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Cecil, II et al.

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[54] CORONA DISCHARGE DEVICE

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[52] **U.S. Cl.** .....**250/49.5 ZC,** 250/49.5 GC

[51] **Int. Cl.**.....**H01j 37/00**

[58] **Field of Search** .....250/49.5 ZC, 49.5 GC; 313/63, 132, 240

[56] **References Cited**

UNITED STATES PATENTS

2,863,063	12/1958	Schulze	250/49.5 GC
3,396,308	8/1968	Whitmore	250/49.5 GC
2,070,307	2/1937	Nicholls	250/49.5 GC
3,369,152	2/1968	Spengler	250/49.5 GC
3,114,877	12/1963	Dunham	250/49.5 GC

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[57] **ABSTRACT**

The continued performance of a charge corona for an electrostatic copy machine is enhanced by the provision of specially configured corona wire support blocks that minimize current leakage through hygroscopic salts accumulating on the support block surface. The support blocks are configured to include a surface interruption that provides a cul-de-sac including surface which is shielded from the path of corona current and ionized gas thereby preventing accumulation of salts on the shielded portion.

12 Claims, 3 Drawing Figures

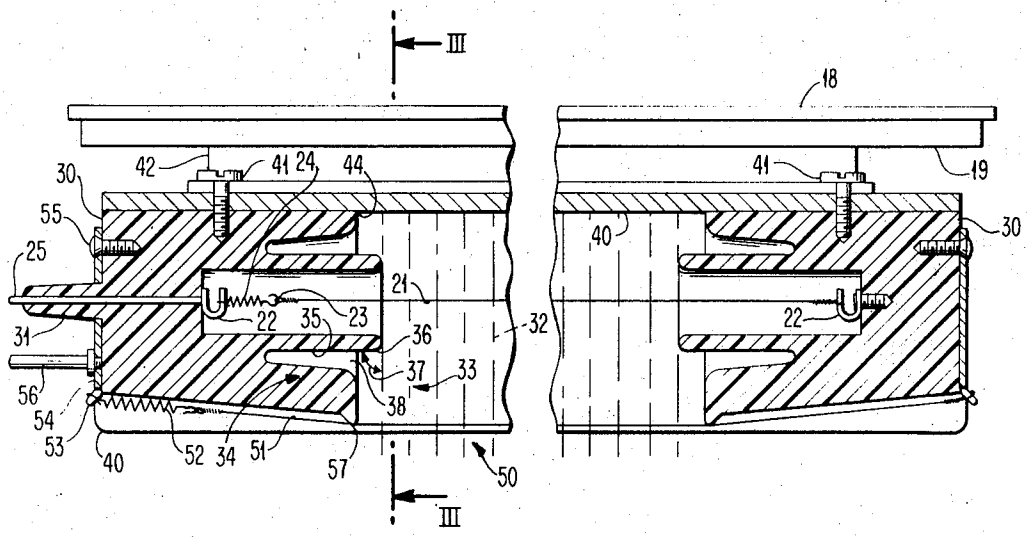


FIG. 1

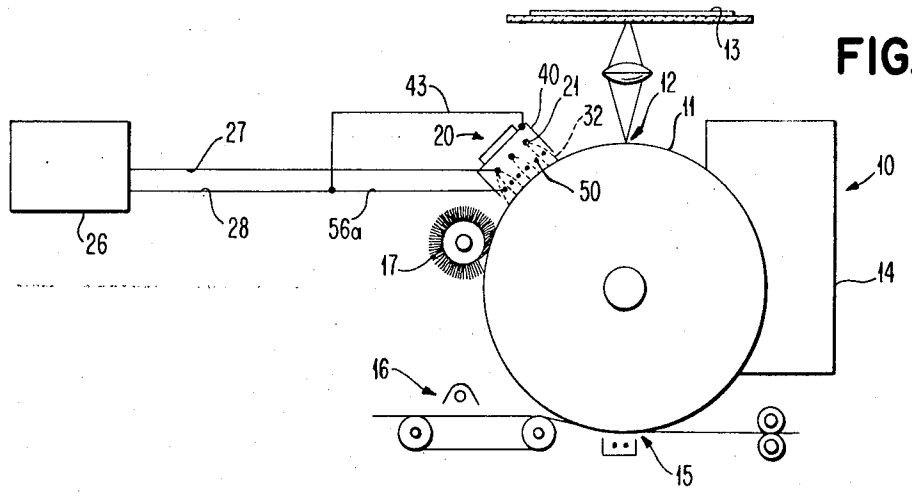


FIG. 2

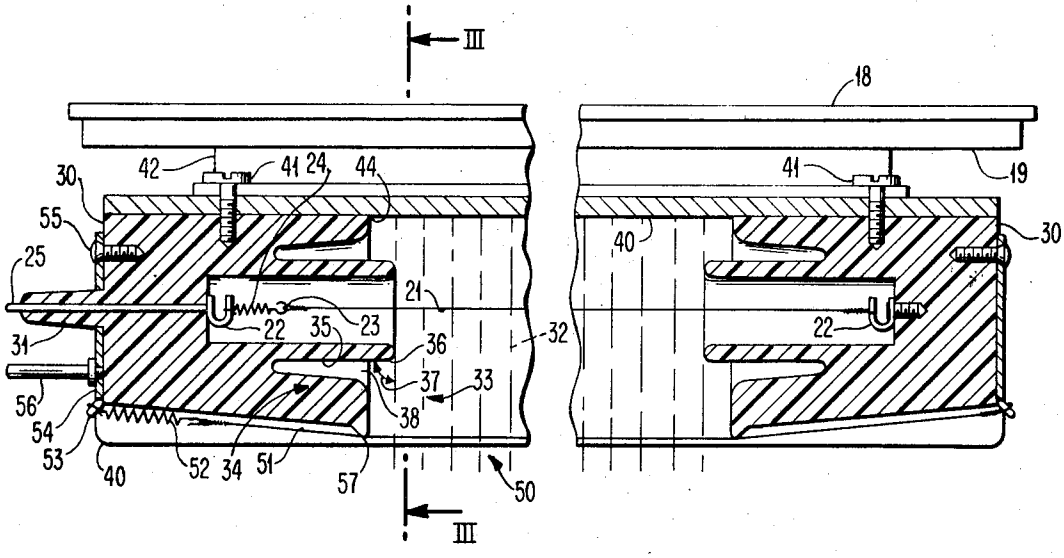
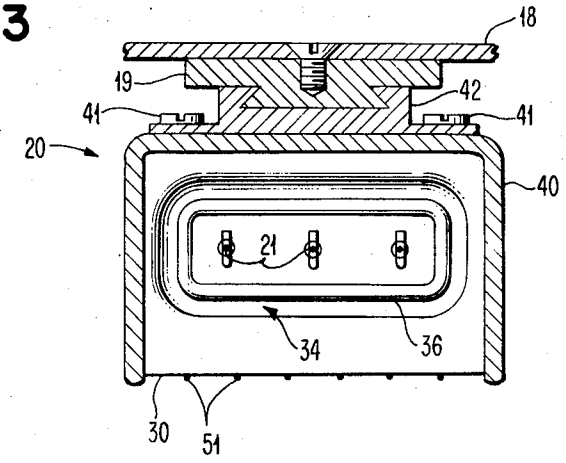


FIG. 3



CORONA DISCHARGE DEVICE

BACKGROUND OF THE INVENTION

Electrostatic document copying machines commonly employ a photoconductive copy surface capable of selectively discharging a uniformly applied initial electrostatic charge in response to a light image.

A latent electrostatic image remains following the discharge which can be developed by the application of charged electroscopic powder through any of several techniques. The more sophisticated techniques employ a magnetic brush or powder cloud with a development electrode and are capable of developing half-tones and solid areas as well as line copy.

