# United States Patent

[11] 3,615,397


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[23] **Division of Ser. No. 647,411,**
**June 20, 1967, Pat. No. 3,526,457**
[45] Patented **Oct. 26, 1971**



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[54] **METHOD OF CLEANING ELECTROSTATIC COPYING MACHINES**
**1 Claim, 5 Drawing Figs.**


[52] **U.S. Cl.** ..... **96/1.4,**
117/17.5, 134/1, 134/7, 15/1.5, 15/100
[51] **Int. Cl.** ..... **G03g 13/14**
[50] **Field of Search** ..... 96/1.4;
117/17.5; 134/1, 7; 15/100



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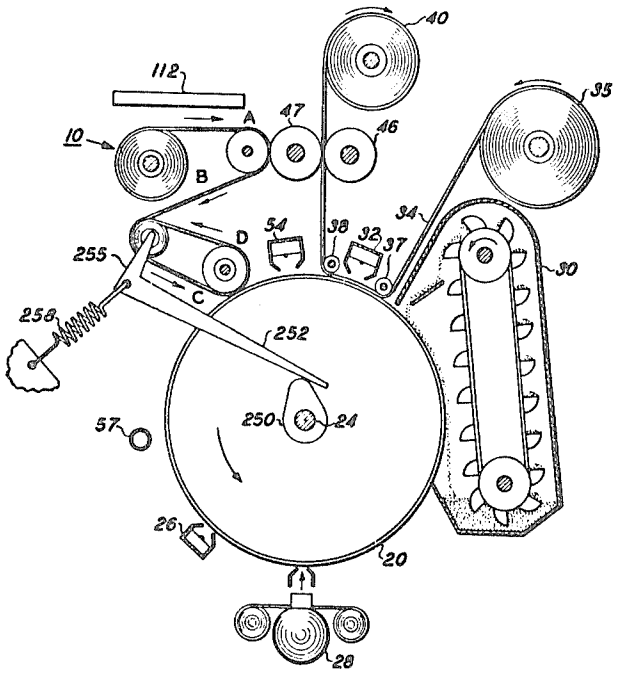
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**ABSTRACT:** Method for cleaning the surface on which electrostatic latent images are formed and developed. A web of fibrous material is advanced in constant linear increments into rubbing contact with the surface to be cleaned. A combination of loops in the web path enables cleaning two surfaces simultaneously utilizing both sides of the web.

