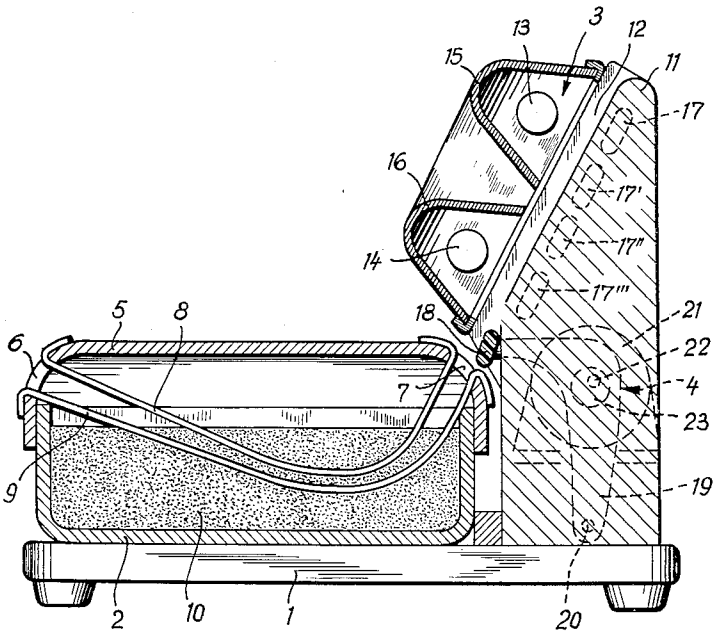
Feb. 21, 1961 W. LIMBERGER 2,972,331

DEVICE FOR DEVELOPING A LATENT ELECTROSTATIC IMAGE

Filed June 27, 1957

Fig. 1



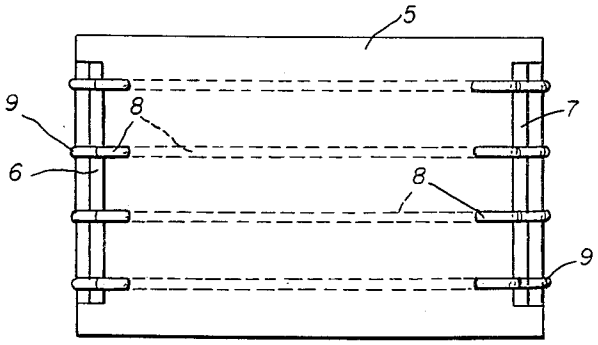


Fig. 2

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United States Patent Office 2,972,331 Patented Feb. 21, 1961

2,972,331

DEVICE FOR DEVELOPING A LATENT ELECTROSTATIC IMAGE

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Filed June 27, 1957, Ser. No. 668,523

Claims priority, application Germany June 29, 1956

10 Claims. (Cl. 118—637)

The invention relates to a device for developing a latent electrostatic image on a previously exposed xerographic layer by the application of pigment particles to a sheet carrying such layer and by fusion of adhering pigment particles to the sheet.

The pigment particles are conventionally used in the development of electrostatic images carried by very small glass or quartz spheres or iron filings. The spheres or filings form with the pigment particles the so-called "toner" which, because of the small size of its carrier elements, is pulverulent.

Known processes for the application of toner to xerographic sheet material do not always achieve a uniform distribution of the particles over the illuminated surface, even if a copious supply of toner is used.

The invention has for its object the provision of a simple apparatus for the developing and fixing of a latent electrostatic image on a xerographic layer forming part of a flexible carrier or sheet.

More particularly, the invention aims at providing a device of this character in which the flexible carrier sheet is quickly and evenly exposed to contact with a mass of toner particles and is immediately thereafter subjected to a fusing operation, preferably with interposition of means for removing excess toner particles from its surface, so that the entire process is carried out rapidly and with a minimum of waste.

In accordance with this invention I provide a device of the general type referred to in which a receptacle, containing a mass of granular toner, is internally provided with elongated, narrow upper and lower guide elements which are supported above the bottom of the receptacle and curved with close vertical separation to a location below the toner level, thereby forming a descending branch and an ascending branch adapted to guide the flexible carrier through the toner accumulation; a heating device, designed to fuse the adhering toner particles to the xerographic layer, is positioned adjacent the ascending branch of the guide elements. Advantageously, agitator means such as a mechanical vibrator may be positioned just ahead of the heating device on an upward extension of the path defined by the ascending branch of these elements.

