

[54] **WIPER BLADE CLEANING
APPARATUS FOR XEROGRAPHIC
MACHINES**

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[22] Filed: May 13, 1971

[21] Appl. No.: 142,964

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

[51] Int. Cl. G03g 15/00

[58] Field of Search... 15/256.53, 256.51, 256.5, 308,
15/301; 118/637, DIG. 23, 261; 355/15;
117/17.5

[56] **References Cited**

UNITED STATES PATENTS

T879,005	10/1970	Leinbach et al.	15/256.5
3,552,850	1/1971	Royka et al.	15/256.51 X
3,626,833	12/1971	Koch	118/261
2,878,505	3/1959	Ziegler	15/250.16 X

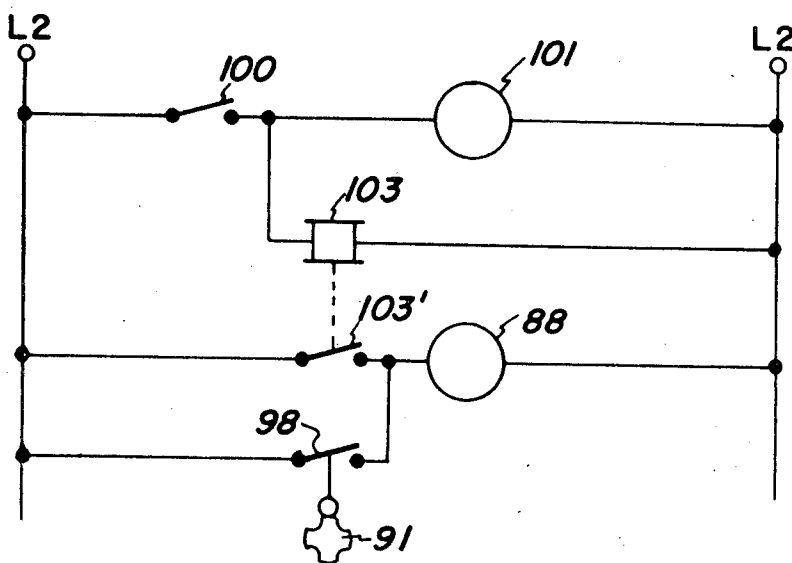
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[57] **ABSTRACT**

Apparatus for cleaning dry residual toner from the photoconductive surface of a xerographic type copying machine for reuse. The apparatus comprises a wiper blade disposed across the path of operating movement of the photoconductive surface with the wiping edge thereof in physical contact therewith. The wiper blade is supported on a carriage movable in a direction generally longitudinal of the blade. A driver is provided to slowly oscillate the carriage together with the wiper blade back and forth to improve blade cleaning action and wear, and reduce the tendency for toner and other foreign matter to become trapped under the blade. A control means is provided to operate the carriage driver while the photoconductive surface is moving and thereafter up to a short interval.