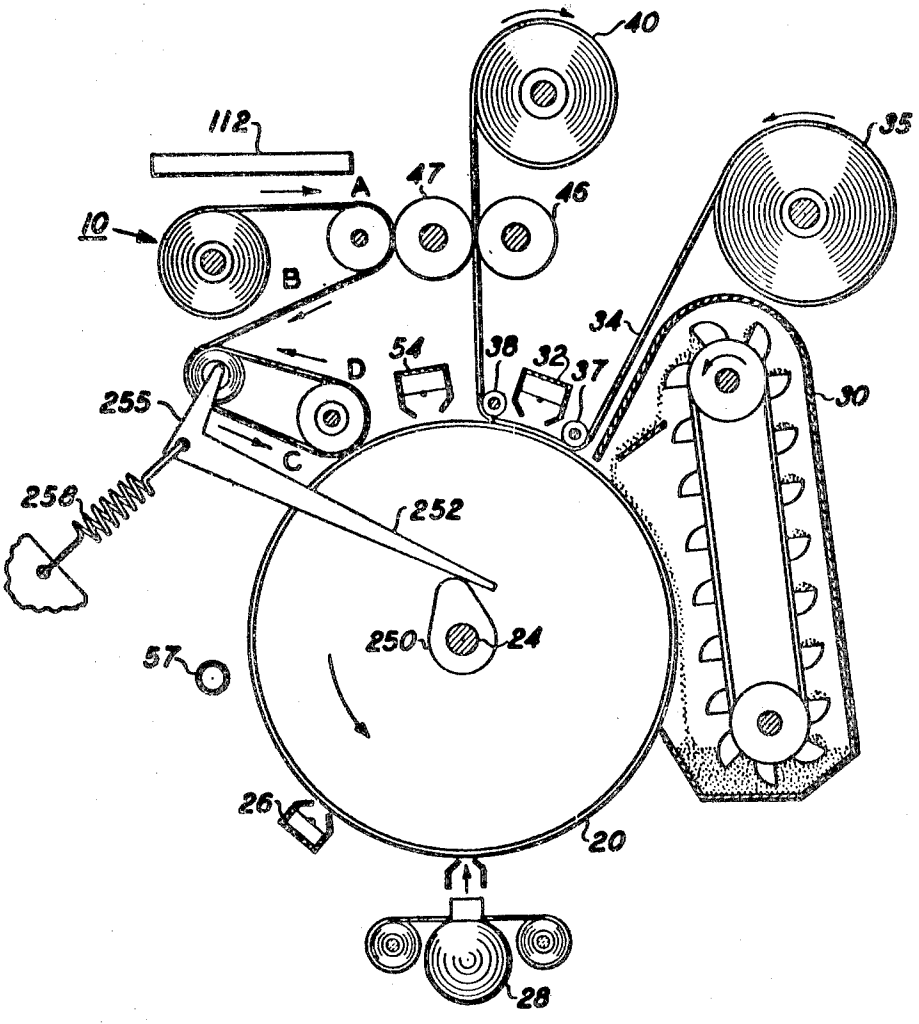



FIG. 1

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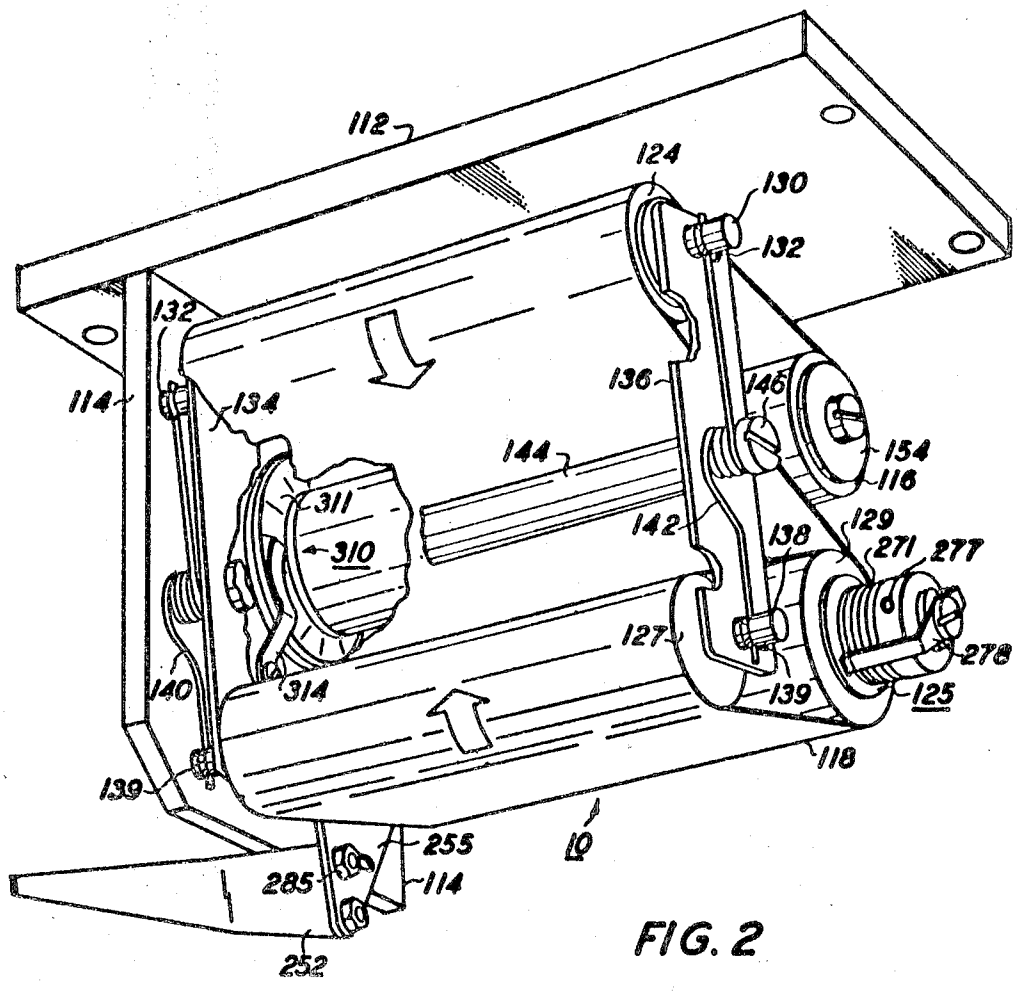

