March 3, 1970 S. W. MARTIN 3,499,143

ELECTROSTATIC CHARGER WITH RESUPPLIABLE CORONA WIRE

Filed May 21, 1968

Fig 1

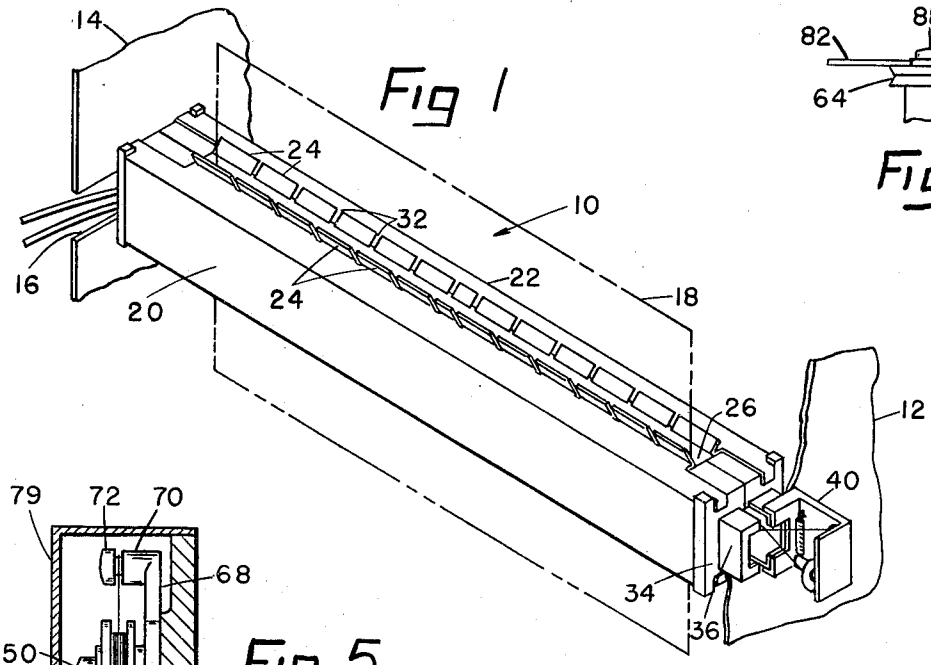


Fig 6

Fig 5

Fig 2

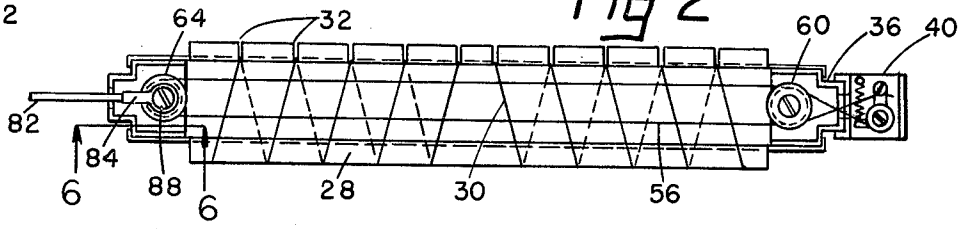


Fig 3

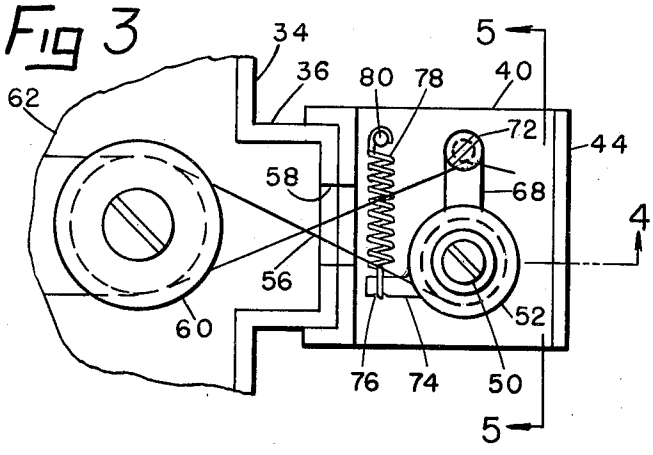
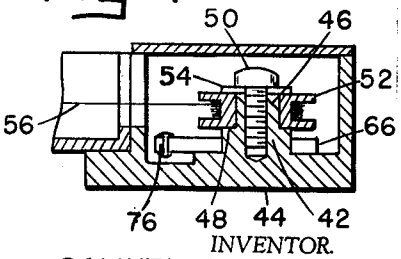


