

[54] **TONER CLEANING AND STORING
APPARATUS**

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[51] Int. Cl. **G03g 13/16**
[58] Field of Search **15/256.51, 1.5, 100;**
118/637; 96/1.4; 117/17.5; 355/15

[56] **References Cited**

UNITED STATES PATENTS

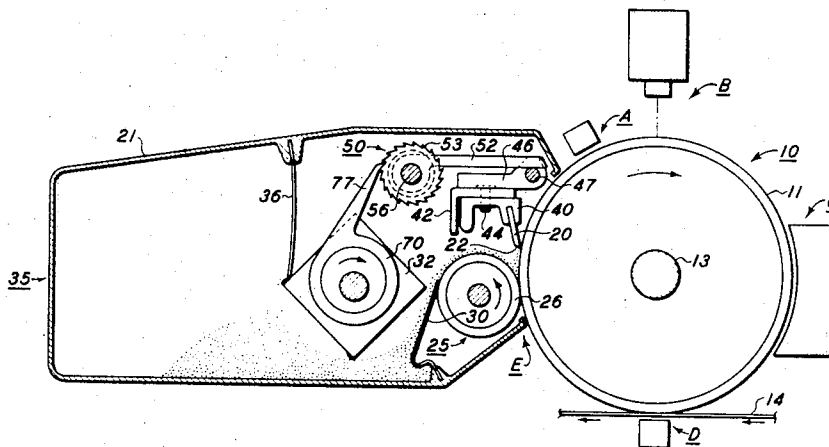
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[57] **ABSTRACT**

Apparatus for separating residual toner particles from a moving photoconductive surface and automatically storing the separated particles within a storage area. A blade element is arranged to move between the photoconductive surface and the residual toner material to separate the toner from the surface and direct the toner into contact with a transport roll. The transport roll moves the toner away from the cleaning zone and into a collecting zone wherein a paddle is rotatably supported to pump the toner into a substantially horizontally aligned storage area. Further means are provided to clean the paddle as it passes through the storage area and to seal the storage area to prevent the separated residual toner from migrating back into the cleaning zone.