112
124
130
132
132
114
134
136
146
144
154
116
311
310
142
138
129
271
277
127
278
140
314
139
125
118
139
10
255
285
114
252

FIG. 2

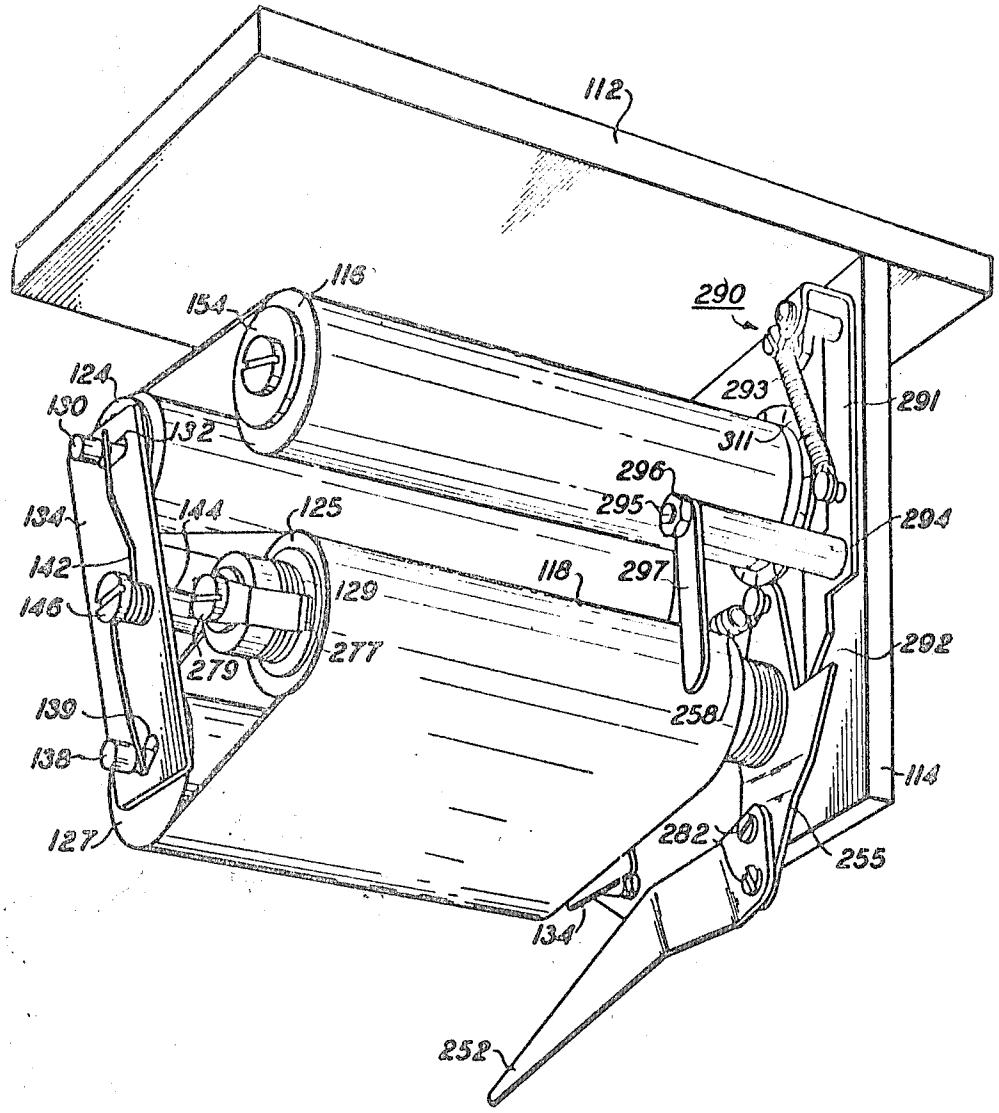

112
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277
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292
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258
138
114
127
282
255
134
252

