

[54] **CLEANING OF
ELECTROSTATOGRAPHIC SURFACES**

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[58] **Field of Search**355/3, 15; 118/104, 203, 261; 15/256.51, 256.53, 1.5

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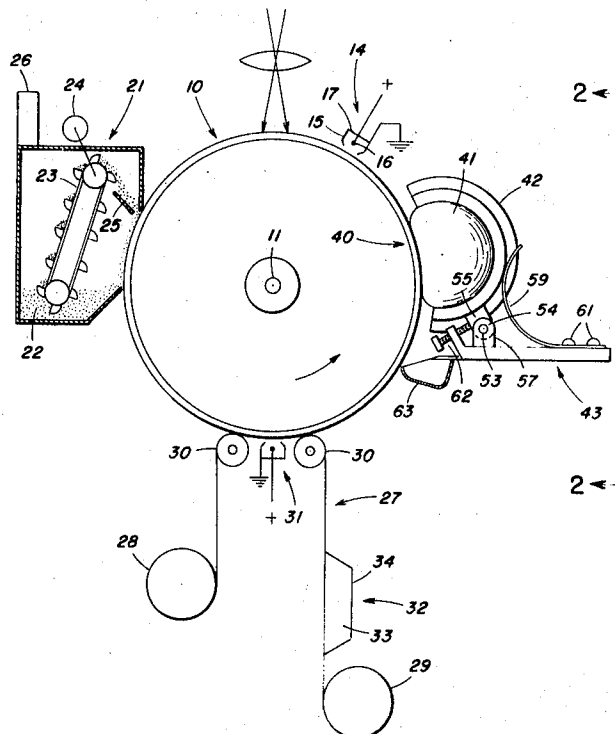
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[57]

ABSTRACT

An inflated elastic tube is maintained in pressure contact with a moving electrostatographic recording surface having residual toner thereon whereby a ridge of toner is accumulated on the recording surface. The contact between the inflated tube and the recording surface is periodically interrupted; e.g., by deflating the tube or moving the tube away from the surface, and the accumulated toner is carried by the recording surface into the development apparatus.

21 Claims, 4 Drawing Figures



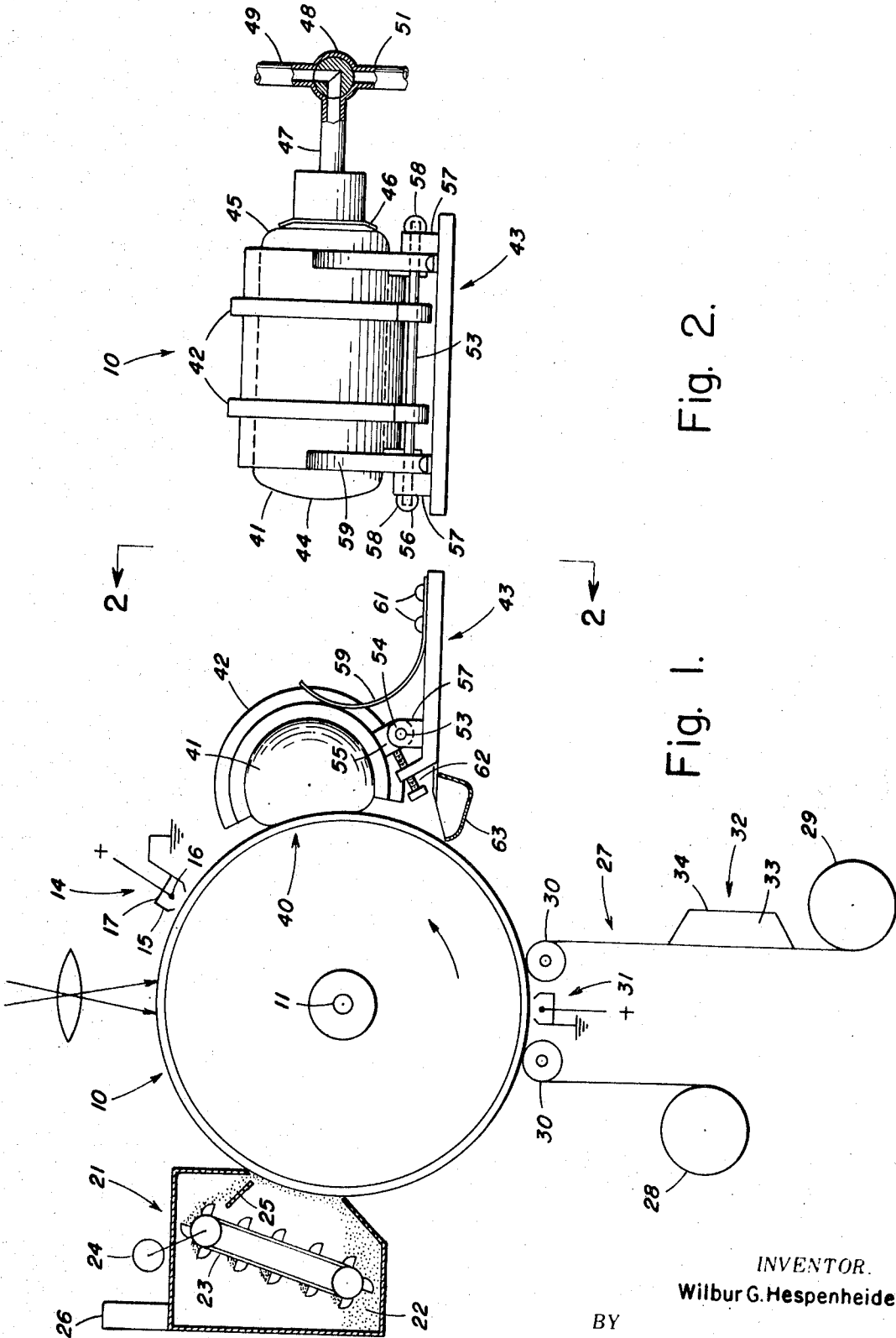


Fig. 2.

