

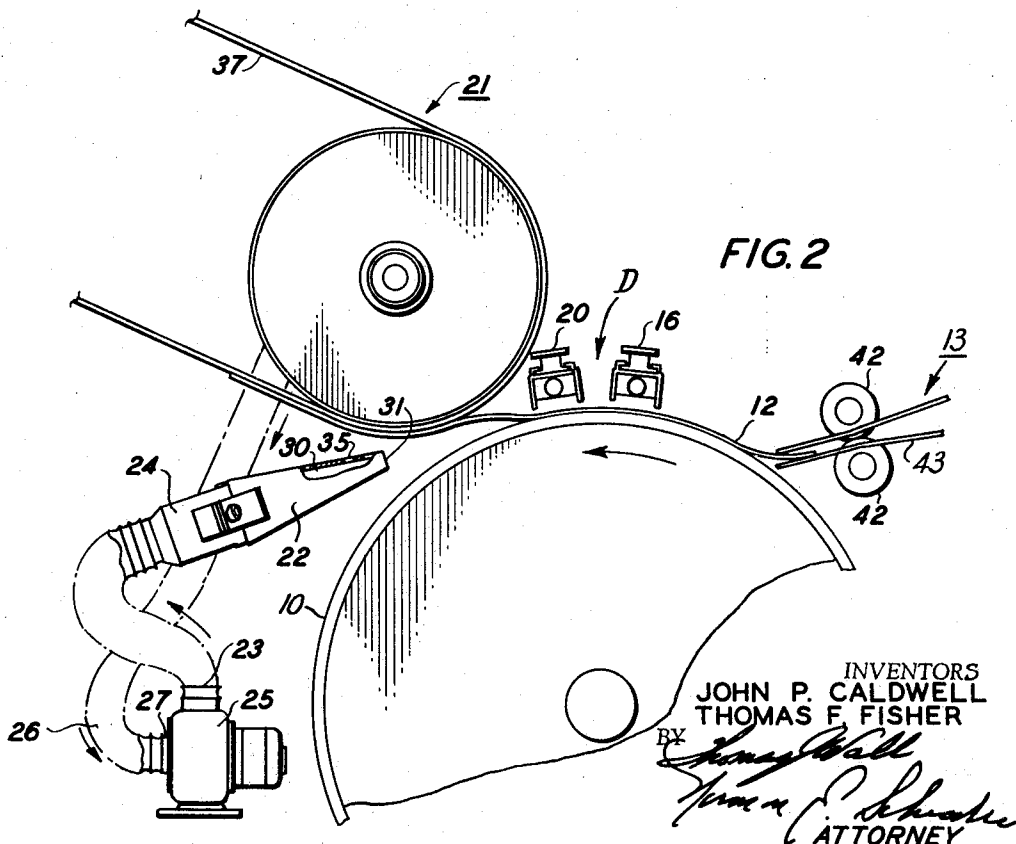
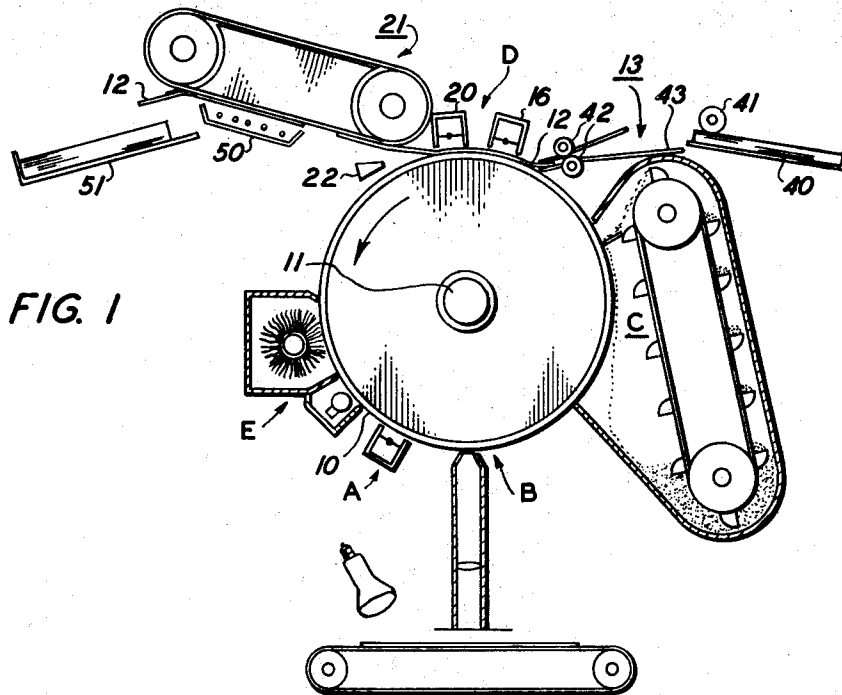
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ELECTROSTATIC SHEET DETACHING APPARATUS