5 Claims, 6 Drawing Figures



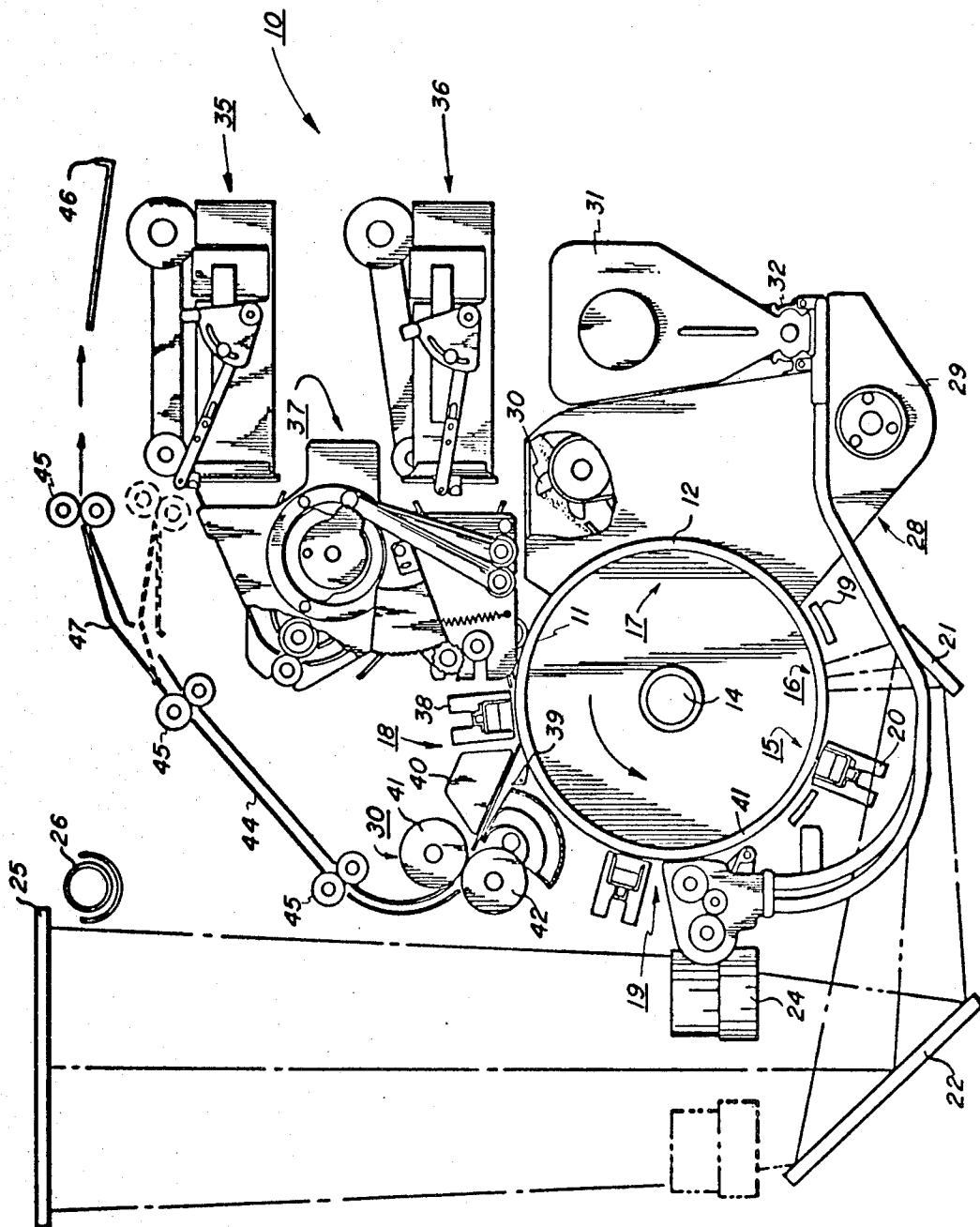
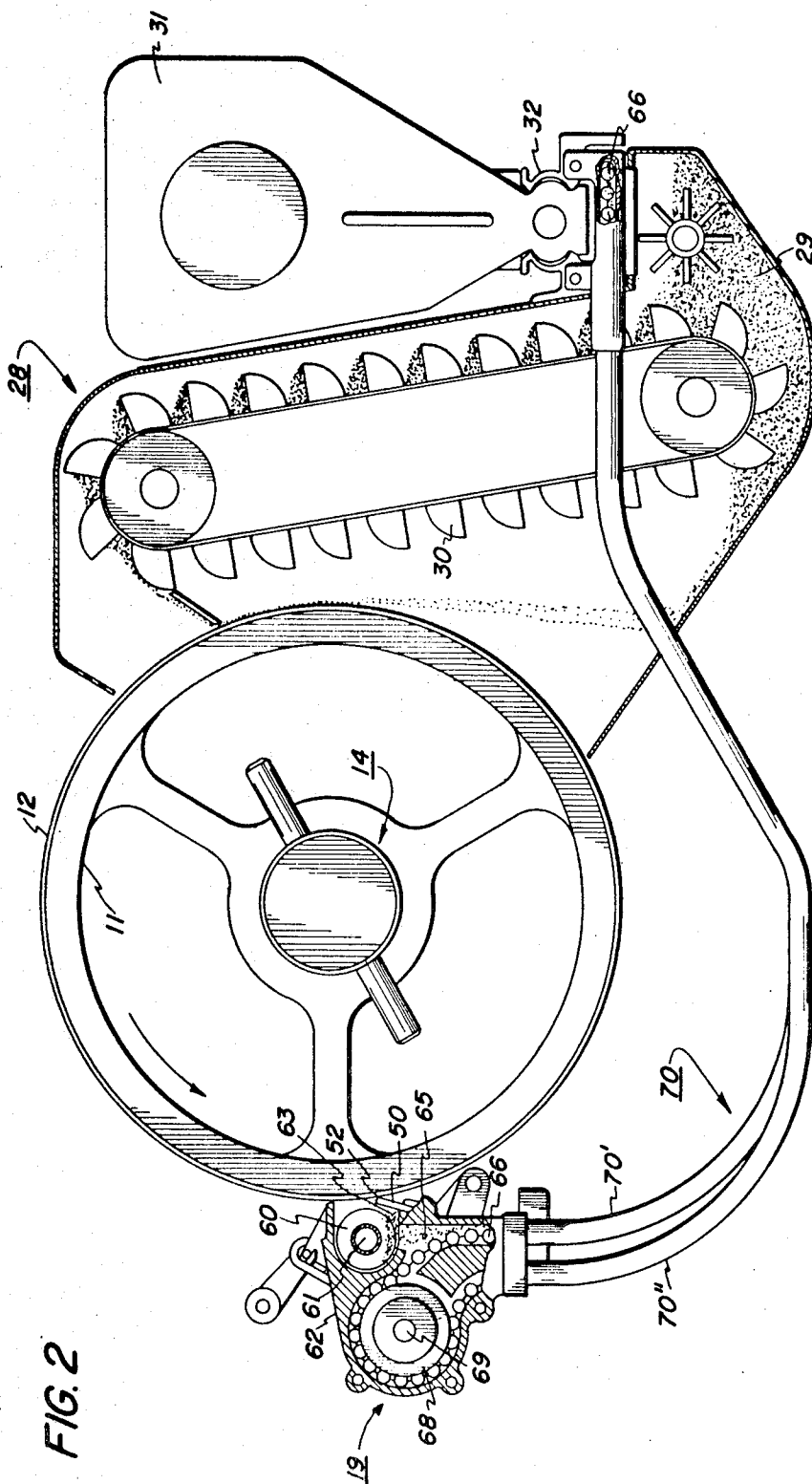