FIG. 3

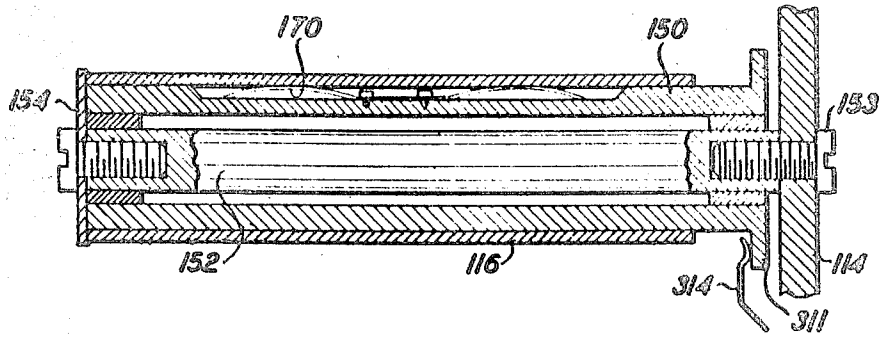

170
150
154
159
152
116
114
314
311

FIG. 4

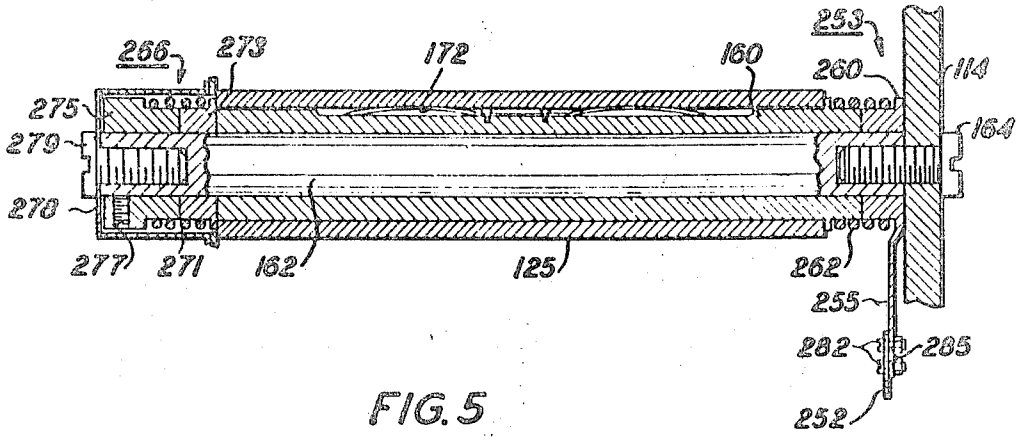

266
273
172
160
253
260
114
275
279
164
270
277
271
162
125
262
255
282
285
252

FIG. 5

# METHOD OF CLEANING ELECTROSTATIC COPYING MACHINES

This application is a division of application, Ser. No. 647,411 filed June 20, 1967, now U.S. Pat. No. 3,526,457.

## BACKGROUND OF THE INVENTION

This invention relates to electrostatic copying and, more particularly, to apparatus for cleaning the surfaces contacted by an electrostatic powder image during the production of copy.

In one process of electrostatic copying, commonly referred to as xerography and disclosed in Carlson U.S. Pat. No. 2,297,691 issued on Oct. 6, 1942, a plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to a document to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the radiation intensity that reaches them and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged, finely divided material that is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the developed xerographic powder image is usually transferred to a support surface to which it may be fixed by any suitable means, such as, by heat and/or pressure.

As an incident to this cycle of operation and after the transfer of the powder image, a residue of unremoved developing material usually remains on the plate in image configuration. This residue is generally referred to as a "residual powder image." Before the plate can be used for a subsequent reproduction cycle, it is necessary to remove completely the residual powder image from the plate. Also in the case of pressure fixing the image to its support material it is necessary to remove image powder offset on the pressure roll in contact with it for the continuous production of high-quality copy.

Heretofore, plate cleaning in electrostatic copiers was normally accomplished by one or more rotating brushes which brushed residual powder from the plate. Typical brush cleaning apparatus is disclosed in U.S. Pat. No. 2,832,977 to Walkup. Generally speaking, a cleaning brush material must be sufficiently soft so that it does not abrade the plate surface and at the same time be sufficiently firm to remove the residual powder image without becoming matted or clogged after repeated use. Other factors, such as the triboelectric characteristics of the material also enter into the desirability of its selection for brush cleaning.