4 Claims, 5 Drawing Figures



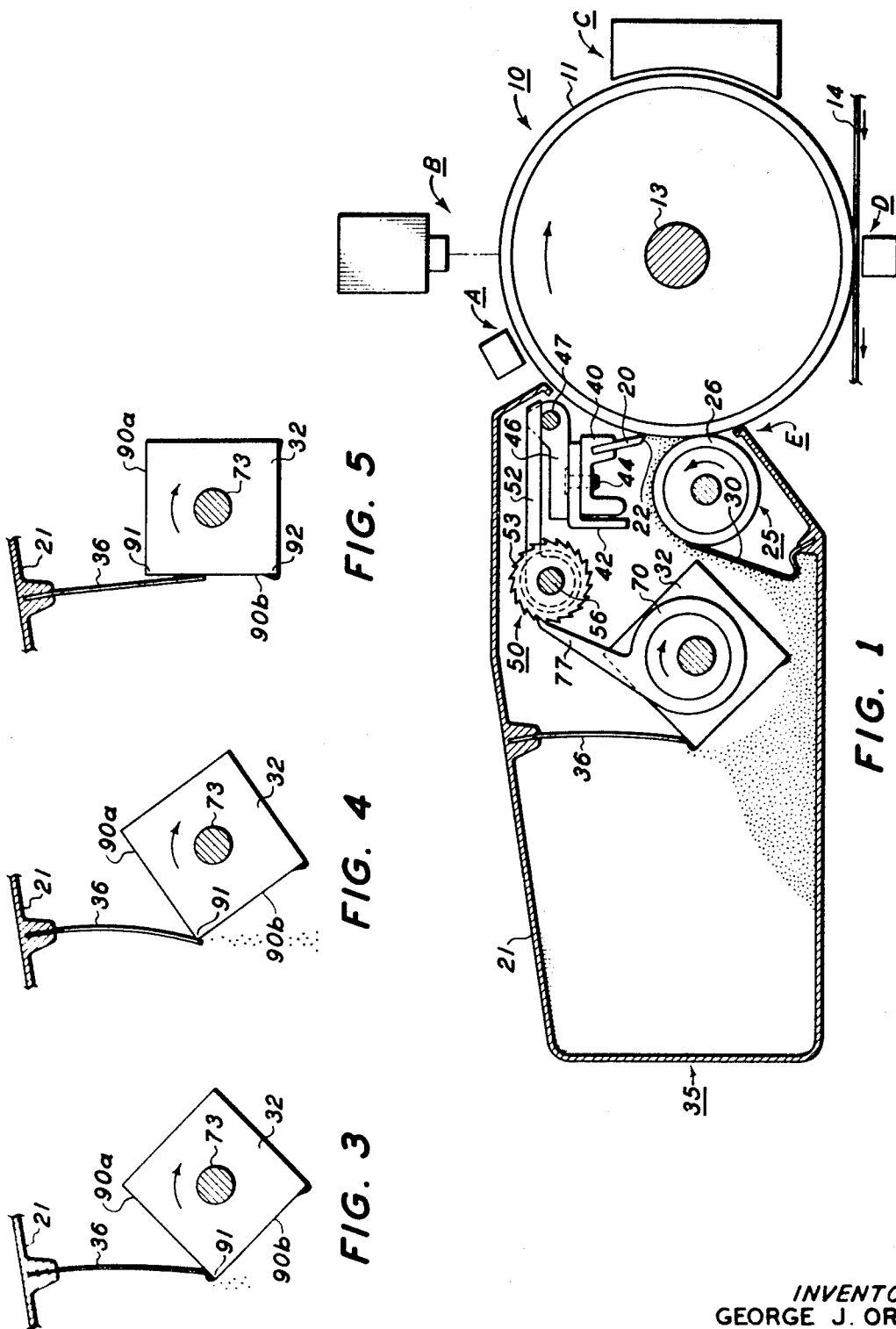


FIG. 5

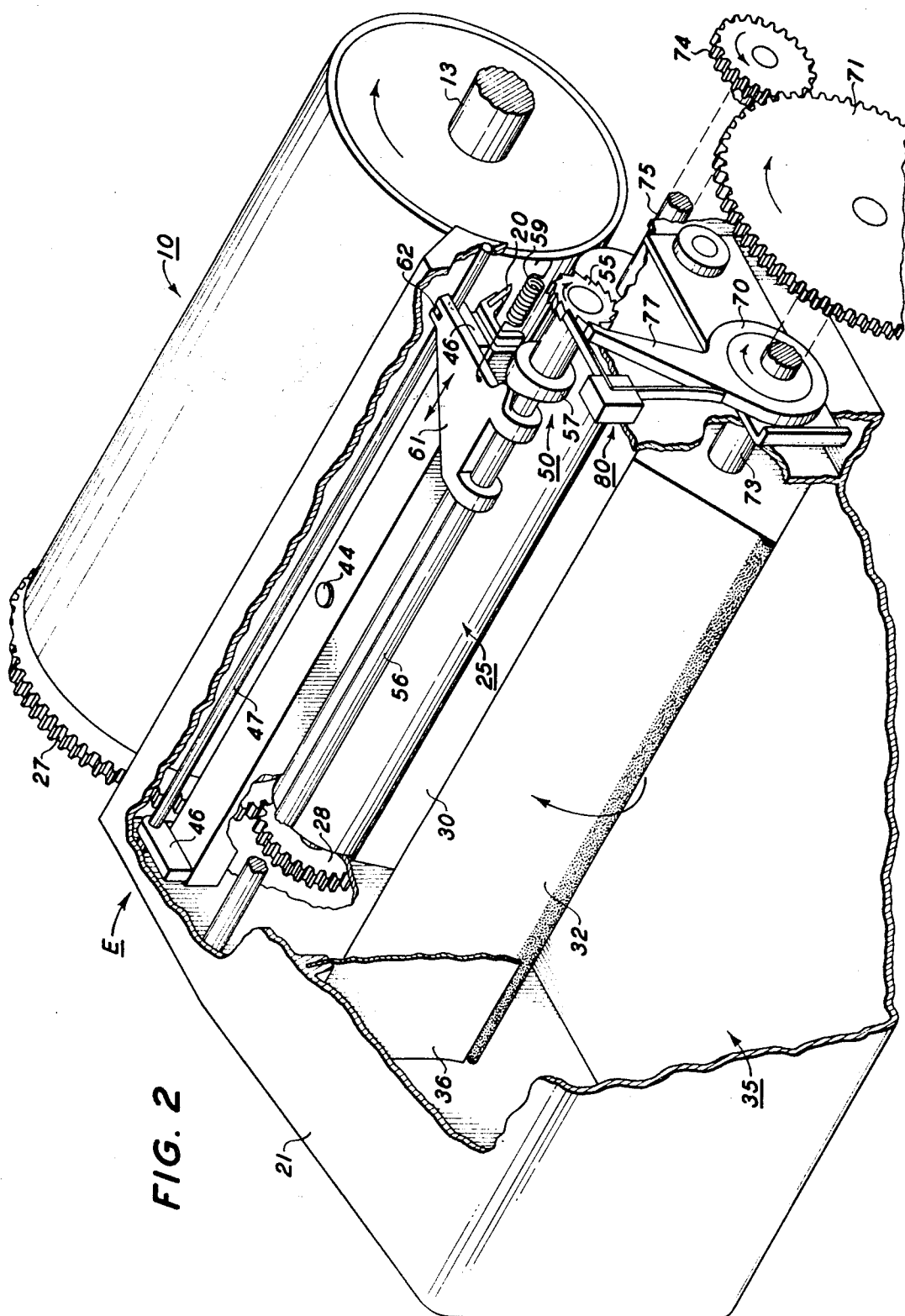
FIG. 4

FIG. 3

FIG. 1

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TONER CLEANING AND STORING APPARATUS

This invention relates to the cleaning of residual toner material from the surface of a reusable image retaining plate and, in particular, to apparatus for automatically handling and storing residual toner material cleaned from the surface of a reusable xerographic plate.

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 means of a finely divided particulate 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 input scene information. Although a preponderance of the toner material comprising the developed image is transferred to the final support sheet, a small amount of residual toner is nevertheless invariably left behind on the plate surface after the transfer operation. In order to restore the plate to a condition suitable for reuse, this vestige of toner must be cleaned or removed from the plate surface before a new imaging cycle is instituted.

The cleaning of the xerographic plate may be accomplished in a number of different ways. One prevalent technique is to separate the residual toner from the plate by means of an elastomeric blade element as disclosed in U.S. Pat. No. 3,660,863 to Gerbasi. In the blade cleaning process, the cutting edge of the blade is arranged to move between the residual toner particles and the image bearing plate surface to chisel or cut the toner particles therefrom.

The trend in automatic xerographic apparatus has been to smaller machines capable of producing copy of a relatively rapid rate, as for example, in high speed desk top duplicators. This trend towards smaller but yet faster devices has placed an extremely heavy burden upon the machine's cleaning systems in that they must now handle and store within an extremely restricted area an ever increasing amount of residual toner material.