Fig 4



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ELECTROSTATIC CHARGER WITH RESUPPLIABLE CORONA WIRE

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ABSTRACT OF THE DISCLOSURE

A charger for use with electrostatic copying machines in which the corona wire is renewable or resuppliable when it becomes sufficiently defective by reason of dirt or other foreign matter on the wire to cause unacceptably poor quality copy. There is a supply of corona wire of indefinite length mounted on the charger for which one or more runs of fresh wire can be periodically withdrawn with provision for releasably holding the wire under tension during periods of use.

Background of the invention

In the process of electrostatic copying, a sheet of copy paper having a coating of a photoconductive insulating material is passed through a corona charging device which imparts a uniform electrostatic charge to the coated side of the paper. The paper is then subjected to a light patterned image or indicia on an original document whereupon the electrostatic charge is dissipated in the light non-image areas but is retained in the darker image areas, after which the sheet is subjected to an aplication of electrostatically attractable toner particles to develop the latent image lift on the paper.

Substantially the same principles are applied in the field of reusable electrostatic copying in which the photoconductive insulating material is a coating on a drum or plate which is grounded and on which the latent electrostatic image is formed and developed. The developed image is then transferred to ordinary paper, and the drum or plate is cleaned and resued in the same manner to make successive copies.

In either of the above processes, both of which are well known in the art, it is necessary to uniformly charge the photo conductor prior to exposing it to the light pattern. One preferred method for charging is by means of corona discharge from one or more very thin wires, in the order of 2 to 3 mils in diameter, which are stretched across the path of the photoconductor and to which is applied a negative electric current in the order of 6000 volts. Although the exact phenomenon is not precisely understood, it is believed that this extremely high charge breaks down the air immediately surrounding the wire into a cloud of ions which causes electrons to migrate from the negative wire toward either a positive wire which completes the charging circuit in the case of a two wire charger for charging photoconductive paper, or a grounded drum or plate which completes the charging circuit in the case of a single wire charger for charging a reusuable photoconductor The flow of electrons toward and through the photoconductor produces a uniform electrostatic charge or negative polarity thereon.

A major drawback of the corona discharge device is the accumulation of dirt and other foreign matter on the negative wire in the charging unit, which is the wire facing the sensitive side of the photoconductor. It is known that accumulations of dirt, such, for example as paper dust, spray paint, face powder, or dry toner particles, prevents a corona effect from being achieved along the portion of the wire covered by the dirt, either because the dirt acts as an effective insulator or because the

dirt increases the diameter of the wire which must remain extremely thin in order to produce the corona effect. A covering of only 2 mils has been found to be sufficient to prevent a corona from being produced along a portion of the wire. The result of this is that the portion of the photoconductor adjacent the dirty portion of the wire is not charged and therefore any image projected on this portion of the photoconductor is not reproduced since no toner particles will adhere to a non-charged area of the photoconductor.

Thus a copy made on or from a photoconductor which has been charged with a dirty corona wire may be streaked with bands of imageless areas of varying width depending on the length of wire portions over which corona discharge is not achieved due to the accumulation of dirt or other foreign matter.

It is possible to clean dirty corona wires either by a wet swab, since most dirt accumulations are water soluble, or by scrapping the dirt off with a knife. Both of these methods and particularly the latter, have an adverse effect on the life of the wire. Also, both methods require that the copying machine be sufficiently disassembled to permit removal of the charging device from the machine so that it can be opened to provide access to the wires. It is also significant to note that it is a very delicate, time-consuming and diffcult task to rethread a charger with corona wires in the event that one or more should break or be dislodged during a wire cleaning operation. Thus the solution of cleaning the corona wires presents obvious disadvantages.

