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Smith et al.

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[45] **Dec. 4, 1973**

[54] **CLEANING MECHANISM FOR PHOTOCONDUCTIVE SURFACES**

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[21] Appl. No.: **228,873**

[52] **U.S. Cl.** ..... **355/15**, 117/37 LE, 355/10

[51] **Int. Cl.** **G03g 15/00**

[58] **Field of Search** ..... 355/15, 10; 117/37 LE; 15/256.53

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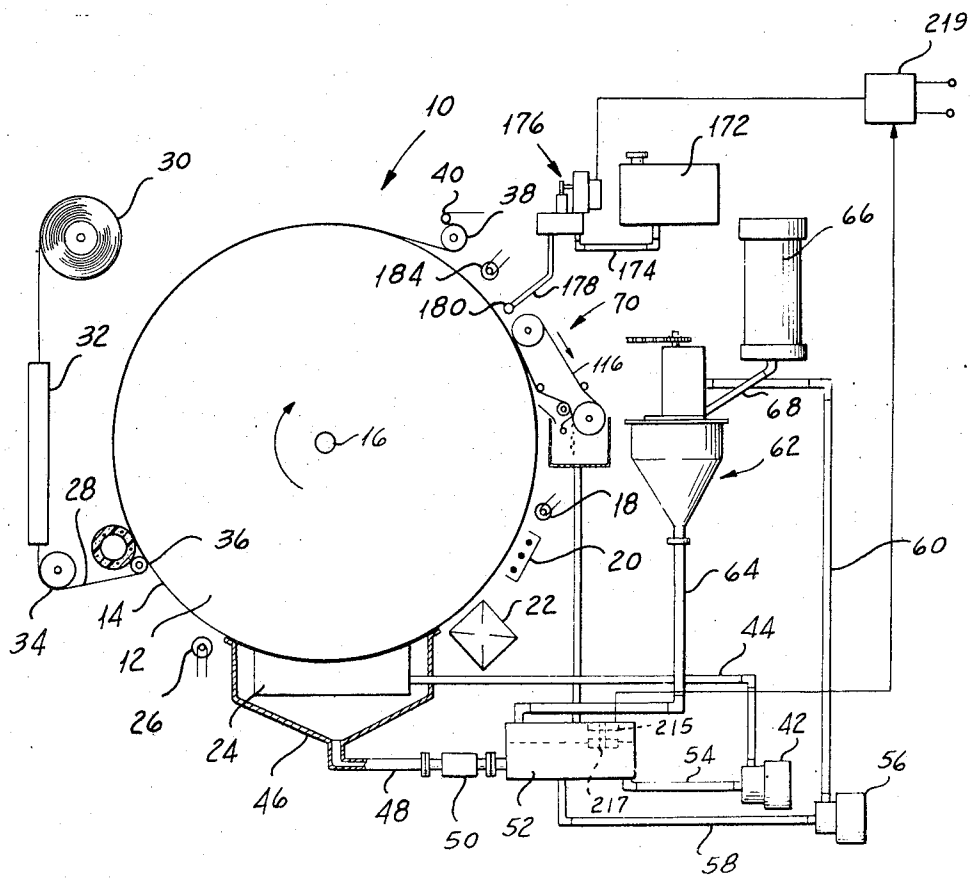
Primary Examiner—Richard L. Moses

Attorney—Henry L. Shenier et al.

[57] **ABSTRACT**

A cleaning system for the moving photoconductive surface of an image transfer electrostatic copying system using a developer made up of toner particles and a liquid carrier in which a cleaning belt with a rough surface is constrained to cause an area of the belt surface to contact the photoconductive surface at a location past the image transfer station with the belt being driven in a direction opposite to the direction of movement of the photoconductive surface and with clear carrier liquid being metered across the photoconductive surface just ahead of the cleaning belt at a rate which is approximately equal to the rate at which the carrier liquid evaporates from the developer. Preferably the belt is reciprocated transversely and preferably the photoconductive surface is flooded with light as it leaves the image transfer station.

