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Ticknor

[11] **3,740,789**

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[54] **XEROGRAPHIC ROLLER OSCILLATING CLEANING BLADE WITH DRIVE MECHANISM THEREFOR**

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[52] **U.S. Cl.** **15/256.53**, 355/15

[51] **Int. Cl.** **G03g 13/08**

[58] **Field of Search** 15/256.53, 100, 1.5; 118/637, 261; 117/17.5; 355/15; 96/1

[56] **References Cited**

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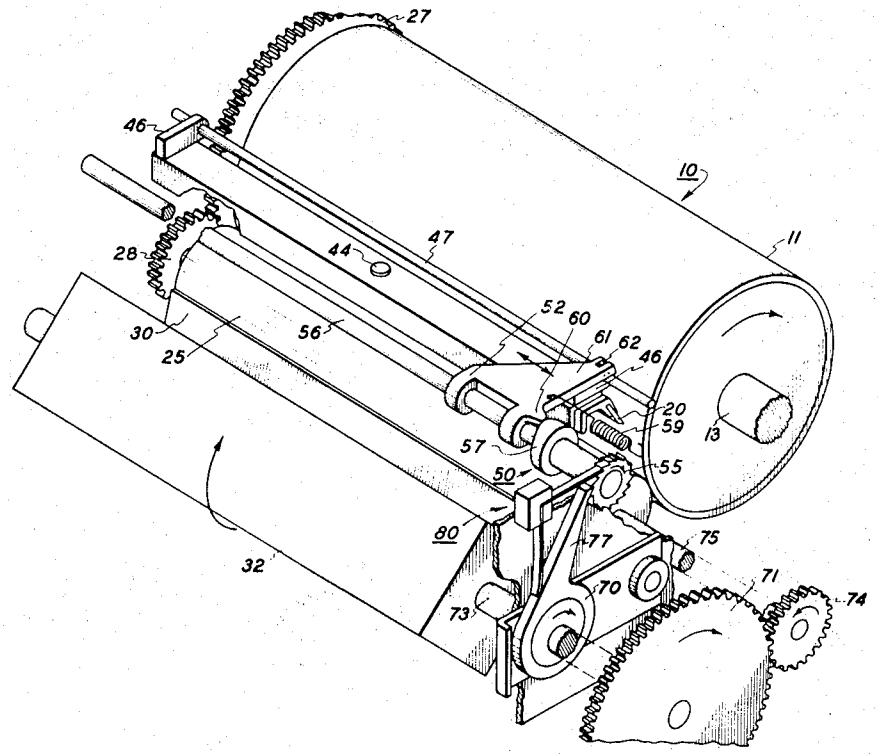
[57] **ABSTRACT**

Apparatus is herein disclosed for removing residual dry toner particles from the photoconductive surface of a reusable xerographic plate preparatory to reusing the plate in an automatic xerographic reproducing machine. The apparatus includes an elastomeric doctor blade disposed across the path of movement of the plate and having a cutting edge thereon biased into contact with the photoconductive surface. The blade is supported within a carriage and the carriage arranged to move along a path of travel substantially transverse to the path of movement of the plate. A drive mechanism, operatively associated with the carriage, is provided to periodically reposition the blade incrementally along its path of travel thereby improving the blade efficiency and blade life as well as reducing the possibility of foreign matter from being permanently entrapped between the blade and the photoconductor.

