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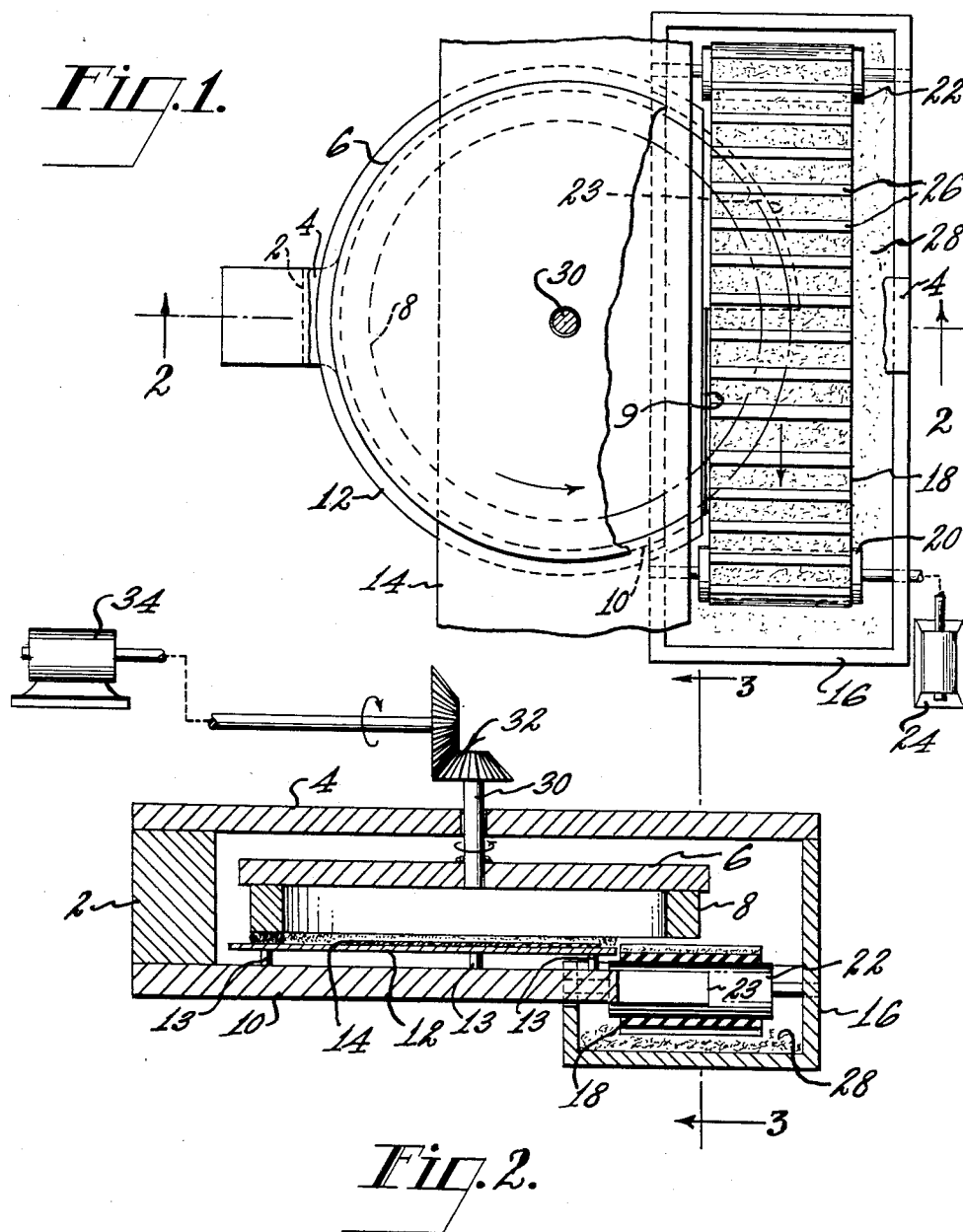
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MAGNETIC BRUSH APPARATUS FOR DEVELOPMENT OF ELECTROSTATIC IMAGES