Brief summary of the invention

The present invention obviates the disadvantages of prior art corona discharge electrostatic chargers by providing a charging device in which the corona wire is renewable or replaceable

The principles of the present invention are embodied in a preferred form of an electrostatic charger which consists generally of a shell member which forms a housing for a corona discharge wire which extends longtudinally of the shell and substantially from one end thereof to the other. The shell is provided with means for mounting it between a pair of spaced parallel plates which constitute a frame for supporting the several working components which make up a copying machine. The charger includes a bracket or housing which projects beyond one of the frame plates so as to be accessible to an operator of the copying machine. A spool of corona wire of indefinite length is rotatably mounted on the bracket with releasable means to normally constrain the spool against rotation, and there are supporting means on the shell which support at least one run and preferably two runs of wire in such manner that the wire can be pulled freely through the shell when the spool is not constrained against rotation Tensioning means is provided on the bracket to which the free end of the wire is releasably secured so that the wire is maintained under proper tension at all times except when it is being replaced. A suitable electrical connection is also made to the wire through the wire supporting means so that no electrical connections need be disconnected when it is necessary to replace the wire after a period of use.

In this construction, when the operative portion of corona wire in the charger accumulates sufficient dirt so as to be considered inoperative to produce satisfactory copy, the spool constraining means is loosened sufficiently to permit rotation of the spool and the free end of the wire is removed from the tension device. A desired length of wire is pulled through the charger, after which the spool is retightened and the free end is resecured to the tensioning device in such manner that the wire is again placed under tension.

Having briefly described the general features of the present invention, it is a principle object thereof to provide an electrostation charging device for photocopy machines having novel features of construction and operation which avoid the disadvantages of prior art charging devices.

It is another object of the present invention to provide an electrostatic charging device for photocopy machines in which a corona discharge wire is renewable or replaceable when necessary as determined by the quality of copy delivered by the copying machine.

It is still another object of the present invention to provide an electrostatic charging device for photocopy machines in which a corona discharge wire is renewable or replaceable without removing the charging device from the copying machine and without having to disassemble any part of the charging device.

It is yet another object of the present invention to provide an electrostatic charging device for photocopy machines in which a corona wire is renewable or replaceable without the necessity of removing the electrical connection to the corona wire.

A feature of the present invention is the provision of an electrostatic charging device for photocopy machines having a self contained supply of corona wire and means for maintaining the wire under proper tension when the charging device is in use.

It is a still further object of the present invention to provide an electrostatic charging device for photocopy machines which is readily adaptable to known copying machines without substantial modification, is economical to manufacture and reliable in operation.

These and other objects and advantages of the invention will be more readily apparent from an understanding of the following detailed description of a preferred embodiment of the invention when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a electrostatic charging device embodying the principles of the present invention;

FIG. 2 is a front elevation of the rear half of the electrostatic charging device shown in FIG. 1;

FIG. 3 is a fragmentary front elevation drawn to an enlarged scale of the right hand end of the component shown in FIG. 2;

FIG. 4 is a sectional view taken on the line **4—4** of FIG. 3;

FIG. 5 is a sectional view taken on the line **5—5** of FIG. 3; and

FIG. 6 is a detailed view of the electrical connection taken on line **6—6** of FIG. 2.

Detailed description of the invention

Referring now to the drawings and particularly to FIG. 1 thereof, an electrostatic charger **10** embodying the principles of the present invention is shown as being supported by the spaced, parallel, upstanding side frame plates **12** and **14** of which only fragmentary portions are shown as being sufficient for the purpose of this disclosure. The charger is supported by slots **16** extending inwardly from an edge of the plates **12** and **14** in position to lie in the path of a sheet of copy paper **18** which is being fed along a copy paper path generally defined by a copy paper transport means, all in a manner well known in the art and forming no part of the present invention.

The charger generally comprises a pair of juxtaposed charger shells **20** and **22** each of which is elongate to extend between the side plates **12** and **14** of the cop.ying machine and which are generally rectangular in cross section and closed on three sides, the side of each shell facing inwardly and adjacent the opposite shell being open. Each shell is provided with a plurality of angularly disposed tabs **24** disposed on the upper or infeed side in relation to the direction of travel of the sheet of copy paper **18** which converge in said direction of feed to define an entrance slot **26** into the charger **10**. Each shell also has a flange **28** (FIG. 2) disposed along the exit side of the paper passageway through the charger. A string **30** of suitable material is wound around each shell in a helical pattern diverging from the center of the shell, the string **30** being engaged in slots **32** between the tabs **24** to maintain the string **30** in position. The wire prevents the copy paper from entering the shells and coming in contact with the corona wire as located therein.