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ELECTROSTATIC SHEET DETACKING APPARATUS

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9 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for removing and insulating copy sheets from a moving surface to which the sheet is electrostatically tacked. The back side of the sheet is subjected to an A.C. corona discharge of sufficient strength to cause the leading edge of the sheet to be repelled from the surface. The fluid transport is established beneath the repelled portion of the sheet which directs the sheet away from the surface.

This invention relates to apparatus for stripping an insulating transfer material from a photoconductive surface.

More specifically, this invention relates to apparatus for removing an insulating support material from a moving xerographic drum in an automatic xerographic machine. In the process of xerography, a plate, comprising a conductive backing upon which is placed a photoconductive insulating material, is charged uniformly and the photoconductive surface then exposed to a light image of an original to be copied. The photoconductive coating becomes conductive under the influence of the light image so as to selectively dissipate the electrostatic charge found thereon to produce what is known as a latent image. The latent image is developed by means of a variety of pigmented resins which have been specifically developed for this purpose. The pigmented resins, or, as commonly referred to, "toners" are electrostatically attracted to the latent image on the photoconductive surface in proportion to the amount of charge found thereon. That is, an area of small charge concentration becomes an area of low toner density while an area of greater charge concentration becomes proportionally more dense. The developed image is then transferred to a final support material, as for example paper, and permanently affixed thereto to produce a copy of the original subject matter.

In conventional automatic xerographic machines, the photoconductive surface is usually formed in a cylindrical shape to produce an endless surface capable of being rotated through the various xerographic processing stations. An insulating support material, usually paper, is brought into synchronous contact with the drum surface and a potential, opposite in polarity to the potential found on the toner material, placed thereon.

A corona generating device, generally referred to as a transfer corotron, ionizes the air in the vicinity of the transfer station producing a charge build-up of sufficient strength and proper polarity to cause the toner on the drum to be attracted electrostatically to the support material. However, this charge on the support material induces an opposite charge in the non-image areas of the xerographic drum and this new charge orientation creates an electrostatic bond between the transfer material and the drum. In order to separate the transfer material held to the drum surface the electrostatic bond between the two surfaces must be overcome.

Many mechanical devices such as stripper fingers, air puffers, and the like, have been used with varying degrees of success to effect separation. However, these devices,

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because of their inherent nature, are such as to cause unfused images, which are loosely adhered to the support material, to be disturbed. These disturbances are reflected as smears and voids on the final copy produced. Furthermore, it has been found that mechanical stripping fingers placed in contact with a photoconductive surface produce scratches and abrasions therein which render the photoconductor useless.

Electrostatic stripping, a method of stripping in which the forces holding the support material to a photoconductive surface are eliminated or neutralized by subjecting the support material to a charge sufficient to overcome the electrostatic bond, is another means of effecting separation of the support material. Method and apparatus to accomplish electrostatic stripping are disclosed in copending application to Kaupp, Ser. No. 585,816, filed Oct. 11, 1966 in which an insulating support material is moved past a detacking corotron mounted at about a 6 o'clock drum position. The detacking corotron produces a charge of proper polarity and sufficient magnitude to neutralize the charge on the paper. The forces of gravity acting on the paper, coupled with the tendency of the material to resume its natural straight posture, cause the detacked support material to fall away from the drum surface.