6 Claims, 2 Drawing Figures



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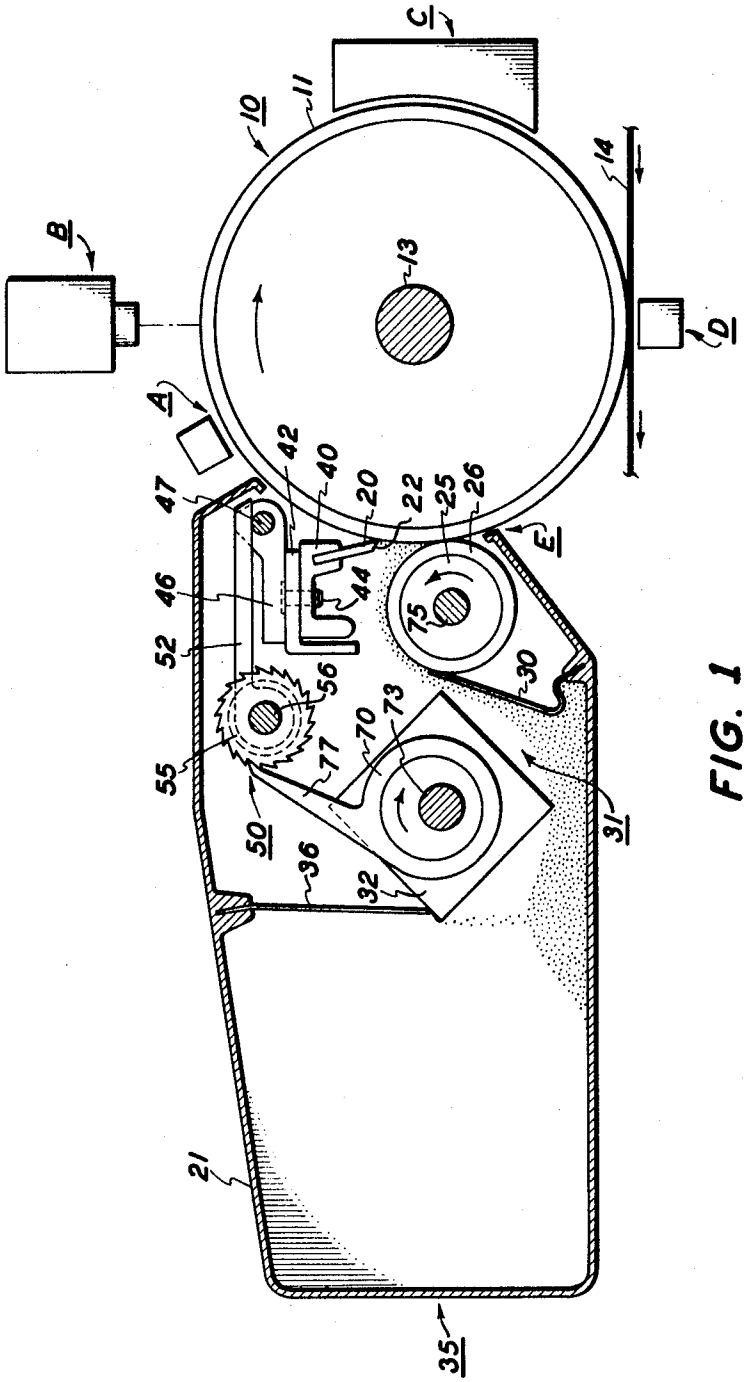