Each shell is provided with an end cap **34** on the opposite open ends, and each end cap **34** has an outwardly extending projection **36** which engages with the slots **16** in the frame plates **12** and **14** to support the charger **10** therein, and also to provide a convenient means and location for securing the ends of corona wires in a manner well known in the art. The shell **20** is conventional in all respects and therefore need not be further described nor shown in greater detail.

The present invention is embodied specifically in the shell **22** which houses the negative corona wire which, it will be recalled from above, is the corona wire adjacent the coated side of the photoconductive paper and is the one adversely affected by attraction and deposit thereon of foreign matter.

Referring now to FIGS. 2–5, it will be seen that a generally U-shaped bracket member or housing **40** is suitably secured to projection **36** of the end cap **34** on one end of the shell **22**. As best seen in FIG. 4, a boss **42** is formed on the bottom wall **44** of the housing **40**, and another boss **46** of reduced diameter extends upwardly from the boss **42**, thereby defining a shoulder **48** between the two bosses. Both bosses are tapped to receive a screw **50**.

A spool **52** having an aperture therethrough is mounted on the upper boss **46** and rests on the shoulder **48**. The spool is at least as thick as the boss **46** is high, and is held on the boss **46** by means of a washer **54** which bears on the upper surface of the spool **52** to lock the spool against rotation when the screw **50** is tightened. The screw **50**, washer **54** and shoulder **48** thus define a releasable means for normally constraining or locking the spool against rotation. It will be understood that other means could be provided, such as a clamp or merely friction retaining means.

The spool **52** holds a supply of corona wire **56** which, as best seen in FIGS. 2 and 3, extends from the spool **52** through an opening **58** formed in the projection **36** of the end cap **34**, and over a pulley **60** suitably mounted in the shell **22** in spaced relationship with the bottom wall **62** thereof. The corona wire then extends across the length of the shell **22** to another pulley **64** similarly mounted adjacent the opposite end of the shell **22**. The wire passes around the pulley **64** and returns to the pulley **62**, thereby forming 2 runs of spaced parallel wires. From the pulley **60**, the second run of wire passes through the opening **58** and the terminal end of the wire is secured to a tensioning means.

The tensioning means comprises an L-shaped lever having an apertured central portion **66** pivotally mounted on the lower boss **42** coaxially with the spool **52** and resting on the bottom wall **44** of the bracket member **40** so that the spool **52** retains the lever in operative position on the bracket member **40**. One leg **68** of the lever extends away from the central portion perpendicularly to the longitudinal axis of the shell **22** and terminates in tapped head **70** which receives a screw **72**. The terminal end of the wire **56** is adapted to be wound around the screw by a few turns after which the screw is tightened to prevent the wire from unwinding from the screw **72**.

The other leg **74** of the lever extends toward the shell **22** and terminates in a hook portion **76** which holds one end of a tensioning spring **78**, the other end of the spring **68** being secured to a stud **80** formed on the bracket member **40**. The spring **78**, when in a stressed condition,

urges the lever in a clockwise direction as viewed in FIG. 3. The tensioning device is preferably enclosed by a suitable cover member **79** secured to the bracket **40**.

A high voltage electric current is supplied to the wire **56** by means of a lead **82** having a terminal **84** resting on the pulley **64**, which is made of conductive material, the pulley **64** resting on a stud **86** (see FIG. 6) formed on the bottom wall of the shell **22** and secured thereto by a screw **88**.

From the foregoing, it will now be understood that when either one or both runs of the corona wire have become covered with dirt to the extent that poor quality copy is delivered by the copying machine, the operator removes the cover **79** and loosens the screws **50** and **72** for the spool and terminal end of the wire respectively. He then unwinds the wire from the screw **72** and pulls off a length of wire equivalent to twice the length of the charger **10**, or approximately 20 inches. The screw **50** is then tightened to prevent further rotation of the spool **52** after which the operator takes a turn or two of wire around the screw **72** and pulls on the wire in a counterclockwise direction about the screw **50** in order to rotate the tensioning lever enough to place the spring **78** again under tension, the tension having been relieved when the screw **50** is loosened. After the spring **78** is suitably tensioned, the screw **72** is tightened, the used portion of wire is cut off, and the cover **79** replaced, whereupon the charger is again ready for operation with two runs of fresh corona wire.

