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[54] **HEART-SHAPED CORONA DISCHARGE DEVICE**
7 Claims, 4 Drawing Figs.
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[51] Int. Cl. H01j 37/04
[50] Field of Search. 250/49.5
ZC, 49.5 GC, 49.5 TC, 61 T; 317/262

ABSTRACT: Electrostatic charging apparatus for charging a photoconductive coating on a sheet member, having improved guiding means including exterior, converging housing walls for guiding the sheet member to an entrance throat of the charging apparatus and interior converging housing walls for guiding the sheet member to an exit throat of the apparatus. The apparatus is void of any interior mechanical guiding structure, exhibits improved charging efficiency due to a novel housing design, and may also be fabricated economically.

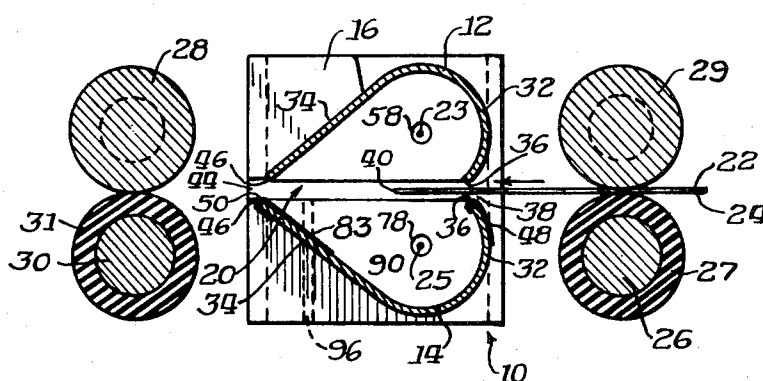


Fig. 1

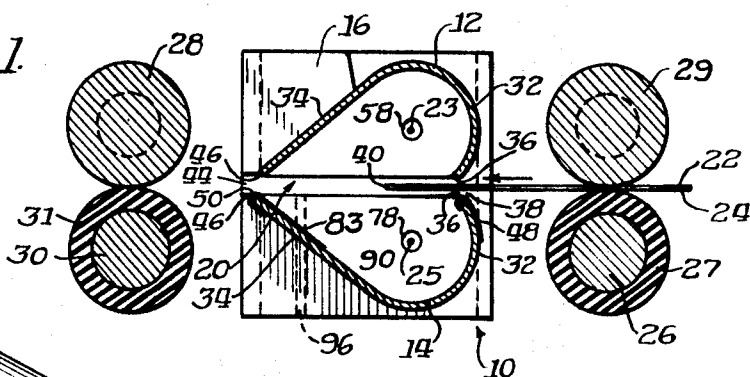


Fig. 2

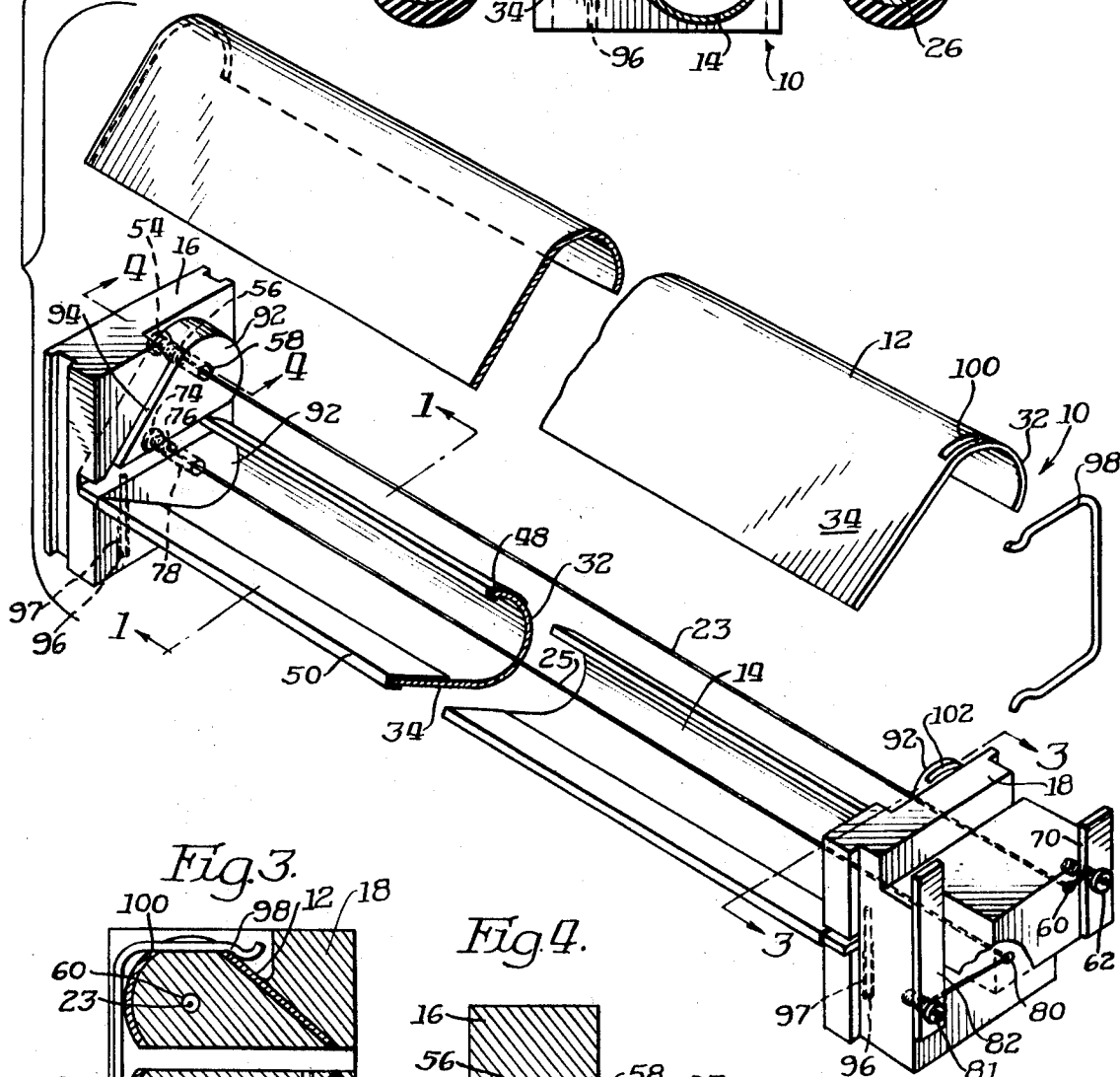


Fig. 3

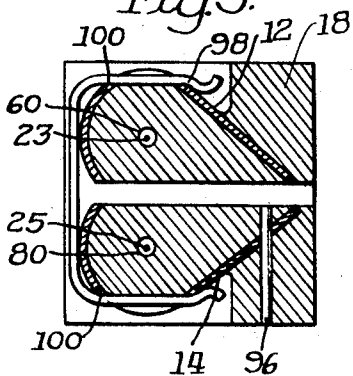
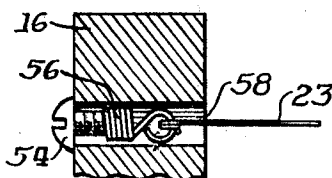


Fig. 4



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HEART-SHAPED CORONA DISCHARGE DEVICE

FIELD OF THE INVENTION

This invention relates in general to corona discharge devices. In particular, this invention is directed to corona discharge devices having improved paper sheet guiding capabilities, high charging efficiency and of economical construction.

DESCRIPTION OF THE PRIOR ART

In conventional electrostatic copying machines of the type employing a sheet member having a layer of photoconductive material on one surface, the photoconductive layer is typically electrostatically charged by transporting the sheet member along a path between a pair of spaced apart corona discharge wires coupled to the positive and negative terminals, respectively, of a high voltage DC power source. The corona discharge wires may be supported in a corona discharge device comprising a housing for shielding the dangerous high voltage and by various internal mechanical appurtenances which also insure uniform movement of a warped or deformed sheet member past the corona wires and out of the device without the sheet member striking the wires and without it becoming jammed within the charging device.

