de tension élevée d'une fréquence allant de 60 Hz à 4 MHz.

25. Appareil selon la revendication 1, dans lequel le potentiel variable en fonction du temps est constitué d'une tension pulsée.

26. Appareil pour générer des ions (110) par décharge corona, comportant: un conducteur de forme allongée (112); une gaine diélectrique (113) qui s'étend dans le sens longitudinal du conducteur de forme allongée et qui s'interpose entre le conducteur de forme allongée et les électrodes de commande constituées d'une paire de tiges conductrices de forme allongée (116, 117) disposées de chaque côté du conducteur de forme allongée, les tiges s'étendant dans le sens longitudinal de la gaine diélectrique et venant au contact de la gaine diélectrique en une position tangentielle; des moyens pour appliquer un potentiel, variable en fonction du temps, entre le conducteur de forme allongée et les tiges conductrices pour créer une décharge lumineuse dans une région de l'air voisine des électrodes de commande et de la gaine diélectrique, ainsi que des moyens pour appliquer un potentiel d'extraction pour extraire de la décharge lumineuse des ions pour produire un courant ionique de sortie sensiblement proportionnel au potentiel d'extraction.

27. Appareil selon la revendication 26 comportant une base isolante (115), la paire de tiges conductrices de forme allongée (116; 117) étant montées contre la base isolante, et le conducteur de forme allongée, gainé (111) étant également monté contre la base.

28. Appareil pour générer des ions (120, 130) par décharge corona, comportant une paire de conducteurs de forme allongée (123, 127; 133,

137), gainés d'un matériau diélectrique et s'étendant dans le sens longitudinal d'une électrode conductrice centrale de commande de forme allongée (121, 131), des moyens pour appliquer un potentiel, variable en fonction du temps, entre les conducteurs de forme allongée et l'électrode de commande pour créer une décharge lumineuse dans une région de l'air voisine de l'électrode de commande et des gaines diélectriques des conducteurs de forme allongée, et des moyens pour appliquer un potentiel d'extraction pour extraire de la décharge lumineuse des ions pour produire un courant ionique de sortie sensiblement proportionnel au potential d'extraction; les gaines diélectriques étant en contact avec l'électrode de commande en une position tangentielle.

29. Appareil selon la revendication 28 dans lequel chacun des conducteurs de forme allongée (133, 137) est constitué d'un tube capillaire en verre (134, 138) avec un revêtement intérieur conducteur.

30. Appareil selon la revendication 28 dans lequel chacun des conducteurs de forme allongée (123, 127) est constitué d'un tube capillaire en verre (124, 128) avec un noyau conducteur plein (123, 127).

31. Appareil selon la revendication 30, dans lequel le noyau (123, 127) est constitué de l'un des alliages de bismuth à bas point de fusion, ou d'un alliage d'indium.