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2 Sheets-Sheet 1



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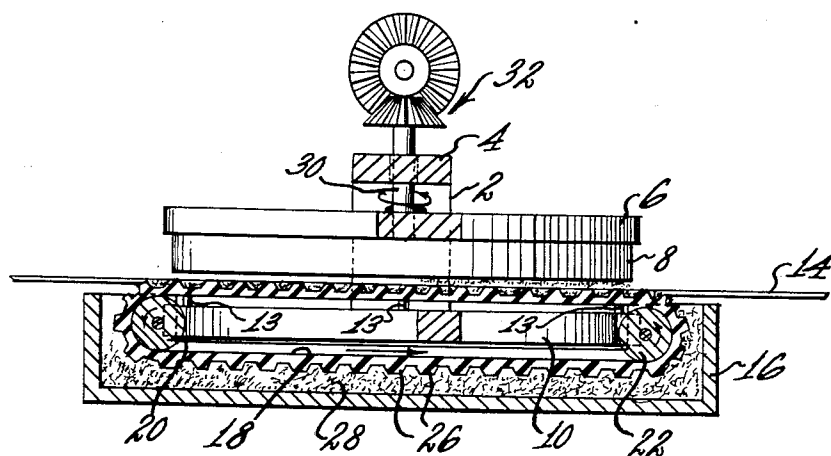


Fig. 3.

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MAGNETIC BRUSH APPARATUS FOR DEVELOPMENT OF ELECTROSTATIC IMAGES

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5 Claims. (Cl. 118—637)

This invention relates to electrostatic photography, and more particularly to novel automatic electrostatic image development means.

In the art of electrostatic photography, means have been provided whereby a quantity of electroscopic developer powder having magnetic properties is supported in brush-like tufts by a magnetic field produced by a suitable magnetic structure, and is carried in brushing contact with the charged surface of an electrostatic image bearing member. As the brush-like tufts are swept across the image bearing member, the electroscopic developer powder is deposited from the tufts onto the surface of the image bearing member in accordance with an electrostatic charge image impressed thereon. As the particles are deposited out of the brush-like tufts onto the surface of the image bearing member, the supply of the electroscopic powder in the mixtures become depleted.

It is therefore an object of the present invention to provide improved means for developing latent electrostatic images on a chargeable record member.

It is another object of the present invention to provide developing means employing brush-like tufts of electroscopic developer powder and including novel means for replenishing the supply of electroscopic developer powder in the tufts.

It is a further object to provide an improved powder replenishing means for brush-like tufts of electroscopic developer powder characterized in that the powder is thoroughly mixed with magnetic particles and is carried into position to be formed into brush-like tufts by a suitable magnet structure.

In accomplishing these and other objects, there has been provided, in accordance with the present invention, a reservoir positioned adjacent a suitable magnetic structure which forms and carries the brush-like tufts of magnetic developer mix. Positioned in the reservoir is an endless conveyor member having a roughened external surface. Means are provided whereby the brush-like tufts are dropped onto the surface of the conveyor member which carries them into the reservoir to be mixed with a supply of developer powder therein. The mixture is carried, by the roughened surface of the conveyor member, into the path of the magnetic structure whereby fresh brush-like tufts of the developer mix are formed. This action is continuous.

A better understanding of the present invention may be had from the following detailed description when read in connection with the accompanying drawing, in which:

Fig. 1 is a top plan view, partly broken away, of a developer apparatus constructed in accordance with the present invention;

Fig. 2 is a cross sectional view taken along the line 2—2 of Fig. 1 as viewed in the direction of the arrows; and

Fig. 3 is a cross sectional view taken along the line 3—3 of Fig. 2 as viewed in the direction of the arrows.

Referring now to the drawing in more detail, there is shown a magnetic structure which includes a magnetic 2, a yoke member 4, a magnetic disk 6 and a cylindrical

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pole piece 8. The latter is in the form of a ring suitably secured concentrically on the disk 6. Below the pole piece 8, there is positioned a magnetic flux return path plate 10. This return path plate 10 is shaped to substantially match the configuration of the cylindrical pole piece 8 with the exception that a semisegment is removed, as indicated by reference character 9, from the return plate for reasons which will be more fully set forth hereinafter.