18 Claims, 10 Drawing Figures



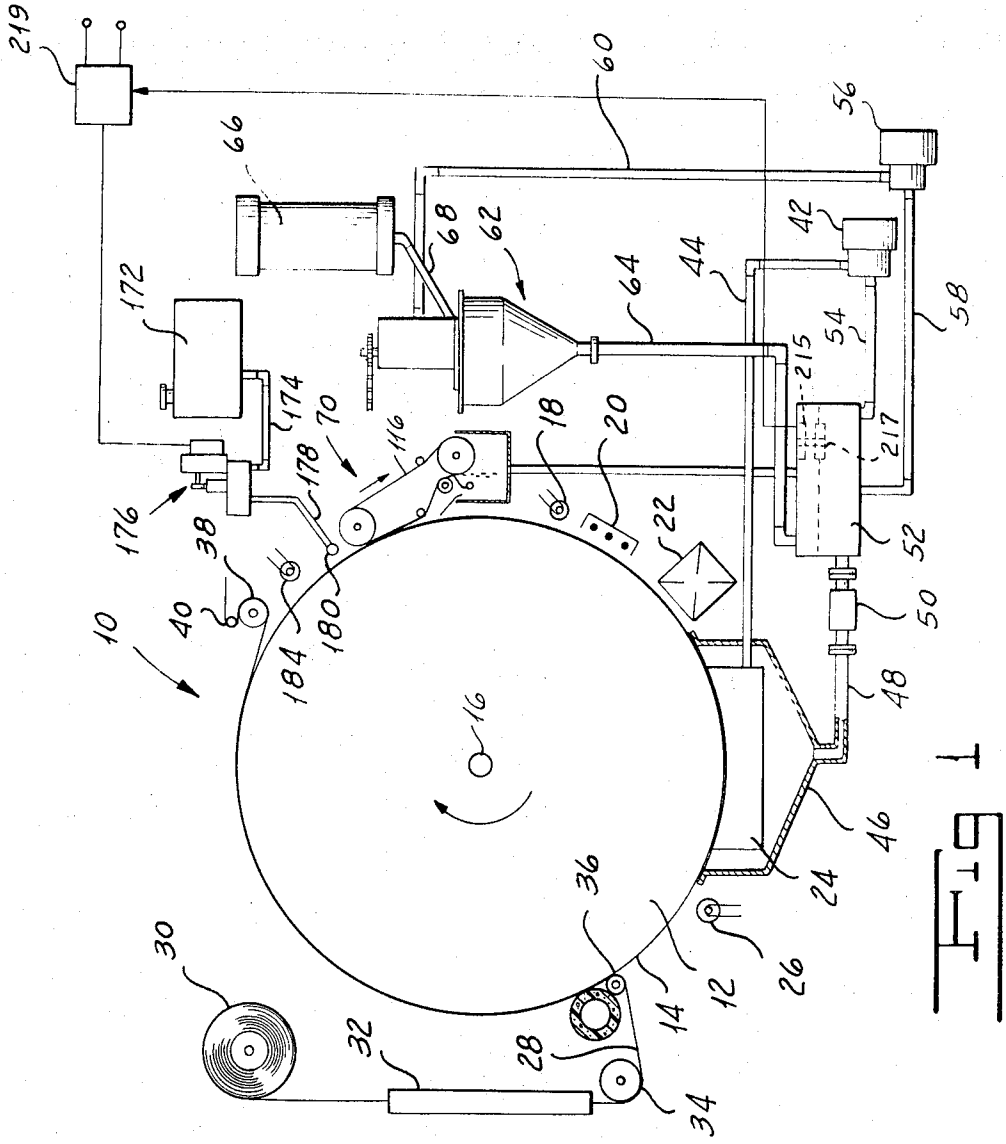

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FIG. 1

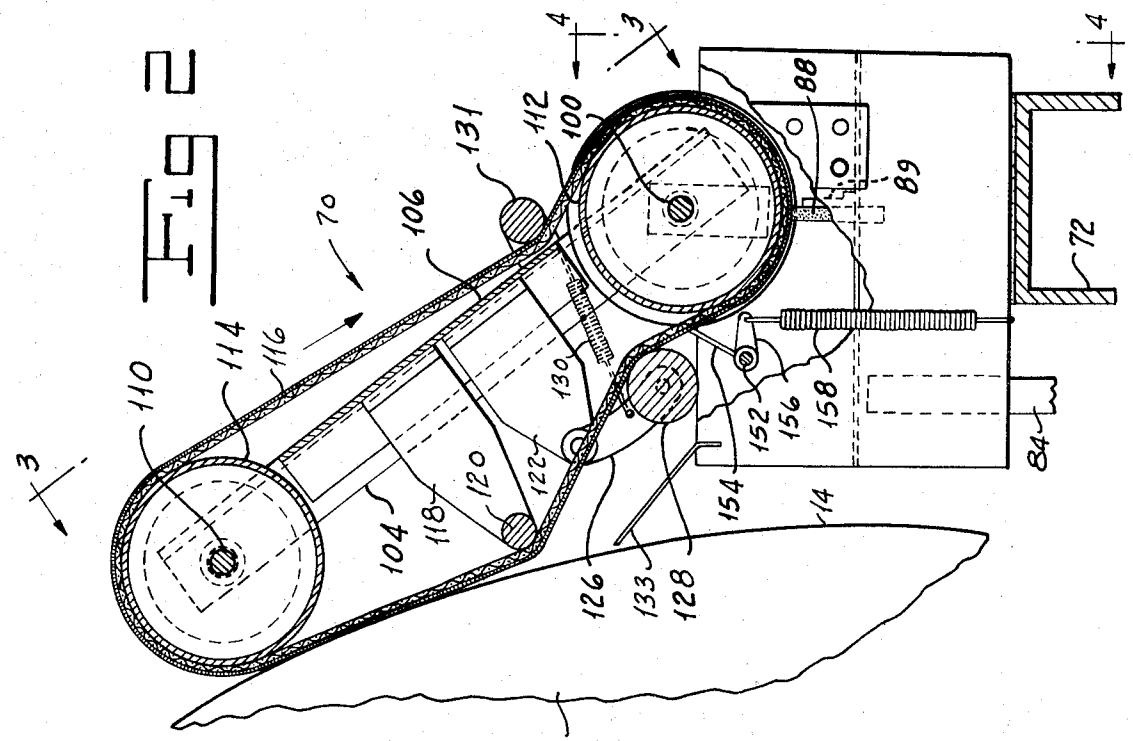

FIG 2

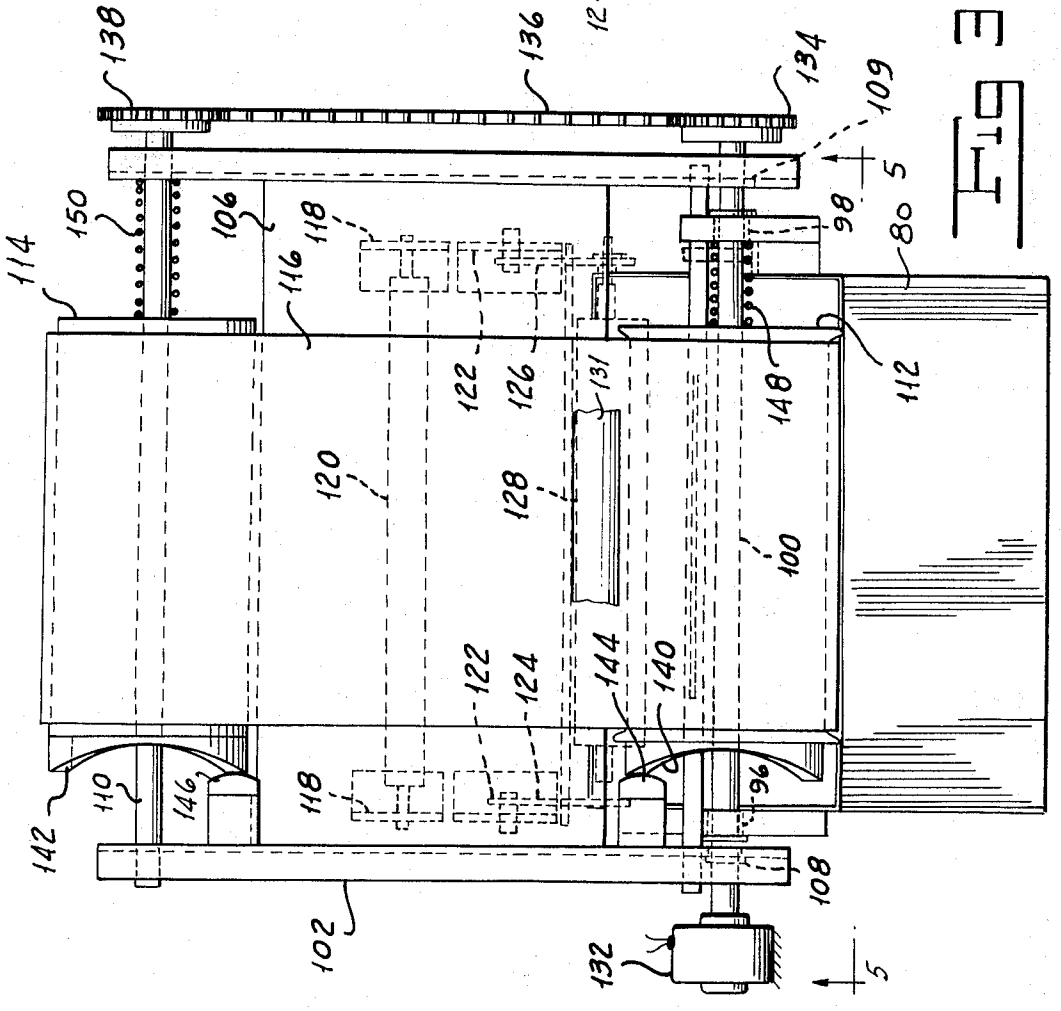

FIG 3

