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[31] 43/48137

[56] References Cited
UNITED STATES PATENTS
3,058,405 10/1962 Limberger..... 118/637 X
3,176,652 4/1965 Mott et al. 118/637
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[54] **ELECTROPHOTOGRAPHIC DEVELOPING APPARATUS**
1 Claim, 4 Drawing Figs.

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303, 630, 124, 633; 117/17.5; 346/74 ES, 74 ESX,
74 MY; 355/1 NE

ABSTRACT: A developing apparatus comprising an electrically insulative cylinder rotatably mounted relative to a fixed magnet therein in which a carrier-toner mix is fed onto said cylinder for forming magnetic brushes on the outer surface of the cylinder for brushing a photosensitive paper bearing an electrostatic latent image. The guiding means for guiding the paper along the brushes comprise generally linear reciprocating means disposed between an endless belt and the cylinder and engaging with guide rollers. The reciprocating means reciprocate transversely to the path of the paper and through the carrier-toner mix of the brushes so that the paper is prevented from deviating from its path and the developer powder forming the brushes is stirred.

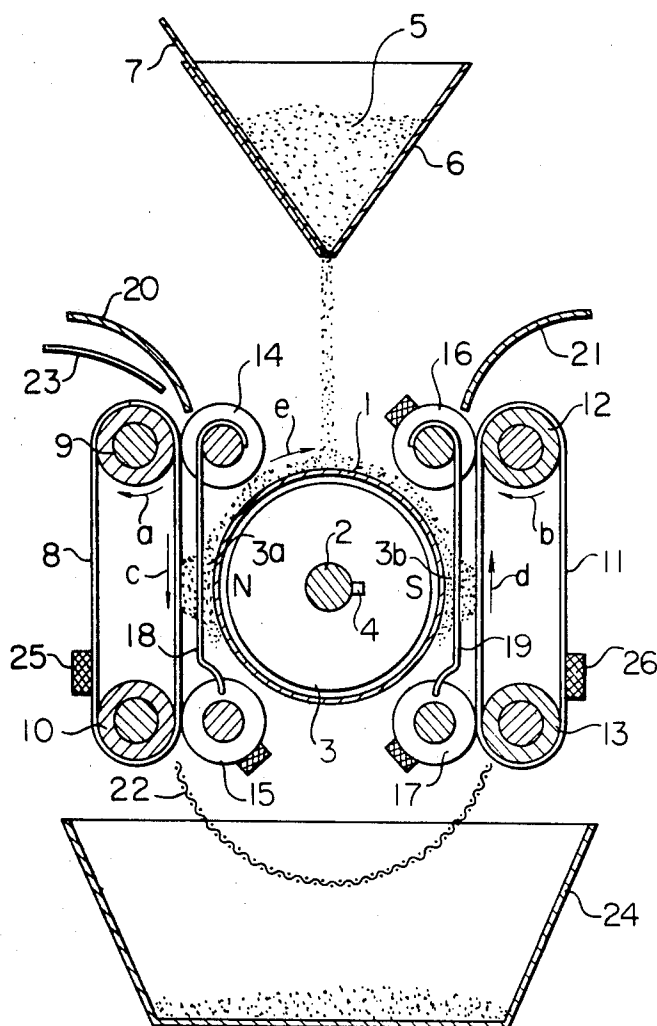


Fig. 1

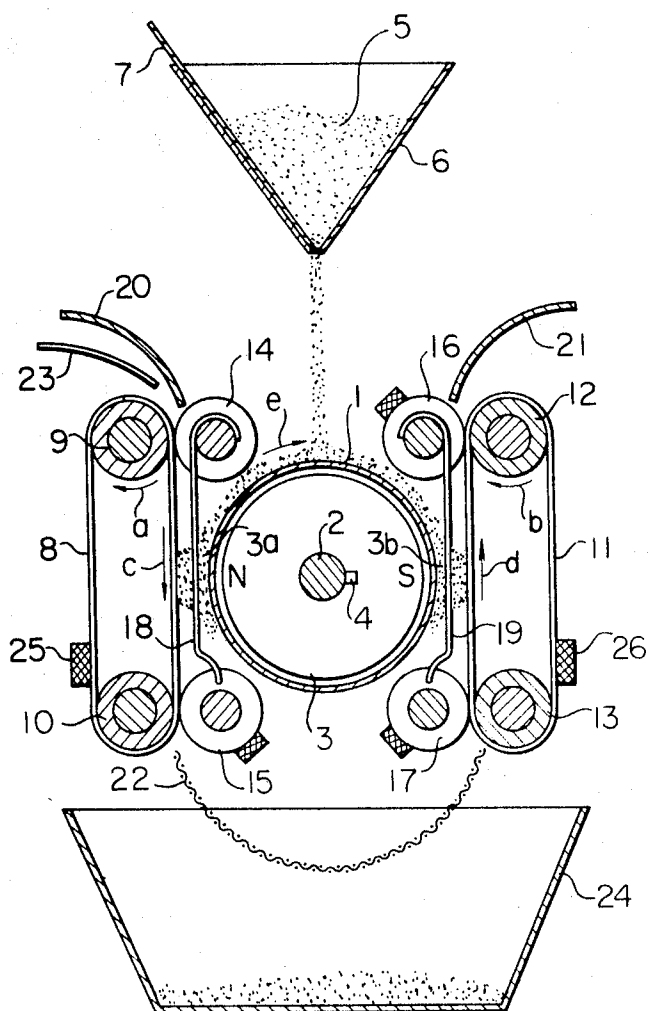


Fig. 2

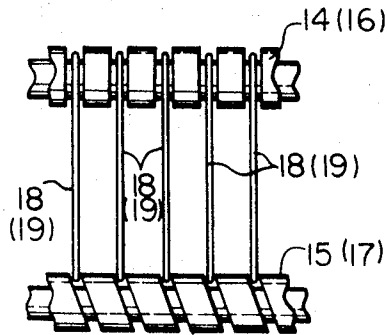


Fig. 3

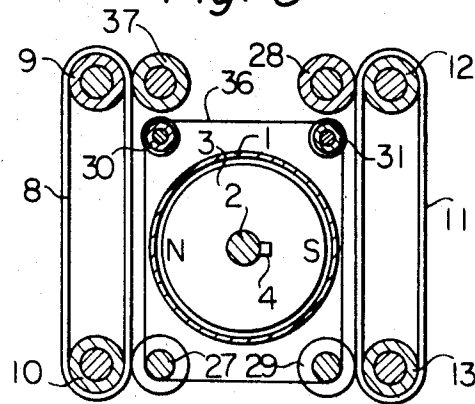
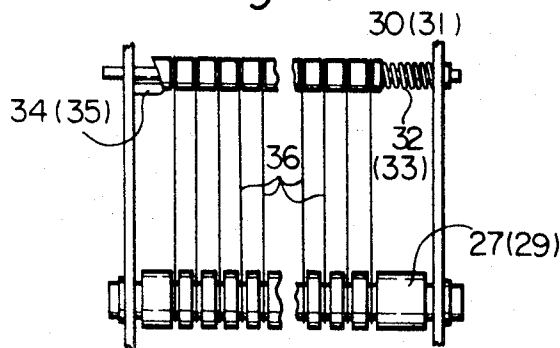


Fig. 4



ELECTROPHOTOGRAPHIC DEVELOPING APPARATUS

This invention relates to an electrophotographic developing apparatus, and in particular, to a dry-type electrophotography with magnetic brushes.

Dry-type electrophotographic developing apparatus are known which comprise a magnet to which a carrier-toner mix, such as a powder comprising carbon black mixed with iron, is attracted for forming magnetic brushes which brush a paper, such as photosensitive paper coated with a photoconductive material dissolved in a binder and carrying a latent image caused by charging and exposing it, to make the electrostatic latent image thereon visible.