Fig. 1.

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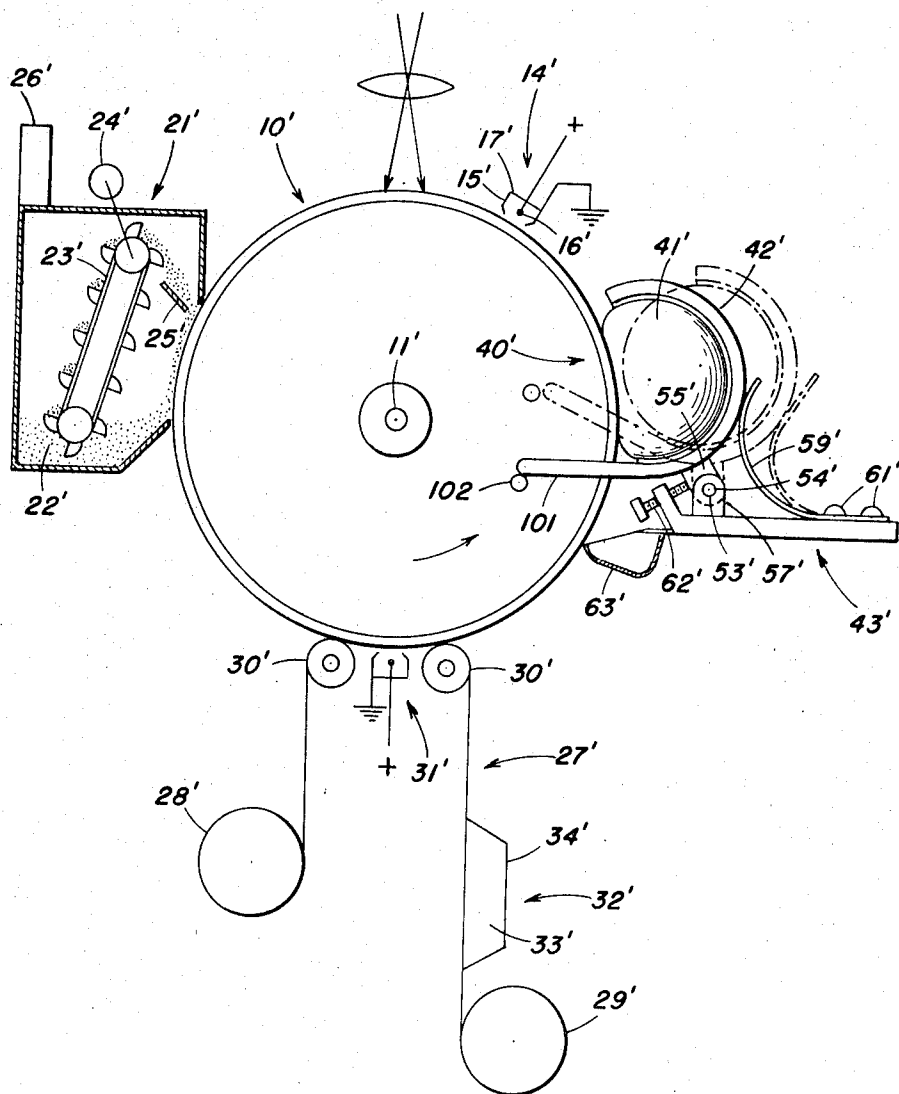


Fig. 3.