FIG. 1

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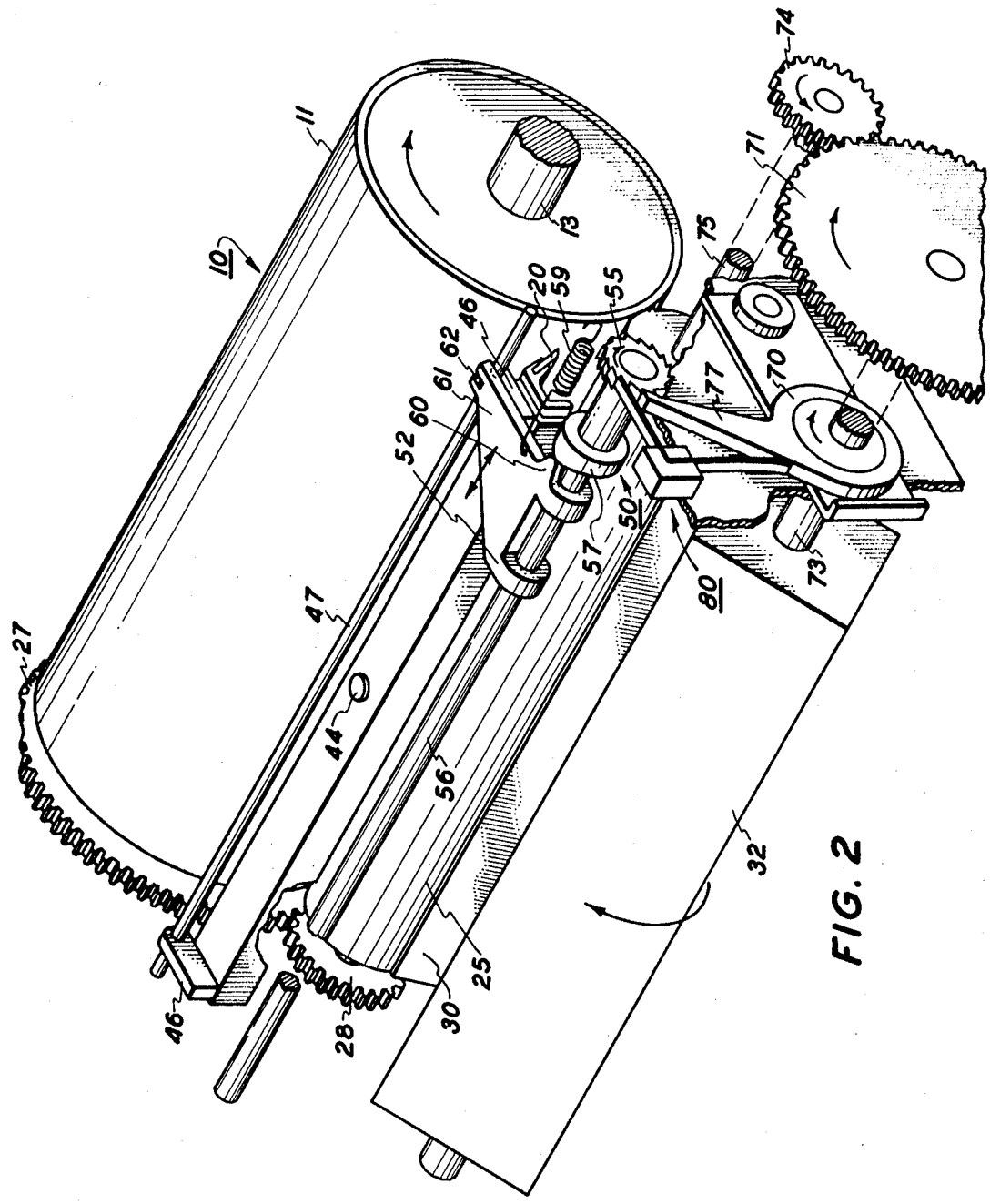
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FIG. 2

XEROGRAPHIC ROLLER OSCILLATING CLEANING BLADE WITH DRIVE MECHANISM THEREFOR

This invention relates to a doctor blade cleaning device suitable for removing residual toner particles from a xerographic plate and, in particular, to an improved doctor blade drive mechanism for extending the life of a cleaning blade and improving cleaning efficiency.

Conventionally, in the automatic xerographic process, a latent electrostatic image of an original to be reproduced is recorded upon an image retaining member and the image then made visible, or developed, by use of a finely divided "toner" material which has been specifically developed for this purpose. In reusable xerography, the developed toner image is generally transferred from the xerographic plate to a final support material, such as paper or the like, and the image affixed thereto to form a permanent record of the original. Although a preponderance of the toner material comprising the developed image is removed to the final support sheet, a small amount of residual toner nevertheless is retained upon the plate surface after the transfer operation. In order to preserve the integrity of the reusable plate, this vestige of toner must be cleaned therefrom before a new imaging cycle is initiated.

The cleaning of the xerographic plate may be accomplished in a number of different ways. One prevalent technique is to remove the residual toner from the plate by means of an elastomeric doctor blade as disclosed in U.S. Pat. No. 3,660,863. This particular type of cleaning necessitates that the cutting edge of the doctor blade be arranged in moving biased contact with the image bearing plate surface whereby the blade is caused to pass between the plate and any foreign matter supported thereon. As a consequence, any defects or protrusions contained in or on the surface of the plate will in most instances cause ineffective cleaning and result in a rapid and uneven wearing of the blade due to high stresses produced in these localized regions. Because of these defects, ghost images, generally in the nature of extended streaks, are eventually produced on the plate and are subsequentially transferred to the final support sheet thereby degradating the quality of the copy. Furthermore, as is the general condition in a paper handling machine of this type, a great deal of lint and/or paper fiber is normally broadcast throughout the machine and this waste material eventually comes to rest upon the reusable xerographic plate. This material becomes lodged between the cleaning blade and the plate surface, particularly in the deteriorated blade regions, resulting in accelerated blade failures and a more pronounced degrading of the copy produced.