FIG. 1

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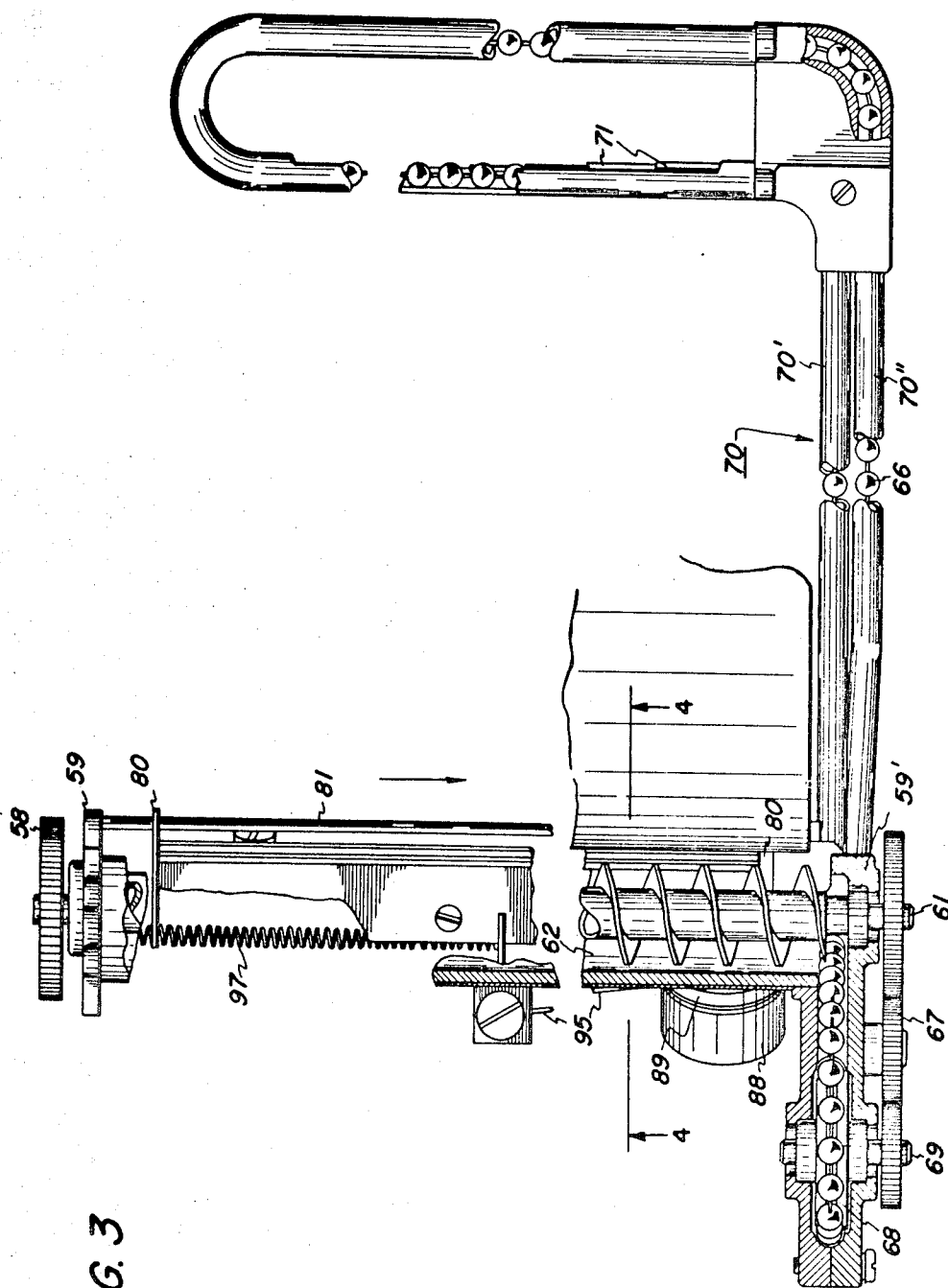