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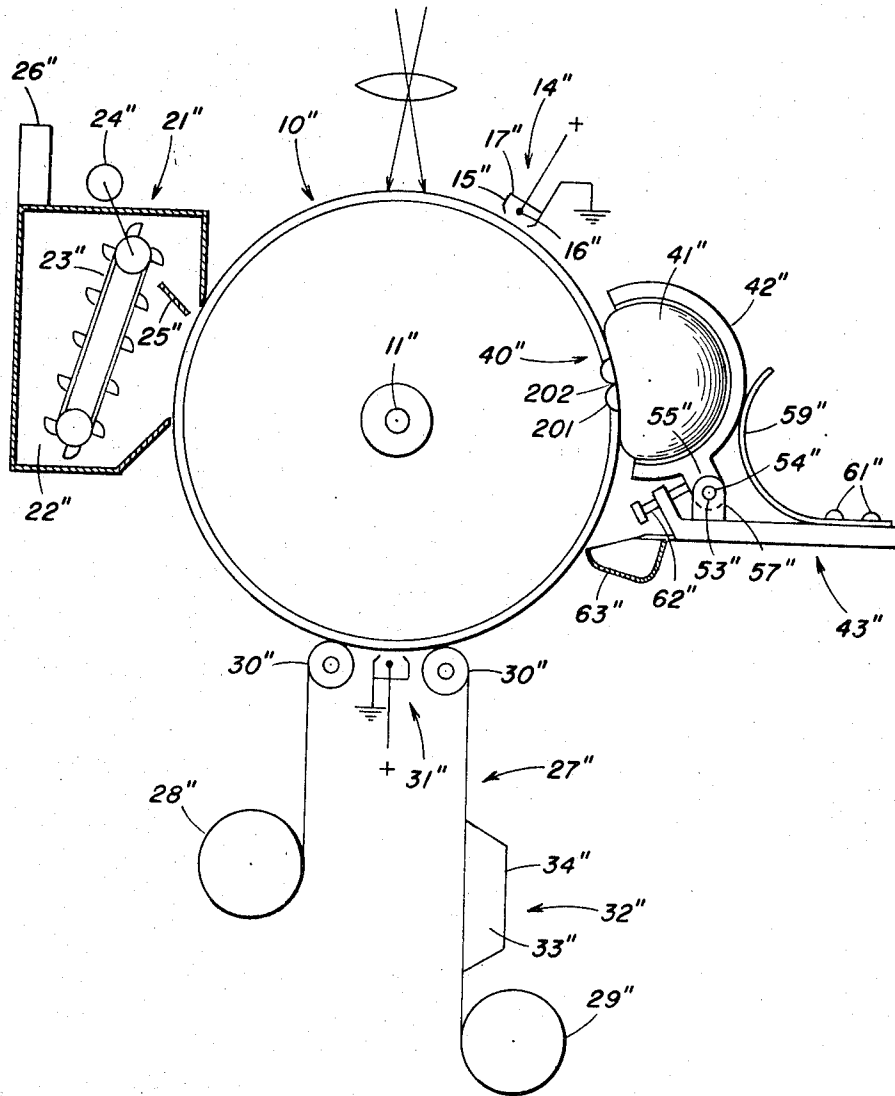


Fig. 4.

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CLEANING OF ELECTROSTATOGRAPHIC SURFACES

BACKGROUND OF THE INVENTION

This invention relates to cleaning of particles from a surface and more particularly to removing residual toner from an electrostatographic recording surface.

The most common electrostatographic process is the electrophotographic process, for example, as disclosed in U.S. Pat. No. 2,297,691 to Carlson. As disclosed in the Carlson Patent, an electrostatographic recording surface, comprising a photoconductive insulating material on a conductive backing, is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the charged areas in accordance with the light intensity which reaches them and thereby creates an electrostatic latent image on or in the photoconductive material.

Development of the latent electrostatic image is usually effected by an electrostatically attractable material, which is generally a thermoplastic resin in the form of finely divided particles usually in the size range from 1 to 30 microns, commonly referred to as toner. In the development of the latent electrostatic image, the toner is brought into surface contact with the latent electrostatic image bearing surface and is held thereon electrostatically in a pattern corresponding to the latent electrostatic image. The developed image is then transferred to a suitable support material, such as paper, and fused thereon to make a permanent image. In the transfer step the resin material or toner is caused to adhere to the support material to form the images thereon, but usually a portion of the resin material or toner remains on the surface of the photoconductive material.

The quantity of resin material or toner remaining on the photoconductive surface will affect future operating steps of the process, and if left remaining thereon has an accumulative effect in that additional toner adheres more readily to the photoconductive surface in both image and non-image areas thereon.

The accumulated toner material is generally removed from the photoconductive surface by the process disclosed in U.S. Pat. No. 2,751,616 to Turner. As disclosed in the Turner Patent, a rotating brush mounted in a hood is rotated in surface contact with the photoconductive surface to dislodge any residual toner adhering thereto. The bristles of the brush are then contacted with a flicking bar mounted in the hood to detach the particles of toner adhering thereto. The hood in which the brush is mounted is in fluid flow communication with a filter box having a filter mounted therein through an exhaust duct, with the portion of the filter box, downstream of the filter, being preferably connected to a centrifugal blower to draw air from the hood which entrains the toner particles removed from the brush by the flicking bar. The toner particles are separated from the air as the air passes through the filter.

The cleaning mechanism hereinabove described is complex and occupies a significant portion of the overall space of the machine, and in addition, requires an additional power source and drive system. Furthermore, such a cleaning mechanism does not have any

provision for the recovery of the residual toner particles. Moreover, the brush fibers must be replaced as a result of either wear or an accumulation of toner particles on the brush fibers which causes filming on the recording surface. In addition, the rotating brush often throws toner particles into the environment surrounding the brush housing resulting in unwanted toner deposits in other areas of the machine. Accordingly, there is a continuing need for new systems for cleaning reusable electrostatographic recording surfaces.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to provide for cleaning of electrostatographic recording surfaces.

Another object of this invention is to provide for both the removal and recovery of residual toner from electrostatographic recording surfaces.

A further object of this invention is to provide for simple and inexpensive cleaning of an electrostatographic recording surface.

These and other objects of the invention should be more apparent from reading the following description thereof with reference to the accompanying drawings.

