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Smith et al.

[11] **3,949,703**

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[54] **SELF-CLEANING DEVELOPER APPLICATOR**

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[21] Appl. No.: **213,885**

[52] **U.S. Cl.** **118/637;** 118/DIG. 23; 427/17

[51] **Int. Cl.²** **G03G 15/10**

[58] **Field of Search**............ 118/623, 637, DIG. 23; 117/37 LE, 93.4 A; 427/15, 17

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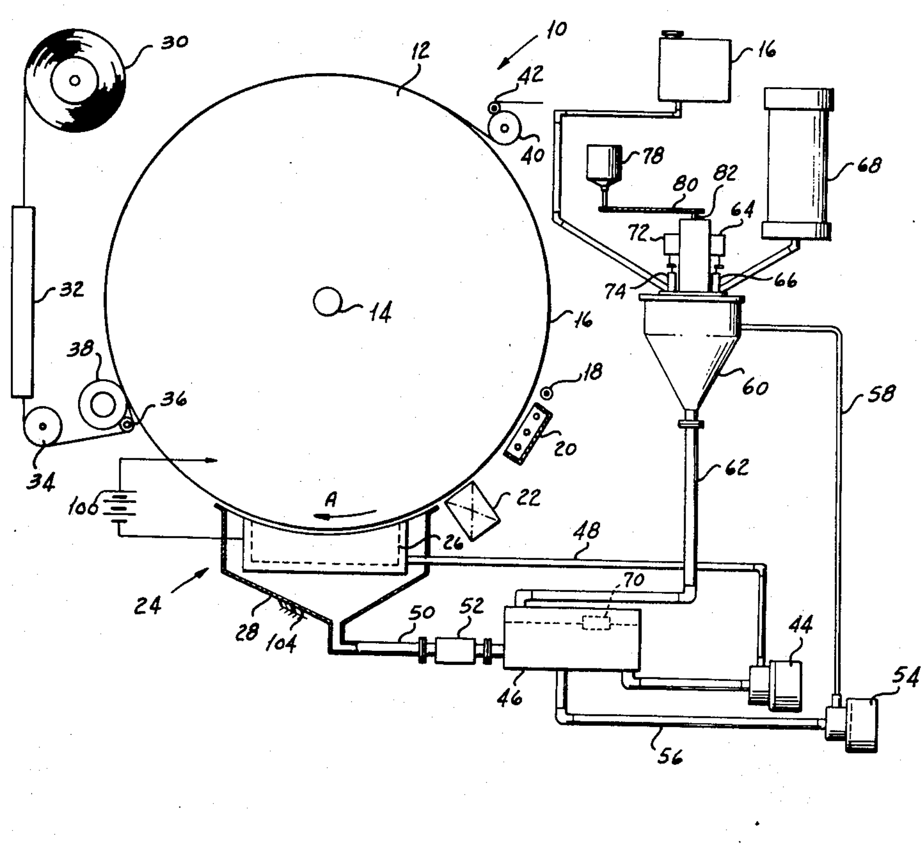
[57] **ABSTRACT**

A self-cleaning developer applicator system for applying liquid developer to a latent electrostatic image carried by an organic photoconductor supported on a conductive substrate which moves relative to a developer station in which a biasing potential is applied between the substrate and a conductive developer applicator electrode to reduce the effect of the background potential of the latent image while adequately developing desired image areas together with means for cleaning the applicator electrode continuously during operation of the system to remove toner particles which collect thereon under the influence of the biasing potential. In a preferred embodiment the applicator is arranged to flow a film of developer liquid at the speed of movement of the photoconductive surface over a relatively extended area of the image during development thereof.