The principal object of the present invention is to provide a developing apparatus in which magnetic brushes are formed on the outer surface of a rotating drum at the points corresponding to the poles of a magnet installed therein to brush the photosensitive surface of a sheet of photosensitive paper bearing an electrostatic latent image, and in which linear reciprocating guiding means for the paper are provided adjacent said drum and passing through the magnetic brushes for preventing photosensitive papers from deviating from the path which they should intentionally follow and for stirring the developer powder which forms said magnetic brushes.

The further objects, features and advantages of the invention will be apparent from a consideration of the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a sectional view of an embodiment of the developing apparatus in accordance with the present invention;

FIG. 2 is a side view of an essential part of the apparatus of FIG. 1,

FIG. 3 is a sectional view of an essential part of another embodiment of the developing apparatus in accordance with the present invention; and

FIG. 4 is a side view of an essential part of the apparatus shown in FIG. 3.

In FIG. 1, a hollow rotating drum 1 made of an electrically insulating material is supported by a fixed shaft 2. The cylinder 1 may comprise two end plates movable on the shaft. Within the rotating drum 1, a magnet 3 is fixed on the shaft 2 by a key 4. Above the rotating drum 1, there is provided a container 6 filled with developer powder 5 comprising toner particles and iron powder. The developer powder 5 drops down through the mouth in the bottom of the container 6 towards the outer surface of said rotating drum 1 and is attracted to the surface by the magnetic force. An ejector plate 7 is provided for controlling the ejection of the developer powder. The rotating drum 1 is rotated as shown by arrow *e* in clockwise direction by a driving means (not shown in the drawing), and the developer powder attracted to the outer surface forms magnetic brushes 3*a* and 3*b* at the points on the outer surface of the drum corresponding to both poles of said magnet 3. Above and below each of the poles of said magnet 3, rollers 9 and 10 carrying an endless belt 8 and rollers 12 and 13 carrying an endless belt 11 are movably mounted to fixed shafts. Rollers 14 and 15 movably mounted to fixed shafts are pressed against said rollers 9 and 10 the belt 8 intervening. In similar manner rollers 16 and 17 movably mounted to fixed shafts are pressed against the rollers 12 and 13. On the rollers 14 and 16, there are provided a plurality of gaps as shown in FIG. 2 and at places on the rollers 15 and 17 corresponding to said gaps, a plurality of cam grooves are provided. In each of the grooves on the rollers 14 and 16, there is fitted one end of each of linear guide members 18 and 19 made of wires, and the other end of each of the linear guide members 18 and 19 is engaged with each of the cam grooves on the rollers 15 and 17 respectively. The endless belts 8 and 11 and the linear guide members 18 and 19 form paths of photosensitive paper through the magnetic brushes 3*a* and 3*b*, respectively. At the upper ends of said paths there are a fixed inlet guiding plate 20 and a fixed outlet guiding plate 21 for feeding photosensitive paper in and

out respectively. Between the lower ends of said paths the paper is guided by a guide member 22 comprising a porous plate or a net. The rollers 9 and 12 are rotated by a driving means (not shown in the drawing) in the direction shown by arrows *a* and *b*, respectively, and consequently the belts 8 and 11 move in the direction shown by arrows *c* and *d*, respectively. As the rollers 15 and 17 rotate in accordance with the movement of the belts 8 and 11, respectively, each of said linear guide members 18 and 19 move back and forth in the direction transverse to the path of photosensitive paper. A sheet of photosensitive paper 23 fed in at the inlet guide plate 20 thus passes between the rollers 9 and 14 and moves in the direction shown by the arrow *c*. The photosensitive surface of the paper is brushed by the magnetic brush 3*a*, and as a result, toner particles mixed with iron powder are attracted to the electrostatic latent image on the surface of the paper so that said photosensitive paper is developed. The developed photosensitive paper 23 is led further by the belt 8 to pass between the rollers 10 and 15. Then the guide plate 22 reverses the forward direction of the paper and the belt 11 feeds it in between the rollers 13 and 17. After having passed between the rollers 13 and 17 the paper is brushed by the magnetic brush 3*b* and it thus undergoes the second development procedure. After this second development, the photosensitive paper 23 is led further by the belt 11 to pass between the rollers 12 and 16 and be fed out of the developing apparatus. The developed paper out from the developing apparatus may be made to enter into a fixing device (not shown in the drawing), which may be arranged subsequent to the developing apparatus as shown and in which the powder image is caused to be fixed permanently on the surface of the paper. The linear guide members 18 and 19 prevent the photosensitive paper 23 from deviating from the desired path for the photosensitive paper, and supply the appropriate amount of toner particles on the surface of the photosensitive paper smoothly by reciprocating to stir the developer powder which forms the magnetic brushes 3*a* and 3*b*. Underneath said guide member 22, there is provided a container 24 which collects the used developer particles. Cleaners 25 and 26 are pressed softly on the belts 8 and 11, respectively, to remove the toner particles attracted to those belts 8 and 11. There is provided also the same kind of cleaner for each roller that is directly pressed against the developed photosensitive paper 23.