Since the latent image is in the form of differential charge levels on the copy surface to which the charged electroscopic powder is attracted, it is important that these differences represent the intended image as accurately as possible. The charge corona is one possible source of non-image variations in charge which can interfere with the accurate reproduction of a document. Uniform operation of a charge corona is achieved through the selection of relatively large corona current flow which, by its very magnitude, reduces the significance of potential non uniformities.

It can be appreciated that loss of current through leakage paths thus, would reduce the quality and efficiency of corona performance. Where leakage paths develop through continued use or through use under varying conditions, the performance of the entire copying process will suffer accordingly.

It has thus been an object of our invention to eliminate a major source of corona current leakage caused by the accumulation of conductive salts on the surface of necessary electrode support structure. A further object of our invention has been to provide a corona discharge unit having a sustained high quality performance that is achieved by the simple configuration of the electrode support parts.

DISCLOSURE OF THE INVENTION

It has been determined that the ionization of gases in the air characteristic of a corona discharge result in the precipitation of hygroscopic electrically conductive salt on surfaces over which ionized gases pass. The corona discharge operation itself creates a gas movement in the direction of ion flow. The gases brush against the surfaces adjacent to their path and deposit salts thereon. These salts can form a conductive path along the surface of various supporting members from the corona wire to other conductive structure such as a control grid, a current receiving shield, or even the machine frame. Our invention provides an interruption in the surface of corona wire support structure such as end-blocks, to prohibit a continuous path of conductive salts from being developed through corona operation. The interruption comprises a shielded surface portion that is substantially out of the path of ionized gases and can preferably be in the form of an elongated cul-de-sac having a restricted entrance that is inherently non-receptive to gaseous flows. Thus, in a corona unit designed in accordance with our invention, all paths from the point of corona electrode contact with support structure to adjacent conductive structure, must traverse a shielded non-conductive surface.

Our invention will be more completely understood from the following description of a specific illustrative

embodiment of our inventive concepts wherein reference is made to the accompanying drawings, of which:

FIG. 1 is an elevational schematic view of a xerographic type electrostatic copy reproducing machine;

FIG. 2 is a cross-sectional view of a charging corona unit constructed in accordance with our invention and taken along the line of its longitudinal axis; and

FIG. 3 is a side cross-sectional view of the corona unit shown in FIG. 2 taken along axis III — III thereof.

Referring now more specifically to the drawings, in FIG. 1 there is shown a xerographic type electrostatic copy reproducing mechanism **10** having a corona discharge assembly or charge corona unit **20** for placing a uniform electrostatic charge on a copy drum surface **11.** The charged copy surface **11** is passed under an imaging station **12** where the original charge is selectively discharged by a light image from an original document **13.** The resultant latent image is moved to a development station **14** which for example could be like that described in U. S. Pat. No. 3,599,605. After the image is developed, it is passed to a transfer station **15** where plain paper is fed into superimposition therewith and the image is transferred to the paper. The paper then is separated from the drum surface **11** and passed to a heat fixing station **16** while the drum surface **11** continues to move to a cleaning station **17** for preparation for further copying. As discussed above, the ability of the copy machine **10** to faithfully reproduce an image of the original document **13** depends, in part, upon the uniformity of the initial charge received by surface **11** from the charge corona unit **20.**

One preferred form of corona construction is shown in FIGS. **2** and **3.** The corona unit **20** includes three elongated corona emitting electrode wires **21** that are suspended in spaced relation from the copy surface **11** between hooks **22** carried by a pair of electrically insulative end blocks **30** best shown in FIG. **2.** The end blocks **30** are connected to suitable frame-work **18** through an electrically conductive shield **40** by screws **41.** The shield **40** is slideably mounted by a track member **42** on dovetail frame part **19** connected to the machine frame part **18** to permit removing of the corona unit **20** for repair or cleaning.