Between the lower edge of the pole piece member 8 and the upper surface of the return path plate 10 there is positioned a non-magnetic guide plate 12 supported by non-magnetic posts 13, for example. A record member 14 bearing an electrostatic charge image is drawn over the surface of the guide plate 12 in such a manner as to pass between the return path plate 10 and the lower end of the pole piece 8.

Adjacent to one edge of the apparatus there is positioned a reservoir 16 in which is mounted an endless belt 18. The belt is carried on a pair of rotatable rollers 20 and 22. One of the rollers 20 is coupled to a suitable drive means such as a motor 24. The outer surface of the belt 18 is provided with a roughened surface such as the serration 26. An example of a suitable belt is a belt designed for use in conjunction with geared rollers, however, with the serrations on the outside surface of the belt.

The reservoir 16 contains a quantity of electroscopic developer powder 28. The serrated belt, in its run between the two rollers 20 and 22, underlies a segmental portion of the circular path described by the pole piece 8. The remaining semisegmental portion 23 of the return path plate 10 lies between the upper and lower run of the belt and, together with a portion of the pole piece 8, sandwiches a portion of the upper run of the belt therebetween. The disk 6, carrying the pole piece 8, is coupled through a shaft 30 and suitable coupling means 32 to a drive motor 34.

In operation, the motor 34 drives the disk 6 through the coupling 32 of the shaft 30 in a rotary motion about an axis which is perpendicular to the surface of the record member 14. As the disk 6 is rotated, a magnetic field is developed between the pole piece member 8 and the return path plate 10 under the influence of the magnet 2. In this respect, the return path plate 10 constitutes a second or lower pole piece, the field being developed between and defined by the two pole pieces. The belt 18 is driven in the reservoir 16 in the direction indicated by the arrows in Figs. 1 and 3. The serrations 26 on the surface of the belt 18 provide a mixing action on the electroscopic powder and the magnetic particles 28 in the reservoir 16. As the serrations move about the roller 22 to travel along the upper run of the belt 18, quantities of the mixture of powder and magnetic particles are carried in the serrations along this upper run of the belt. It will be noticed that the surface motion of the belt along this upper run is generally in the opposite direction from the direction of motion of the adjacent portion of the pole piece 8. Shown most clearly in Fig. 1, the return path plate 10 is so shaped by omission of the semisegment 9 that a portion of the plate is removed so that a magnetic field is established between the plate and the pole piece 8 under only a portion of the travel of the pole piece adjacent to the belt 18. Where this field is established, the mixed magnetic particles and electroscopic powder are picked up by the pole piece and formed into brush-like tufts which extend in the general direction of the magnetic field between the lower surface of the pole piece 8 and the plate 10.

As the disk 6 is rotated, as aforementioned, these brush-like tufts are caused to sweep across the surface of the charged record member in a direction which is

transverse to the direction of motion of the record member. Suitable means (not shown) are provided for uniformly advancing the record member over the guide plate 12. As the brush-like tufts are swept across the surface of the record member, the electroscopic powder is deposited out of the brush-like tufts onto the surface of the record member in the pattern of the charge image impressed thereon. This produces a visible image of the latent charge image which had previously been impressed on the record member.

In the illustrative embodiment, the pole piece member continues its rotation taking the brush-like tufts with it. The tufts, therefore, travel beyond the edge of the record member, then again sweep across the surface of the record member in a traverse in the opposite direction. When the brush-like tufts have again completed the passage across the record member they are brought into the area where the magnetic field between the pole piece and the return path plate is diminished by virtue of the removal of the semisegmental portion of the plate. The reduction in the magnetic field allows the brush-like tufts to be dropped from the pole piece member. Since the area of the reduced magnetic field coincides with a portion of the path of travel of the endless belt 18, the dropped tufts fall onto the belt and are carried thereby into the reservoir 16 where a fresh supply of developer powder is mixed with the magnetic particles to provide an enriched mixture. This enriched mixture is then carried by the belt back into the influence of the magnetic field where the brush-like tufts are reformed and the cycle is repeated. Reference to the repetition of the cycle has reference, of course, to an elemental portion of the structure. As may be readily seen, the operation is one continuous cycle providing a continuous stream of brush-like tufts which are swept across the surface of the record member.