14 Claims, 6 Drawing Figures



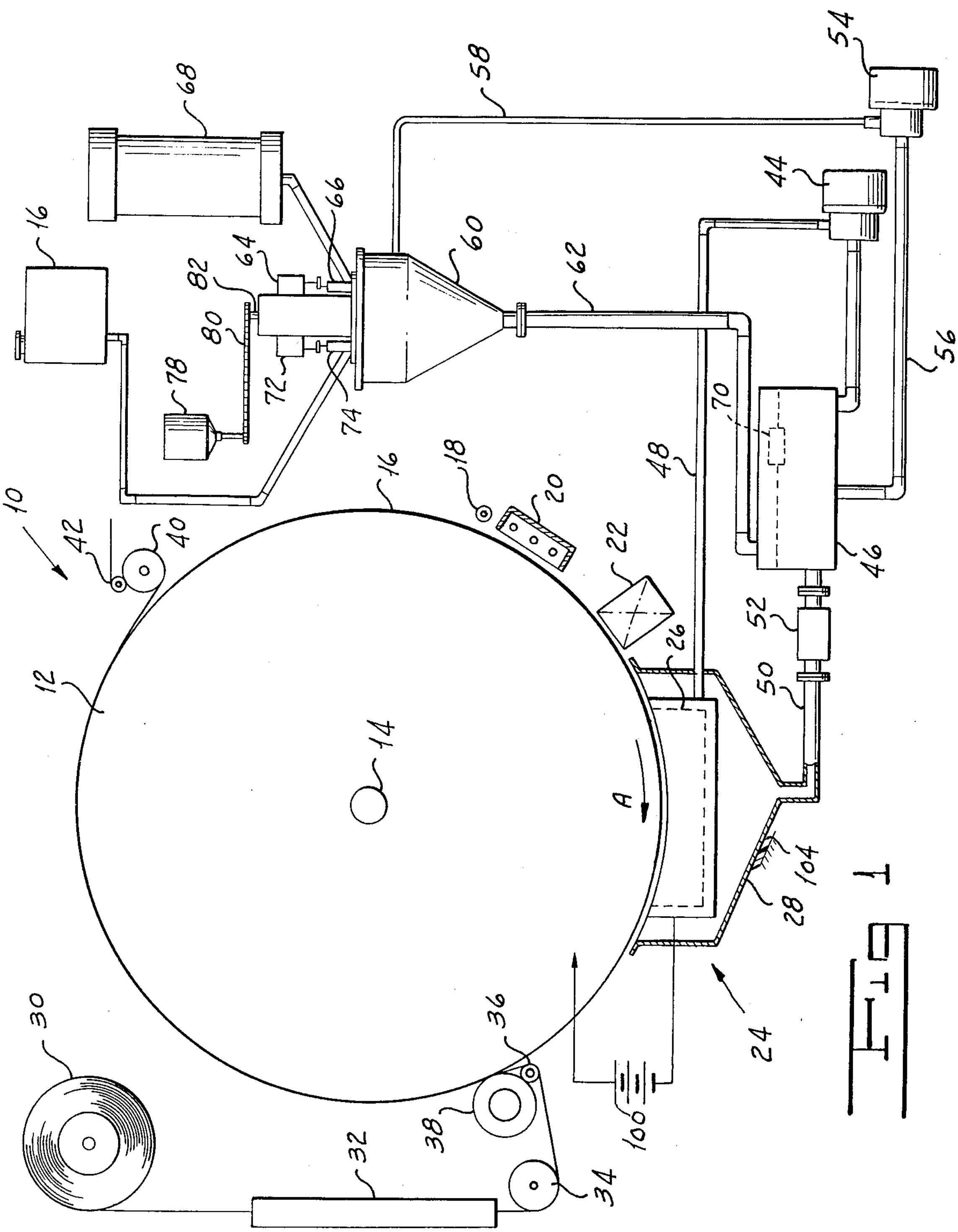


FIG. 1

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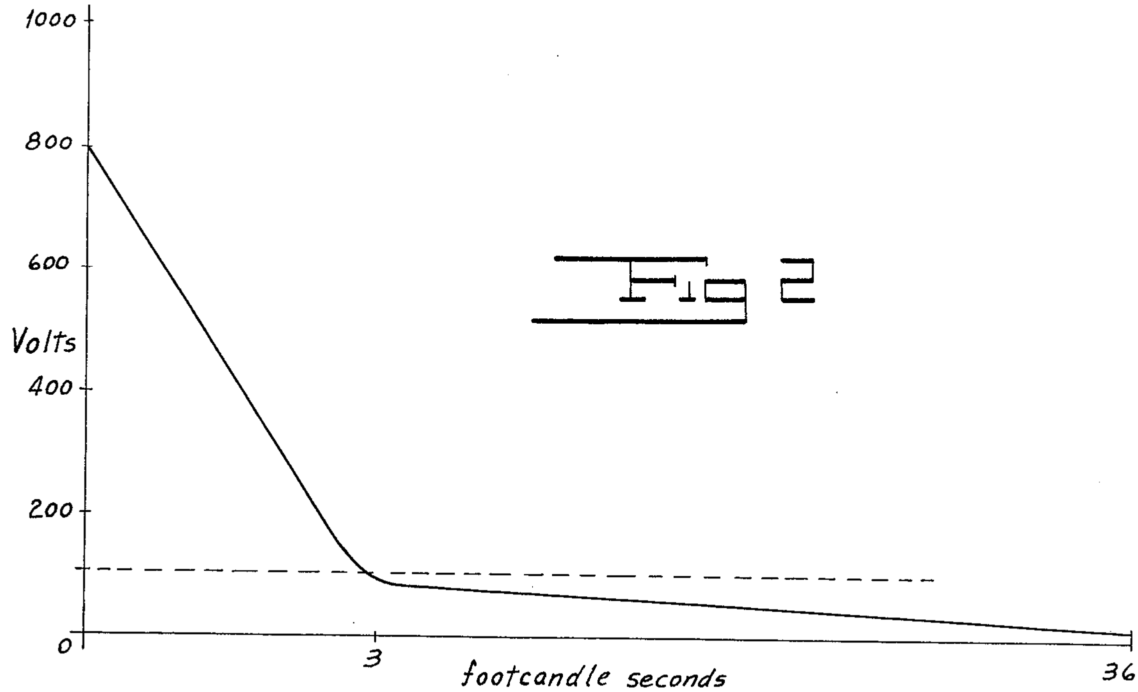