FIG. 3

FIG. 4

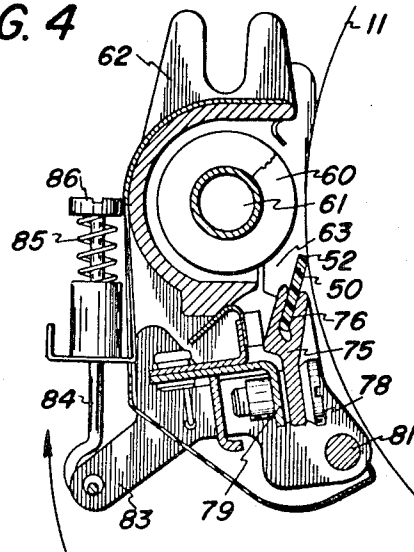


FIG. 5

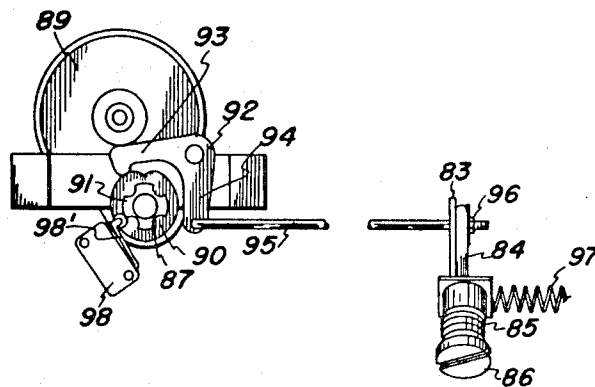
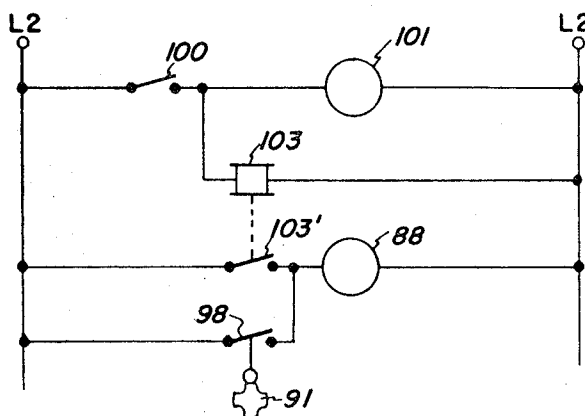


FIG. 6



WIPER BLADE CLEANING APPARATUS FOR XEROGRAPHIC MACHINES

This invention relates to an apparatus for cleaning the photoconductive surface of a xerographic type copying machine, and more particularly, to an improved wiper blade apparatus for cleaning toner from the photoconductive surface of a xerographic type copying machine.

In xerographic type copying machines, an electrostatic image of the document being copied is formed on a photoconductive surface, and that image is then developed with a suitable powdered material, conventionally called toner. The toner delineated image is thereafter transferred to the copy material, normally paper, which is then fixed to form the finished copy.

In machines of this type, the photoconductive surface is normally reused, and in preparation therefor, the surface is cleaned to remove vestiges of toner from the previous imaging cycle. While cleaning the photoconductive surface may be effected in a number of ways, one way is to wipe or scrape the photoconductive surface with a blade or wiper. This type of cleaning arrangement normally requires that the wiper blade be in physical contact with the moving photoconductive surface and as a result any defect, protrusion, scratch, or the like in the photoconductive surface may result in accelerated or uneven wear of the blade wiping edge with consequent deterioration in cleaning efficiency. As such uneven wear progresses, undesirable ghosting and streaking of the copy sheets may appear.