The objects of this invention are broadly accomplished by cleaning an electrostatographic recording surface by means of an inflated elastic member which is held in contact with a moving electrostatographic recording surface containing residual particles, whereby the particles are prevented from moving past the elastic member and are accumulated on the recording surface. The accumulated particles are periodically removed from the recording surface, preferably by periodically interrupting the contact between the inflated elastic member and the electrostatographic recording surface whereby the accumulated particles are moved on the recording surface past the cleaning station for subsequent recovery.

The elastic member is formed of an abrasion resistant elastomeric material such as polyurethane, natural rubber, neoprene, etc. which does not adversely affect the recording surface; i.e., the material does not affect the electrical characteristics of the recording surface, and is preferably in the form of an inflatable elastic tube which is of circular or other cross-section, with the tube being inflated by the application of fluid pressure; either by liquid pressure, such as water, or by gaseous pressure, such as air. The diameter of the tubular member may vary over wide limits from very small to very large diameters, but in general, the tubular member has a diameter which ranges from about 0.5 inch to about 3 inches, with the smaller diameter tubes generally requiring a rigid backing member to maintain uniform pressure contact between the inflated member and recording surface. The inflated elastic member is maintained in contact with the recording surface by the application of a uniform pressure thereto, with the applied biasing pressure being sufficient to maintain such contact without increasing the friction between the elastic member and recording surface to a value at which the elastic member vibrates against the recording surface, such vibration allowing particles to channel under the elastic member. In general, the biasing pressure is less than about 0.1 psig. The inflated elastic member functions as a wiper which accumulates particles on the recording surface and is extremely effective

in that the inflated member can conform to the irregularities on the surface without requiring high local pressures.

The cleaning station of the present invention may also include means for supplying a dry solid lubricant to the interface between the inflated elastic member and the electrostatographic recording surface to reduce the friction between the inflated member and the recording surface and thereby enhance the ability of the elastic member to maintain sealing contact with the recording surface. In many cases, however, no lubricant is required for maintenance of such sealing contact. The dry solid lubricant, if required, may be supplied to the interface between the inflated member and the imaging surface by various techniques. For example, the dry solid lubricant may be in the form of a powder which is intimately mixed with the toner and supplied to the surface of the imaging surface during development of the latent electrostatic image. Alternatively, the dry solid lubricant may be dispersed throughout the photoconductive layer or suspended in a photoconductor overcoating. As the surface of the overcoating or treated photoconductor gradually wears away, additional dry lubricant which was originally distributed through the photoconductive or overcoating layer is exposed and made available at the interface of the elastic member and imaging surface. In another alternative embodiment, the dry solid lubricant may be sprinkled or smeared on the imaging surface at any point during the imaging cycle prior to the cleaning station. For example, a suitable dispenser such as a plurality of dispensers described in U.S. Pat. No. 3,013,703 may be positioned over an electrophotographic drum between the exposure and development stations and adapted to continuously or intermittently sprinkle dry solid lubricant particles on the imaging surface. Any suitable dry solid lubricant may be employed. Hydrophobic dry solid lubricants are preferred. Further, when the lubricant may ultimately transfer to the receiving sheet, the lubricant is preferably selected from the group of materials having a color which matches the color of the receiving sheet, e.g., white lubricant particles would be employed with white receiving sheets. Obviously, contrasting colors may be employed for novel effects if desired. Typical dry solid hydrophobic lubricants include metal salts of fatty acids such as zinc stearate, barium stearate, lead stearate, iron stearate, nickel stearate, cobalt stearate, copper stearate, strontium stearate, calcium stearate, cadmium stearate, magnesium stearate, zinc oleate, manganese oleate, iron oleate, cobalt oleate, copper oleate, lead oleate, magnesium oleate, zinc palmitate, cobalt palmitate, copper palmitate, magnesium palmitate, aluminum palmitate, calcium palmitate, lead caprylate, lead caproate, zinc linoleate, cobalt linoleate, calcium linoleate, zinc ricinoleate and cadmium ricinoleate; higher aliphatic acids such as stearic acid and palmitic acid; and colloidal pyrogenic silica particles such as Cab-O-Sil available from the Cabot Corporation and mixture thereof.

Any suitable reusable electrostatographic imaging surface may be employed in the system of this invention. Well known electrostatographic imaging surfaces include photoconductive materials such as vitreous selenium, organic or inorganic photoconductors em-

bedded in a non-photoconductive matrix, organic or inorganic photoconductors embedded in a photoconductive matrix and the like. Representative patents in which photoconductive materials are disclosed include U. S. Pat. No. 2,803,542 to Ullrich, U. S. Pat. No. 2,970,906 to Bixby, U. S. Pat. No. 3,121,006 to Middleton, U. S. Pat. No. 3,121,007 to Middleton and U. S. Pat. No. 3,151,982 to Corrsin. Generally, photoconductive materials are supported by conductive substrates. Typical conductive substrates include brass, aluminum, gold, platinum, steel, glass coated with conductive oxides, metallized non-conductive substrates, laminated sheets of metal and plastic and the like. The conductive substrate may be in the form of a flat plate, cylinder, flexible sheet or other suitable configuration. Preferably, the photoconductive surface comprises vitreous selenium, selenium alloys or mixtures of selenium and other inorganic materials because superior copy quality is maintained for a greater number of copying or duplicating cycles.