While these prior art internal mechanical appurtenances provide acceptable guidance of the sheet member, interference is present to the path of the charging ions from the corona discharge wires to the photoconductive layer. In addition, construction of such prior art devices including fabrication of the interior elements and labor required for assembly thereof, is costly.

In addition to guiding the sheet member through and out of the path between the corona discharge wires, it is also necessary to reliably guide or direct the sheet member into the path. This is typically accomplished in prior art devices by providing a large entrance opening capable of accepting sheet material transported thereto through a wide angle of deflection. However, the large entrance opening increases the difficulty of applying a uniform charge to the photoconductive layer due to the difference in spacing from the corona wires of successive sheet members.

SUMMARY OF THE INVENTION

This invention obviates many of the above mentioned problems and difficulties by providing a novel corona discharge device fabricated of two identically shaped longitudinal housing sections which are suitably supported in spaced apart relation to form a passageway therebetween for movement of the sheet member through the device. As assembled, a cross-sectional view of the housing sections exhibits a generally heart-shape which is bisected by the passageway extending through the "heart" from its stem to its apex or point.

The exterior surfaces of the curved walls forming the stem converge inwardly in the direction of the sheet member movement to form a small entrance throat to the corona discharge device. The interior surface of the housing walls forming the point also converge in the direction of the sheet member movement to form a small exit throat of the passageway. The entrance and exit throats, and their adjacent wall surfaces, provide the sole guiding means for the sheet members enabling the elimination of all other interior guide appurtenances and structure, resulting in a corona device which may be economically fabricated while providing excellent sheet guidance.

A corona discharge wire is provided in each housing section closely adjacent an imaginary plane perpendicular to the passageway and through the entrance throat, to prevent a sheet member having a fortuitously warped leading edge from striking either corona wire.

This invention also provides a corona discharge device having improved electrostatic charging efficiency in the manner

of a housing structure having a large open wall exposed to the passageway which enables the photoconductive layer to be exposed to the corona discharge wires, and the ions emitted therefrom, for a long period of time for a given rate of sheet member movement.

Accordingly, a primary object of this invention is to provide a corona discharge device having improved sheet member guiding means.

Another object of this invention is to provide a corona discharge device having improved sheet member guiding means and which is void of interior guiding structure to provide an unencumbered ion path from the corona discharge wires to a photoconductive layer.

It is also an object of this invention to provide a corona discharge device for more uniformly charging a layer of photoconductive material on a sheet member.

An additional object of this invention is to provide a corona discharge device having a high charging efficiency.

A further object of this invention is to provide a corona charging device which is void of interior sheet member guiding structure thereby providing an assembly of economical manufacture.

Other objects of this invention will become apparent to those versed in the art upon an understanding of the following detailed description of the corona discharge device of the invention taken in conjunction with the accompanying drawings in which a preferred embodiment of the invention is shown, and wherein:

FIG. 1 is an elevational cross-sectional view of the corona discharge device of the invention taken along line 1—1 of FIG. 2, and including entrance and exit sheet member transport rollers;

FIG. 2 is an exploded, foreshortened, perspective view on a reduced scale, of the corona discharge device shown in FIG. 1;

FIG. 3 is an enlarged, elevational cross-sectional view taken along line 3—3 of FIG. 2; and

FIG. 4 is an enlarged, elevational cross-sectional view of the corona wire securing structure taken along line 4—4 of FIG. 2.

Turning now to FIGS. 1 and 2 of the drawings, a corona discharge device 10 is seen to generally comprise an elongated upper housing section 12, a substantially identical lower housing section 14, and end support blocks 16 and 18 for supporting the housing sections in spaced apart relation forming a passageway 20 therebetween for movement of a sheet member 22 through the device. Blocks 16 and 18 also support upper and lower corona discharge wires 23 and 25, respectively, located within the respective housing sections. The sheet member may be transported through the device by any suitable means, such as by driven transport rollers 29 and 26 adjacent the passageway entrance and driven transport rollers 28 and 30 adjacent the passageway exit.