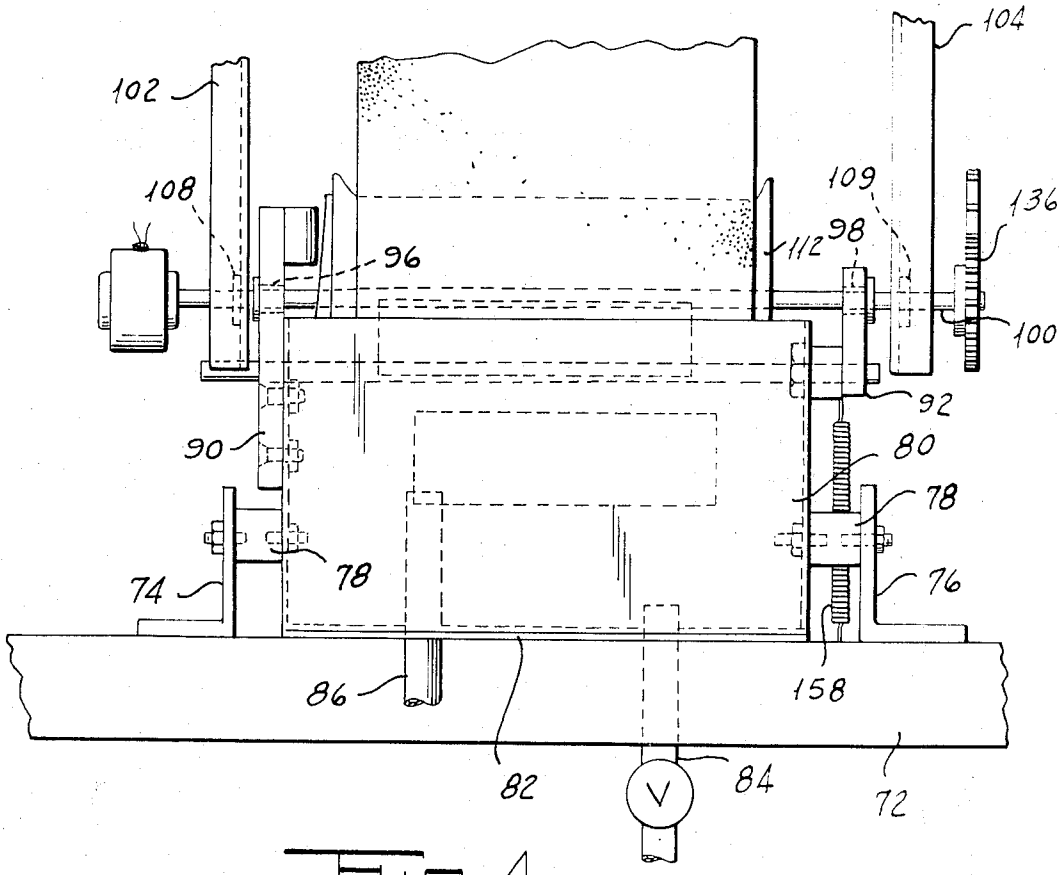
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Fig 4

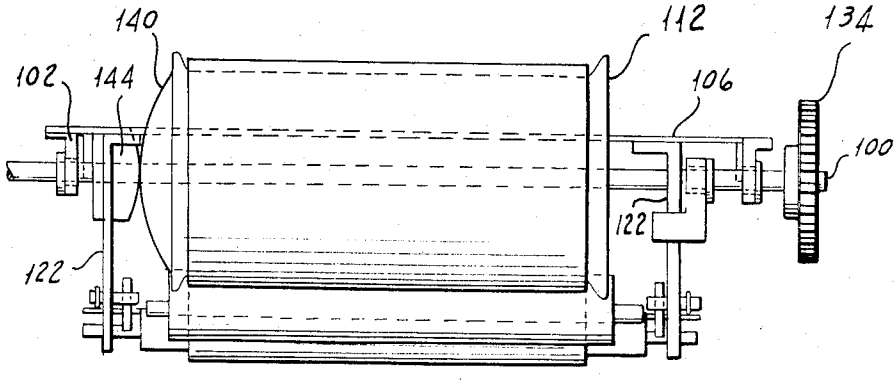
140
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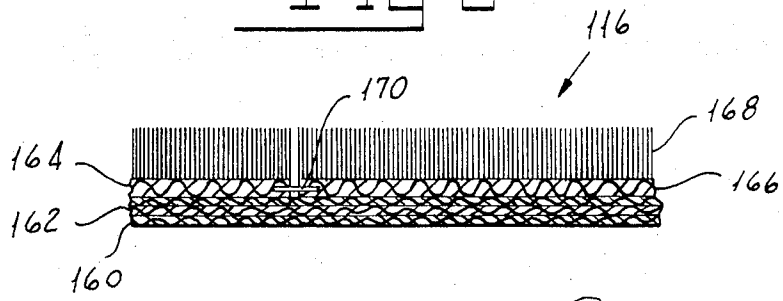
Fig 5