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

It is the further object of this invention to improve apparatus for handling and storing residual toner material as it is cleaned from the surface of an image bearing plate.

It is yet another object of this invention to provide apparatus capable of storing a maximum amount of residual toner material in a minimum amount of machine space.

These and other objects of the present invention are attained by means of a cleaning device comprised of at least one cutting blade element adapted to separate residual toner particles from a moving image recording plate, means to collect the separated toner particles and to transport the particles away from the cleaning zone into a collecting area, and a mechanical impeller within the collecting area which is arranged to pump the collected toner into a substantially enclosed storage region.

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 cleaning apparatus embodying the teachings of the present invention;

FIG. 2 is a perspective view partially broken away showing the toner handling and storing mechanism associated with the cleaning apparatus illustrated in FIG. 1;

FIGS. 3-5 are partial end views of the impeller for pumping separated residual toner material into the storage area of the cleaning device shown in FIG. 1 illustrating the step of cleaning the impeller and sealing the storage region.

Referring to the drawings, there is shown, for the purposes of explanation, an automatic xerographic reproducing machine incorporating the improved cutting 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 layer 11 which is well known to those skilled in the art. Drum 10, which is suitably journaled for rotation in the machine by means of a shaft 13, rotates in the direction indicated in FIG. 1 to bring the image retaining surface 11 thereon 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 of the original input scene information is xerographically created.