Sheet member 22 carries a coating or layer 24 of photoconductive material, such as zinc-oxide in a resinous binder, and outer surfaces 27 and 31 of transport rollers 26 and 30 respectively, which contact the photoconductive layer, are preferably fabricated of electrically nonconductive material so as not to interfere with the charging operation.

In cross section, the housing generally exhibits a "heart" shape, the two halves of the heart being separated by passageway 20 extending through a line bisecting the heart from its stem to its point or apex. Thus, the walls of each housing section 12 and 14 are formed in the shape of one-half of a heart.

More particularly, each housing section is fabricated of sheet metal or the like formed to define a semicircular arcuately shaped front portion 32 and an integral, straight rear portion 34. The exterior surfaces of the front portions are thus arcuately convergent in the direction of paper travel, and the longitudinal edges 36 at the stem of the heart define a small entrance throat 38 to passageway 20. These exterior surfaces function to deflect a leading edge 40 of sheet member 22 into throat 38 of the passageway in the event that the sheet has acquired a set curl or warp.

The interior surfaces of the straight rear housing wall portions also converge in the direction of travel of the sheet member and similarly function to guide leading edge 20, which may deflect out of the passageway due to electrostatic forces or the set of the paper, to an exit throat 44 defined by longitudinal edges 46—46 of each housing section at the point of the heart.

A covering of electrically insulating material 48 is desirably provided over the edge 36 of the housing section opposite the photoconductive layer, in the illustrated embodiment, the lower housing section, to prevent electrical contact between the photoconductive material and the housing wall. Similarly, a covering 50 of electrically insulating material is provided over the edge 46 of the lower housing section.

Upper corona discharge wire 23 is strung taut between end support walls 16 and 18 by tying one end, (FIG. 4), to a coil spring 56 secured to a threaded fastener 54 carried in an opening 58 defined by wall 16, and threading the remaining end through an opening 60 in end wall 18. This remaining end is subsequently wrapped around a threaded fastener 62 after stretching spring 56 slightly. Fastener 62 also secures a high voltage terminal lug 70 to the outer side of wall 16 which may be conveniently connected to a suitable DC power source. Similarly, lower corona wire 25 is strung between the end walls and secured by a threaded fastener 74 and spring 76 carried in an opening 78 in end wall 16. The remaining end of wire 25 is threaded through an opening 80 in end wall 18 and wrapped about a fastener 81 for suitable electrical connection to a second terminal lug 82.

The corona discharge wires are generally parallel to each other and located in the center of their respective semicircular front housing portions. As noted best in FIG. 1, the corona wires are located a short distance behind an imaginary vertical plane extending through edges 36 forming entrance throat 38 to passageway 20, and are located a suitable distance above and below the passageway 50 so as to be well out of the path of any fortuitously misdirected leading edge 20. Thus, the delicate corona wires are well protected against damage or breakage by a misdirected sheet member.

As also noted in FIG. 1, an open sidewall of each housing section, as defined by the horizontal distance between housing edges 36 and 46 and between end walls 16 and 18, provides a large exposure area to passageway 20. The size of this exposure area allows the sheet member surfaces to be exposed to the ions emanating from the corona wires for a long period of time for a given rate of sheet movement. The beneficial result of the long exposure time is a corona discharge device exhibiting a high charging efficiency and which accordingly reduces the power requirements of associated transformers and other electrical apparatus.

The charging efficiency of the corona discharge device may be controlled by varying the area of the interior wall surfaces which are covered by insulating materials 48 and 50. For instance, for a fixed power source, the charging efficiency may be reduced to compensate for overcharging the photoconductive layer by adding additional insulating material to area 46 in a rearward direction as indicated at 83. An electrostatic charge buildup on the surface of this additional material effectively repels charging ions emanating from the wire in that direction.