Fig 6



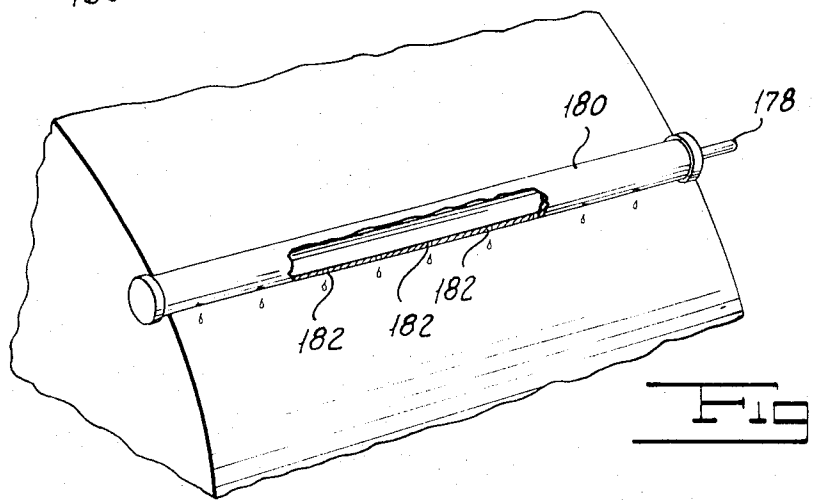


Fig 7

Fig 8

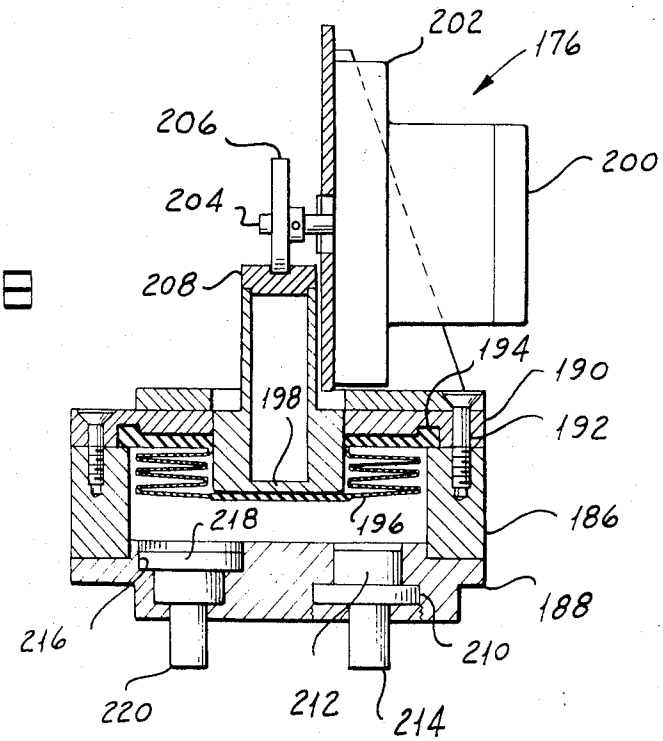


Fig 9

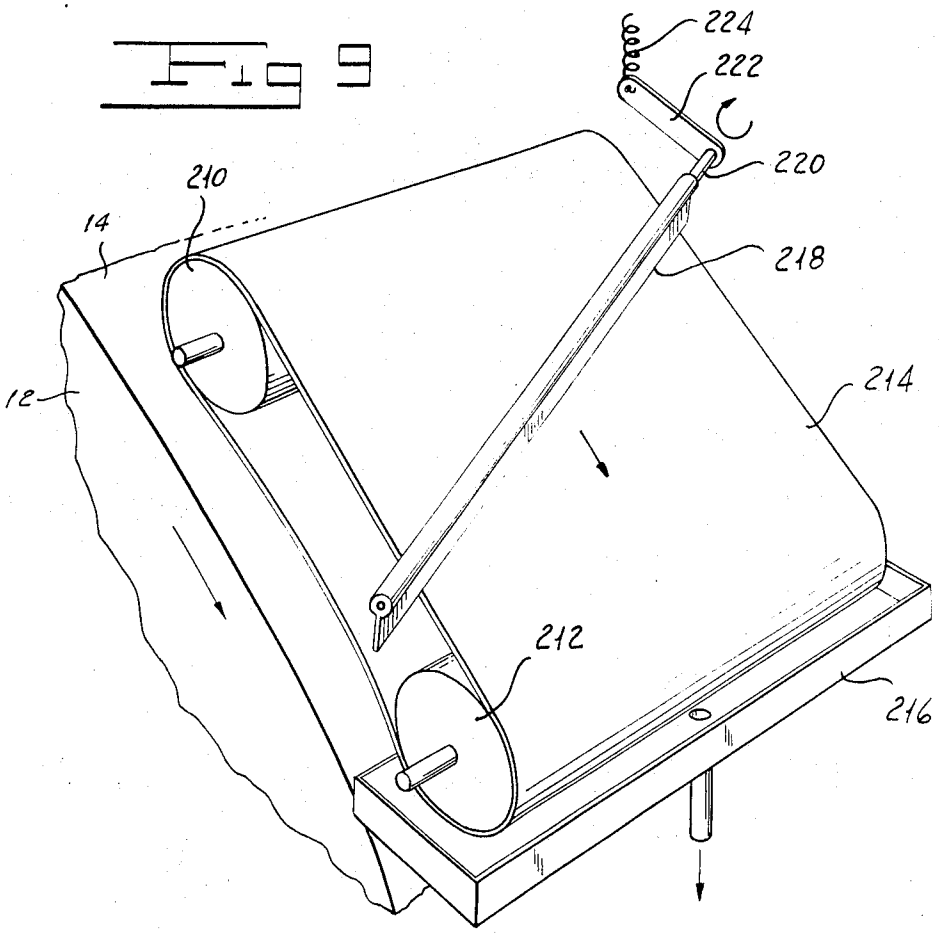

224
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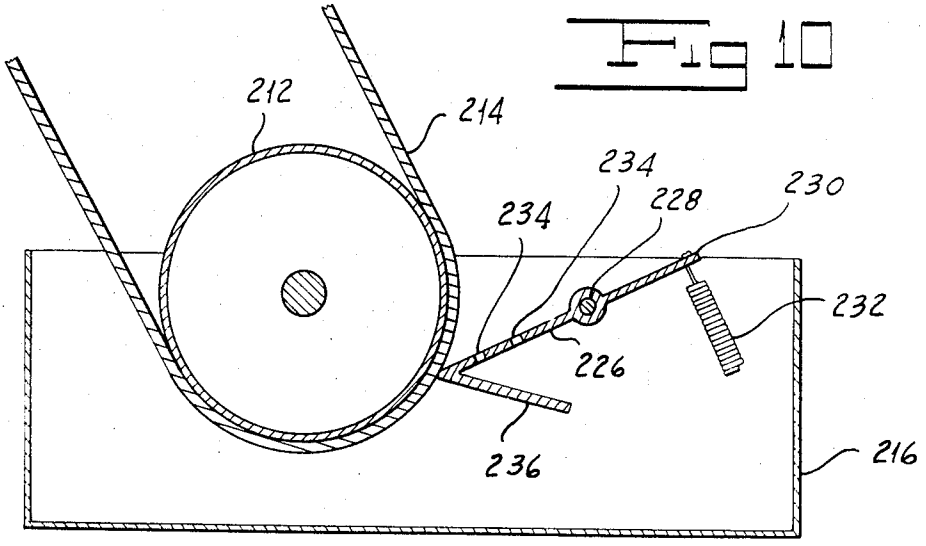
Fig 10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CLEANING MECHANISM FOR PHOTOCONDUCTIVE SURFACES

BACKGROUND OF THE INVENTION

There are known in the prior art copying machines in which a latent electrostatic image on a photoconductive surface first is developed and then the image later is transferred to a sheet of copy material such as paper or the like. Our copending application, Ser. No. 155,108, filed June 21, 1971, discloses a Method of Contact Transfer of Developed Electrostatic Images and Means for Practicing the Same. In the arrangement disclosed in our copending application, a photoconductive surface is moved successively past a charging station and an exposure station and a developing station and an image transfer station. In the course of its operation, the surface first receives a static charge and then is exposed to the image to be copied to produce a latent electrostatic image on the surface. In our copending application, the latent image is developed by subjecting the surface to the action of a developer comprising particles of a tacky toner in a suitable carrier. Following this development of the image, the surface is brought into intimate contact with the material on which the copy is to be made. Owing to the greater affinity of the tacky toner for the copy material, such as paper, than for the photoconductive surface, the image is transferred to the copy material.

Ideally, in the operation of a machine such as that described above, all of the toner particles would be transferred from the photoconductive surface to the copy material in the course of the image transferring step. Such, however, is not the case, and some toner particles remain adhered to the photoconductive surface. It will readily be appreciated that after a relatively short period of time in use, the surface will become so dirty that copies made by the machine are entirely unsatisfactory. This may be the result of interference by the buildup with the charging operation and the exposure operation or haphazard transfer of some of the buildup during subsequent copying operations.

Various suggestions have been made for cleaning the photoconductive surface of adhered toner particles so as to avoid the problem outlined above. These efforts have generally been unsuccessful. Either the surface is not effectively cleaned or toner buildup on the cleaning element necessitates maintenance at such frequent intervals as to render the arrangement entirely impracticable.

We have invented a cleaning mechanism for a photoconductive surface which overcomes the problems pointed out hereinabove in image transfer electrophotographic systems of the prior art. Our mechanism effectively cleans the photoconductive surface of an image transfer electrophotographic system. Our mechanism requires maintenance at only relatively infrequent intervals. It has a long life in use. It is simple in construction and in operation for the results achieved thereby.

SUMMARY OF THE INVENTION

One object of our invention is to provide a cleaning mechanism for the photoconductive surface of an image transfer electrostatic copying machine.

Another object of our invention is to provide a cleaning mechanism which effectively cleans a photoconductive surface of toner particles adhered thereto.