The hooks **22** are connected to the electrode wire ends **23** by tensioning springs **24.** Conductor rod **25** extends through the end block **30** and is electrically connected with the hooks **22** at one end and projects outwardly of a tapered plug portion **31** for connection to a suitable power supply **26,** see FIG. **1.**

The charge corona unit **20** also includes a wire control grid **50** positioned between the corona wires **21** and the drum surface **11** for limiting the corona current received by the drum surface **11.** The wires **51** of grid **50** are also supported by the end blocks **30** as best shown in FIG. **2.**

One end of each grid wire **51** is connected through tensioning springs **52** to a tab **53** of a mounting plate **54.** A screw **55** anchors the mounting plate **54** to the end block **30.** A conductor rod **56** is connected to the mounting plate **54** to provide for connection of the grid **50** to a suitable potential source such as power supply **26,** see FIG. **1.**

In operation, the electrode wires **21** are connected to a high potential line **27** of power supply **26.** Also, the shield **40** and grid **50** are connected to a lower potential line **28** of the power supply **26,** through conductors **43** and **56*a*** respectively. Alternatively, the shield **40** can

be connected to ground if desired. The difference in potential between the electrode wires **21** and the shield **40** and grid **50** causes the air therebetween to become ionized and a so-called corona current discharge or flow occurs. Since the copy surface **11** is at a different potential than the corona electrode wires **21**, a potential exists for causing a portion of the corona current flow to go past the grid **50** and deposit charge on the copy surface **11**. The path of the corona discharge current flow is shown by the lines **32** in FIGS. **1** and **2**.

The flow of current in a corona discharge is accompanied by a movement of the gases that are ionized and these gases also move along the path of corona discharge **32**. As seen in FIG. **2** these gases will brush against inwardly facing external surface **33** of the supporting end blocks **30**. While all of the end blocks **30** are made of electrically insulated material and thereby provide no conductive path for current flow between the corona electrode wires **21** and other conductive parts connected thereto, such as the grid wires **50** or the shield **40**, the inwardly facing external surface **33** which is generally exposed to the path of corona current flow can become conductive due to the deposition of salts from the corona gas movement.

The corona exposed surface region **33** of the end block **30** of our corona includes an interrupted configuration in the form of a long and narrow cul-de-sac **34** that is positioned between the point of corona wire suspensing connection **22** and the point of contact such as **57** between the end block **30** and the grid wire **50** or the point **44** between the end block **30** and the shield **40**. The cul-de-sac **34** includes a shielded surface portion **35** including an overhanging lip **36** that faces outwardly away from the corona wire **21** and extends at a substantial angle **37**, greater that 45° and preferably 90° from the path **32** of corona discharge flow. The cul-de-sac **34** further, is preferably formed with a narrow inlet **38** and is relatively long with respect to the inlet **38** to substantially eliminate any regular flow of ionized gases therewithin.

In operation, corona discharge from electrode wires **21** produces ionized gases which precipitate salts on the exposed inwardly facing surface **33** of the corona end block **30**. While the surfaces thus become conductive, a complete electrical path is not formed, however, due to the presence of the shielded surface **35** of the cul-de-sac **34** which does not receive corona generated salts. Thus, surface portion **35** remains an electrically insulated interruption lying in any path that can be traced on the corona exposed surface **33** from the corona wires **21** to a conductive member such as grid wires **50** or shield **40** that is also in contact with the end blocks **30**. The performance of the charge corona unit **20** thus will not deteriorate with time due to the accumulation of corona generated salts on its necessary supporting end blocks **30**.

While we have described a preferred illustrative embodiment of our invention to illustrate certain principals of our inventive concepts, those skilled in the art will recognize that various modifications, deletions and additions can be made to the embodiment shown without departing from the spirit and resultant benefits of our invention. For example, our invention can be beneficially employed in corona units having electrodes other than wire electrodes and in corona units that do not have a control grid. Accordingly, it is to be understood that the protection sought by Letters Patent is to be defined and limited solely by the appended claims.