Fig 2

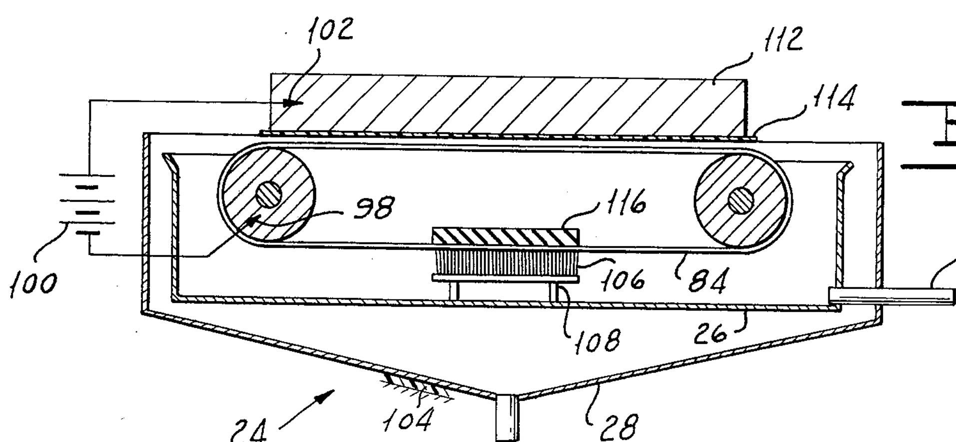

Fig 4

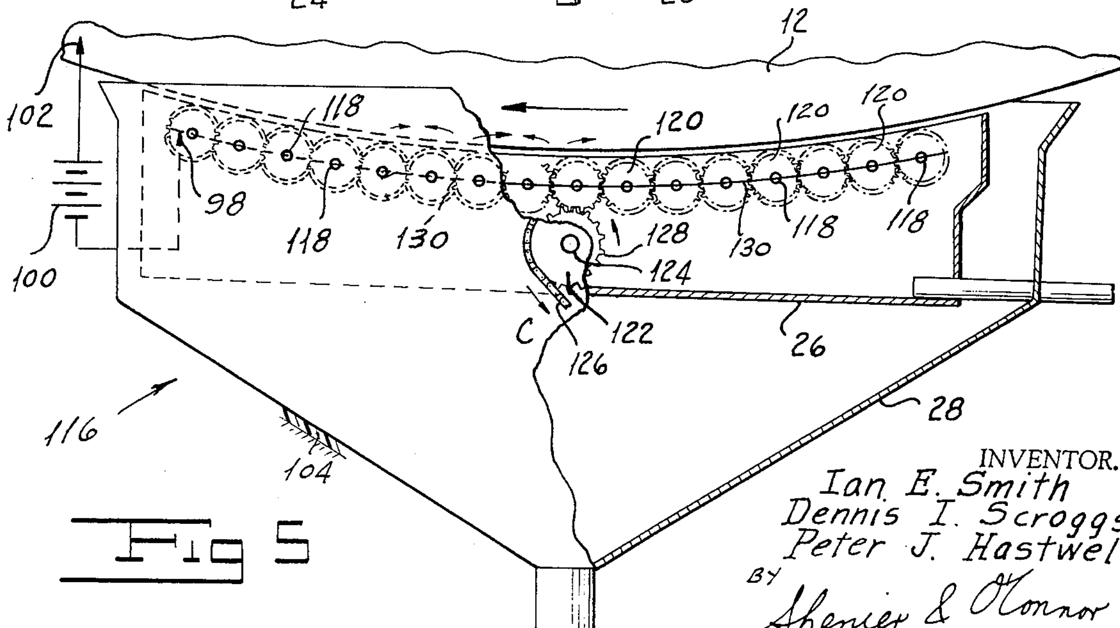

Fig 5

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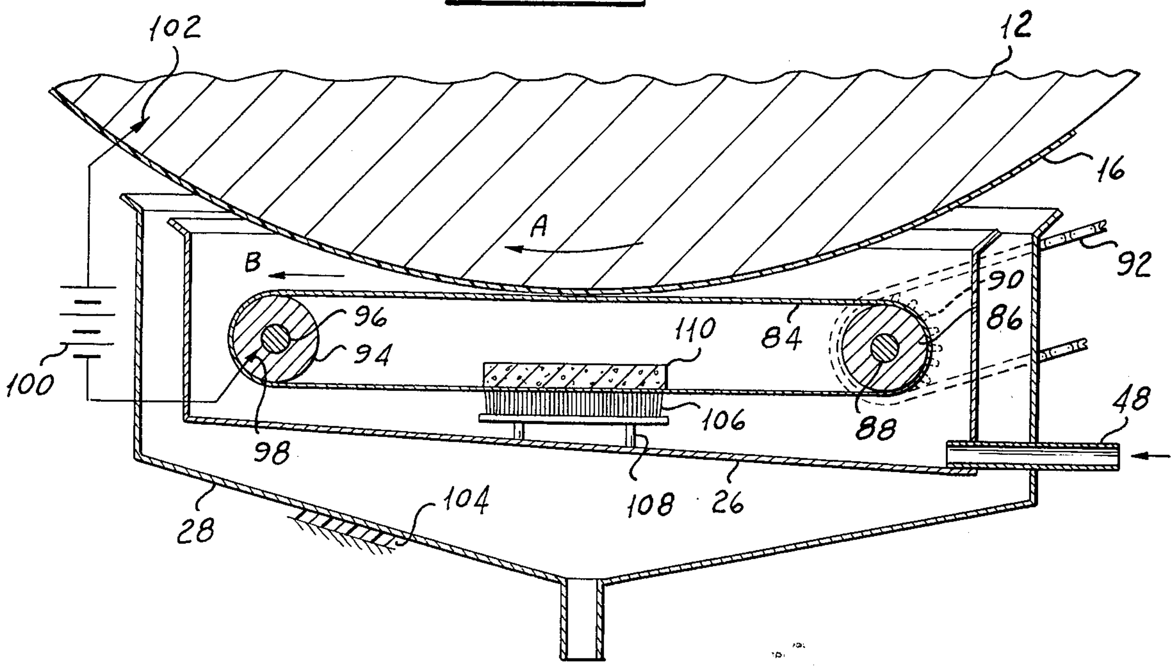
Fig 3