It is therefore an object of this invention to improve xerographic cleaning.

It is a further object of this invention to improve doctor blade cleaning of residual toner from a xerographic plate.

Yet another object of this invention is to improve the efficiency of doctor blade cleaning in the automatic xerographic process.

A still further object of this invention is to prolong the life of a doctor blade used to clean residual toner material from an image retaining element.

Another object of this invention is to provide a doctor blade cleaning device that will substantially eliminate localized blade failures caused by irregularities in the surface of the member being cleaned.

A further object of this invention is to improve the quality of copy produced in an automatic xerographic reproducing machine.

These and other objects of the present invention are attained by means of a cleaning device comprised of at least one doctor blade member having a cutting edge riding in contact with a moving photoconductive plate and being of sufficient length to span the entire image recording area thereon, means to periodically reposition the blade in small increments along a path of travel that is transverse to the path of movement of the plate to facilitate cleaning, and control means to regulate the incremental stepping of the blade to sustain the reciprocal motion of the blade for at least as long as the plate is in motion thereby enhancing blade life and its cleaning efficiency.

For a better understanding of the present 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 conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic view of an automatic xerographic reproducing machine incorporating the improved doctor blade cleaning apparatus of the present invention;

FIG. 2 is a perspective view partially broken away showing the blade cleaning apparatus illustrated in FIG. 1.

Referring to the drawings, there is shown, for the purposes of explanation, an automatic xerographic reproducing machine incorporating the improved doctor blade cleaning apparatus of the present invention. The copying machine employs a drum like member **10**, the outer periphery of which is furnished with a suitable xerographic imaging or photoconductive material **11** in a manner known to those skilled in the art. Drum **10**, which is suitably journaled for rotation within the machine by means of a shaft **13**, rotates in the direction indicated in FIG. 1 to bring the image retaining surface **11** thereof past a plurality of xerographic processing stations. Suitable drive means (not shown) are provided to power and coordinate the motion of the various machine operating components whereby a faithful reproduction on the original input scene information is produced.

Since the practice of xerography is well known in the art, the various processing stations for producing a copy of the original are herein represented as blocks A, B, C, D and E. At station A, a uniform charge is placed upon the photoconductive surface of the drum. The charged drum surface is then passed through an exposure station B for illuminating the charged surface with a light image of the original input scene information whereby the charge is selectively dissipated in the light struck regions to record the original information in the form of a latent electrostatic image. Means for applying toner material to the image bearing surface is provided at station C wherein the latent image is made visible. The developed image is then brought into contact with the final support material **14** at station D and the toner image transferred from the plate surface to a final support sheet. Finally, at station E, the improved doctor blade cleaning apparatus of the present invention removes residual toner material from the photoconductive surface in a manner to be explained in greater de-

tail below thereby placing the plate in a condition to be once again reused in the xerographic process.

The cleaning station E includes a relatively flexible blade member **20.** Blade **20,** as will become evident from the disclosure below, is movably supported within the cleaning housing **21** so as to be stepped incrementally back and forth across the drum surface **10** along a predetermined path of travel with the cutting edge **22** of the blade riding in contact with the drum surface. Preferably, the working surface, or cutting edge of the blade should be equal to the width of the photoconductive layer supported on the drum surface plus the total amount that the blade is to be extended as it is stepped back and forth in a reciprocal manner over its prescribed path of travel. The blade is also preferably positioned with the cutting edge extending towards the drum in a direction substantially opposed to the direction of drum movement so that the cutting edge thereon is caused to move between the residual toner and the drum surface to effect cleaning. The relative angles between the blade surfaces and the plane tangent to the line of contact between the blade edge **22** and drum surface **11** is selected for optimum cleaning or toner removal effect.