We claim:

1. A corona discharge assembly of the type having electrode means, means for suspending said electrode means in spaced relation to a corona current receiving member whereby a corona current flow path is defined between said electrode means and said corona current receiving member, said suspending means comprising at least one electrically insulative member supportively connected to said electrode means and including an external surface having a region that is generally exposed to the path of corona current flow, and electrically conductive means engaging said insulative member at a location spaced from said electrode means wherein the improvement comprises:

means forming an interruption in said corona exposed external surface region positioned between said electrode means and said electrically conductive means whereby substantially all paths on said corona exposed external surface region of said insulative member between said electrode means and said electrically conductive means cross said interruption,

said interruption including a shielded surface portion that lies out of the path of corona current flow.

2. The corona discharge assembly as defined in claim **1** wherein said shielded surface portion extends in a direction making a substantial angle with the path of corona current flow and faces outwardly away from said electrode means.

3. The corona discharge assembly as defined in claim **1** wherein said shielded surface portion extends in a direction making an angle in excess of 45° with the path of corona current flow and faces outwardly away from said electrode means.

4. The corona discharge assembly as defined in claim **1** wherein said shielded surface portion extends in a direction that is substantially normal to the path of corona current flow and faces outwardly away from said electrode means.

5. The corona discharge assembly as defined in claim **1** wherein said interruption comprises a cul-de-sac configuration formed in said insulative member and having at least a restricted external opening to minimize gaseous movement therethrough.

6. The corona discharge assembly as defined in claim **5** wherein said cul-de-sac configuration long relative to said restricted external opening.

7. A corona discharge assembly of the type having at least one elongated electrode means, means for suspending said electrode means in spaced relation to a corona current receiving member whereby a corona current flow path is defined between said electrode means and said corona current receiving member, said suspending means comprising at least a pair of electrically insulative members supportively connected to opposed ends of said elongated electrode means, and each including an external surface region that is generally exposed to the path of corona current flow and electrically conductive means engaging said insulative members at points spaced from said electrode means, wherein the improvement comprises:

means forming an interruption in said corona exposed external surface region of each of said insulative members positioned between said electrode means and said electrically conductive means whereby substantially all paths on said corona ex-

posed external surface region of said insulative members between said electrode means and said electrically conductive means cross said interruption,

said interruptions each including a shielded surface portion that lies out of the path of corona current flow.

8. The corona discharge assembly as defined in claim **7** wherein said electrically conductive means comprises a control grid positioned in the path of corona current flow and supportedly mounted on said insulative members.

9. The corona discharge assembly as defined in claim **7** wherein said electrically conductive means comprises a conductive shield partially surrounding said electrode means and being supportingly connected to said insulative members.

10. The corona discharge assembly as defined in claim **8** wherein said electrically conductive means comprises a conductive shield partially surrounding said electrode means and being supportingly connected to said insulative members.

11. A corona discharge assembly of the type having at least one elongated electrode wire, means for suspending said electrode wire in spaced relation to a corona current receiving member whereby a corona current flow path is defined between said electrode wire and said corona current receiving member, said suspending means comprising at least a pair of electrically insulative members supportively connected to opposed ends of said electrode wire and each including an external surface region that is generally exposed to the path of corona current flow, and electrically conductive control grid means supportedly connected to said electrically insulative members and positioned between said electrode wire and said corona current receiving member for limiting corona current flow, wherein the improvement comprises:

means forming an interruption in said corona exposed external surface region of each of said insulative members,

said interruption including a surface portion extending a substantial distance generally normal to the path of corona current flow and facing outwardly away from said electrode wire, and positioned between said electrode wire and said conductive grid

whereby substantially all paths on said corona exposed external surface regions of said insulative members between said electrode wire and said conductive grid cross said interruptions.

12. An electrostatic copy reproducing mechanism having a copy surface, for receiving an electrostatic charge and comprising the improvement of a corona discharge assembly as defined in claim **11** wherein

said copy surface comprises said corona current receiving member and further comprising

high voltage power supply means for delivering corona generating potential to said electrode wire, and

means connected with said conductive grid for controlling the potential thereon.

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