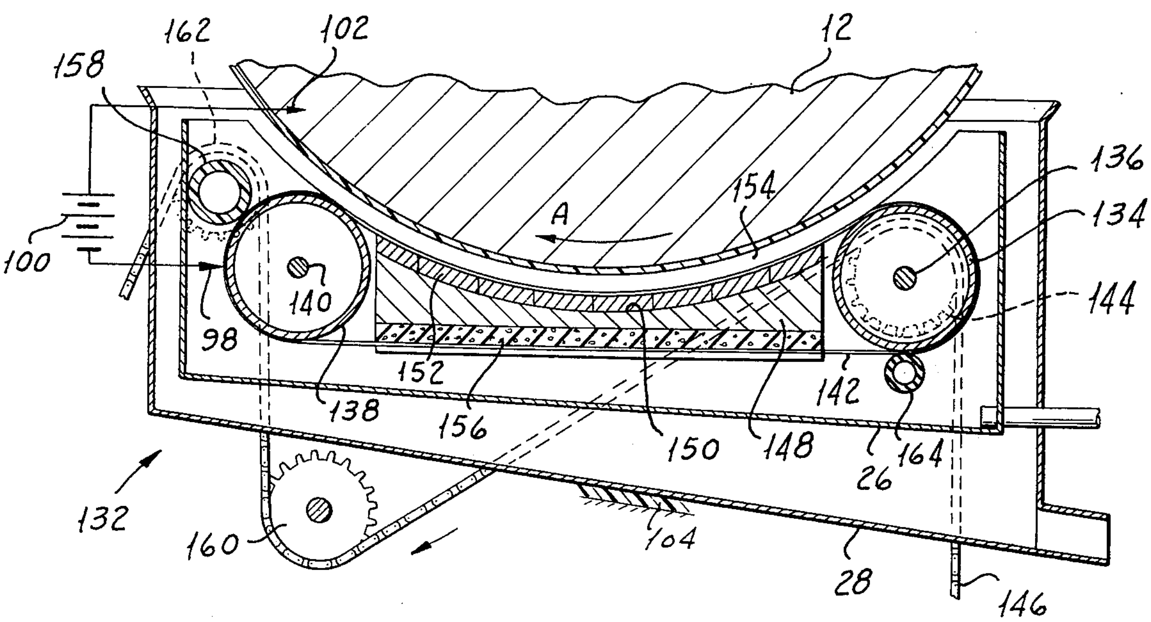


Fig 6

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SELF-CLEANING DEVELOPER APPLICATOR

BACKGROUND OF THE INVENTION

Electrostatic copying systems are known in the prior art in which a photoconductive surface first is charged and then is exposed to a light image of the original to be copied to produce a latent electrostatic image on the photoconductor. This image is subjected to a developer made up of electrostatic toner particles in a carrier. In the course of development, the toner particles are attracted to the charged areas to develop the latent image.

There are known in the prior art organic photoconductive materials which combine the advantages of transparency, flexibility, ease of coating and panchromatic response with low cost. Kaale & Company of Germany has developed a large number of organic photoconductors such as the oxazoles described in Uhlig German Pat. No. 1,117,391 of Nov. 16, 1961. Many other organic photoconductors are known such as benzanthrones, triazines, acylhydrazones and the like.

While organic photoconductors of the type mentioned above combine many advantages, their use heretofore has been limited owing to the fact that their discharge times are inordinately long. That is to say, in use of such materials in electrostatic copying, they may be initially charged to, for example, 800 volts. Tests have shown that an initial discharge from about 800 volts to about 100 volts requires about 3 footcandle-seconds. However, to discharge the photoconductor to about 10 volts requires 36 footcandle-seconds. Complete discharge of the photoconductor requires an inordinately great exposure of the material. To achieve such a discharge, the exposure time would have to be so long, or the optical system so large, or both, as to make a system of electrostatic copying employing an organic photoconductor entirely impracticable. That is to say, if, using an organic photoconductor, an electrostatic copying machine were run at conventional speeds with a conventional exposure system, development would result in a copy in which desired image areas could scarcely be distinguished from background areas.

Recognizing the problem of employing organic photoconductors in an electrostatic copying system, we conceived of the application of an electrical field to counteract the effect of background potential in the organic photoconductor while at the same time adequately developing desired image areas. In setting up such a counter field, we apply a bias potential between a conductive substrate carrying the organic photoconductor and a conductive developer applicator electrode.

While application of the counter field in the manner described above initially successfully overcame background potential in the photoconductor, it resulted in collection of toner particles on the electrode with the result that the system ultimately became ineffective and the quality of copies produced rapidly deteriorated. We provide our system with means for continuously cleaning the biasing electrode to remove toner particles which otherwise would collect thereon under the influence of the biasing potential.