The cleaning system of this invention is particularly effective in electrostatographic processes employing two-component type developing materials comprising carrier and toner particles. Representative patents in which these developer compositions are disclosed include U. S. Pat. No. 2,618,551 to Walkup, U. S. Pat. No. 2,618,552 to Wise, U. S. Pat. No. 2,633,415 to Walkup and Wise, U. S. Pat. No. 2,659,670 to Copley, U. S. Pat. No. 2,788,288 to Rheinfrank and Jones and U. S. Re. Pat. No. 25,136 to Carlson. Generally, the toners have an average particle diameter between about 1 and about 30 microns, and the relatively larger carrier beads have an average particle diameter from about 30 to about 1,000 microns in diameter. Typical toner concentrations include a range from about 0.5 to about 10 percent by weight based on the total weight of the two-component developer composition.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic sectional view of an electrostatographic reproducing apparatus incorporating an embodiment of the invention.

FIG. 2 is a schematic sectional view of an electrostatographic reproducing apparatus incorporating another embodiment of the invention.

FIG. 3 is a schematic sectional view of an electrostatographic reproducing apparatus incorporating a further embodiment of the invention.

FIG. 4 is a schematic sectional view of an electrostatographic reproducing apparatus incorporating yet another embodiment of the invention.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Referring to FIG. 1 of the drawings, there is illustrated an electrostatographic machine employing an embodiment of this invention. The machine includes an image forming member such as, for example, an electrophotographic cylinder designated 10 and generally including an insulating or photoconductive insulating layer disposed on a conductive backing. The cylinder is rotatably mounted on a suitable axle 11 or other bearing member and is adapted to be rotated by drive means such as, for example, an electric motor (not shown) or the like. Preferably the cylinder, and in par-

particular its conductive backing, is electrically grounded. The image forming or image receiving surface of the electrophotographic cylinder 10 is adapted to be rotated past appropriate electrophotographic processing stations disposed and positioned to form an electrostatic image on the cylinder surface. For example, when used with a photoconductive insulating electrophotographic image surface, the electrophotographic processing stations may include means for charging or sensitizing, exposure means, developing means and cleaning means. Illustrated in the figure is a charging station generally designated 14 at which is positioned a corona discharge electrode 15, desirably one or more high voltage corona discharge wires 16 mounted within a grounded shield 17 and adapted to be connected to a high voltage source such as, for example, a positive polarity direct current source of several thousand volts. In general the voltage applied to the corona discharge electrode will be sufficient to cause air ionization surrounding the corona wires and it is understood that such a corona discharge potential is generally in the order of several thousand volts and usually 5 to 10 thousand volts as disclosed, for example, in Walkup U. S. Pat. No. 2,777,957.

Positioned next adjacent to the charging station is an exposure station generally designated 18 and including suitable means for projecting or otherwise directing a light or optical image onto the surface of the electrophotographic drum. The exposure station may include a slit projection mechanism for exposing onto the drum surface a moving projected image of microfilm or the like, and may include means for projecting onto the surface documentary or other information or an image corresponding to the face of a cathode ray tube of the like. As is disclosed in Carlson U. S. Pat. No. 2,297,691, the combination of electric field and exposure to activating radiation forms on the drum surface an electrostatic image capable of being developed or made visible by deposition of finely divided charged particles.

A development station for developing the latent electrostatic image, generally designated as 21, is positioned at a subsequent location around the circumference of the drum. The development station, as shown, includes a sump 22 containing a two component developer material comprised of toner and carrier, for example of the type disclosed in U. S. Pat. No. 2,618,551 to Walkup; a conveyor 23, which is driven through suitable drive means by a motor 24; and a chute 25 for transporting developer released from the conveyor to the surface of the drum 10. In operation, the conveyor 23 transports the developer from the sump 22 to the chute 25, and the developer released from the chute 25 cascades over the surface of the drum 10, whereby the toner particles are attracted to the image areas previously formed thereon to render the image visible. The unused developer material which has cascaded over the surface of the drum 10 falls into the sump 22, and the developer material in the sump 22 is periodically provided with toner through dispenser 26, e.g., of the type described in U. S. Pat. No. 3,013,703 to Hunt, to replenish the toner used to develop the image.

Although the embodiment is described with reference to a cascade development system, it is to be understood that the latent image may be developed by

any one of a wide variety of other development techniques, such as, for example, fur brush development and the like.

Positioned subsequently around the surface of the electrophotographic drum is an image transfer station generally designated 27 including for example a supply roll 28 of transfer material such as, for example, a roll of paper and a take-up roll 29 together with guide means and the like to feed the image transfer material into contiguous relationship with the electrophotographic drum. As illustrated in the figure, suitable guide rolls 30 may guide and optionally drive the transfer web into contact with the electrophotographic drum, and transfer means such as, for example, a corona discharge electrode 31 is positioned to transfer the developer image to the image web at the transfer station. Preferably, the transfer means in a corona discharge electrode of substantially the same construction as is located at the charging station 14 although other transfer means may be employed such as the means disclosed in U. S. Pat. No. 2,807,233. For the usual case of direct or positive-to-positive photographic copy the charging electrode 15 and the transfer electrode 31 are of the same polarity and for the opposite situation of photographic reversal the electrodes are of opposite polarity. Optionally positioned near the transfer station and along the line of travel of the transfer web subsequent to the transfer station is a fusing station generally designated 32 and including a plurality of heating elements 33 suitably contained within a housing 34 and adapted to fuse onto the web surface the image that has been transferred thereto. It is understood that suitable vapor fixing means may be employed as disclosed for example in Carlson U.S. Pat. No. 2,776,907.

