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CORONA UNIT WITH A TAPERED PASSAGEWAY OF ELECTRICALLY
NONCONDUCTIVE MATERIAL BETWEEN CONDUCTIVE HOUSINGS
THAT ARE ELECTRICALLY INTERCONNECTED

Original Filed July 19, 1965

2 Sheets-Sheet 1

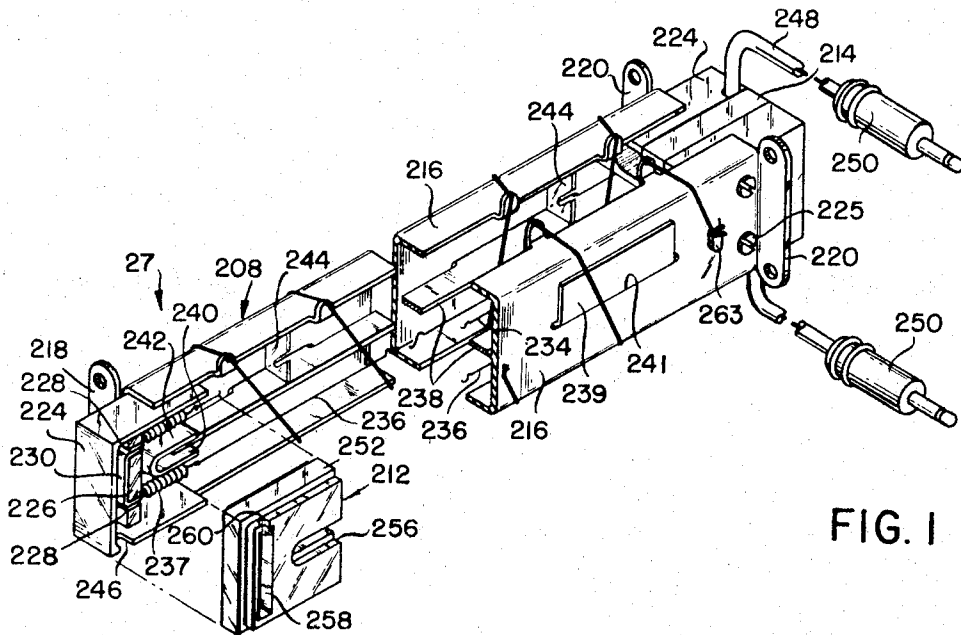


FIG. 1

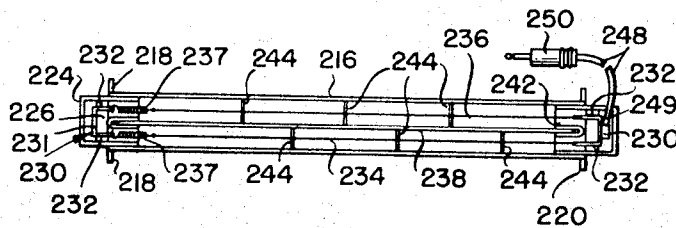


FIG. 2

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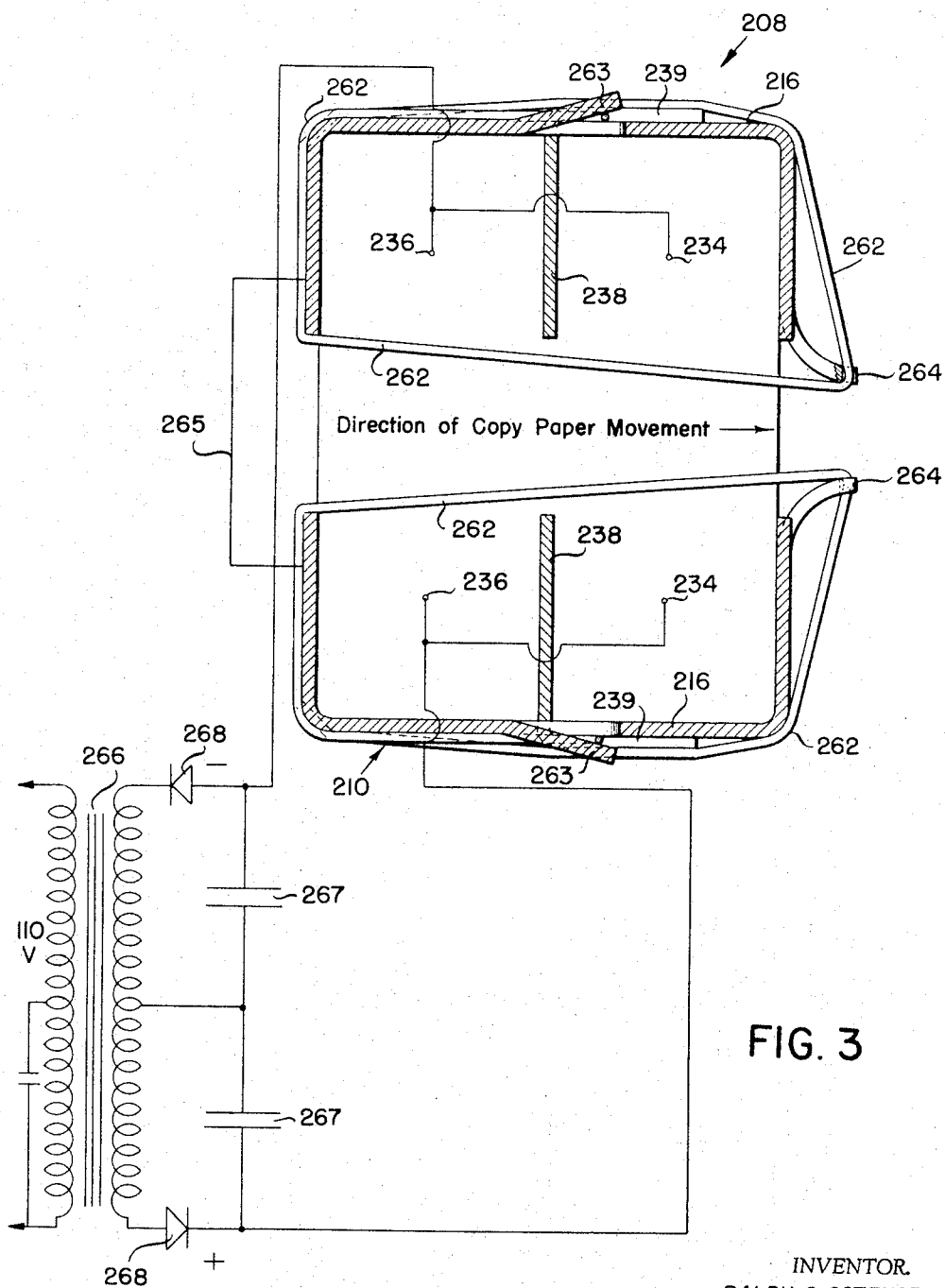


FIG. 3

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CORONA UNIT WITH A TAPERED PASSAGEWAY OF ELECTRICALLY NONCONDUCTIVE MATERIAL BETWEEN CONDUCTIVE HOUSINGS THAT ARE ELECTRICALLY INTERCONNECTED

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Continuation of application Ser. No. 473,110, July 19, 1965. This application May 9, 1966, Ser. No. 548,799
19 Claims. (Cl. 250—49.5)

This application is a continuation of my now abandoned application Ser. No. 473,110, filed July 19, 1965, which is a continuation-in-part of my now abandoned application Ser. No. 249,248, filed Jan. 3, 1963.

This invention relates to electrostatic photocopying apparatus, and more particularly, to a corona unit for applying a homogeneous charge on a photosensitive surface of a sheet adapted to pass through the corona unit.

One of the objects of the present invention is to provide an improved corona unit adapted to place a homogeneous charge on a cut sheet of copy paper containing a layer of photoconductive or photoactive material where the corona unit is characterized by having a tapered copy sheet passageway which provides a comparatively wide entrance opening and a relatively narrow exit opening to thereby facilitate processing of the copy sheet through the corona unit without mechanical difficulty and to maintain careful positioning of the copy sheet so as to assure a substantially uniform charge on each successive sheet of copy paper.

Another object is to provide a corona unit characterized by having a pair of corona wires mounted in side by side parallel relationship and connected to a common potential with the wires being mounted in a U-shaped housing having two parallel side walls and an end wall and there being a central partition of conductive material secured to the end wall and extending midway between the side walls to thus separate the two corona wires providing improved uniformity of electrostatic charge applied to the surface of a chargeable member.