Blade **20** is comprised of any suitable flexible material such as polyurethane or the like. Preferably, the elastomeric blade material employed should be relatively soft to prevent or minimize abrasion, scratching etc. of the photoconductive surface **11** and the material should have sufficient strength and resiliency to allow effective cleaning of surface **11.**

As illustrated in FIG. **1,** toner particles removed from the drum surface are allowed to fall downwardly into contact with a sealing roll **25.** The cylindrical sealing roll has an extended surface thereon being at least equal in length to the width of the cylindrical drum surface. The sealing roll is rotatably supported between the side walls of the cleaning housing so as to ride in pressure contact against the drum surface as the two members are rotated in the directions indicated. An outer blanket **26,** constructed of a relatively smooth resilient material is placed over the outside of the roll and the roll supported in relation to the xerographic plate so that the blanket is lightly biased into pressure contact against the drum surface. In operation, the roll **25** serves as a movable seal to prevent the toner material cleaned from the drum surface by the blade from leaving the cleaning zone. The roll also serves on the plate surface as an expedient for transporting the removed toner particles away from the photoconductive drum surface towards a toner collection station **31.** A pair of cooperating gear members **27, 28** (FIG. **2**) having a 1 to 1 ratio coordinates the motion of the sealing roll with that of the xerographic drum so that the two contacting surfaces move at the same relative speed.

As the sealing roll rotates in the direction indicated, the cleaned or separated toner material in contact therewith is carried away from the drum area on the surface of the roll and the toner is then scraped from the roll surface by means of a scraper bar **30** and allowed to fall into the collecting station **31.** The toner is then picked up by a rotating paddle block **32** and pumped laterally to the rear of the housing into a storage area **35.** A second flexible scraper bar **36** is extended downwardly from the top wall of the housing and is arranged to span horizontally across the entire storage area of the housing. The flexible scraper is adapted to clean residual toner material from the tips of the paddle block and also serves as a retaining wall to prevent toner materials stored within the storage area from being carried or migrating back into the cleaning region.

To enhance the cleaning efficiency of the doctor blade and to avoid, or at least considerably reduce, localized wear on the blades cutting edge as well as substantially eliminating entrapment of foreign matter between the blade and the drum surface, the doctor blade is periodically stepped in predetermined increments back and forth across the drum surface **11** over a path of travel substantially normal to the direction of motion of the drum.

Referring more specifically to FIG. **2,** the blade element is supported within a U-shaped mounting bracket **40** and the bracket suspended from a support bar **42** by means of centrally located pivot pin **44.** As can be seen, the blade is free to swing about the axial center line of the pivot whereby the cutting edge of the blade is free to align itself across the width of the drum surface. The support bar has rigidly affixed thereto a pair of hinges **46.** The hinges are both slidably and rotatably supported upon a hinge pin **47** anchored in the side walls of the housing. The blade support assembly is offset horizontally from the hinge pin in the manner illustrated in FIG. **1** causing the entire assembly to want to rotate in a counter clockwise direction. This, in turn, mechanically biases the flexible blade into pressure contact with the drum surface with sufficient force to insure that a continuous unbroken line of contact is maintained between the cutting edge of the blade and the photoconductive surface being cleaned.

In order to step the blade incrementally back and forth along its longitudinal path of travel, there is provided a drive mechanism, generally referenced **50** (FIG. **2**) acting in concert with a movable carriage **52.** The drive mechanism includes a ratchet **55,** rotatably supported upon one end of tie rod **56** and being arranged to turn a cylindrical cam element **57** secured thereto. Carriage **52** is slidably mounted upon the tie bar and is continually urged towards the cam element by means of a spring member **59** whereby cam follower **60,** secured to the carriage, rides in contact with the contoured working profile of the cam. Extended arm **61,** of the carriage, is provided with a slotted aperture **62** that operatively engages the raised portion of the right hand hinge **46.** The prescribed cam motion is translated through the movable carriage and the blade support assembly to produce a longitudinally back and forth motion of the blade across the drum surface over its predetermined path of travel. Preferably the cam is adapted so as to translate a constant velocity to the blade holding element, however, any suitable motion producing efficient cleaning may be employed.