A further object of our invention is to provide a cleaning mechanism for photoconductive surfaces which does not require frequent maintenance.

Still another object of our invention is to provide a cleaning mechanism for a photoconductive surface which is simple in construction and in operation for the result achieved thereby.

Other and further objects of our invention will appear from the following description.

In general our invention contemplates the provision of a cleaning mechanism for the moving photoconductive surface of an image transfer electrostatic copying machine using liquid developer comprising toner particles in a carrier in which an area of the rough surface of a cleaning belt driven in a direction opposite to the movement of the drum surface, engages the drum surface at a location past the image transfer station and in which developer liquid is metered into the surface just ahead of the belt at a rate substantially equal to the rate at which liquid evaporates from the developer system of the machine. Preferably, we flood the surface with light as it leaves the transfer station to facilitate the cleaning operation. Further the belt may be reciprocated transversely as it is driven to enhance the scrubbing action thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

FIG. 1 is a schematic view of an image transfer electrostatic copying machine incorporating one form of our cleaning mechanism.

FIG. 2 is a sectional view of the form of our cleaning mechanism for photoconductive surfaces illustrated in FIG. 1.

FIG. 3 is a top plan view of the form of our cleaning mechanism illustrated in FIG. 2 taken along the line 3—3 of FIG. 2.

FIG. 4 is an end elevation of the form of our cleaning mechanism shown in FIG. 2 taken along the line 4—4 of FIG. 2.

FIG. 5 is an end elevation of the mechanism illustrated in FIG. 3 taken along the line 5—5 of FIG. 3.

FIG. 6 is a fragmentary sectional view of one form of cleaning belt which we may employ in our system.

FIG. 7 is a fragmentary perspective view of the liquid metering portion of our cleaning mechanism for photoconductive surfaces.

FIG. 8 is a sectional view of the liquid supply pump of our cleaning mechanism for photoconductive surfaces.

FIG. 9 is a perspective view of an alternate form of our cleaning mechanism for photoconductive surfaces.

FIG. 10 is a fragmentary sectional view of the form of our cleaning mechanism illustrated in FIG. 9 showing an alternate arrangement of the doctor blade thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, one form of image transfer electrophotographic copying apparatus, indicated generally by the reference character 10, with which our cleaning system can be used, includes a drum 12, having a photoconductive surface 14. Drum 12 is sup-

ported on a shaft 16 adapted to be driven in any suitable manner in the direction of the arrow in FIG. 1 to carry the photoconductive surface past an exhaust discharge lamp 18, a charging station at which a corona 20 applies a charge to the surface, past an exposure station at which the machine optics 22 expose the surface to an image of the material to be copied and to a developing station at which a tray 24 carrying developer liquid is located. As the latent image passes through the tray 24, it is subjected to the action of a liquid developer comprising toner particles in a liquid carrier. In the arrangement shown in our copending application in the course of the development of the image, tacky toner particles adhere to areas of the surface 14 which retain the charge, thus to develop the image.