Fig. 1

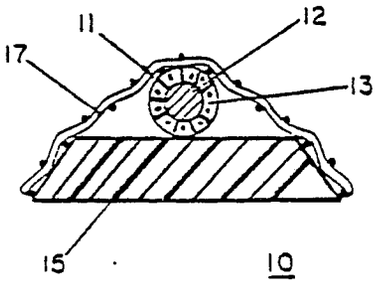


Fig. 2

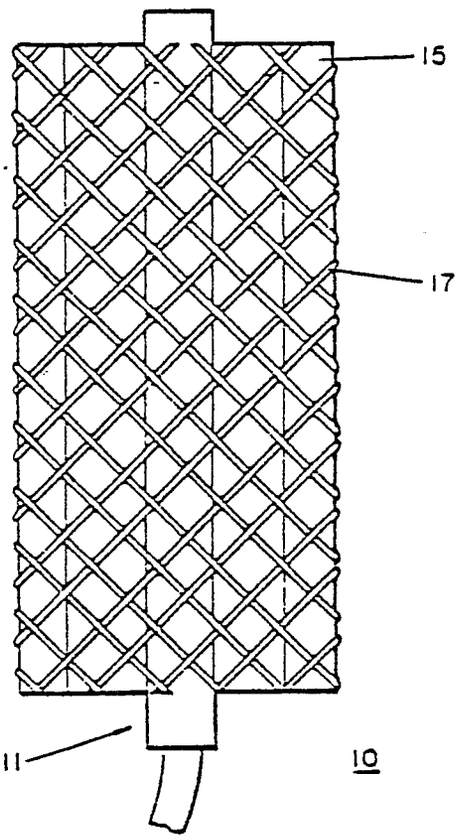


Fig. 3

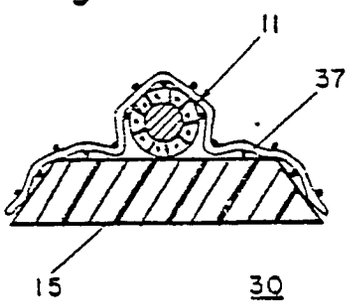


Fig. 4

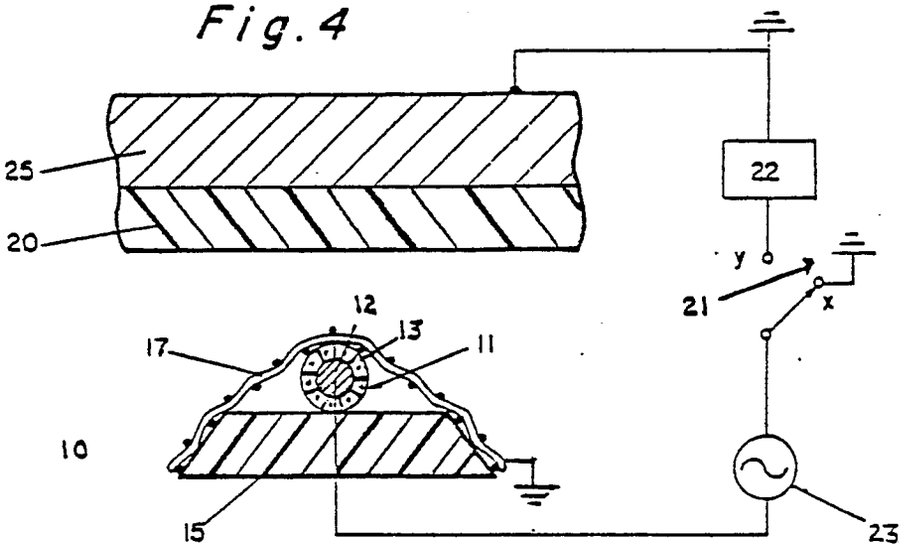


Fig. 5

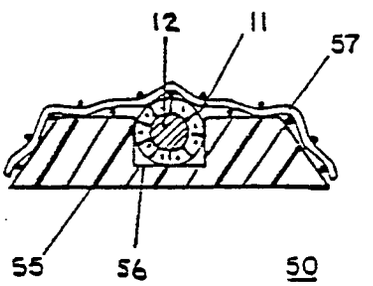


Fig. 6