In xerography animal furs, such as New Zealand rabbit, have shown themselves to be preferred for cleansing brushes. Unfortunately, brushes of the animal fur type are expensive. Moreover, they have a limited cleaning life of approximately 35–40 hours, when used, for example, to clean a 15½-inch diameter drum rotating at about 5 r.p.m. before they become clogged and operate at decreased efficiency.

Various attempts have been made at cleaning a moving xerographic surface by other than fur brush, such as, by pulling a fibrous material across it. The latter, while satisfactory in one sense, requires a rather complicated and costly transport mechanism. Also the fibrous material normally is advanced continuously in synchronization with the moving plate causing it to be used up quickly and resulting in its frequent replacement.

Now in accordance with the instant invention a fur brush cleaner is completely eliminated and a web of fibrous material economically utilized instead. More than this, it is possible to clean two different surfaces simultaneously.

## SUMMARY OF THE INVENTION

Therefore it is an object of this invention to improve cleaning apparatus in electrostatic-copying equipment.

Another object of the invention is to provide method and apparatus to increase the efficiency of cleaning one or more surfaces while decreasing the cost of the cleaning apparatus.



Another object of the invention is to clean simultaneously a photoconductive insulating member on which a powder image is formed and pressure roll fuser on which residue from the image has been offset.

Still another object of the invention is to ensure a constant incremental linear advance for a cleaning web transported past one or more cleaning stations in an automatic-electrostatic-copying machine.

Yet still another object of the invention is to construct a unique cleaning module for use in an automatic-electrostatic-copying machine.

The foregoing objects are accomplished in accordance with this invention, generally speaking, by selectively advancing a web of dispensable fibrous material in constant linear increments into rubbing contact first with a xerographic surface on one side while at the same time the other side of the web is presented into rubbing contact with the surface of a pressure roll of a pressure-fixing assembly.

## BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings in which:

FIG. 1 illustrates schematically a xerographic reproducing apparatus employing a preferred embodiment of the web cleaner apparatus according to the invention;

FIG. 2 is a left-hand perspective view of the web cleaner apparatus removed from the machine apparatus;

FIG. 3 is a right-hand perspective view of the web cleaner apparatus removed from the machine apparatus;

FIG. 4 is a sectional view of the supply roll with the web removed; and

FIG. 5 is a sectional view of the takeup roll with the web removed.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 there is shown a xerographic system adapted for continuous and automatic operation employing a cleaning web assembly generally designated **10** according to the present invention. As is usual in xerographic systems, a xerographic member **20** having a photoconductive layer or light-receiving surface on a conductive backing is formed in the shape of a drum and mounted on a shaft **24** for movement past several xerographic processing stations in a direction indicated by the arrow.

For purposes of the present disclosure the several xerographic processing stations in the path of movement of the xerographic surface will be described briefly except for the cleaning station which forms the basis of the present invention.

At a charging station a uniform electrostatic charge is deposited on the xerographic surface of the drum by means of a corotron **26**.

Next there is an exposure station at which a light or radiation pattern of an original to be reproduced is projected onto the drum surface by an optical projector **28** to dissipate the drum charge in the exposed areas to leave an electrostatic latent image in the unexposed areas.

Adjacent the exposure station is a developing station at which a xerographic developing material, which includes toner particles having an electrostatic charge opposite to that of the latent image, is moved into contact with the drum surface by a developer apparatus **30** whereby the toner particles adhere to the latent image to form a powder image.

Positioned adjacent the developing station is a transfer station at which the powder image is electrostatically transferred by means of a corotron **32** from the drum surface to a web of support material **34**. Support material **34** is taken from a supply roll **35** and urged into contact with the drum surface by a pair of pressure rollers **37** and **38** before being received onto a takeup roll **40**. Takeup roll **40** is driven by a suitable drive and clutch arrangement (not shown). After the image has

been transferred support material **34** is passed through the nip of pressure rolls **46, 47** to permanently fix the image on the support material.