As the surface 14 carrying the developed image leaves the developer tank, it is subjected to light from a lamp 26 which is adapted to bleed any background charge off the surface. Next, the image travels through a transfer region at which the image is transferred to the surface of suitable copy material, such as paper 28, which is fed from a supply roll 30 and through a heater 32 around guide rolls 34 and 36 into contact with the drum. As the paper and the drum surface move together the toner particles making up the developed image are transferred to the paper until the paper arrives at a pair of rolls 38 and 40 which deliver the copy to the user of the machine. It will readily be appreciated that a suitable cutter (not shown) may be incorporated in the machine to cut the copy to length.

A first pump 42 is adapted to supply developer liquid to the tray 24 through a line 44. Overflow from the tray 24 is collected in a trough 46 from whence the developer flows through a line 48 and through a toner concentrate sensing arrangement 50 to a supply tank 52. A line 54 connects the tank 52 to the intake of pump 42.

A second pump 56 connected to tank 52 by a line 58 feeds developer from the tank to a line 60 leading into an impingement mill indicated generally by the reference character 62 which feeds developer to tank 52 through a line 64. In response to a signal from the sensing system 50, additional concentrate is fed to the mill 62 from a supply tank 66 through a pipe 68. The developer supply apparatus including mill 62 is described in greater detail in our copending application Ser. No. 212,155 filed Dec. 27, 1971. Our system differs from that disclosed in the last-mentioned application only in that, for a reason which will be apparent from the following description, clear carrier liquid is not supplied directly to the mill 62. One carrier liquid or diluent which we may use is an isomerized paraffinic hydrocarbon having a specific gravity of 0.75 at 60°F. and a kauri-butanol number of 27. This material is manufactured by Standard Oil Company of New Jersey and sold under the trademark "ISOPAR G." Other diluents and examples of toners we may employ are disclosed in our firstmentioned copending application.

We position our cleaning mechanism, indicated generally by the reference character 70, at a location around the periphery of the drum 12 between copy discharge rolls 38 and 40 and the exhaust exposure lamp 18.

Referring now to FIGS. 2 to 5, the form of our cleaning mechanism indicated generally by the reference character 70 illustrated in FIG. 1 includes spaced brackets 74 and 76 carried by a channel iron 72 of the frame of the machine 10. Respective flexible mounting elements 78 on the brackets 74 and 76 position a tank 80 which rests on a pad 82 of any suitable shock-absorbing material such, for example, as synthetic rubber, on the channel 72. We provide the tank 80 with an outlet tube 86 the inlet end of which is disposed at a predetermined level above the bottom of the tank 80 so that the tank always contains liquid carrier up to that level. We also provide the tank with an inlet tube 84 through which diluent may be admitted to fill tank 80 to the required level before beginning operation of the machine. A bracket 89 in the tank 80 carries an applicator member such as a sponge 88 adapted to apply developer liquid to the cleaner belt in a manner to be described.

A pair of brackets 90 and 92 on the sides of the tank 80 carry respective bearings 96 and 98 which rotatably receive a shaft 100. Shaft 100 extends through bearings 108 and 109 in the sides 102 and 104 of a cleaning belt frame including a center web 106 extending between sides 102 and 104 and secured thereto by any suitable means such as by welding. We rotatably mount a second roller shaft 110 on the frame sides 102 and 104 at a location remote from the shaft 100. Shafts 100 and 110 receive respective belt-supporting rolls 112 and 114 for rotation therewith and for axial movement relative thereto by means of splines or the like. Rolls 112 and 114 carry the cleaning belt 116.

A pair of spaced brackets 118 secured to the underside of web 106 carry a guide bar 120 adapted to engage the inner surface of belt 116 to cause the outer surface thereof to conform to the surface of drum 12 over a relatively large area. Another pair of spaced brackets 112 secured to the underside of the web 106 pivotally carry arms 124 and 126 which rotatably support a belt tensioning roller 128 adapted to engage the outer surface of the belt 116. Springs 130 extending between web 106 and the arms 124 and 126 urges roller 128 into engagement with belt 116 with sufficient force to give the belt the desired tension. A guide bar 131 is supported by the frame in a position to engage the outer surface of the outer stand of the belt 116 to increase the area of contact between the belt 116 and the rollers 112 and 114 to ensure good driving contact therebetween. Tank 80 supports a splash shield 133.

A motor 132 supported on the frame side 102 is adapted to be energized to drive shaft 100 to rotate roll 112. A sprocket wheel 134 carried by shaft 100 at its end remote from motor 132 drives a pitch chain 136 which engages a sprocket wheel 138 carried by shaft 110 for rotation therewith. It will thus be seen that as motor 132 drives shaft 100, rollers 112 and 114 are driven to drive belt 116 by virtue of their frictional engagement therewith. We so arrange our system that the portion of the belt 116 in engagement with drum 12 is driven in a direction opposite to the direction of movement of the drum surface.

In the form of our invention illustrated in FIGS. 2 to 5, we reciprocate the belt 116 transversely of its length as the belt is driven by rollers 112 and 114. We form the left edges of the respective rollers with cam surfaces 140 and 142 adapted to engage respective stationary cams 144 and 146. Respective compression springs 148 and 150 urge surfaces 140 and 142 into engagement with cams 144 and 146. Thus as the rollers rotate they are moved in synchronism back and forth axially so as to cause the belt 116 to reciprocate trans-

versely of its length. The movement of the belt in a direction opposite to that of the drum surface together with the lateral reciprocation of the belt affords an extremely effective scrubbing action on the surface **14** of the drum **12.**

Tank **80** rotatably supports a shaft **152** located within the tank adjacent to the top thereof. Shaft **152** carries a wiper blade **154** adapted to engage the outer surface of belt **116** as it emerges from the tank to remove excess liquid therefrom. A spring **158** acts on an arm **156** carried by shaft **152** at a location outside the tank to urge blade **154** into engagement with the outer surface of the belt **116.**