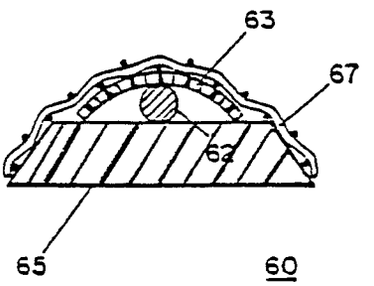


Fig.7

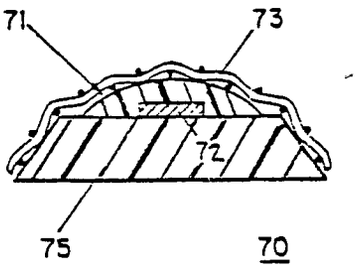


Fig.8

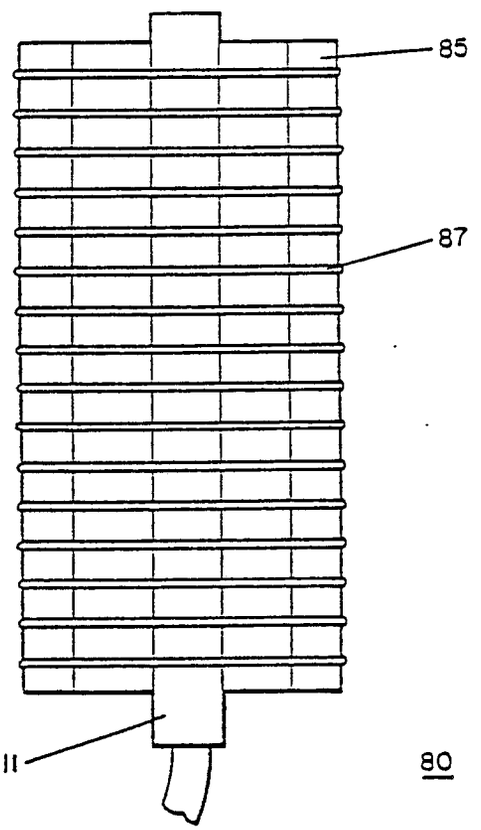


Fig. 9

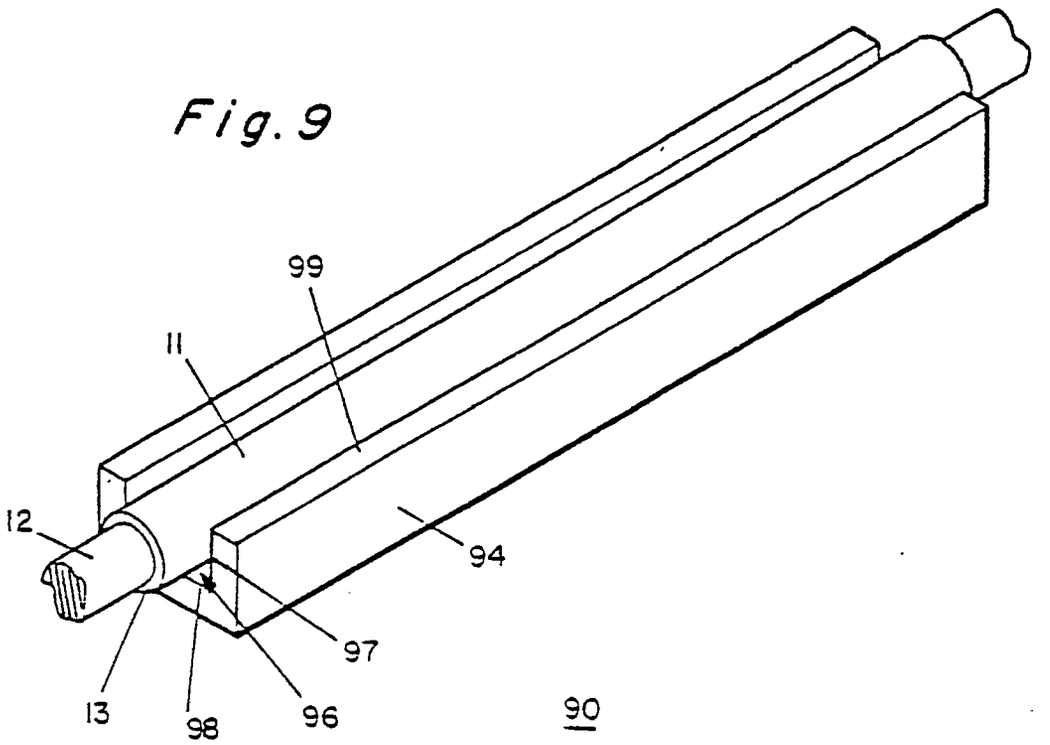


Fig. 10

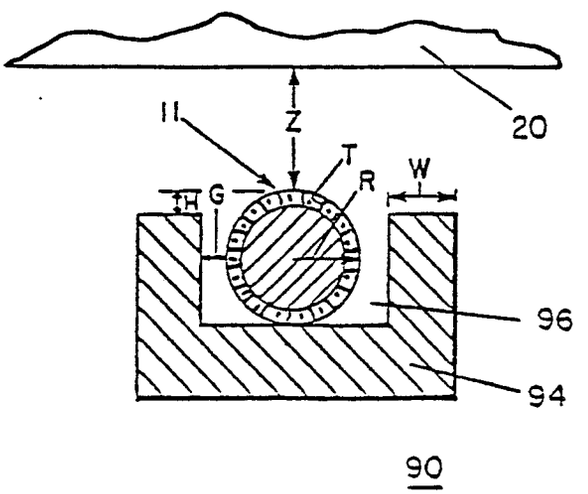
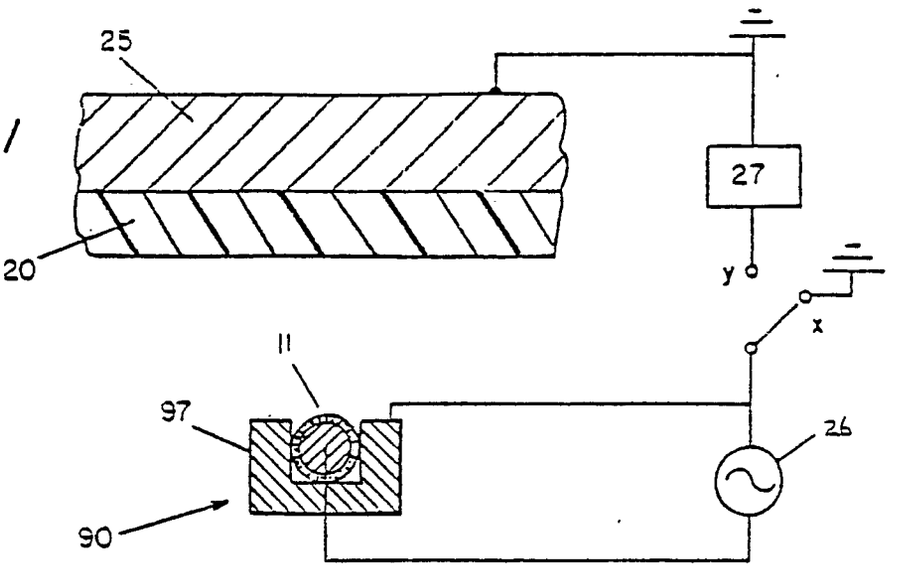