In addition, foreign matter and material, such as fibrous elements from the copy paper, plastic components in the machine, drive belts, and other sources may become lodged between the blade and the photoconductive surface. This may result in improper or incomplete cleaning of the photoconductive surface and streaking or marring of the copies.

It is a principal object of the present invention to provide a new and improved wiper blade cleaning apparatus for copying machines.

It is an object of the present invention to provide an improved oscillatory wiper blade cleaner for the photoconductive surface of a copying machine which oscillates while the photoconductive surface is in use and up to a preset interval thereafter.

It is an object of the present invention to provide a movable wiper blade cleaner for the imaging surface of a xerographic type copying machine incorporating means to help restore the cleaning effectiveness of the blade following use thereof.

It is an object of the present invention to provide a blade cleaner for scraping the photoconductive surface of a copying machine to remove residual toner material therefrom incorporating means to slowly reciprocate the blade back and forth during operating movement of the copying machine photoconductive surface and for a limited time thereafter to obviate trapping of material and improve blade wear.

It is an object of the present invention to provide an improved wiper blade apparatus for cleaning the copy drum of a xerographic machine having means adapted to oscillate the blade following stopping of the copy drum to enhance cleaning action of the blade.

This invention relates to means for cleaning a repetitively movable xerographic surface in preparation for

imaging thereon, comprising, in combination: at least one blade-like element having a wiping edge adapted to bear against the xerographic surface, the blade being of sufficient length to enable the wiping edge to bridge substantially the entire imaging width of the xerographic surface; drive means for the blade adapted when actuated to slowly oscillate the blade back and forth across the xerographic surface in a direction generally normal to the direction of movement of the xerographic surface whereby the opposing surface portions between the blade wiping edge and the xerographic surface shift to thereby facilitate cleaning of the xerographic surface by the blade wiping edge; and operating means for the drive means adapted on movement of the xerographic surface to actuate the drive means and oscillate the blade, the operating means being adapted to sustain actuation of the drive means and oscillation of the blade for at least as long as the xerographic surface is moving and up to a predetermined interval following stopping of the xerographic surface to enhance subsequent cleaning by the blade.

Other objects and advantages will be apparent from the ensuing description and drawings in which:

FIG. 1 is a schematic view of an exemplary xerographic type copying machine incorporating the improved wiper blade cleaning apparatus of the present invention;

FIG. 2 is an enlarged side view with parts broken away showing details of the copying machine wiper blade cleaning apparatus and toner return mechanism;

FIG. 3 is an enlarged partial top view of the wiper cleaning apparatus and toner return mechanism shown in FIG. 2;

FIG. 4 is a cross-sectional view taken along lines 4—4 of FIG. 3 showing details of the wiper blade cleaning apparatus of the present invention;

FIG. 5 is an enlarged view showing the driving mechanism for the wiper blade cleaning apparatus shown in FIG. 4; and

FIG. 6 is a schematic operating circuit for the wiper blade cleaning apparatus of the present invention.

Referring to the drawings, there is shown, for purposes of explanation, a xerographic type copying machine, designated generally by the numeral 10, incorporating the improved wiper blade cleaning apparatus of the present invention. Copying machine 10 has a drum-like part 11, the exterior surface 12 of which is finished with a suitable xerographic imaging or photoconductive material in a manner known to those skilled in the art. Drum 11, which is suitably journaled by means of shaft 14, rotates in the direction indicated by the solid line arrow of FIG. 1 to bring the photoconductive surface 12 thereof past a plurality of xerographic processing stations as will appear more fully herein. Suitable drive means, represented herein by motor 101 (shown in FIG. 6) is provided to drive the various operating components of copying machine 10, there being suitable transmission means (not shown) to drivingly connect drum 11 with motor 101.

While a cylindrical or drum shaped photoconductive part 11 has been shown herein, other configurations, such as a flat plate, belt, or the like may be contemplated.

The xerographic processing stations of copying machine 10 include a charging station 15, wherein an

electrostatic charge is deposited on the photoconductive surface 12 preparatory to imaging; an exposure station 16 where a light or radiation transmitted image of the document being copied is projected onto the photoconductive surface 12 to form a latent electrostatic image; a developing station 17 where a suitable xerographic developing material including ink or toner particles is cascaded onto the drum surface 12 to develop the latent electrostatic image on the drum surface; a transfer station 18 where the toner defined image is electrostatically transferred from the surface 12 of drum 11 to another surface, normally the copy sheet; and a drum cleaning and toner collecting station 19 where the surface of drum 11 is cleaned in preparation for reuse thereof.