Referring now to FIG. **6,** the cleaning belt, indicated generally by the reference character **116,** may be any suitable type which will afford the desired scrubbing action on the surface **14** of drum **12.** One form of belt which we have found gives a good scrubbing action is made up of three layers **160, 162** and **164,** of fine, sheer, plain-woven linen cloth such as lawn. These layers may be held together by use of a suitable adhesive such as a polyvinyl alcohol glue. Over the layers of lawn we apply a layer **166** of nylon fabric having a pile **168.** We adhere the layer **166** to layer **164.** The various layers are assembled on a suitable mandrel and taped thereon until the adhesive sets. After removal, the edges are stitched together by means of stitching **170.**

We have found that the cleaning action of the belt is enhanced when the surface **14** is wetted with a liquid developer diluent such as Isopar G just before being subjected to the scrubbing action of the belt. A tank **172** holds a supply of the liquid diluent which is fed to a pump assembly indicated generally by the reference character **176** through a line **174.** Pump **176** delivers a metered amount of diluent through a line **178** to a manifold **180.** Manifold **180** extends over substantially the entire width of the drum **12** and is provided with a plurality of spaced outlet openings **182** through which diluent trickles onto the surface **14.**

Further to enhance the cleaning action of the belt **116,** we mount a floodlight **184** adjacent to the surface of the drum just ahead of the manifold **180.**

Referring now to FIG. **8,** pump **176** includes a housing **186** carrying a base plate **188** and provided with a cover plate **190** secured to the housing by any suitable means such as by screws **192.** A recess **194** in the cover plate **190** is adapted to receive the upper end of a flexible diaphragm **196.** Pump **176** includes a piston **198** secured to the diaphragm **196** and adapted to be driven so as to reciprocate the diaphragm with a predetermined stroke.

A motor **200** is adapted to be energized to drive the input of a gear box **202** having an output shaft **204** carrying an eccentric **206.** The eccentric **206** drivingly engages a follower plate **208** on the upper end of the rod of piston **198.** An opening **210** in base plate **188** receives an inlet valve **212** which admits fluid into housing **186** through a fitting **214** during the upstroke of piston **198.** A second opening **216** in base plate **188** receives an outlet valve **218** which permits liquid to flow out of housing **186** through a fitting **220** during the downstroke of the piston **198.** It will readily be appreciated that we connect line **174** to fitting **214** and we connect fitting **220** to the line **178.**

From the structure just described, it will be seen that we have provided a positive displacement pump which delivers the liquid diluent to the manifold **180.** We so arrange our system that the amount of diluent supplied to the surface **14** through the openings **182** is approximately equal to the amount of diluent which is lost by evaporation in the course of the normal operation of the machine incorporating our cleaning system. By way of example we may monitor the level of diluent in tank **52** by means of a switch **215** operated by a float **217** to actuate a motor speed controller **219** of any suitable type known to the art to control the speed of motor **200** and thus the amount of diluent metered onto the surface **14.** We have discovered that the liquid diluent which is lost is from approximately 20 to approximately 40 milliliters per hour at a copying speed of about 40 copies per minute. The pump **176** is designed to deliver liquid at a minimum rate of about 100 milliliters per hour. In response to the actuation of the pump piston **198** by the eccentric **206,** pump **176** delivers sufficient liquid to the manifold **180** as to maintain the total amount of Isopar substantially constant. We achieve this by making the holes **182** of such a size that liquid normally is retained in the manifold **180** under surface tension at the holes. When the pump operates pressure of the fluid fed to the manifold overcomes the effect of surface tension and drops of liquid fall into the photoconductive surface **14** across the width of the drum **12.** The liquid supplied to the surface of the drum softens the residual toner to facilitate its removal under the scrubbing action of the belt **116.** The wiper blade **154** removes the toner and diluent from the surface of the belt to permit it to flow into the tank **80** from whence it flows through tube **86** back to the supply tank **52.** With this arrangement, cleaning of the belt **116** by a serviceman is required at only relatively infrequent intervals.

While the preferred form of our cleaning system incorporates a belt **116** which is reciprocated laterally of its length as the belt is driven, in FIG. **9** we have shown a possible alternate arrangement in which rollers **210** and **212** support a belt **214** which may be of the same material as is the belt **116.** Belt **214** has a width which approaches that of the drum **12** so as effectively to clean the entire surface thereof. In this arrangement, as in the case of belt **116,** the belt **214** is driven in a direction opposite to the direction of rotation of the drum. In this system, the same liquid feeding manifold **180** is used to apply liquid developer to the drum surface as it approaches the cleaning belt. After leaving the belt in a manner to be described, the liquid falls into a tray **216** from whence it is conducted back to the supply tank **52.** In the arrangement illustrated in FIG. **9,** a shaft **220** supports a doctor blade **218** over the belt so that the blade engages the belt to remove liquid and toner particles from the belt. In order to facilitate passage of the liquid back to the tray **216,** we arrange shaft **220** at an angle of about **30°** to the direction of travel of the belt. An arm **222** carried by shaft **220** receives one end of a spring **224** to bias the blade **218** into engagement with the belt.

As an alternative to the doctor blade arrangement shown in FIG. **9,** we may mount the blade shaft **228** on the tank **216** to cause the blade **226** to engage the belt **214** at a location at which it is trained around the roll **212.** A spring **232** acting on an arm **230** on shaft **228** urges the blade into engagement with belt **214.** In this arrangement, liquid collected by the blade **226** is permitted to pass into the tank **216** through a plurality of holes **234** formed in the blade. A guide portion **236** se-

cured to the edge of the blade directs liquid back toward the tank **216** thus to prevent it from being carried around with the belt. Doctor blades **218** and **226** as well as guide portion **236** may be made from any suitable relatively rigid material such as brass sheet.

In operation of a copying machine provided with our cleaning system, in order to make a copy a lamp **18** illuminates surface **14** to afford an exhaust exposure which substantially eliminates any charge remaining on the drum. Next, the surface passes a corona **20** which applies a predetermined electrostatic charge to the surface. After being charged, the surface is exposed through the machine optics **22** to an image of the original to be copied. The resultant latent image is developed in tank **24** with tacky toner particles. After development the surface may again be exposed to light from a source **26** to overcome the effect of any residual background charge. Following that operation, the image is brought into contact with paper **28** to which the image is transferred as a result of the fact that the tacky toner particles have greater affinity for the paper than they do for the photoconductive surface **14.** The copy paper carrying the developed image is removed by takeoff rolls **38** and **40.**

As the surface leaves the takeoff rolls it is first subjected to light from a source **184** to remove any remanent image charge. Any toner deposit which has not been transferred has a relatively low optical density so that light from the lamp **184** substantially reduces the charge to facilitate cleaning. Upon leaving lamp **184,** clear liquid carrier is applied across the surface from the manifold **180** at a rate which is approximately that at which carrier liquid is lost from the system by evaporation. This clear diluent softens any residual toner deposite on the drum. Next, the surface passes by the belt **116** which, as is pointed out hereinabove, is driven in a direction opposite to the direction of movement of the drum surface. Under the scrubbing action provided by the belt, the toner particles are removed from the drum and carried downwardly toward the tank **80.** The wiper blade **154** prevents an excessive amount of developer from being carried back up to the drum surface. Operation of the forms of belt illustrated in FIGS. **9** and **10** will be apparent from the description hereinabove.