It should be understood, of course, that it is optional with the operator as to the length of wire which is pulled from the spool since it may not be necessary to completely replace both runs of wire in order to remove the cause of poor quality copy.

It is apparent from the foregoing that there is provided an electrostatic charger with resuppliable corona wire which avoids the disadvantages of heretofore known chargers and which achieves the foregoing objects of the invention. It is to be understood that the present invention is not to be considered as limited to the embodiment disclosed herein and shown in the accompanying drawings, which is intended to be merely illustrative of the best mode presently contemplated for carrying out the principles of the invention and which is subject to change in size, form, arrangement and detail of parts, the invention being intended to cover all such variations, modifications and equivalents thereof as may be deemed to be within the scope of the claims appended hereto.

I claim:

1. An electrostatic charging device for photocopy machines comprising
   (A) an elongate housing having means adjacent the opposite ends thereof for mounting said housing in a photocopy machine, said housing having an opening therein adjacent the path of movement of a photoconductive element to be electrostatically charged in the photocopy machine,
   (B) means mounted on said housing for storing a supply of corona discharge wire of indefinite length,
   (C) means on said housing for supporting at least one run of said wire substantially between said opposite ends of said housing and adjacent the opening in said housing,
   (D) means mounted on said housing for engaging the free end of said wire and being selectively operable to normally hold the free end of said wire in a fixed position relative to said housing and to permit movement of said wire from said storing means through said housing,
   (E) tensioning means coacting with said storing means and said engaging means for normally maintaining said run of wire under tension, and
   (F) means for connecting a power supply to said corona wire.

2. A device according to claim **1** wherein said storing means comprises a spool rotatably mounted on said housing and including means for normally constraining said spool against rotation.

3. A device according to claim **1** wherein said engaging means is located on said housing in a position accessible to an operator without removing said housing from the photocopy machine.

4. A device according to claim **1** wherein said means for supporting said wire includes means for establishing an electrical circuit to said wire from an external source of current.

5. An electrostatic charging device for photocopy machines comprising
   (A) an elongate housing having means adjacent the opposite ends thereof for mounting said housing in a photocopy machine, said housing having an opening therein adjacent the path of movement of a photoconductive element to be electrostatically charged in the photocopy machine,
   (B) a bracket member secured to said housing in a position to be accessible to an operator while said housing is in the photocopy machine,
   (C) means on said bracket member for storing a supply of corona discharge wire of indefinite length,
   (D) means on said housing for supporting two spaced apart parallel runs of said wire substantially between said opposite ends of said housing and adjacent the opening in said housing,
   (E) means mounted on said bracket member for engaging the free end of said wire and being selectively operable to normally hold the free end of said wire in a fixed position relative to said housing and to permit movement of said wire from said storing means through said housing,
   (F) tensioning means mounted on said bracket means and coacting with said storing means and said engaging means for normally maintaining said runs of wire under tension, and
   (G) means for connecting a power supply to said corona wire.

6. A device according to claim **5** wherein said storing means comprising a spool rotatably mounted on said bracket member and including releasable means for normally locking said spool against rotation.

7. A device according to claim **5** wherein said means for supporting said runs of wire comprises a pulley mounted on said housing adjacent each of said opposite ends of said housing, at least one of said pulleys being made of electrically conductive material and being secured to said housing by means which permits the terminous of an electric current supply line to be connected thereto.

8. A device according to claim **5** wherein said engaging means comprises a lever pivotally mounted on said bracket member and having means on one end thereof for removably holding said wire, and said tensioning means comprises spring means coacting between said bracket member and an opposite end of said lever and biasing said one end of said lever in a direction to exert a pull on said wire.

9. A device according to claim **8** wherein said lever is substantially L-shaped and is mounted on said bracket member coaxially with said spool between said spool and a wall of said bracket member whereby said spool retains said lever in operative position on said bracket.

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WILLIAM F. LINDQUIST, Primary Examiner

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