The recording surface of the drum 10 is then cleaned in cleaning station 40 to complete the cycle which includes: charging, exposure, development, transfer and cleaning.

The cleaning station 40 is comprised of an inflated elastic member in the form of inflated elastic tubing 41 which is positioned transverse to and coextensive with the recording surface of drum 10. The elastic tubing may be shaped other than as shown; for example, the tubing may have a smaller diameter and include a rigid backing member to permit the application of a uniform pressure. A housing in the form of an arcuate shaped resilient holding or clamping member 42 pivotally mounted, as hereinafter described, on a support member 43, releasably holds the elastic tubing 41 with a portion of the surface thereof extending beyond the clamping member 42 in pressure contact with the recording surface of drum 10. The end 44 of tubing 41 is closed, and the opposite end 45 of tubing 41 is clamped by means of a suitable clamp 46 in fluid tight, fluid flow communication with a conduit 47 which includes a three way valve 48 such as a solenoid valve, which places the interior of the tubing 41 in fluid flow communication with either a source of fluid pressure (not shown), such as air pressure, through conduit 49 of the atmosphere through a vent conduit 51. The holding member 42 is provided with axially spaced screw clamps 52 for compressing and releasing the free ends of the holding member 42 to grip and support the inflated tubing 41 in a manner such that a portion of the

tubing 41 extends beyond the holding member 42 and in pressure contact with the recording surface of the drum 10.

The holding member 42 is pivotally mounted on a rod 53 which is telescopically received in aligned apertures 54 in downwardly extending brackets 55 fixedly mounted to the ends of the holding member 42. The rod 53 is removably supported in aligned apertures 56 in axially spaced upwardly extending brackets 57 fixedly mounted to the supporting member 43 with axial movement of the rod 53 being limited by caps 58 removably mounted on the ends of the rod 53.

A pressure loading mechanism, comprised of a resilient member 59, is fixedly supported, at one end, to the support member 43 by a fastening means, such as a screw 61, and is positioned in deformation, at the upper end, in abutment with the holding member 42, thereby biasing the pivotally supported holding member 42 toward the recording surface of drum 10. A stop mechanism, comprised of axially spaced screws 62, rotatably mounted in the support member 43, are positioned with the shanks thereof in abutment with the brackets 55 of holding member 42, thereby preventing further movement of the holding member 42 toward the recording surface of drum 10. Thus, a proper positioning of the screws 62 determines the position of the holding member 42 with respect to the recording surface of the drum 10, with the holding member 42 being maintained in this position by the resilient member 59 urging the holding member 42 toward the recording surface of drum 10.

The cleaning station further includes a removable trough like container 63, positioned below the horizontal axis of the drum 10 to collect any toner particles which may gravitate away from the recording surface of drum 10.

In operation, the elastic tube 41 is inflated to a predetermined pressure and the screws 62 are set in a manner such that the holding member 42 holds the inflated tube 41 in sealing contact with the recording surface of drum 10, with the holding member 42 being positioned closely adjacent to but not contiguous with the recording surface of drum 10. The holding member 42 is maintained in this position by the resilient member 59. If required, a dry solid hydrophobic lubricant is employed in finely divided form and admixed with the toner particles in the development station for introduction onto the recording surface. It is to be understood, however, that in many cases there is no necessity for a lubricant.

The elastic tubing 41 which is in sealing contact with the recording surface of drum 10 prevents residual toner from moving past the tubing and, therefore, there is a buildup of toner on the recording surface of the drum 10. Periodically, the valve 48 connects the interior of the tubing 41 to vent for a short period of time which causes the tubing 41 to deflate, thereby breaking the sealing contact between the tubing 41 and the recording surface of drum 10, whereby the accumulated particles are transported by the rotating drum 10 into the developing apparatus where the toner is removed by the cascading developer. The valve 48 is then switched to connect the tubing 41 to the source of pressure, thereby reinflating the tubing 41 and reestablishing the sealing contact between the tubing

41 and the recording surface of drum 10. In this manner, the recording surface rotated past the cleaning station 40 is maintained free of residual toner particles and such residual toner particles instead of being wasted as in conventional cleaning apparatus are accumulated and recycled for use in the development portion of the process.

Another embodiment of the invention is illustrated in FIG. 3. The embodiment of FIG. 3 is similar to the embodiment of FIG. 1, except for the manner in which the contact between the inflated member and the recording surface is periodically interrupted and, therefore, like parts are designated by like prime numerals.

Referring to FIG. 3, there is shown an inflated elastic member 41' releasably held in pressure contact with the recording surface of drum 10' by a holding member 42' pivotally supported on a supporting member 43'. In the embodiment of FIG. 3, the inflated member 41' may be an elastic member which has been previously inflated in that there is no necessity to inflate and deflate the elastic member to establish and interrupt contact between the elastic member and the recording surface. Accordingly, the apparatus need not include special means for providing a source of fluid pressure.