In the course of our investigation we further noted the presence of "tails" at the trailing edge of each toner image deposit. We discovered that this phenomenon,

which can be termed "toner-tank tailing," can be substantially eliminated by producing over the image area being developed a flow of developer at the surface speed of the photoconductor relative to the developer station.

SUMMARY OF THE INVENTION

One object of our invention is to provide a self-cleaning developer applicator for use with an organic photoconductor imaging surface.

Another object of our invention is to provide a self-cleaning developer applicator which substantially eliminates the effect of background potential in an image-carrying organic photoconductor.

A further object of our invention is to provide a self-cleaning developer applicator which inhibits the buildup of toner particles on the applicator biasing electrode.

Still another object of our invention is to provide a self-cleaning developer applicator for use with an organic photoconductor which produces clear copies over a relatively long period of time in use.

A still further object of our invention is to provide a self-cleaning developer applicator which substantially eliminates "toner-tank tailing" in copies produced in a system incorporating the applicator.

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

In general, our invention contemplates the provision of a self-cleaning developer applicator for use with an organic photoconductor in which a bias potential is applied between a conductive substrate carrying the photoconductor and a developer applicator electrode as the image bearing photoconductor moves relative to the developer station to overcome the effect of background potential in the image together with means for continuously cleaning the biasing electrode to remove toner particles which collect thereon under the influence of the biasing potential. We prefer to flow a film of developer over an area of the image under development at the same speed as that of the image-bearing surface relative to the developer station during the course of development.

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 one form of electrostatic copying system incorporating our self-cleaning developer applicator.

FIG. 2 is a diagrammatic view illustrating the discharge characteristic of a typical organic photoconductor.

FIG. 3 is a sectional view of one form of our self-cleaning developer applicator.

FIG. 4 is a sectional view of an alternate form of our self-cleaning developer applicator.

FIG. 5 is an elevation with parts broken away and with other parts shown in section of a further form of our self-cleaning developer applicator.

FIG. 6 is a sectional view of yet another form of our self-cleaning developer applicator.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, one type of electrostatic copying machine, indicated generally by the reference character **10**, which may incorporate our self-cleaning developer applicator, includes a drum **12** carried by a shaft **14** for rotary movement in the direction of the arrow A. Drum **12** carries a film **16** of a suitable photoconductive material which may, for example, be one of the organic photoconductors described hereinabove.

In operation of the machine **10**, as the drum **12** rotates surface **16** moves past an exhaust exposure source **18** of light which is adapted to remove any charge remaining on the drum as a result of a previous operation. Drum **12** moves surface **16** past a corona discharge system **20** which, as is known in the art, is adapted to apply a predetermined electrostatic charge to the photoconductive film **16**. After receiving the charge the film passes an exposure system **22** which exposes the film to the image of the original to be copied so that surface charge is lost in non-image areas while being retained in areas to be developed.

After leaving the exposure system **22** the surface **16** carrying the latent electrostatic image moves through the developer system indicated generally by the reference character **24** which applies a developer to the surface of film **16** to develop the image. The system **10** may, for example, be of the type disclosed in the copending application of Smith et al (I) Ser. No. 155,108 filed June 21, 1971, now U.S. Pat. No. 3,839,032, in which the developer applied by the system **24** is made up of a tacky toner in a suitable carrier. Paper or other material from a roll **30** moves through a heating unit **32** around a guide roll **34** and is pressed into contact with the surface of the film **16** by means of a pressure roll **38**. As the tacky toner image leaves the developer station, it is pressed into contact with the paper in engagement with the surface of film **16**. Owing to the fact that the tacky toner has greater affinity for the surface of the paper than for the photoconductive film, the image is transferred to the paper. Following transfer of the image to the paper, it moves around guide rolls **40** and **42** which deliver the copy. As is more fully pointed out in the Smith et al. (I) application, a cutter may be employed to cut the copy to length.

We employ apparatus of the type disclosed in the copending application of Smith et al. (II) for "Apparatus for Developing Electrostatic Images " Ser. No. 212,155 filed Dec. 27, 1971, now U.S. Pat. No. 3,789,794 for supplying an emulsion of tacky toner particles in a carrier to the developer tank **26** of the developer applicator apparatus **24**. A pump **44** delivers developer liquid from a supply tank **46** through a pipe **48** to the tray **26**. Overflow from the tray **26** is collected in a trough **28** from which the liquid travels back through a line **50** to the tank **46**. A developer liquid concentration monitoring unit **52** of any suitable type known to the art monitors the concentration of toner in carrier liquid. A second pump **54** circulates developer liquid from tank **46** through a line **56** through the pump **54** to a line **58** through an emulsifier **60** and to a line **62** leading back to the tank **46**.

As is more fully pointed out in the Smith et al. (II) application, when the concentration of toner in the developer liquid falls below an acceptable level monitor **52** puts out a signal which energizes a solenoid **64** to open a valve **66** to admit toner concentrate from a tank **68** into the emulsifier **60**. A liquid level switch **70** senses the level of developer liquid in tank **46**. When the liquid falls below a predetermined level, switch **70** completes the circuit of a solenoid **72** to open a valve **74** to admit carrier liquid from a tank **76** into the mill **60**. A motor **78** drives a pitch chain **80** to drive the input shaft **82** of the emulsifier **60**. Since the construction and operation of the liquid supply system does not per se form part of our invention, we will not describe it in greater detail. The details of this system are more fully shown and described in the Smith et al. (II) application.