FIG. 3 shows a development apparatus with endless linear guide members 36 made of nylon wire instead of said linear guide members 18 and 19 made of metal wire as mentioned above. In FIG. 3, elements having the same reference numbers as those of shown in FIG. 1 have the same function in the apparatus. Rollers 37 and 27 and rollers 28 and 29, which are mounted loosely to fixed shafts, are pressed against the rollers 9 and 10 and rollers 12 and 13 respectively the belts 8 and 11 intervening respectively. On the surfaces of said rollers 27 and 29, a plurality of gaps are provided as shown in FIG. 4. Adjacent said rollers 37 and 28, rollers 30 and 31 are loosely mounted to fixed shafts. On one end of each of the rollers 30 and 31, there is provided a cam and there are springs 32 and 33 on the other ends of both rollers so that pins 34 and 35 fixed on a fixed member press the cam-shaped ends through said springs. The linear guide members 36 are hung between the gaps on said rollers 27 and 29 and the rollers 30 and 31, and together with the belts 8 and 11 they define the path for photosensitive paper through the magnetic brushes 3*a* and 3*b*. When the rollers 10 and 13 rotate with the movement of the belts 8 and 11, the linear guide members 36 also rotate so that the rollers 30 and 31 move back and forth in the direction of their axes, that is, the direction transverse to the path of photosensitive paper. The present invention does not impose a special limitation in the choice of materials and shapes of said linear guide members, nor in the method of mounting the linear guide members, and there would be many alternative methods for making the linear guide members moving back and forth in the direction transverse to the path of photosensitive paper. It will be understood that the present invention is

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not intended to be restricted to the embodiments shown, and it will be clear to anyone skilled in the art that without departing from the scope and spirit of the invention many modifications may be made of the developing apparatus in which linear guide members are mounted adjacent the path of photosensitive paper to move back and forth in the direction transverse to the path of photosensitive paper so as to prevent the slip-off of the photosensitive paper from the paper path, and stir the developer powder forming magnetic brushes so that the supply of toner particles to the surface of the photosensitive paper is made smoothly to obtain a good quality image reproduction.

What I claim is:

- 1. An electrophotographic developing apparatus comprising:
an electrically insulative cylinder rotatably mounted relative to a fixed magnet therein having substantially

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horizontally aligned fields of magnetic poles; means for feeding a magnetic carrier toner mix onto said cylinder for forming magnetic brushes on the outer surface of said cylinder at said poles; and guiding means for guiding a photographic substrate sheet along said brushes, said guiding means including a first pair of guide rollers carrying a substantially vertically extending endless belt juxtaposed to each side of said cylinder opposite to one of said poles, a second pair of guide rollers pressing against the guide rollers of said first pair from the outside of said belt nearest to said cylinder, and a wire-shaped reciprocating means engaging with at least one of said rollers of said second pair to reciprocate removed from said substrate transversely to the path of said substrate and through the carrier toner mix of the brush at said one pole.

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