Although electrostatic detacking has been found to be an effective means of stripping an insulating support material from an image retaining member, it is confined, as to use, to positions where the forces of gravity can act on the support material. That is, the detacking operation must take place at some point where the support material is free to fall away from the photoreceptor in order for the operation to be effective.

It is therefore a primary object of this invention to improve apparatus for removing an image-bearing xerographic copy from a photoconductive surface.

It is a further object of this invention to remove an image-bearing support material from a photoconductive surface with the minimum amount of image degradation.

Another object of this invention is to provide apparatus for removing an image-bearing support material from any position on a xerographic drum.

A still further object of this invention is to extend the useful life of a photoconductive plate.

These and other objects of the present invention are accomplished by placing upon an insulating support material electrostatically tacked to a moving image retaining member an electrostatic charge having a polarity capable of eliminating or neutralizing the bonding forces created during image transfer. Sufficient charge is induced in the support material to cause at least a portion of the support material to be repelled from the photoconductive surface and a transport of aeriform fluid material created under the repelled portion of the support material to direct the sheet away from the image bearing member surface.

For a better understanding of the invention, as well as other objects and features thereof, reference is had to the following detailed description of the invention to be read in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic diagram of an automatic xerographic reproducing machine utilizing the principles of the instant invention;

FIG. 2 is a partial view embodying the transfer and stripping apparatus of the present invention.

For a general understanding of the xerographic processing system by which the invention is being illustrated, reference is had to FIG. 1 in which the various system components are schematically illustrated. As in most xerographic systems based on the concepts disclosed in the Carlson patent, U.S. 2,297,691, a light radiation image

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of the copy to be reproduced is projected onto a sensitized surface of a xerographic plate to form an electrostatic image. Thereafter, the latent image is usually developed with oppositely charged developing material to form a xerographic powder image corresponding to the latent image on the xerographic surface. In most conventional automatic xerographic machines a reusable xerographic plate in drum configuration is employed. The powder image is electrostatically transferred to a final support surface and then fused by means of a fusing device causing the image to be permanently adhered thereto.

Referring now to FIG. 1 there is shown an embodiment of the present invention in a suitable environment such as an automatic xerographic reproducing machine. The machine has a xerographic surface 10 comprising a photoconductive layer placed on a conductive backing. The surface is formed in the shape of a drum and is rotatably mounted on a shaft 11 which is journaled in the machine frame so as to rotate in the direction as indicated by the arrow. This rotation causes the drum surface to move sequentially past a plurality of xerographic processing stations.

For the purpose of the present disclosure, the several xerographic processing stations in the path of movement of the drum surface may be described functionally as follows:

A charging station A, at which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum by means of a charging corotron;

An exposure station B, at which time a light or a radiation pattern of a copy to be reproduced is projected onto the drum surface thereby dissipating the charge in the exposed areas so that a latent electrostatic image is formed of the original;

A development station C, where the xerographic developing material, including toner particles having an electrostatic charge opposite to that of the latent image, are cascaded over the drum surface whereby the toner particles adhere to the latent image to form a developed powder image in the configuration of the original to be reproduced;

A transfer station D, at which the xerographic powder image is electrostatically transferred from the drum surface to a transfer or final support material and then removed from the drum so that the image may be fused to the final support material; and,

A drum cleaning and discharge station E, where the drum surface is cleaned of all residual toner particles remaining after transfer and at which time the drum surface is exposed to a relatively intense light source capable of completely discharging any residual charge remaining thereon.

It is believed that the foregoing description is sufficient for the purposes of this application to show the general operation of the xerographic reproducing apparatus.