Fig. 11



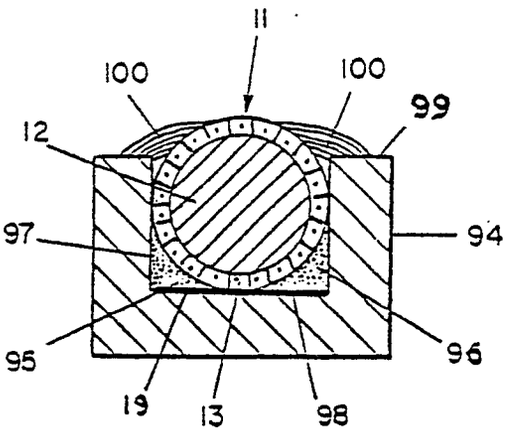


Fig. 12A

Fig. 12B

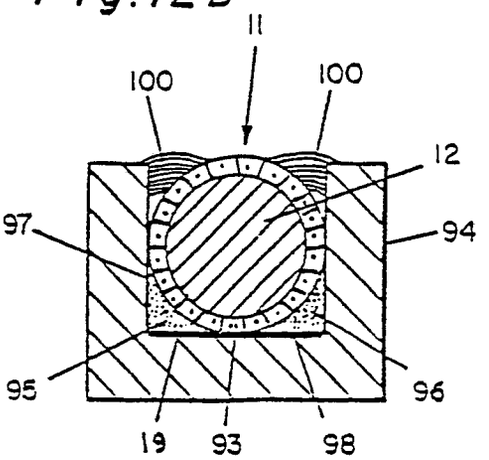


Fig. 12C

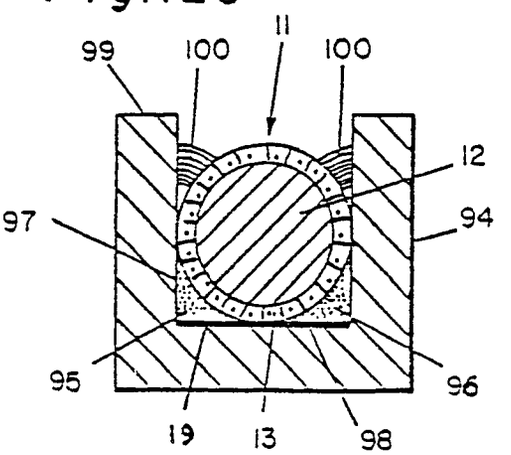


Fig.13

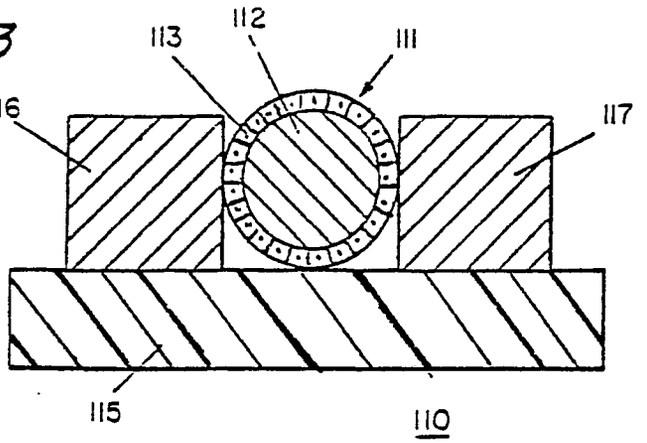


Fig.14

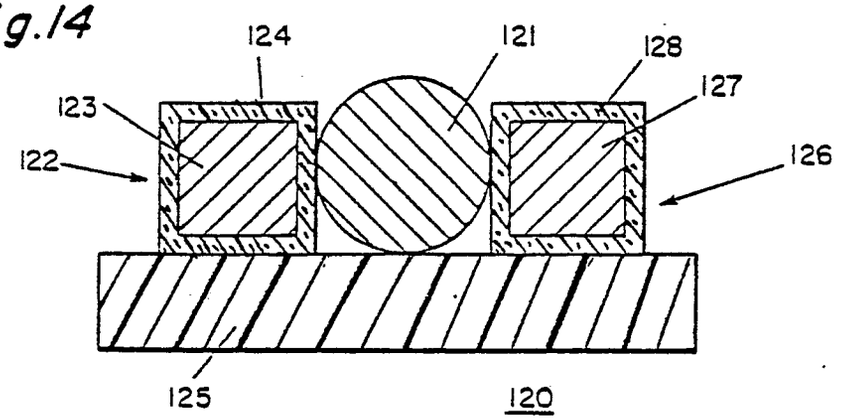


Fig.15