As has been pointed out hereinabove, the machine **10** with which our developer applicator is used employs an organic photoconductor **16** on which the latent image is formed. Referring now to FIG. **2**, we have shown an idealized discharge curve of a typical organic photoconductor. In the FIGURE, the initial voltage or voltage to which the film is charged is the ordinate while the logarithm of the light exposure in footcandle-seconds is the abscissa. As can be seen from the FIGURE, with the film initially charged to about 800 volts, 3 footcandle-seconds of exposure is required to discharge the film to about 100 volts. To discharge the film further to about 10 volts requires 36 footcandle-seconds of exposure. It can further be seen from the characteristic curve that an extremely great exposure is required fully to discharge the film. As is also pointed out hereinabove, such an exposure would require a very large optical system and would require an inordinately long period of time. We apply such a bias between the conductive substrate of the drum **12** and an electrode for applying the developer in a manner to be described as effectively to raise the abscissa of the plot of FIG. **2** thus to counteract the effect of the residual charge after a predetermined exposure. By way of example, we may apply a bias of 100 volts to raise the abscissa to the level indicated by the broken line in FIG. **2** thus to require an exposure of only 3 footcandle-seconds and yet be able effectively to develop desired image areas.

Referring now to FIG. **3**, the developer applicator system **24** includes a belt **84** of any suitable material which enables it to function as an electrode to which the biasing potential can be applied. The belt may be made of a fabric having a metallized outer surface to which the biasing potential is applied in any suitable manner or the belt may be formed entirely of conductive material. We support belt **84** on a driven roll **86** carried by a shaft **88** rotatably supported in tray **26** in any suitable manner known to the art. Shaft **88** extends outwardly through the wall of tray **26** and through the wall of trough **28** to a location at which a sprocket wheel **90** thereon can receive a pitch chain **92**. Chain **92** may be the main driving chain of the apparatus which also drives the drum **12** in operation of the machine. Preferably, we so construct the apparatus that chain **92** drives the belt **84** in the direction of the arrow B in FIG. **3** and at the same linear speed as the surface speed of drum **12**. An idler roller **94** carried by a shaft **96** rotatably supported in tray **26** also supports belt **84**. We so arrange the parts in this form of our developer system as to form a narrow gap of from about 0.005 to 0.030 inch between the film **16** and the surface of belt **84** at their closest point of approach. Thus, as will be described hereinbelow, as the belt is driven it carries developer into that gap to cause the developer to contact the surface of the drum, but no physical contact is made between the belt and the surface of film **16.**

As has been pointed out hereinabove, we apply such a bias to the developer applicator electrode belt **84** as to counteract the effect of the residual potential in exposed background areas of film **16** after exposure thereof. This may be accomplished in any convenient manner. For example, where both the belt **84** and the roller **94** are conductive, a brush **98** connects the negative terminal of a suitable source of potential such as a battery **100** to the roller **94.** A brush **102** connects the positive battery terminal to the conductive substrate of drum **12.** It will readily be appreciated that we may either make the drum **12** itself of conductive material or we may provide the drum with a conductive film underlying the film **16** of organic photoconductive material. Where the photoconductive material has a characteristic such as that illustrated in FIG. **2** we may select battery **100** to have a potential of, for example, 100 volts. In this form of our invention, we also insulate trough **28** from ground as indicated by insulation **104** to inhibit collection of toner particles thereon.

As has further been pointed out hereinabove, application of the biasing potential to the belt **84** causes particles of toner in the developer within the tray **26** to collect on the surface of the belt. We mount a brush **106** on a bracket **108** in the bottom of tray **26.** Brush **106** engages the outer surface of the belt **84.** The brush **106** may be made of any suitable material such, for example, as a nylon pile fabric or the like. A backing member **110** in engagement with the inner surface of the belt **84** ensures good contact of the brush **106** with the outer surface of the belt **84.** If the belt proper is formed of an insulating material, the outer surface of which is metallized, brush **98** is arranged to make electrical contact with the metallized surface. In such case, particles of toner tend to collect on the outer surface of the belt so that the brush **106** effectively removes these particles from the belt. If the entire belt is conductive, we may form backing member **110** from a suitable material such as sponge rubber or the like to remove any toner particles which might tend to collect on the inner surface of the belt.

Alternatively to the arrangement described above in which the biasing potential is applied to the applicator belt **84,** we might apply the biasing potential to the tray **26** and employ an insulated belt. In such case, however, toner particles would tend to collect on the surface of the tank. Such an arrangement would create the obvious difficulty of cleaning particles from the tray surface. As a further alternative, the belt **84** might be biased with the tray **26** at ground. Such an arrangement, however, would result in deposition of toner particles both on the belt and on the tank, thus compounding the difficulty of cleaning surfaces on which toner particles are deposited. Owing to these facts, we prefer to apply the biasing potential to the applicator element and to insulate the developer system from ground.