A further object of the invention resides in providing a novel mechanical housing for corona wires with the housing being characterized by being formed from a pair of identical elongated channel members of conductive material having a U-shaped cross-section and blocks of insulating material for maintaining the corona wires in their desired position in each of the housing units, and further having identical spacer blocks of insulating material that have surfaces formed to engage the surfaces of the blocks of insulating material holding the corona wires in place to thereby form a unitary structure that serves as a sub-assembly that is easily adapted to be mounted in a photocopy apparatus.

Still another object of the invention is to provide a novel high voltage circuit for supplying the energizing voltage to the corona unit with the secondary circuit of the power transformer being characterized by being in a floating condition free of any galvanic connection to the printer frame or any other part of the circuit. As a further feature, the housings for the corona wires are mounted to the printer in a manner so as to be electrically floating and free of any galvanic connection to either the printer frame or any part of the electrical circuit.

These and other objects will become more fully apparent from the claims, and from the description as it proceeds in connection with the drawings wherein:

FIGURE 1 is a partially exploded and partially cut-away perspective view of a corona unit employed to charge the copy paper;

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FIGURE 2 is an elevation of one of the two identical halves of the corona unit; and

FIGURE 3 is a schematic of the high voltage circuit.

Referring to the drawings, corona unit 27 is composed of a pair of identical assemblies 208 and 210 held in parallel, spaced apart relation by two identical spacer blocks 212 and 214 of plastic insulation material located at the opposite ends thereof.

Referring now specifically to FIGURE 2, each of the corona unit assemblies includes a metal housing 216 having a U-shaped cross section. At its opposite ends, exterior tabs 218 and 220 are provided by which the corona unit assemblies may be attached to appropriate brackets (not shown) fixed to the side wall of the frame of an electrostatic printer. Supported in and extending from the ends of each housing 216 are identical hollow plastic end members 224 which may be attached to the housing with a suitable adhesive and/or fasteners 225. Provided in each plastic end member 224 is an inwardly extending, transverse, integral rib 226 in which are formed a pair of laterally spaced slots 228 (FIGURE 1). A U-shaped, electrically conductive connector 230 is mounted in each end member with its web 231 (see FIGURE 2) engaging the outer side of rib 226 and its legs 232 extending through slots 228 toward the opposite end of the unit. Extending between end members 224 within outer housing 216 in parallel, spaced relationship are two corona discharge wires 234 and 236 which are preferably made of stainless steel and which may have a diameter on the order of 0.001 inch.

Wires 234 and 236 are fixed, at one end, directly to the legs 232 of a connector 230. At the other end of the corona unit, helical springs 237 are interposed to hold wires 234 and 236 under tension.

Wires 234 and 236 serve as the corona charging wires and the electric fields associated with each wire are isolated from each other by a metal separator or partition 238 (see also FIGURE 3) which at its opposite ends extends into slots 240 formed in inwardly extending projections 242 in plastic end members 224. Tabs 239 formed on the outer edge of partitions 238 extend through slots 241 in housing 216 and are bent over to secure the partition in the housing as is also shown in FIGURE 3. The free edge of partition 238 may be in the plane containing the edges of the opposite side walls of U-shaped housing member 216 to increase the current flow through the power supply which current flow is proportional to the amount of charge laid down on the paper. Partition 238 has been found to broaden out the ion spray and to give a more even charge pattern with substantially no voids in it as compared with use of housings 216 without partitions 238. Wires 234 and 236 are connected electrically together to be at the same potential, but are maintained in spaced relation to the housing side wall, rear walls and inner partition 238 by spacers 244 through which the conductors extend. Spacers 244 are formed of a suitable insulating material such as mica.

A groove 246 is formed in a wall of each of plastic end members 224. A high tension cable 248 extends through groove 246 and is electrically connected, at its inner end, to an electrically conductive connector 249 clipped to the U-shaped connector 230. Plug connectors 250 fixed to the outer ends of high tension leads 248 permit the corona unit to be readily connected to a source of high voltage.

Spacer blocks 212 and 214 by which corona unit assemblies 208 and 210 are assembled into a unitary component are generally rectangular blocks of rigid insulating material such as Lucite. Since blocks 212 and 214 are identical, only spacer block 212 will be described. An outwardly directed, rectangularly sectioned rib 252

is formed around three sides of the spacer block to provide a ledge. When block 212 is inserted into the end member 224 of corona unit assembly 208, rib 252 engages the edge of plastic end member 224 to thereby support spacer block 212.