As the drum-shaped photoconductive surface 10 passes from development station C, a suitable insulating support material 12 is brought into contact with the drum surface by means of sheet feeding mechanism 13. Any suitable insulating support material such as Mylar, paper, or the like may be employed with the present invention. The sheet and drum are moved in unison at synchronous speed past transfer corotron 16. Corotron 16 ionizes the atmosphere in the vicinity of the support material whereby charge of proper polarity and sufficient strength is produced on the support to overcome the electrostatic bond holding the toner particles to the drum surface.

Although transfer corotron 16 affects transfer of the xerographic image, it also causes the insulating support material to become charged in the non-image areas as well. This charge on the insulating support material bonds the support material to the drum surface in the non-image areas; the strength of the bond being proportionally to the amount of non-imaged surface area. In the repro-

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duction of line copy, in which the preponderance of surface area treated by the transfer corotron is non-imaged, this bonding strength is relatively high. The drum surface and support material, electrostatically tacked thereto, remain bonded together until some suitable instrumentality capable of separating the two is employed.

Although mechanical means, such as strip fingers common in the printing art, may be used to remove the transfer material from the drum surface, mechanical means of this type scratch the photoconductive surface of the drum as well as disturbing the powder image loosely adhered to the transfer material.

Puffers, which propel a jet of air or other aeriform fluids, are also widely employed to pick off the leading edge of a support material from the drum surface. Conveniently, a puffer is arranged so that a relatively high pressure jet of aeriform fluid is directed at the surface of the xerographic drum to coincide with the appearance of the leading edge of a sheet of transfer material thereon. The aeriform fluid is regulated by a pulsator or the like so that a stream of short duration is jetted at the leading edge of the support material to peel the edge away from the drum surface. The edge is then engaged by stripper fingers or the like which complete the operation. The timing of the high pressure blast is critical. If the blast is premature, the support material will not be acted upon and therefore not stripped. The unstripped material will remain on the xerographic plate and be carried through the subsequent processing stations. On the other hand, if the blast duration is too long, the high pressure stream will strike the unfused toner causing it to be moved over the surface of the support material or even blown away.

To prevent destruction of the powder image on the transfer material and to prevent damage to the xerographic drum surface there is provided a preferred form of pick-off mechanism as shown in FIGS. 1 and 2. A detacking corotron is employed which is capable of rapidly charging the insulating support material to a potential sufficient to cause the leading edge of the support material to be electrostatically repelled from the photoconductive surface. A support of aeriform fluid is created under the repelled edge and acts as a transport upon which the support material can ride or be directed out of the immediate drum area. The support material may be driven under the influence of the moving xerographic drum along the aeriform fluid support or the aeriform fluid itself may be used as a means to transport the repelled portion of the support material into communication with further sheet handling means.

Specifically, in the embodiment disclosed, the transfer and detacking step are shown taking place at a 12 o'clock drum position. However, it should be clear that the instant invention is equally adaptable for performing the stripping operation at any desired drum position. Furthermore, for purposes of this disclosure, it will be assumed that the original charge placed on the photoconductive surface, and therefore, the potential of the latent image, is positive. Negative toner particles are used to develop this positive latent image. Transfer corotron 16 must therefore produce a positive DC output greater in magnitude than the electrostatic charge holding the developed xerographic image to the drum surface so that toner particles are attracted to the support material.

An AC detacking corotron 20 is positioned downstream from the transfer corotron 16. As shown in the previously noted Kaupp disclosure it has been determined that the electrostatic bond holding the insulating support material to the drum surface can be eliminated by use of a corotron which is energized by AC electrical energy. The corotron is energized to a high enough level whereby air near the support material is ionized sufficiently during the negative portion of the cycle to cause the insulating support material to be electrostatically repelled from the drum surface. This repelling of the paper support 12 from drum surface 10, coupled with the paper's inherent tendency to

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recover or return to its natural straight posture, is sufficient to cause the leading edge of paper to be lifted some distance from the curved drum surface.