Charging station 15 includes a suitable corona generator 20, the discharge electrode or electrodes of which extend in spaced relation transversely across the drum surface in a direction generally parallel to the axis of drum 11. A suitable source of electrical energy is provided for corona generator 20 together with suitable shielding means to direct the charge emitted therefrom toward the drum surface.

Exposure station 16, which is downstream of charging station 15, has an image mirror 21 arranged opposite the surface 12 of drum 11 and adapted, via object mirror 22 and movable lens 24, to transmit an image of the document being copied onto the photoconductive surface 12 of the rotating drum 11 as the surface 12 moves therepast. The document being copied is supported by a transparent platen 25, a suitable illuminating device such as lamp 26 being provided to illuminate the document during the copying process. Lens 24, which is optically positioned below platen 25, moves along a path generally parallel to platen 25 in timed relation to rotation of drum 11.

Developing station 17 is downstream of exposure station 16 and as best seen in FIG. 2, includes a developer housing 28, the leading edge of which is complementary to drum 11. The portion of housing 28 forms a sump 29 within which a quantity of xerographic developing material is stored. A bucket type conveyor 30 is provided for bringing the developing material from the sump 29 to the drum surface 12, conveyor 30 serving at the discharge point thereof to cascade the developing material downwardly onto the upwardly moving photoconductive surface 12 of drum 11. As will be understood by those skilled in the art, the toner particles deposited onto the drum surface are electrostatically attracted thereto in a pattern complementary to the charge pattern on the photoconductive surface 12 to develop the xerographic image. Unused developing material falls back into the sump 29. Toner is supplied to sump 29 from plastic supply bottle 31 through an automatic dispensing apparatus 32. In addition, and as will appear more fully, toner removed from drum 11 at the toner cleaning and recovery station 19 is returned to sump 29.

Referring again to FIG. 1, image transfer station 18 is downstream of developer station 17. There, individual copy sheets drawn from either upper feed tray 35 or lower feed tray 36 are brought, by sheet feeding mechanism 37, into transfer relationship with the surface 12 of drum 11 where the developed image is electrostatically transferred from drum 11 to the copy sheet

by means of transfer corotron 38 in a manner known to those skilled in the art. A stripper finger 39, operatively supported adjacent the surface 12 of drum 11 downstream of corotron 38, serves to remove or strip the copy sheet from drum 11 and onto vacuum transport 40. Transport 40 carries the image bearing copy sheet forward into the nip formed by fuser roll pair 41, 42. There a combination of heat and pressure functions to fix the toner image on the copy sheet as the sheet moves through the rotating fuser roll pair 41, 42 and into the sheet return track 44. Return track 44 includes pinch rolls 45 to carry the copy sheet to output tray 46.

A movable guide mechanism 47 is provided to allow the copy sheet to be alternatively routed into the upper feed tray 35. From there, the copy sheet can be run back through the copying machine 10 to image the reverse side thereof following which the new image is fixed and the finished copy sheet having images on both sides discharged into output tray 46.

The drum cleaning and toner recovery station 19, which is downstream of the transfer station 18 and upstream of the charging station 15, serves to clean residual toner from the surface of drum 11 following image transfer. The removed toner is returned to sump 29 of developer housing 28 for reuse.

Referring particularly to FIGS. 2-4, toner cleaning and recovery station 19 includes a relatively soft, flexible wiper or cleaning blade 50. Blade 50, which as will appear, oscillates back and forth across drum 11 during cleaning, has a leading or wiping edge 52 in contact with drum surface 12. Since the normal imaging or working width of drum surface 12 is somewhat less than the overall width of drum 11, the effective length of blade 50 is preferably equal to the working width of drum surface 12 plus an amount equal to the stroke of blade movement to assure effective cleaning of the entire working width of drum 11. Blade 50 is preferably positioned so that wiping edge 52 thereof extends toward drum 11 in a direction opposite to the direction in which drum 11 rotates so that blade 50 in effect chisels toner from the drum surface. The relative angle between blade 50 and the plane tangent to drum 11 at the line of contact of the blade edge 52 with drum surface 12 is selected for optimum cleaning or scrapping effect.

Blade 50 is comprised of any suitable flexible material, for example, polyurethane. Preferably, the blade material used should be relatively soft to prevent or minimize abrasion, scouring, scratching, etc., of the photoconductive surface 12 by the blade, yet allow effective cleaning of the surface 12.