Spacer block 212 is further supported by the inwardly extending projection 242 in end member 224 which, when the spacer block is assembled in the end member, engages the inner end wall of a U-shaped recess 256 formed in the spacer block. A rectangular, laterally extending recess 258 is also formed in the spacer block to accommodate electrical connector 249 and high tension cable 248 which extends through a groove 260 communicating with recess 258. Spacer block 212 has identical recesses 256 and 258 and a groove 260 which is on the lower rather than upper edge on the side not visible in FIGURE 1. Spacer blocks 212 and 214 are thus symmetrical which permits the use of a single construction for both ends of the corona unit.

From the foregoing, it is apparent that spacer blocks 212 and 214 have surfaces which extend into recesses in plastic end members 224 to thereby provide a rigid assembly which may be mounted by tabs 218 and 220 to the frame of a printer machine. It is significant to note that housings 216 are electrically isolated from each other before corona unit 27 is mounted to a printer.

Housings 216 are mounted to a printer frame in a manner to be isolated from both ground and the electrical potential of the frame of the machine, and hence not connected to any electrical reference point relative to the high voltage circuit. Housings 216 are thus electrically floating. The reason housings 216 are electrically floating, rather than connected to the machine frame or any electrical reference point relative to the high voltage circuit is that upon occasion a broad band would print on the leading edge of the copy paper as the paper was trailing through the machine and its leading edge was in the developer solution at the same time that the trailing edge was still being charged by the corona unit. By mounting housings 216 to a printed in such manner as to be disconnected from ground, this problem was eliminated.

With reference now to FIGURE 3, which is a schematic of the high voltage circuit, the two housings 216 are shown as being electrically connected together by connection 265, but isolated from the remainder of the electrical circuit. The high voltage transformer 266 has a center tapped secondary winding which is ungrounded and a voltage doubler circuit consisting of two capacitors 267 and two diodes 268, the diodes being poled as shown in the drawing and arranged to produce a D.C. voltage of about 11,500 volts.

In the printing process, the copy paper travels between corona unit assemblies 203 and 210. To insure that the leading edge of the paper moves freely through the corona unit, a cord 262 is wrapped around housing 216 of each of the corona unit assemblies. Cord 262 may for example be a nylon line as used with fishing reels. Projections 263 on the rear walls of housing 216 and projections 264 extending from the housing side walls adjacent the copy paper exit from the corona unit support cord 262.

The opening on the paper input side of the corona unit is made sufficiently large, as for example about one-half inch to assure easy entry of the cut paper sheet into the space between housing members 216 of the corona unit from a paper feed. Projections 264 are formed as by bending to extend toward each other as best shown in FIGURES 1 and 3 to provide a narrow slot from which the paper emerges after leaving the corona unit. The width of the paper exit slot may, for example be about one-quarter inch. The ends of projections 264 may be notched to keep cord 262 in position and thereby form a tapered passageway through the corona unit.

As best shown in FIGURE 1 cord 262 is so wound on the housing members that on opposite sides of the

centerline of the sheet of copy paper, the individual lengths of cord inside the slot are directed outwardly. By this arrangement, the corners on the leading edge of the copy sheet are directed outwardly to oppose any tendency to curl and become caught in the corona unit.

Also, as the copy sheet leaves the corona unit, cord 262 centers the copy sheet more nearly equidistant between the corona wires 236 to thereby assure a reasonably uniform charge on each sheet of paper.

A satisfactory paper may consist of a coating of photoconductive material on a supporting base. The photoconductor is typically solid zinc oxide particles which are dispersed in a resin coating. The resin has a high electrical resistance and may be selected from silicones, polyesters, styrene-butadiene copolymers and cellulose esters, and forms a smooth, uniform, highly adherent coating on the paper base. The paper may be made to have a charge when it leaves the corona unit on the order of 400 volts.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive with the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

I claim:

1. A corona unit for electrostatically charging a carrier member having a layer of photoactive material serving as a chargeable layer in an electrostatic photocopying process comprising:

(a) a pair of U-shaped elongated housings of conductive material mounted generally parallel to each other and electrically connected together with open sides facing each other and having adjacent side walls, said side walls of the respective housings defining opposed openings and being spaced apart sufficiently to enable the carrier member to pass between said housings in a direction transverse to the longitudinal dimension of said housings;

(b) a corona discharge member mounted in each of said housings and insulated therefrom;

(c) means for connecting a source of energizing potential between said corona discharge members, with said corona discharge members being effective to apply through said openings an electrostatic charge to a carrier member passing between said housings; and

(d) insulating means forming a tapered passageway between said housings convergent in the direction of movement of said carrier member providing a relatively wide entrance opening between said housings to permit easy ingress of said carrier member and a comparatively narrow exit opening between said housings for egress of said carrier member to improve uniformity of the electrostatic charge on said carrier member, said insulating means also serving to prevent the carrier member from contacting any conductive portion of said housings and said corona discharge members as the carrier member moves through the corona unit, said insulating means being discontinuous to provide for the substantially unblocked, uniform application of the electrostatic charge by said corona discharge members as the carrier member passes between said housings.

2. The corona unit as defined in claim 1 wherein said insulating means comprises a cord of nonconductive material wrapped around each housing at predetermined spacings to prevent the carrier member from contacting said housing and said corona discharge members, and wherein the one of said side walls of each said housings that is adjacent said exit opening has projections extending away from said side walls toward said exit opening,

and said cord is supported over free end portions of said projections to form said tapered passageway between said housings.

3. The corona unit as defined in claim 2 wherein said projections on the side walls of each of the housings are aligned and contain notched portions through which said cord is passed to provide an exit slot width of about one-half the entrance slot width of said corona unit.

4. The corona unit as defined in claim 1 wherein each corona discharge member consists of a pair of wires connected electrically together and disposed in parallel relation on opposite sides of a plane centrally located between said housing side walls, said corona wires being located substantially midway between the central plane and the nearest housing sidewall; and a partition of electrically conductive material supported by and electrically connected to said housing along said central plane to increase the intensity and uniformity of the electrostatic charge on said chargeable layer.

5. A corona unit as defined in claim 1 comprising two pairs of units with each unit of one pair being interchangeably identical with the other unit; one of said pairs of units comprising said U-shaped housings together with a body of nonconductive material in each end of each of said housings serving as means for supporting said corona discharge members in said housings; and the other said pair of units each being readily detachable unitary members of insulating material having surface configurations engaging said bodies of nonconductive material in said housings for supporting said U-shaped housings in parallel spaced positions with the open sides facing each other in the desired spacial relationship to control the flow of current between said discharge wires and to permit passage of a sheet of carrier material to be charged therebetween.

6. In an electrostatic printer, a corona unit composed of two pairs of members, the members of each pair being interchangeably identical for electrostatically charging copy paper having a photoconductive material serving as a chargeable layer in an electrostatic photocopying process comprising:

(a) a pair of interchangeable corona discharge members composed of:

- (1) a pair of electrically interconnected elongated housings of conductive material each having a U-shaped cross section with opposed side walls and an open side, said housings being mounted generally parallel to each other and with the open sides facing each other and the side walls spaced apart sufficiently to enable the copy paper to pass therebetween in a direction transverse to the longitudinal dimension of said housings
- (2) corona discharge means in each of said housings consisting of a pair of corona wires mounted in blocks of insulation material secured at opposite ends of each housings, connected electrically together and disposed in parallel relation on opposite sides of a plane centrally located between said housing side walls, said corona wires being located substantially midway between the central plane and the nearest housing side wall; and a partition of electrically conductive material supported by and electrically connected to said housing along said central plane;

(b) a pair of interchangeably identical, readily detachable end spacer units of insulating material having surface configurations engaging portions of said blocks of insulation material;

(c) means connecting a source of energizing potential between the corona wire in the opposed corona discharge members including a high voltage circuit comprising a floating transformer secondary winding free of galvanic connection to any point of reference potential on said printer or said housings;

(d) insulating cord means

(1) wrapped around each housing to form a tapered passageway between said housings convergent in the direction of movement of said copy paper having a relatively wide entrance opening to permit easy ingress of said copy paper and a comparatively narrow exit opening to permit egress of said copy paper to improve uniformity of the electrostatic charge on said copy paper;

(2) said cord means being wound in an outwardly direction at predetermined spacings in the form of a two directional helix with the direction of of the lead angle reversed so as to form windings diverging away from the center of said housings in the direction of travel of said copy paper to prevent said copy paper from contacting said housing and said corona discharge units and to urge the leading corners of said copy paper outwardly from the center as said copy paper passes through said corona unit; and

(e) one of said side walls of each said housing being adjacent said exit opening and having projections extending away from said side walls toward said exit opening, with said cord means being supported over free end portions of said projections to form said tapered passageway between said housings.