For example, a 100 bond paper sheet tacked to a selenium drum by means of a corotron similar to that disclosed in Vyverberg, U.S. Patent 2,836,725 was acted upon by a single wire AC detacking corotron comprising a .0035 inch diameter platinumiridium wire. The detacking corotron was located downstream from the transfer corotron at about a 12 o'clock drum position. An AC potential of about 5.2 kv. was placed on the detack corotron and the leading edge of the paper support material lifted approximately $\frac{1}{8}$ of an inch from the drum surface. No degradation of the transferred image due to the AC detacking operation was noted. Control can be maintained over the system by adjusting the position of the corotron or by varying the voltage applied thereto. By impressing the AC voltage on an adjustable DC bias very close control can be obtained.

In the present invention, a high volume-low velocity air transport is created in the area of continuous AC detacking so that an image bearing support material repelled from the drum surface is prevented from recontacting the drum surface. This high volume-low velocity fluid stream is also utilized as a transport for moving the support material into contact with a vacuum transport 21. Referring now to FIG. 2, there is provided a discharge manifold 22 positioned adjacent to the drum and being mounted by means of clamps or the like (not shown) which may be secured to the structural elements of the machine, as for example, the machine support frames. The manifold has a series of openings capable of discharging an aeriform fluid to establish a barrier or cushion capable of supporting and transporting paper away from the drum surface. Aeriform fluid is delivered to the manifold by means of flexible tube 23, connected at one end to the manifold coupling 24 and at its other end to centrifugal blower 25. Any suitable low pressure centrifugal blower may be used to supply a stream of aeriform fluid to the manifold. The blower illustrated in FIG. 2 is used also to provide a negative pressure required to hold a sheet brought into contact therewith against the surface of belt 37 of vacuum transport 21. A second flexible tube 26 is connected at one end to the blower at tube coupling 27, located on vacuum end of the centrifugal blower, while the other end is connected to the exhaust coupling (not shown) of the vacuum transport system 21.

Manifold 22 consists of an expanded chamber 30 which terminates in a relatively wide duct opening running longitudinal to the drum surface. Chamber 30 is wedge-shaped, widening from the connector 24 to the port end, so that it transverses the entire width of drum 10. The position of duct opening in relation to the detack point is not critical. That is, the fluid barrier can be created anywhere in the vicinity of the detack point when the repelled edge of the support material can be contacted and acted upon. Once the leading edge of a sheet of transfer material has been repelled from the surface of the xerographic drum, it comes under the influence of the fluid barrier which acts to support it above the drum surface.

In this embodiment, the exit duct of the manifold is positioned so that a fluid support column is created which tends to direct the transfer sheet 12 towards vacuum transport 21. Although not required, a series of nozzles 35 are also machined in the upper surface of the manifold for directing a stream of fluid against the transfer material which is in contact with vacuum transport belt 37 thereby insuring that positive contact is maintained between the belt and the support material during initial contact.

In operation, a sheet of transfer material 12, as for example paper, is fed from stack 40 (FIG. 1) by means of feed roller 41 into the nip of a set of drive rollers 42. The support material is delivered to the image bearing drum surface by means of the drive rollers acting in conjunction with guide plates 43. The support material is

immediately brought under the influence of positive transfer corotron 16 causing the developed image to be transferred from the drum surface to the transfer material. The insulating transfer material, at this time, also becomes electrostatically tacked to the drum surface in the non-image areas. The transfer material continues downstream under the influence of the rotating drum until it comes under detacking corotron 20 where a negative charge is rapidly sprayed on the backside of the paper insulating material which is sufficient to cause the leading edge of the paper to be repelled from the drum surface. In the present embodiment, detacking corotron 20 is in continuous operation so that the entire length of the paper transfer material is sprayed with ions of a negative polarity thus negating or neutralizing the electrostatic bonding force holding the paper to the drum surface. The moving drum drives the repelled portion of the support material forward where it encounters the fluid transport barrier created by the manifold system. The partially detacked support material moves under the influence of the drum along the fluid transport barrier until the non-imaged side of the sheet is operatively engaged by the vacuum transport belt 37 which moves the support material on to subsequent processing stations. Ports 35 in the top of the manifold extend the fluid barrier to a point where the support is able to be securely contacted by the vacuum transport. As shown in FIG. 1, the vacuum transport system then moves the transfer material through fuser 50 and deposits it in tray 51.