To return toner removed from drum 11 to developer sump 29, there is provided a transfer auger 60. Auger 60 is carried on shaft 61 journaled in end caps 59, 59' of toner recovery housing 62. Suitable transmission means (not shown) are provided to drivingly interconnect gear 58 on auger shaft 61 with motor 101.

The lower portion of toner recovery housing 62, together with wiper blade 50, cooperate to form a channel-like recess 63 behind blade 50 into which toner removed by blade 50 deposits. Auger 60, which is operatively disposed within housing 62 adjacent recess 63 conveys toner accumulating in recess 63 laterally along recess 63 to inlet 65 of toner conduit 70. There, bead chain conveyor 66 carries the toner through leg 70' of toner conduit 70 to developer sump 29.

A gear-like drive sprocket 68 is provided for bead chain conveyor 66, sprocket 68 being supported by stub shaft 69 rotatably journaled in end cap 59' of toner recovery housing 62. Stub shaft 69 is conveniently driven from auger shaft 61 through suitable gearing means 67.

Leg 70' of toner conduit 70 leads from toner recovery housing 62 to sump 29 of developer housing 28, suitable openings 71 being provided in conduit 70 opposite sump 29 to enable the toner to be discharged therefrom. Toner conduit leg 70'' leads back to housing 62 to complete the toner recovery loop. As will be understood, the relative interior and exterior dimensions of toner conduit 70 and conveyor 66 are chosen to assure effective conveying of toner from recovery housing 62 through conduit 70 to developer sump 29.

To enhance the cleaning efficiency of wiper blade 50 and avoid or at least reduce localized wear on the blade wiping edge 52 and trapping of toner or other foreign material between blade 50 and the drum surface 12, the wiper blade 50 is slowly moved or oscillated back and forth across the drum surface whenever drum 11 is turning and up to a limited duration thereafter as will appear. Referring particularly to FIGS. 3-5 of the drawings, wiper blade 50 is supported on carriage 75 below and to one side of auger 60, carriage 75 having a longitudinally extending slot-like recess 76 therewithin for blade 50. Carriage 75 is in turn spring mounted on a movable support 79, adjustable mounting screw pair 78 being provided for this purpose. It is understood that the screw pair 78 permit the wiping edge 52 of blade 50 to be squared with the surface of drum 11. Support 79 is, in turn, slidably and pivotally mounted through ends 80 thereof on a transversely extending shaft 81 carried by end caps 59, 59' of toner recovery housing 62.

Support 79 includes a rearwardly projecting drive arm 83 to which bias link 84 is pinned. The opposite end of link 84 is attached through spring 85 to toner recovery housing 62. As will be understood, spring 85 serves to bias support 79 together with blade carriage 75 upwardly (clockwise as shown by the solid line arrow in FIG. 4) to hold the wiping edge 52 of blade 50 in operative contact with the surface 12 of drum 11. Suitable tension adjusting means in the form of screw 86 is preferably provided to enable the bias imposed by spring 85 to be regulated.

To move wiper blade 50 back and forth, motor 88 is provided. Motor 88 together with speed reducer 89 therefor are supported as a unit on toner recovery housing 62. Output shaft 87 of speed reducer 89 carries drive and control cams 90, 91 respectively thereon.

A cam follower 92 is provided for drive cam 90, follower 92 being pivotally secured to toner recovery housing 62 with follower arm 93 thereof riding on the peripheral surface of cam 90. The output arm 94 of follower 92 is drivingly connected through cross link 95 with drive arm 83 of housing 79. Preferably, a oneway coupling is provided between link 95 and arm 83, stop 96 on link 95 being relied upon to provide the requisite driving engagement therebetween on movement of link 95 in one direction (toward the left as shown in FIG. 5). Return spring 97, anchored between housing 62 and arm 83, serves to bias housing 79 in the opposite direction and maintain the several operating parts in driving contact with one another.

A control switch 98 is disposed adjacent control cam 91, arm 98' of switch 98 riding on the surface of cam 91. Referring particularly to FIG. 6, drive motor 101 is connected with a suitable source of electrical energy represented by leads L_1 , L_2 , through suitable switching arrangement shown here schematically as control switch 100. In the simplified schematic representation of FIG. 6, closure of switch 100 energizes motor 101 to operate the various components of copying machine 10, drum 11 rotating in the direction shown by the solid line arrow in FIG. 1 to move the drum photoconductive surface 12 past the various xerographic processing stations as described heretofore. Auger 62 which together with bead chain conveyor 66 are driven from motor 101, are also operated to return toner removed from the surface 12 of drum 11 through toner conduit 70 to sump 29 of developer housing 28.