The inflated tube 41' normally rests in pressure contact with the recording surface of drum 10' due to the pressure applied by the resilient member 59'. The holding member 42' is provided at one end with a cam follower 101 which extends radially inward beyond one of the axial ends of the recording surface of drum 10' for engagement with a cam 102 rigidly mounted on the end surface of drum 10' for rotation therewith. The cam follower 101 upon engaging cam 102 follows the curved surface of cam 102 causing the holding member 42' to be lifted away from the recording surface of drum 10', thereby interrupting the contact between the inflated tube 41' and the recording surface of drum 10'. The interruption of the contact between the inflated member 41' and the recording surface of drum 10', permits the accumulated toner particles to be carried by the recording surface of drum 10' to the development station at which point the toner is removed by contact with cascading developer.

Another embodiment of the invention is illustrated in FIG. 4. The embodiment of FIG. 4 is similar to the embodiment of FIG. 1 except for the manner in which the contact between the inflated member and the recording surface is periodically interrupted and, therefore, like parts are designated by like double prime numerals. Similar to the embodiment of FIG. 3, the elastic member is preferably inflated prior to being inserted into the apparatus.

Referring to FIG. 4, there is shown an inflated elastic member 41'' releasably held in pressure contact with the recording surface of drum 10'' by a holding member 42'' pivotally supported on a supporting member 43''. The inflated tube 41'' normally rests in pressure contact with the recording surface of drum 10'' due to the pressure applied by the resilient member 59''.

The recording surface of drum 10'' is provided with adjacent transverse grooves 201 and as drum 10'' rotates, the residual toner on the recording surface of drum 10'' is dislodged and carried thereon by the inflated tube 41'' until contact is interrupted between the

inflated tube 41'' and the recording surface by grooves 201. The toner particles are carried in the grooves 201 to the development station at which point the toner is removed by cascading developer. Although two grooves have been particularly shown, it is to be understood that the recording surface may be provided with less than or more than two grooves and that if two or more grooves are employed it is not necessary that each groove extend across the entire surface.

The stop screw 62'' is adjusted in a manner such that the holding member 42'' holds the inflated tube 41'' in contact with the recording surface, but prevents the inflated tube 41'' from removing accumulated toner from the grooves 201. The grooves 201 in addition to functioning as a reservoir for accumulated toner remove residual toner adhering to the inflated tube 41'' by the wiping action between the faces 202 of grooves 201 and the inflated tube.

Numerous modifications and variations of the hereinabove described embodiments are possible within the spirit and scope of the invention. For example, the embodiments have been particularly described with reference to an annular recording surface on a rotating drum, and it is to be understood that the present invention is equally applicable to other types of recording surfaces; e.g., movable belts.

Similarly, the lubricant, if required, may be introduced into the machine in a manner other than with the toner as particularly described with respect to the illustrated embodiments. The lubricant could be introduced through a suitable dispenser prior to or after the development station or may be incorporated into the reusable electrostatographic surface.

The cleaning system of the present invention may be supplemented with other devices to aid in the cleaning process. Thus, for example, there may be provided a pre-cleaning station which would include a corona discharge device; e.g., similar to the device employed for precharging the recording surface, to charge the recording surface and residual toner, subsequent to the transfer station, and prior to the cleaning step. The polarity of the charge is dependent upon the particular results desired. Thus, for example, the corona discharge device is employed to provide a charge polarity which increases the electrostatic attraction between the residual toner and the recording surface in a situation in which elimination of the possibility of toner gravitating away from the recording surface is desired. Alternatively, the charge may be of a polarity which reduces the electrostatic attraction between the residual toner and the recording surface which in turn facilitates removal of residual toner from the recording surface.

Similarly, the contact between the inflated member and the recording surface may be interrupted in a manner other than those particularly described. For example, the inflated member may be moved away from contact with the recording surface by electrical or magnetic means in addition to the various mechanical means particularly described. Various mechanisms for interrupting contact between the inflated member and the recording surface should be readily apparent to those skilled in the art from the teachings herein.

As another alternative, the accumulated toner could be removed from the recording surface without inter-

rupting contact between the inflated member and recording surface; e.g., the accumulated toner may be periodically removed from the recording surface by a brush or other suitable means.

As a further alternative, a plurality of inflated members may be employed to clean the recording surface. Each of the plurality of inflated members may be each coextensive with the recording surface whereby any residual material moving past the first member is removed by the second member. Alternatively, the plurality of members may be positioned in a manner such that each member extends over a portion of the recording surface, with the members being staggered and overlapped to insure coverage of the entire axial length of the recording surface. Similarly, although the invention has been described with reference to the use of a cascade development technique, other development techniques may also be employed; e.g., fur brush development, fluidized development and the like. Representative patents in which various development techniques are described include: U. S. Pat. No. 2,895,847 to Mayo; U. S. Pat. No. 2,251,706 to Wal-kup; and U. S. Pat. No. 2,874,063.