As noted above, each housing section is fabricated of metal or the like while end blocks 16 and 18 are fabricated of electrically nonconductive material. Each end block is provided with a pair of bosses 92 having a shape complementary to the interior shape of the housing section for firmly supporting the latter. The end walls also include adjacent slots 94 which snugly receive the straight rear portions 34 of each housing section. Lower housing section 14 is permanently secured to the end blocks 16 and 18 as by pins 96 inserted in holes 97 drilled through each of the end blocks and the end portions of the lower housing section.

Upper housing section 12 may be removably secured to the end blocks for servicing purposes, by a U-shaped resilient retaining clip 98. To assemble the upper housing section,

straight rear portion 34 is inserted into slots 94 of end blocks 16 and 18 and resilient clip 98 is urged over an end of each housing section at block 18. The clip may be positively positioned by providing slits 100 through arcuate portions 32 of each housing section at end block 18, and relieving the adjacent portions of bosses 92 on block 18, at 102.

What has been described is a highly efficient corona discharge device suitable for charging a sheet member carrying a layer of photoconductive material, having improved sheet guiding means without interior guiding structure, and which is of economical manufacture.

It is obvious that upon study by those skilled in the art, the disclosed invention may be altered or modified both in physical appearance and construction without departing from its inventive concept. Therefore, the scope of protection to be given this invention should not be limited by the embodiment described above, but should be determined by the essential descriptions thereof which appear in the appended claims.

The embodiments of the invention in which an exclusive property or privilege are claimed are defined as follows:

1. A corona discharge device for electrostatically charging a layer of photoconductive material on a carrier member, comprising: a pair of elongated housing sections, each having an open sidewall; end means for supporting said housing sections in spaced apart relation with the open sidewalls facing each other and defining a passageway therebetween forming a path for movement of the carrier member through the corona device; corona discharge wires strung between said end means and disposed in each of said sections; each of said housing sections including an arcuately shaped front wall portion and a straight rear wall portion joining said arcuate front wall portion, said front wall portions converging inwardly in the direction of travel of said carrier member and extending rearwardly to present exterior wall surfaces for guiding a carrier member into said passageway and past said corona discharge wires, said straight rear wall portions also converging in the direction of travel and presenting interior wall surfaces for guiding the carrier member out of the passageway.

2. The corona discharge device as set forth in claim 1 wherein said front and rear wall portions comprise the sole guide means for guiding movement of said carrier member into, through, and out of the passageway.

3. The corona discharge device as set forth in claim 2 wherein said front wall portions include longitudinal edges forming a passageway entrance throat, and wherein said rear wall portions include longitudinal edges forming a passageway exit throat having substantially the same dimensions as said entrance throat.

4. The corona discharge device as set forth in claim 3 wherein said housing sections are fabricated of electrically conductive material and wherein a portion of at least one of said housings forming said entrance and exit throats has a covering of electrically insulating material for preventing electrical contact between the photoconductive material and the housing.

5. The corona discharge device as set forth in claim 4 wherein said arcuate front wall portions each comprise a semicircle and wherein only one corona discharge wire is strung in each of said housing sections substantially at the center of the semicircular wall portions.

6. The corona unit as set forth in claim 5 wherein the corona discharge wires are protectively located in each of said housing sections closely adjacent a plane extending perpendicular to the passageway and through the entrance throat coincident with said longitudinal edge of said front wall, thereby being well out of the path of a fortuitously misdirected copy sheet.

7. A corona discharge device for electrostatically charging a layer of photoconductive material on a carrier member, comprising: a longitudinal housing having a heartshaped cross section when viewed along its longitudinal axis, including an upper housing section forming one-half of said heart and an identically shaped lower housing section forming the remaining one-half of said heart; end means supporting said housing

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sections in spaced apart relation forming a passageway generally bisecting the heart between its stem and its apex for passage of the carrier member through said corona device; a corona discharge wire strung in each housing between said support means interior of the housing sections; the exterior surfaces of the curved wall portions of each of said housing

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sections forming said stem cooperating to guide a carrier member into said passageway, and the interior surfaces of the planar wall portions of each housing section forming said apex cooperating to guide said carrier member out of the passageway.

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