7. In an electrostatic printer, a charging unit comprising: a pair of corona discharge units each having a corona wire mounted within a housing unit, said corona wires being spaced and the housing units arranged to permit passage of a chargeable member therebetween; and a high voltage circuit connected to produce a current discharge between said corona wires including a transformer high voltage secondary winding and rectifier means connected to said secondary winding for producing a direct voltage, said high voltage circuit being free of galvanic connection to any point of reference potential on said printer.

8. The printer as defined in claim 7, wherein the housing units are made of conductive material and are galvanically isolated from said high voltage circuit.

9. The printer as defined in claim 8 wherein the housing units are electrically interconnected and free of galvanic connection to any point of reference potential on said printer.

10. In an electrostatic printer, a charging unit comprising: a pair of corona discharge units each having at least one corona wire mounted in an insulated manner within a conductive housing unit, said corona wires being spaced apart and the housing units arranged in face-to-face relation to permit passage of a chargeable member therebetween for simultaneous charging of opposite sides of the chargeable member, said housing units being electrically interconnected and free of galvanic connection to any point of reference potential on said printer.

11. A corona unit for electrostatically charging a layer of photoconductive material on a carrier member in an electrostatic photocopying process, said corona unit comprising a pair of opposed housing sections between which a carrier member to be charged is adapted to pass, said housing sections having openings facing each other, corona discharge members mounted on said housing sections on opposite sides of the carrier member path between said housing sections and being adapted to apply through said openings an electrostatic charge to a carrier member passing between said sections, and electrically nonconductive means on said housing sections for guiding the movement of a carrier member between said housing sections and the discharge members thereon, said electrically nonconductive means defining between said sections a tapered passageway adapted to receive a moving carrier member and converging in the direction of carrier member movement from a relatively wide entrance opening to a comparatively narrow exit opening,

said electrically nonconductive means being discontinuous to provide for the substantially unblocked, uniform application of an electrostatic charge to the carrier member by said corona discharge members.

12. The corona unit defined in claim 11 wherein said housing sections are formed from electrically conductive material, wherein said means comprises elements formed from electrically nonconductive material, and wherein means are provided for positioning said elements on said housing sections to prevent the moving carrier member from contacting said housing sections as it passes through said tapered passageway.

13. The corona unit defined in claim 12 wherein said means for positioning said elements comprises a plurality of fingers projecting in generally parallel relation from the edge of each housing section at said exit opening and being spaced apart transversely with respect to said passageway, and wherein said elements comprise cords wrapped around said housing sections at predetermined spacings to extend over and be engagingly supported by the ends of said fingers, said fingers being disposed to space said cords from the housing section edges extending transversely of said passageway at said exit opening.

14. The corona unit defined in claim 13 wherein said cords are positioned by said fingers at said exit opening to urge said carrier member toward a centered position between said discharge members for rendering the charge applied to said carrier member essentially uniform.

15. The corona unit defined in claim 11 wherein said means comprises relatively thin guides formed from electrically nonconductive material and bridging said openings of said housing sections lengthwise of said passageway to prevent the carrier member moving through said passageway from contacting said discharge members.

16. The corona unit defined in claim 15 wherein at least a portion of each housing section is formed from electrically conductive material and wherein said guides prevent said carrier member from contacting said electrically conductive housing section portions to insulate said carrier member therefrom.

17. The corona unit defined in claim 15 wherein said guides are positioned at said exit opening to urge said carrier member toward a centered position between said discharge members.

18. The corona unit defined in claim 15 wherein said guides are diagonally disposed on each housing section to diverge in the direction of carrier member movement from opposite sides of a plane disposed transversely of and intersecting said carrier member and extending in the direction of carrier member movement through said passageway.

19. The corona unit defined in claim 18 wherein said guides on at least one of said housing sections are portions of a cord helically wrapped around the housing section.

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