Referring now to FIG. **4,** we have shown an arrangement similar to that described in FIG. **3** in which our developer apparatus **24** is applied to a linear rather than to a rotary machine. In such a linear machine a carriage **112** supports a film of organic photoconductive material **114** for movement along a line past the developer unit **24.** The parts of the system **24** are substantially the same as those described in connection with FIG. **3.** In FIG. **4,** however, brush **102** engages the conductive carriage **112** instead of the conductive substrate of the drum **12** as in FIG. **3.**

Referring now to FIG. **5,** we have shown yet another form of developer system, indicated generally by the reference character **116,** which includes a tray **26** and a return trough **28** similar to those described hereinabove in connection with the showings of FIGS. **3** and **4.** In this form of our invention, a plurality of shafts **118** are rotatably supported in the walls of tray **26** for rotary movement around axes disposed on the locus of an arc parallel to the surface of the film **16.** Each shaft **118** carries for rotation therewith a gear roller **120** extending axially of the drum **12** for a distance at least equal to the axial extent of the film **16.** The teeth of adjacent gear rollers 120 mesh. Their peripheries are slightly spaced from the surface of the film **16.** A sprocket wheel **122,** supported on a shaft **124** carried by the tray **26** is driven by a pitch chain **126** in the direction of the arrow C. Pitch chain **126** may, for example, be the main driving chain of the apparatus. A pinion **128** within the tray **26** engages and drives one of the gear rollers **120** which, in turn drives the remaining gear rollers of the system. As a result, as indicated by the arrows over the rollers in FIG. **5,** adjacent rollers rotate in opposite directions. Owing to this rotation, developer liquid is carried upwardly into contact with the surface of the film **16** over a relatively extended area thereof. moreover, as the gear rollers rotate, interengagement of the teeth thereof over the length of the rollers produces a self-cleaning action which removes toner particles which otherwise would collect thereon. In this form of our invention, brush **102** engages the conductive substrate of drum **12.** Brush **98** engages a conductive arc **130** which is in electrical contact with all of the shafts **118.** In this way, we apply the biasing potential of battery **100** to all of the gear rollers **120.**

Referring now to FIG. **6,** still another form of our developer system, indicated generally by the reference character **132,** includes the tray **26** and a collecting trough **28.** A driven roller **134** of any suitable material such, for example, as an aluminum alloy is carried by a shaft **136** rotatably supported in the walls of tray **26.** An idler roller **138** is supported on a shaft **140** rotatably supported in the walls of tray **26.** Rollers **134** and **136** carry a thin belt **142** of conductive magnetic material such, for example, as a 0.002 inch thick steel shim material. Shaft **136** extends outwardly of tray **26** and trough **28** to receive a sprocket wheel **144** driven by a pitch chain **146.** Pitch chain **146** may be the main driving chain of the apparatus. As will more fully be explained hereinafter, we so arrange the apparatus that the belt **142** is driven at the same speed as the surface speed of the film **16.**

A support **148,** located within the tray **26,** is formed with an arcuate concave surface **150** which receives a plurality of magnets **152** on the locus of an arc generally parallel to the surface of film **16.** Magnets **152** attract belt **142** to cause a portion thereof adjacent to the surface of film **16** to assume an arcuate configuration with a narrow space or flow gap **154** between the belt and the film **16.** Gap **154** may have a radial dimension of from about 0.005 to about 0.030 inch. When the belt **142** is driven, developer material is carried along the gap **154** at substantially the same velocity as the speed of movement of the surface of the film **16.** Owing to that fact, the "tails" of toner material which otherwise might extend from the trailing edges of developed image areas are substantially eliminated.

In the form of our developer system illustrated in FIG. 6, brush 102 engages the conductive substrate of drum 12. Brush 98 contacts the surface of the steel belt 142 to apply the biasing potential thereto. As the belt rotates, its inner surface engages a foam rubber cleaning pad 156 carried by support 148. We mount a cleaning roll 158 of any suitable material or a brush for rotary movement in tray 26 at a location at which it engages a portion of belt 142 on the roller 138. Pitch chain 146 extends around an idler sprocket wheel 160 to a sprocket wheel 162 which drives roller 158 in a direction opposite to the direction of movement of the belt 142 effectively to clean the outer surface of the belt. A pressure roller 164 ensures firm engagement between belt 142 and the roller 134.

In operation of a system 10 including our self-cleaning developer applicator 24 drum 12 carrying the organic photoconductive film on its surface first passes by the corona 20 which applies an initial charge of, for example, 800 volts to the film 16. As the charged film passes by the exposure station 22, the light image focused thereon causes background areas to be discharged to about 100 volts in the course of an exposure of about 3 footcandle-seconds. Unexposed areas retain a substantial charge. The resultant latent electrostatic image is carried through the developer unit 24. As it moves through this unit, the bias potential applied, for example, between the belt 84 and the conductive substrate of drum 12 in the form of our invention illustrated in FIG. 3 counteracts the effect of the residual potential so that substantially no toner is deposited in these exposed background areas. At the same time, sufficient toner migrates to the unexposed desired image areas to provide adequate contrast for a high quality copy. Under the action of the biasing potential, the toner particles tend to collect on the belt 84. Where only the outer surface of the belt is metallized, brush 106 removes this undesirable buildup of toner particles on the outer surface. If the belt is conductive throughout, toner particles deposited on the inner surface may be removed by use of a backing member 110 of a material which removes particles from that surface.

The operator of our developer applicator in a machine of the linear type such as that illustrated in FIG. 4 is substantially the same as that described above in connection with FIG. 3.

In operation of the developer unit 116 shown in FIG. 5, the counter-rotating gear rollers carry the developer liquid into contact with the surface of film 16 to cause toner particles to be deposited in the desired areas. At the same time, the interengagement of the teeth of the counter-rotating gear rollers provide a cleaning action which removes toner particles which tend to collect thereon under the action of the biasing potential.