It will be seen that we have accomplished the objects of our invention. We have provided a mechanism for cleaning the photoconductive surface of an image transfer electrostatic copying machine. Our mechanism effectively removes any toner deposit remaining on the surface after transfer of the image. Our mechanism operates for a relatively long period of time without maintenance. It is simple in construction and in operation for the result achieved thereby.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is, therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, what we claim is:

1. An electrophotographic copying machine including in combination, a member having a photoconductive surface, means for forming a latent electrostatic image on said surface, a first reservoir for holding a supply of liquid developer comprising tacky toner particles suspended in a carrier liquid, means including said reservoir for developing said image with said developer liquid, means holding a supply of copy material, means for transferring a developed image from said surface to said copy material, a cleaning station, means for moving said member sequentially to carry said surface past said image forming means and said developing means and said transferring means and said cleaning station, an endless belt at said cleaning station in contact with said surface, a second reservoir for holding a supply of clear carrier liquid, means independent of said belt for flowing clear developer liquid from said second reservoir onto said surface in advance of its arrival at said belt, means for driving said belt to remove residual toner from said surface to which said clear liquid has been applied, and means for conducting said liquid which has been flowed onto said surface and toner particles removed from said surface by said belt to said first reservoir.

2. A machine as in claim **1** in which said belt has a rough surface.

3. A machine as in claim **2** in which said member is a drum, said machine including means for driving said drum, the surface of said belt engaging said drum, and means for driving said belt to move the belt surface engaging the drum in a direction opposite to the direction of movement of the drum surface engaged thereby.

4. A machine as in claim **3** in which said cleaning means comprises means for constraining said belt to engage said drum over an arcuate area.

5. A machine as in claim **4** in which said belt comprises a pile fabric.

6. A machine as in claim **1** in which said applying means comprises means for metering said clear carrier liquid onto said surface at a predetermined rate.

7. A machine as in claim **6** in which said metering means comprises a manifold extending across said surface, said manifold having openings adjacent to said surface, and means for supplying clear carrier liquid to said manifold.

8. A machine as in claim **7** in which the size of said openings is such that carrier liquid normally is held therein by surface tension, said manifold supplying means comprising a pump adapted to be actuated to force liquid into said manifold to overcome said surface tension and means for periodically actuating said pump.

9. A machine as in claim **8** in which said pump is a positive displacement pump.

10. An electrophotographic copying machine including in combination, a member having a photoconductive surface, means for producing a latent electrostatic image extending over an area of said surface, means for driving said member in a certain direction to move said area successively past a developing station and and an image transfer station and a cleaning station, a first reservoir for holding a supply of liquid developer comprising tacky toner particles suspended in a diluent liquid, means for maintaining a suspension of said toner particles in said diluent liquid in said reservoir, means at said developing station for applying liquid developer from said first reservoir to said surface to develop said image, means at said image transfer station for transferring the developed image to copy material, an endless cleaning belt, means mounting said belt at said cleaning

station with a portion thereof in engagement with said surface, means for driving said endless belt to move said portion thereof in a relative direction opposite to the direction of movement of said member surface, a second reservoir for holding a supply of clear diluent liquid, and means independent of said belt and located between said transfer station and said cleaning station for flowing clear diluent liquid from said second reservoir onto said surface area from which an image has been transferred in advance of the arrival of said area at said cleaning station.

11. A machine as in claim **10** including a source of illumination disposed between said transfer station and said cleaning station to reduce the remanent image charge to facilitate cleaning.

12. A machine as in claim **10** including a doctor blade in engagement with the surface of said belt.

13. A machine as in claim **10** including means for reciprocating said belt in a direction transversely of its length.

14. An electrophotographic copying machine including in combination, a member having a photoconductive surface, means for producing a latent electrostatic image extending over an area of said surface, means for driving said member in a certain direction to move said area successively past a developing station and an image transfer station and a cleaning station, means at said developing station for applying liquid developer comprising toner particles and a diluent to said surface to develop said image, means for holding a supply of said liquid developer, measn for feeding developer from said supply to said developer applying means, means at said image transfer station for tranferring the developed image to copy material, means at said cleaning station for applying clear diluent to said surface, a cleaning belt, means mounting said belt at said cleaning station with a portion thereof in engagement with said surface, means for driving said belt to move said portion thereof in a direction relatively opposite to the direction of movement of said member surface, means for collecting diluent fed to said surface and toner particles removed from said surface at said cleaning station and means for directing collected diluent and toner to said developer supply.

15. A machine as in claim **14** in which said collecting means comprises a tray, a doctor blade and means mounting said blade adjacent to said belt with the length thereof at an angle to the belt length to cause liquid collected thereby to flow along the blade toward the tray.

16. A machine as in claim **14** in which said collecting means comprises a tray, a doctor blade, means mounting said blade on said tray adjacent to said belt, said blade being provided with holes to permit liquid collected by the blade to pass therethrough, and a guide for directing liquid passing through said holes to said tray.

17. A machine as in claim **14** in which said diluent applying means applies diluent to said surface at approximately the rate at which it is lost from said machine.

18. A machine as in claim **14** in which said diluent applying means comprises a manifold extending across said surface, said manifold being formed with holes opening toward said surface, the size of said holes being such as normally to hold said diluent therein by surface tension, a pump for supplying diluent to said manifold and means for driving said pump to supply diluent to said manifold to overcome the effect of said surface tension.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,776,632 Dated December 4, 1973

Inventor(s) Ian E. Smith, Peter J. Hastwell and Marinus C. Vermeulen

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, line 35, "applying" should read

-- flowing --.

Column 9, line 31 "measn" should read

-- means --.

Signed and sealed this 16th day of April 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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