To control wiper blade motor 88, motor 88 is connected through contact 103' of control relay 103 across leads L_1 , L_2 . Blade control switch 98 parallels contact 103'.

With closure of control switch 100 and operation of motor 101, relay 103 is energized to close contact 103' thereof. Motor 88 is accordingly energized to move support 79 together with carriage 75 and wiper blade 50 back and forth. With actuation of motor 88, control switch 98 is periodically opened and closed in accordance with the configuration of control cam 91 which, in the exemplary arrangement shown, comprises four times per cycle. It will be understood that the cyclic opening and closing of blade control switch 98 is without effect so long as contact 103' of control relay 103 remains closed. However, on opening of control switch 100, motor 101 and control relay 103 are deenergized. The operating components of copying machine 10 including drum 11 stop while deenergization of relay 103 opens relay contact 103'. Blade control switch 98 accordingly becomes controlling to maintain motor 88 energized and blade 50 oscillating until opened by control cam 91. In the exemplary arrangement shown, this may extend up to one-quarter cycle following stopping of drum 11. It is understood that where contact 103' and switch 98 open simultaneously, oscillation of wiper blade 50 terminates at the same time drum 11 stops and no carryover of blade oscillation occurs.

Motor 88 together with speed reducer 89 are chosen so as to move wiper blade 50 back and forth across drum 11 at a relatively slow speed, a speed of approximately 0.0125 inches per second having been found suitable. The effective stroke of cam 90 and hence of blade 50 is approximately one-fourth inch; however, different stroke lengths may be contemplated, for example, one-half inch.

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

What is claimed is:

1. As a means to restore cleaning effectiveness to a wiper blade cleaning apparatus used for cleaning a repetitively movable xerographic surface said cleaning apparatus including

at least one blade-like element having a wiping edge disposed to bear against said xerographic surface, said blade being of sufficient length to enable said wiping edge to bridge substantially the entire imaging width of said xerographic surface;

drive means for said blade adapted when actuated to slowly oscillate said blade back and forth across said xerographic surface in a direction generally normal to the direction of movement of said xerographic surface whereby the opposing surface portions between said blade wiping edge and said xerographic surface shift to thereby facilitate cleaning of said xerographic surface by said blade wiping edge; and

operating means for said drive means adapted to actuate said drive means and oscillate said blade during movement of said xerographic surface and on stopping of said xerographic surface to render said drive means inoperative and stop said blade, the improvement comprising:

control means adapted on random occasions to intervene and override said operating means to continue operation of said drive means and oscillation of said wiper blade after said xerographic surface is stopped; and

timing means adapted to limit such additional operation of said drive means and oscillation of said wiper blade by said control means to no more than a predetermined maximum interval.

2. The cleaning effectiveness restoring means according to claim 1 in which said drive means includes a motor together with at least two energizing circuits for said motor;

said operating means being adapted during movement of said xerographic surface to complete one of said energizing circuits whereby to operate said motor and oscillate said blade,

said control means being adapted on oscillation of said blade to make the other of said circuits so that with opening of said one circuit by said operating means on stopping of said xerographic surface, said other circuit may maintain energization of

said motor and oscillation of said blade; said timing means being adapted to periodically break said other circuit whereby energization of said motor and oscillation of said wiper blade continues until said other circuit is broken by said timing means.

3. The cleaning effectiveness restoring means according to claim 2 in which said timing means includes a control switch for said other circuit

a cam operator for opening said switch in predetermined timed sequence on rotation thereof; and

means to drivingly connect said cam operator with said motor whereby energization of said motor turns said cam to periodically open said control switch and interrupt said other circuit whereby to establish said predetermined maximum timed interval beyond which said other circuit is interrupted to deenergize said motor and stop said wiper blade.

4. In a wiper blade apparatus for removing leftover toner from a recycling photoconductive surface subsequent to use of said surface, said apparatus including means to slowly oscillate the apparatus wiper blade back and forth across said photoconductive surface during operating movement of said surface to enhance cleaning of said photoconductive surface by said wiper blade, the improvement comprising:

means adapted to continue oscillation of said wiper blade for up to a predetermined maximum interval following stopping of said photoconductive surface, the rubbing contact between said oscillating wiper blade and the stationary photoconductive surface aiding clearing of any material trapped by the blade and enhancing subsequent cleaning contact between the blade and the photoconductive surface.

5. The wiper blade apparatus according to claim 4 in which said last mentioned means includes timing means operative in response to oscillation of said blade to periodically render said last mentioned means inoperative whereby on stopping of said photoconductive surface, oscillation of said wiper blade is continued until said timing means intervenes.

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