In accordance with the present invention, next and final station is a cleaning station which serves a dual function of cleaning powder remaining on drum **20** and offset onto pressure roll **47** as will be described more fully hereinafter.

To aid in the removal of any residual powder remaining on the xerographic drum there is provided a corona precleaning device **54** that is similar to the corona discharge device employed at the charging and transfer stations. Any residual electrical charge remaining on the xerographic drum is dissipated by a light from a fluorescent lamp **57**.

Referring now to FIGS. **2–5**, web assembly **10** comprises a frame having a base **112** and a support plate member **114** extending perpendicular to the base. A supply roll **116** is made up of a cleaning web **118** wound on a cylinder which may be of cardboard or other suitable material, rotatably supported from support plate member **114**. Cleaning web **118** is led from supply roll **116** first around a pressure roll **124** with which it makes a first loop and then around a takeup roll **125**. After being looped around takeup roll **125**, the web is passed around a second pressure roll **127** before being secured to takeup roll **125** by an adhesive or other suitable means. For clarity the various loops in the web path are indicated by a series of arrow heads designated as A, B, C, and D, respectively, in FIG. **1**. Web **118** may be made from any suitable fibrous material, such as, paper toweling, cheese cloth, flannel, or cotton fibers, any of which may be impregnated with suitable chemical materials.

In accordance with the invention both sides of the cleaning web are utilized to clean different surfaces. Hence the path of the cleaning web is so arranged that one side is presented at a first surface to be cleaned while the opposite side is presented to a second surface. In this case, the xerographic drum and pressure roll **47** in the pressure fixing assembly are cleaned simultaneously. Pressure rolls **124** and **127** urge opposite sides of the cleaning web onto their respective surfaces to be cleaned. Each of the pressure rolls is made from a soft rubber material in the form of a cylinder mounted for rotation. A rod **130** received through slots **132** formed in plates **134** and **136** serves to support pressure roll **124**. In like manner pressure roll **127** is supported on a rod **138** received through another pair of slots **139** in plates **134, 136**.

To urge pressure rolls **124** and **127** against their surface to be cleaned there is provided a pair of torsion springs **140** and **142**. Torsion spring **140** is coiled about a support post **144** while spring **142** is coiled around an extension of post **144** in the form of shoulder screw **146**. The end portions of each torsion spring extend in opposite directions to engage annular grooves formed on the ends of rods **130** and **138**. By this arrangement forces exerted against one pressure roll are opposed by forces exerted on the other pressure roll. It should be noted that slots **132, 139** permit the pressure rolls to float with respect to their surface to be cleaned against the action of springs **140, 142**.

Supply roll **116** is mounted on a core member **150** (FIG. **4**) which is rotatably supported on a rod **152** secured to support plate **114** by screw member **153**. A plate member **154** and a screw **155** serve to hold core member **150** on rod **152**. In similar fashion takeup roll **125** is mounted on a core **160** (FIG. **5**) rotatably supported on rod **162** secured to frame **114** by a screw member. It should be noted that rolls **116** and **125** are engaged by leaf springs **170, 172**, respectively, extending outwardly from a longitudinally extending undercut portion of their respective cores **150** and **160**.

It is desired that the web be advanced in small equal increments, as for example, one-fourth inch for every cycle or revolution of the xerographic drum. To accomplish this, a driving member **250** in the form of an eccentric member carried on shaft **24** (FIG. **1**) drives a cam follower **252** to oscillate a rocking arm **255** connected to takeup roll **125**. Rocking arm **255** is connected to the frame by a spring **258** to maintain cam follower **252** in surface contact with eccentric member **250**. Unidirectional movement is imparted to the takeup roll via a one-way clutch **253** (FIG. **5**). One-way clutch **253** comprises a coil spring **262** wrapped around a collar portion **260** of rocking arm **255** and core **160**. As rocking arm moves in the driving direction, spring **262** tightens to impart a rotary force on core **160**. However, on the return stroke of cam follower **252**, spring **262** becomes loose freeing core **160** to provide the one-way clutch action desired.