Since the practice of xerography is well known in the art, the various processing stations for producing a copy of an original are herein shown in block diagram form and are referred to as stations A through E. At station A, a uniform charge is placed upon the photoconductive surface of the drum member. The charged drum is then moved past an exposure station B for illuminating the charge surface with a light image of the original input scene information so that the charge is selectively dissipated in the light struck regions to record the original input scene information on the photoconductor in the form of a latent electrostatic image. Means for applying toner material to the image bearing surface is provided at station C whereby the latent image is rendered visible. The developed image is then brought into contact with a final support sheet at transfer station D and the toner image transferred from the xerographic drum surface to the support sheet. Finally, at station E, an improved blade cleaning apparatus, embodying the teachings of the present invention, acts to remove any residual toner material that might remain on the drum surface after the transfer operation and from the surface thereof and automatically stores the toner within a cleaning housing in a manner to be explained in greater detail below.

The cleaning station E includes a relatively flexible blade member 20. The blade is movably supported within the cleaning housing 21 so that it can be incrementally stepped back and forth across the drum surface 11 over a predetermined path of travel with the cutting edge 22 of the blade running 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 sur-

face plus the total amount that the blade is extended as it reciprocates back and forth over its path of travel. The blade is also preferably positioned with the cutting edge extended toward the drum in a direction substantially opposed to the direction of drum motion so that the blade's cutting edge moves between the residual toner particles and the photoconductive drum surface to effect the desired cleaning. The relative blade angles between the blade surfaces and a plane tangent to the line of contact between the blade edge 22 and the drum surface 11 is selected so as to produce optimum cleaning.

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 surface abrasion, scratching, etc. of the photoconductive plate, however, the material should possess sufficient strength and resiliency to allow effective cleaning.

As illustrated in FIG. 1, the blade element is located above the horizontal center line of drum 10 with the cutting edge thereon extending downwardly in opposition to the upward movement of the photoconductive surface. As a consequence, the residual toner particles moving over the cutting edge 22 of the blade are caused to fall downwardly towards the bottom of the cleaning housing. A cylindrical sealing roll 25, which is aligned parallel to the xerographic drum 10, is located below the blade element in a position to intercept the falling toner particles. The roll is rotatably supported between the side walls of the cleaning housing and has an outer blanket 25 thereon constructed of a relatively soft resilient material which is arranged to ride in light biasing contact with the xerographic drum surface. The blanket is preferably constructed of an elastomeric material, such as Neoprene or the like, having a hardness of between 50 and 60 durometers capable of providing a positive seal against the drum surface. The length of the cylindrical roll is at least equal to that of the xerographic drum and serves to seal the entire lower portion of the cleaning region thereby preventing the separated toner particles from escaping from the cleaning housing and thus precluding the toner from being broadcast through the interior of the automatic machine.

A pair of cooperating gear members 27, 28 (FIG. 2) are provided through which the motion of the sealing roll is coordinated with that of the xerographic drum 10 so that the two contacting surfaces move at the same relative speeds. As the gear mechanism turns the sealing roll in the direction indicated, the particulate toner material that has fallen into contact therewith is transported away from the photoconductive surface and out from the cleaning zone. A scraper bar 30 rides in light pressure contact with the surface of sealing roll and is arranged to separate the residual toner particles from the surface of the roll. In operation, the residual toner particles are driven over the back side of the scraper bar and fall into a collecting region 34 located in the bottom of the housing. A square shaped impeller or block paddle 32, extending horizontally across the cleaning housing is rotatably supported between the housing sidewalls and is arranged to rotate in an endless path of travel through the collecting area. Although the paddle can be constructed of any suitable material, it is preferred that it be made of a plastic material exhibiting good release properties in relation to the toner ma-

terials. Although not shown, a side seal can be provided between the ends of the paddle and the sidewalls of the housing to prevent toner particles from moving therebetween.