While the invention has been described with reference to the structure disclosed herein, it is not confined to the details set forth. For instance, although a continuously operated detacking corotron is preferred, it is quite feasible to pulse the corotron to act only upon the leading portion of the support material while completing the stripping by having the vacuum transport pull the remaining portion of the support away from the drum thereby mechanically stripping the sheet from the drum surface. Such a system might be advantageous in apparatus utilizing web or extremely long sheet material. This application is intended to cover such modifications or changes as may come within the purpose of the improvements or the scope of the following claims.

What is claimed is:

1. Apparatus for removing the insulating sheet of final support material having toner particles loosely adhered thereto from a moving image retaining member to which the support material is electrostatically bonded including electrostatic means stationarily positioned in noncontiguous relation to the moving member and being arranged to induce a charge on the insulating support material bonded to said member, said charge having a polarity opposite to the bonding charge and being of a magnitude sufficient to repel the leading edge of the support sheet away from the surface of the moving member,

means to continuously maintain a high volume, low velocity, fluid transport adjacent to said moving member and being arranged wherein the fluid transport supports the imaged side of the sheet as the sheet is repelled from said member and directs said sheet away from said member.

2. The apparatus of claim 1 wherein said electrostatic means comprises a corona generating device for rapidly inducing a charge on the insulating support material.

3. The apparatus of claim 2 wherein said corona generating device is a corotron operable by an alternating current.

4. The apparatus of claim 3 further including means to operatively engage the support sheet directed away from the moving image retaining member to further transport said sheet to a subsequent sheet processing station.

5. Apparatus for removing an insulating sheet of support material from a moving image retaining member to

which said support material is electrostatically tacked including

electrostatic means stationarily positioned above the image retaining member in non-contiguous relation therewith for inducing a charge over the entire surface area of the insulating support sheet, the induced charge being of a polarity opposite the polarity of the tacking charge and being of a magnitude sufficient to neutralize said tacking charge and repel at least a portion of the support material from the moving image retaining member,

means to produce a continuous high volume, low velocity, aeriform fluid transport adjacent to said moving image retaining member and being arranged to support and direct the repelled insulating support sheet away from said moving image retaining member,

a vacuum transport arranged to operatively engage the non-imaged side of the support sheet directed away from said moving image retaining member.

6. The apparatus of claim 5 wherein said electrostatic means comprises an alternating current corona generating device for rapidly inducing a charge on the support material.

7. In a xerographic apparatus of the type wherein a photoconductive drum arranged to rotate about a horizontal axis is charged and then exposed to a light image of an original to form a latent electrostatic image thereon and the image developed by means of a xerographic toner to form a powder image, apparatus for transferring said powder image from the drum surface to a final support material including

a transfer corotron arranged to induce an electrostatic charge on insulating support material placed in contact with the image bearing drum surface whereby the powder image is attracted from the drum surface to the support material

a detacking corotron positioned adjacent to the transfer corotron in the direction of drum rotation for placing a neutralizing charge opposite in polarity to the transfer charge on the surface of the support material, said charge being of a magnitude sufficient to repel the leading edge of said support material from the rotating drum surface, and

means to continuously produce a high volume, low velocity, aeriform fluid transport in close proximity to the drum surface wherein the fluid transport engages in supporting contact the repelled edge of said support material and direct said support material away from the rotating drum surface.

8. The apparatus of claim 7 further including a vacuum transport arranged to operatively engage the non-imaged side of the support material directed away from said rotating drum surface.

9. The apparatus of claim 8 wherein said detacking corotron is positioned above the horizontal center line of said rotating drum.

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