In operation of the system illustrated in FIG. 6 the continuously driven steel belt 142 is drawn into an arcuate configuration below the drum 12 by the magnets 152 to form the flow gap 154. Developer liquid is carried by the belt through this space at substantially the velocity of the periphery of drum 12. Owing to that fact, the "tails" which otherwise might form as a result of the drift velocity of toner particles is substantially eliminated. At the same time, the biasing potential applied to the belt overcomes the effect of the residual charge in exposed areas of the film 16. Pad 156 removes toner particles which collect on the inner surface of belt 142 while roller 158 which is driven in a direction opposite to the direction of movement of the belt, cleans accumulated toner particles from the outer surface of the belt.

After emerging from the developer unit 124 in the system illustrated in FIG. 1, the tacky toner image is transferred to the paper from supply 30 under the action of pressure roll 38 and the copy ultimately is delivered to the user by delivery rolls 40 and 42.

While we have shown and described our self-cleaning developer applicator in connection with a system employing a tacky toner, it will be appreciated that the biasing arrangement which we have disclosed has special utility in any system in which an organic photoconductor is being employed. Further, the form of our developer system in which we provide a flow of developer at the same velocity as that of the photoconductor relative to the developer unit has utility in any system in which the "toner-tank tailing" effect is a problem. It will readily be appreciated that a system incorporating an inorganic photoconductor might involve the same problem. It is to be noted further that the belt cleaning arrangements have utility in systems in which these tails are to be eliminated independently of systems incorporating our biasing arrangement.

It will be seen that we have accomplished the objects of our invention. We have provided a self-cleaning developer applicator for a system utilizing an organic photoconductor. Our applicator overcomes the effect of residual charge in exposed areas of an organic photoconductor. Our system ensures that clean copies can be made over a long period of time in use of our applicator. It provides high quality copies in a system employing an organic photoconductor. It does not require an inordinately large optical system nor an excessively long exposure time. The preferred form of our arrangement substantially eliminates the "toner-tank tail" effect present in many systems of the prior art. 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. Apparatus for developing a latent electrostatic image comprising background areas of residual potential and image areas of relatively greater potential on a photoconductive layer carried by a conductive substrate moved past a developing station including in combination a developer unit at said station for applying developer comprising toner and a carrier to said photoconductive layer, said developer unit comprising a tray for holding a supply of said developer and a conductive applicator member for applying said developer to said layer, a source of biasing potential, means for applying said biasing potential to said applicator member to counteract the effect of said residual potential and means for insulating said tray from ground to inhibit deposition of toner thereon under the influence of said biasing potential.

2. Apparatus as in claim 1 including means for cleaning said applicator member.

3. Apparatus as in claim 2 in which said applicator member is a belt and means for driving said belt.

4. Apparatus as in claim 3 in which said cleaning means comprises a cleaning element in said tray in contact with said belt.

5. Apparatus as in claim 2 in which said applicator member is an endless belt mounted for movement in said tank and in which said applying means comprises means for driving said belt.

6. Apparatus as in claim 5 including means for constraining a length of said belt to assume a generally arcuate configuration.

7. Apparatus as in claim 1 in which said developer unit comprises a plurality of gear rollers including said applicator member, means mounting said rollers in said tank with adjacent rollers meshing and means for driving said rollers.

8. Apparatus for developing a latent electrostatic image comprising background areas of residual potential and image areas of relatively greater potential on a photoconductive layer carried by a conductive substrate moved past a developing station including in combination, means at said station for holding a supply of developer made up of toner particles and a carrier, movable means adapted to be driven to carry developer from said supply into contact with the surface of said layer, means for driving said movable means, a source of biasing potential, means for applying said biasing potential between said substrate and said movable means to oppose the effect of said residual charge, means for cleaning said movable means to remove toner particles which collect thereon under the influence of said biasing potential and means for insulating said holding means from ground to inhibit deposition of toner particles thereon under the influence of said biasing potential.

9. Apparatus as in claim 8 in which said movable means is a belt.

10. Apparatus as in claim 9 including means mounting said belt with a length thereof generally parallel to the surface of said layer to form a flow gap between said layer and said belt length, said drive means driving said belt at a speed approximately equal to the surface speed of said layer past said station.

11. Apparatus as in claim 10 in which said belt is formed of conductive magnetic material, said apparatus including magnet means disposed generally along the locus of an arc adjacent to said belt length to cause said belt length to assume a generally arcuate configuration.

12. Apparatus as in claim 11 in which said cleaning means comprises a cleaning roller in engagement with the outer surface of said belt and means for driving said cleaning roller in a direction opposite to the direction of movement of said belt.

13. Apparatus as in claim 12 including a cleaning pad in engagement with the inner surface of said belt.

14. Apparatus for developing a latent electrostatic image on an arcuate surface moved past a developer station including in combination, means at said station for holding a supply of liquid developer, an endless belt of magnetic material, means mounting said belt with a portion thereof immersed in said liquid developer, magnetic means disposed generally along the locus of an arc adjacent to the length of said belt to constrain said length to assume a generally arcuate configuration generally parallel to said surface, and means for driving said belt in the direction of movement of and substantially at the speed of movement of said surface relative to said station to flow said developer into contact with said surface.

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