To keep core **160** from backing up, another one-way clutch **266** similar to that already described is provided at the opposite end of the takeup roll. In this case, a spring **271** is coiled around collar member **273** and hub member **275** which is secured to one end of rod **162** by a setscrew **277**. When rotary motion is applied to core **160** in the driving direction to advance the web, spring **271** remains loose permitting collar member **273** to move relative to hub member **275**. However, when rotary motion of the core is attempted in the opposite direction, spring **271** becomes tight, fixing collar member **273** to hub member **275**. A clamp **278** fastened by a screw **279** serves to hold clutch **266** firmly against core **160**. It can now be appreciated that the oscillating motion imparted to cam follower **252** advances takeup roll **125** intermittently and desirably prevents the roll from backing up so as to maintain a tension on the web at all times.

Initially the amount of web advanced intermittently on the takeup roll is determined by the angle of oscillation through which the cam follower is moved. This angle can be regulated at the start of the cleaning operation by adjusting the position of screws **282** in elongated slots **285** formed in rocking arm **255** (FIG. **5**).

In order to provide a constant linear incremental advance of the web onto the takeup roll, a web control assembly **290** is provided by which the web is advanced in equal linear increments onto the takeup roll. Control assembly **290** regulates the oscillating angle of the cam follower **252** at a rate which varies with the amount of material wound on the takeup roll. The control assembly comprises a stop finger **291** which engages a cam surface **292** formed in rocking arm **255** so as to limit the follow of cam follower **252** on eccentric member **250**. Stop finger **291** is held by a spring **293** in a direction which affords a maximum oscillating angle for the cam follower at the beginning of a cleaning cycle.

Secured to stop finger **291** at the end of an elongated member **294** by a screw **295** and a nut **296** is a sensing arm **297** which bears against the web material on the takeup roll. It can now be appreciated that as the web material on the takeup roll builds up changing the diameter, sensing arm **297** is displaced, repositioning stop finger **291** along cam surface **292** on rocking arm **255** to thereby limit the rest position of cam follower **252**. In this manner the angular travel of the cam follower is reduced proportionately as the web material builds up to effect a constant linear incremental advance of the cleaning web for each oscillation of the cam follower.

In order to provide tension on supply roll **116**, a brake assembly **310** comprising an annular member **311** with a high-friction surface is mounted on one end of the roll for engagement with a leaf spring **314** secured to the frame. Annular member **311** may be any suitable friction surface as is known to those skilled in the art.

Described above is a new and unique cleaning assembly in which the cleaning web is moved in increments at a constant linear advance along its path. More than this the web simultaneously cleans two different surfaces by utilizing both sides of the web. Heretofore, cleaning assemblies for cleaning highly as, a surfaces, such as, a xerographic plate were either elaborate and expensive brush assemblies which required continuous and frequent replacement or complicated mechanism for continuously driving a fibrous material in synchronism with the plate. Now it is possible to clean with a cleaning surface moved at a constant linear incremental advance by an extraordinarily simple drive mechanism which does not require many moving parts or accurate tolerances. The cleaning as-

sembly is constructed as a module so as to facilitate removal of the web from the machine. It can be readily appreciated that the cleaning assembly of the invention provides a simple and efficient cleaning operation highly desirable for producing high-quality copies in an automatic copying machine.

While the invention has been described with reference to the structure disclosed herein, it should not be confined to the details set forth since it is apparent that various modifications can be made. Thus a belt construction may be substituted for the xerographic drum and a variety of clutch mechanisms may be utilized for advancing the web in one direction. Other modifications will occur to those skilled in the art and it is intended to cover such modifications or changes as may come within the purposes and improvements of the scope of the following claims.

What is claimed is:

1. In a method of copying in which a xerographic plate is moved through a sequence of operations that include placing an electrostatic charge on the plate surface, exposing the charged plate to a radiation image of copy to be reproduced to form an electrostatic latent image thereon, applying developing material to the latent image to form a powder image, and electrostatically transferring the powder image of the plate to a support material whereby after transfer there remains on the plate surface a residue of developing material, and fixing the image to the support material with a pressure-fixing device resulting in a portion of the developed image being offset thereon, an improvement for cleaning the developing material residue from the plate surface and from the pressure fixing device comprising the steps of presenting one side of a web of fibrous material against the powder residue on the plate surface, presenting the opposite side of the web material against the powder offset on the pressure-fixing device, and moving the fibrous web material in constant linear incremental advances to thereby clean the plate and pressure-fixing device simultaneously.