A speed control unit made up of pawl **70,** which operatively engages ratchet **55,** and a speed reducing gear **71** are secured to the paddle block shaft **73.** The reducing gear meshes with a drive pinion **74** which is driven by the sealing roll drive shaft **75.** The pawl is eccentrically mounted upon its supporting shaft so that the tip of pawl arm **77,** which is adapted to engage the teeth of ratchet **55,** advances the ratchet a predetermined distance for each revolution of the shaft. A locking mechanism **80** also is arranged to ride in engagement with the ratchet teeth and prevents the ratchet from slipping backwardly in a counter clockwise direction as

the pawl arm is pulled back preparatory to the next subsequent advancing stroke. The ratchet arrangement together with the reduction gear 71 are chosen to periodically turn the cam element relative to the drum speed thereby incrementally repositioning the blade element in a manner wherein the blade moves back and forth over a path of travel parallel to the drum surface. Periodically repositioning the blade in increments of approximately 0.025 inches over a path of travel of about 0.25 inches while acting upon a photoconductive surface that is moving at approximately 3.5 inches per second has resulted in efficient plate cleaning with a minimum of blade wear. However, different lengths and speeds might be contemplated and it should be clear that this disclosure is not necessarily confined to the details as set forth and it is intended to cover any such modifications or changes as may come within the scope of the following claims.

What is claimed is:

1. Means for cleaning residual toner particles from the surface of a movable image retaining member in preparation for imaging thereon including

at least one blade like element having a cutting edge supported in contact with the surface of the image retaining member to be cleaned, the blade being of sufficient length to enable the cutting edge to span across the entire image retaining surface of said member,

drive means for periodically repositioning said blade in a lateral direction generally normal to the direction of motion of said member whereby each incremental region along said cutting edge is shifted in relation to the members surface to facilitate cleaning thereof, and

means to coordinate the lateral positioning of said blade with the motion of said image retaining member to optimize blade life.

2. The apparatus of claim 1 wherein the blade is formed of an elastomeric material and the cutting edge thereon biased into pressure contact with the surface to be cleaned.

3. Apparatus for cleaning a reusable movable xerographic plate including

at least one blade like element having a cutting edge thereon supported in contact with the xerographic plate surface, the blade being of sufficient length to enable the cutting edge to span across the entire image retaining surface on said plate,

a carriage means for movably supporting said blade while in contact with said plate and being arranged to move said blade along a path of travel transverse to the moving xerographic plate,

means to reciprocate said carriage back and forth over said path of travel,

stepping means for periodically activating said last mentioned means wherein said carriage is shifted laterally a predetermined distance in relation to said xerographic plate, and

means to coordinate the lateral positioning of said blade in relation to the movement of said xerographic plate to optimize blade wear.

4. The apparatus of claim 3 wherein said reciprocating means includes a cylindrical cam having a working surface thereon being biased into contact with said carriage to impart a predetermined reciprocating motion to the carriage and said stepping means comprises a ratchet mechanism operatively connected to said cam and being arranged to periodically advance the working surface thereon whereby the carriage is incrementally advanced and returned over said path of travel.

5. The apparatus of claim 4 wherein said ratchet mechanism includes a pawl member in operative communication with said coordinating means.

6. In a doctor blade cleaning apparatus of the type for removing residual toner particles from a reusable photoconductive surface, said apparatus including means to move the photoconductive surface through a series of xerographic processing stations including an image transfer station, support means, arranged to act upon the blade subsequent to the image transfer operation, for supporting the cutting edge of said blade in contact with the moving photoconductive surface whereby residual toner particles are removed from said photoconductive surface, the improvement comprising:

means to periodically reposition said blade in response to the movement of the photoconductive surface in a direction generally normal to the direction of movement of the photoconductive surface whereby each incremental region on the cutting edge of said blade is caused to act upon a different portion of said moving photoconductive surface when the position of said blade is periodically changed.

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