It is to be further understood that the present invention is also applicable to electrostatographic processes other than of the electrophotographic type, such as for example, electrostatic processes in which a latent electrostatic image is formed by a pulsing electrode. Thus, as should be apparent, although the present invention is particularly applicable to an electrophotographic copying machine, the overall invention is not limited to a particular technique for forming or developing a latent electrostatic image.

Numerous modifications and variations of the present invention are possible in light of the above teachings and, therefore, within the scope of the appended claims the invention may be practiced other than as particularly described.

What is claimed is:

1. An apparatus for cleaning an electrostatographic recording surface, comprising:

an inflated elastic member; and support means for maintaining a portion of the surface of the inflated member in contact with an electrostatographic recording surface having particles on the surface thereof to prevent particles on said recording surface from moving past said member.

2. The apparatus as defined in claim 1 and further comprising:

means for periodically interrupting the contact between the surface of the inflated member and the recording surface to permit particles accumulated on the recording surface to move past the elastic member.

3. The apparatus as defined in claim 2 wherein the means for periodically interrupting the contact between said surface of the inflated member and the recording surface comprises means connected to the inflated elastic member to periodically inflate and deflate said inflated elastic member to maintain and interrupt, respectively, the contact.

4. The apparatus as defined in claim 2 wherein the means for periodically interrupting contact between the inflated elastic member and the recording surface comprises means connected to said inflated elastic

member to move said surface thereof into and out of contact with said recording surface.

5. The apparatus as defined in claim 2 and further comprising means to supply a dry solid lubricant to said recording surface.

6. The apparatus as defined in claim 2 wherein the support means comprises:

a housing holding said inflated elastic member with said portion of said surface of the elastic member extending beyond said housing;

means pivotally supporting said housing; and

a resilient member positioned against said housing biasing said housing toward the recording surface to maintain said portion of said surface of the elastic member in contact with the recording surface.

7. In an electrophotographic imaging apparatus including a movable electrophotographic recording surface; a charging station to provide an electrostatic charge on said recording surface; an imaging station to provide an electrostatic latent image on said recording surface; a development station for applying toner to said recording surface to thereby render the electrostatic latent image visible; a transfer station for transferring the toner image to a support medium; a cleaning station for removing residual toner from the recording surface; and means for moving the recording surface past the charging station, imaging station, development station, transfer station and cleaning station, the improvement comprising:

said cleaning station including: an inflated elastic member; and

support means maintaining a portion of the surface of the inflated elastic member in contact with said recording surface to prevent residual toner particles from moving past said inflated elastic member.

8. The apparatus as defined in claim 7 and further comprising:

means for periodically interrupting the contact between the surface of the inflated member and the recording surface whereby particles accumulated on the recording surface are moved by the recording surface past the inflated elastic member to the development station.

9. The apparatus as defined in claim 8 wherein the movable electrophotographic recording surface is an annular surface on a rotatable drum.

10. The apparatus as defined in claim 9 wherein the means for periodically interrupting the contact between the surface of said inflated member and the recording surface comprises means connected to the inflated elastic member to periodically inflate and deflate said inflated elastic member to maintain and interrupt, respectively, the contact.

11. The apparatus as defined in claim 9 wherein the means for periodically interrupting contact between the surface of the inflated member and the recording surface comprises means connected to said inflated elastic member to move said surface thereof into and

out of contact with said recording surface.

12. The apparatus as defined in claim 9 and further comprising means to supply a dry solid lubricant to said recording surface.

13. The apparatus as defined in claim 9 wherein said means for interrupting contact between the surface of the inflated elastic member and the recording surface comprises at least one groove extending axially across said annular recording surface.

14. The apparatus as defined in claim 9 wherein the inflated elastic member is in the form of a tube.

15. The apparatus as defined in claim 14 wherein the tube has a diameter from about 0.5 inch to about 3 inches.

16. The apparatus as defined in claim 14 wherein the support means for the elastic member comprises: a housing holding said inflated elastic member with said portion of said surface of the elastic member extending beyond said housing; means pivotally supporting said housing; and a resilient member positioned against said housing biasing said housing toward the recording surface to maintain said portion of said surface of the elastic member in contact with the recording surface.

17. In an imaging process wherein a movable electrophotographic recording surface is moved past a charging station to provide an electrostatic charge on said recording surface; an imaging station to provide an electrostatic latent image on said recording surface, a development station for applying toner to said recording surface to thereby render the electrostatic latent image visible; a transfer station for transferring the toner image from the recording surface to a support medium, said recording surface having residual toner thereon, the improvement comprising:

maintaining an inflated elastic member in contact with the movable recording surface having the residual toner particles thereon to prevent the particles from moving past the inflated elastic member whereby the particles are accumulated on the recording surface; and

periodically removing the accumulated toner particles from the recording surface.

18. The process as defined in claim 17 wherein the accumulated toner particles are periodically removed from the recording surface by periodically interrupting contact between the inflated elastic member and the recording surface and returning the accumulated toner particles on the recording surface to the development station.

19. The process as defined in claim 18 wherein said contacting is periodically interrupted by inflating and deflating said elastic member.

20. The process as defined in claim 18 wherein said contacting is periodically interrupted by moving the inflated elastic member away from the recording surface.

21. The process as defined in claim 18 and further comprising applying a lubricant to the recording surface to reduce the friction between the inflated elastic member and the recording surface.

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