In practice, the square paddle serves as a means for moving toner out of the collecting area into the horizontally aligned storage area 35 of the cleaning housing. As illustrated in FIG. 2, a drive pinion 74 is secured to the sealing roll shaft 75 and meshes with a gear member 76 operatively connected to the paddle drive shaft 77. The movement of the paddle wheel is coordinated through the gear system so that the paddle is moved at a speed sufficient to handle and pump rearwardly the toner that is delivered into the collecting area by the sealing roll.

A flexible wall 36 is supported in the top wall of the cleaning housing and extends downwardly in a substantially vertical direction so as to ride in contact with the extended sides of the square paddle. The flexible wall is preferably fabricated of a relatively thin strip of Mylar which extends across the interior of the housing and provides a movable sealing wall capable of retaining the residual toner within the storage area. Although the paddle is constructed of a relatively adhesive material, the toner particles will, under certain conditions, become impacted and coalesce upon the tips of the paddle, that is, the edges formed by the abutment of the rectangular blade sidewalls, as the material is being pumped into the storage area. The flexible wall member is arranged to also function as a cleaning expedient for removing this impacted toner from the paddle tips prior to their passing out of the storage area.

As shown in FIGS. 3-5, the flexible wall 36 initially rides down elongated sidewall 90a of the paddle as the sidewall is moved in an upward direction (FIG. 3). As the sidewall continues to move upwardly towards a horizontal position, the flexible wall is carried over the tip 91 of the paddle and flicks the impacted toner material back into the storage area (FIG. 4). Eventually, the next subsequent sidewall 90b of the paddle block moves upwardly into a vertical position into substantially parallel alignment with the flexible blade member as illustrated in FIG. 5. Continued rotation of the paddle brings the next tip 92 into a position to be cleaned.

Because of its unique design, the square paddle and flexible wall arrangement cooperates to provide a relatively simple and effective means for pumping large amounts of residual toner into a relatively restricted area. As can be seen, the wall 36 is adapted to form a flexible seal capable of preventing toner from being carried over the top of the paddle and as a result enables the entire storage area of the house to be filled to capacity.

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 pivot in a horizontal

direction and can align itself along the width of the drum surface. The support bar has rigidly affixed thereto a pair of hinges 46 which are both slidably and rotatably supported upon a hinge pin 47 anchored in the sidewalls of the housing. The blade support assembly is offset from the hinge pin and tends to rotate thereabout in a counter clockwise direction as seen in FIG. 1. 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 face 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 thus translated through the movable carriage and the blade support assembly causing the blade to move longitudinally back and forth across the drum surface over a predetermined path of travel. Preferably the cam is adapted so as to translate a simple harmonic motion to the blade element.

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 chosed 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.

While this invention has been described with reference to the structure disclosed herein, it is not confined to the details set forth, and this application is intended to cover any modifications or changes as may come within the scope of the following claims.

What is claimed is:

1. Apparatus for separating residual toner material from the surface of a reusable image retaining member preparatory to recycling said member and for automatically storing the separated toner including
 - a housing having a cleaning region therein containing an opening therein through which the reusable image retaining member is capable of being passed, and a storage region remote from said cleaning region,
 - a cleaning element positioned within the housing and being arranged to operatively communicate with said image retaining member as the member passes through said housing to separate residual toner material from the surface thereof,
 - mechanical means for collecting the separated toner material and transporting said toner material away from the cleaning region,
 - impeller means arranged to move in contact with said toner transported away from the cleaning region and to move the toner into said storage region, said impeller comprising a square shaped paddle having rectangular side walls thereon extending substantially across the width of said housing and being arranged to continuously rotate in contact with the separated toner material transported away from the cleaning zone, and
 - means within said storage region for removing the toner material from said impeller.

2. The apparatus of claim 1 wherein said cleaning element comprises an elastomeric blade element having a cutting edge thereon biased into pressure contact with the member to be cleaned whereby the cutting edge of the blade moves between the residual toner material and the member.

3. The apparatus of claim 1 wherein said means to clean said impeller comprises a flexible wall member supported between the cleaning region and the storage region of said housing to prevent toner material from passing therebetween, said flexible wall being biased into contact with the side walls of the impeller to remove toner material therefrom as the impeller is rotated through the storage region.

4. The apparatus of claim 1 wherein said impeller is constructed of a material having release properties in relation to the toner material cleaned from said member.

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