Although the invention has been described as relating to a system wherein the brush forming members constitute a circular pole piece which is carried in a circular path by a rotating disk, it is equally applicable to a system wherein suitable means are provided for causing the tufts to be carried in a straight line path substantially transverse to the direction of motion of the record member. The brush-like tufts formed by means disclosed herein can be carried in sweeping engagement with the surface of the record member by an endless belt of non-magnetic material which operates in a magnetic field established between a pair of fixed, transverse, pole pieces.

Thus there has been provided an improved apparatus for the development of latent electrostatic image on a chargeable record member which apparatus is characterized by improved means for replenishing the supply of electroscopic developer powder in a continuous development process.

What is claimed is:

1. Apparatus for the development of latent electrostatic images on an electrostatically chargeable record member, said apparatus comprising means for supporting an electrostatically chargeable record member, magnetic field producing means for forming brush-like tufts of an electroscopic developer powder having magnetic properties, means for moving said brush-like tufts in a path transverse to the surface of a chargeable record member on said first named means and extending beyond the edges thereof, means for interrupting the magnetic field produced by said field producing means during a portion of said path beyond one of said record member edges whereby to cause said brush-like tufts to be dropped, a reservoir for a supply of said electroscopic developer powder, an endless belt, and means for supporting and driving said endless belt along two runs, said endless belt having one of said runs positioned adjacent to said path whereby to receive said dropped tufts, said endless belt having another of said runs located at least partially

within said reservoir whereby said belt is operable to deliver said dropped tufts into said reservoir and to carry a fresh supply of said developer powder into the magnetic field produced by said field producing means whereby to form fresh brush-like tufts.

2. Apparatus for the development of latent electrostatic images on an electrostatically chargeable record member, said apparatus comprising means for supporting an electrostatically chargeable record member, magnetic field producing means for forming brush-like tufts of an electroscopic developer powder having magnetic properties, means for moving said brush-like tufts in a path which lies transverse to the surface of a record member on said first named means and which extends beyond said record member edges, means for interrupting said magnetic field produced by said field producing means during a portion of said path which lies beyond one of said edges of said record member whereby to cause said brush-like tufts to be dropped, an endless belt positioned adjacent to said path to receive said dropped tufts, a reservoir for a supply of said electrostatic developer powder, a first and a second support member mounted within said reservoir for supporting said endless belt, and means for driving said belt about said two support members, said belt having one run between said support members which lies within said reservoir and a second run which lies parallel and adjacent to said path, said belt being operable between said two support members to carry said dropped tufts into said reservoir and to carry a fresh supply of said electroscopic developer powder into the influence of said magnetic field producing means.

3. The invention as set forth in claim 2 wherein said belt is provided with a serrated surface.

4. Apparatus for developing latent electrostatic charge images on a chargeable record member, said apparatus comprising means for supporting a record member, pole piece means for defining a magnetic field for supporting brush-like tufts of an electroscopic developer powder having magnetic properties, means for moving said brush-like tufts in a path which lies transverse to the surface of a record member on said first named means and extending beyond the edges thereof, means for interrupting said magnetic field during a portion of said path beyond one of said record member edges thereby causing said brush-like tufts to be dropped, a reservoir for storing a supply of said developer powder having magnetic properties, and an endless belt mounted for operation in said reservoir, said belt being operable to transport portions of said supply of electroscopic developer powder from said reservoir into said magnetic field for formation into said brush-like tufts.

5. Apparatus for developing latent electrostatic charge images on a chargeable record member, said apparatus comprising a circular member of magnetic material, means to support said member for rotation, an endless belt, means for supporting and driving said endless belt along two substantially parallel spaced runs, a stationary circular magnetic flux return path member, a non-magnetic guide member for guiding a record member bearing an electrostatic charge image, said guide member being located in the plane of one of said belt runs, a reservoir for storing a supply of developer powder having magnetic properties, the other of said belt runs traversing said reservoir, and said flux return path member having a semisegmental portion lying between said belt runs.

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