The guide elements, which by virtue of their narrow configuration engage only a small portion of the surface of the flexible carrier, are preferably in the form of wires extending between an inlet slot and an outlet slot for the carrier. These slots may be formed in a cover or lid which overlies the receptacle proper and also supports the wires.

Further advantages and features of the invention will appear from the following description of an embodiment illustrated in the drawing in which:

Fig. 1 shows a side view of a device according to the invention; and

Fig. 2 shows a top-plan view of a receptacle forming part of the device of Fig. 1.

In the drawing, the container 2 and the heating device

3 are arranged upon a base plate 1. An agitator 4 is located beneath the heating device.

The container 2 is a substantially closed housing whose upper part can be constructed, for example, as a cover 5. This housing or its cover 5 is provided on opposite sides with two slots 6, 7 which serve as inlet and outlet slots for the sheet carrying the xerographic layer. A sheet-guiding device, extending between the slots, is formed by wires 8, 9. The wires preferably run parallel to the direction of advance of the sheet. It is also possible to arrange the wires at an inclination to the direction of sheet movement. The wires 8, 9 are arranged in several pairs spaced over the width of the slots 6, 7, although the inner wire pairs shown in Fig. 2 could also be omitted to minimize interference with the passage of the toner through the sheet-guiding device.

The slots 6, 7 are so arranged in the container 2 that they lie above the toner 10 located in the container. The guides 8, 9 running between the slots 6, 7 are so curved that they pass down into the toner 10. The extent of the curvature can be varied as desired. In the embodiment shown, the guides 8, 9 have a substantially straight section at a location adjacent the inlet slot 6, thereafter curving sharply upwards in front of the outlet slot 7. By this construction, the sheet on leaving the container 2, is pressed by the weight of the toner onto the lower guide 9.

The sheet can be fed through the container by hand, by being pushed into the slot 6 and thence passing between guides 8, 9 onto the guide path 12 leading to the fusing device 3. The curvature of the guides 8, 9 and the loading of the sheet by the toner insures a correct positioning of the sheet for movement through the guiding path 12, yet such movement can also be expedited by withdrawing the sheet from the heating device to the right over the rounded edge 11. It will be understood that the sheet can also be provided with projections to facilitate its displacement through the apparatus and that automatic feeding means known per se, such as pairs of electrically driven rollers, might be used for its displacement.

The guide path 12 for the fusing device runs straight from the terminal portion of the guides 8, 9. The guide path is inclined upwardly in the embodiment shown. Above the guide path is located an arrangement of infrared lamps 13, 14 which are covered by parabolic reflectors 15, 16, so that the developed heat is directed towards the guide path 12. There is also the possibility of providing heating devices 17, 17', 17'', 17''' beneath the guide path, instead of or in addition to the infra-red lamps 13, 14, by which the carrier sheet is heated at its reverse side, that is on the side not provided with the xerographic layer, in order to fuse in the pigment particles.

The illustrated curvature of the guides 8, 9 extending through the container 2 and the direction of the guide path 12 have the advantage that adherent excess particles fall back into the container 2 as the sheet passes out from the toner 10. To expedite this process, the agitation 4 is provided whose vibratory element 18 contacts the reverse side of the sheet between the guides 8, 9 and the guide path 12. This element consists of a resilient transverse bar which engages the sheet over its whole width. Bar 18 is secured to the free arm of a crank lever whose other arm is pivotally mounted at 20 in a horizontal guide slot. The arm 19 is oscillated by a drive motor 21 by way of a cam 23 secured to the motor shaft 22.

In a further development of the illustrated device according to the invention, the drive 21 for the crank lever 19 can agitate the container 2 which in this case is pivotally mounted or suspended. The oscillation of the

container 2 with a small amplitude leads to continual loosening and shaking of the toner 10 and hence at the same time facilitates the passage of the carrier sheet through the guides 8, 9. The amplitude of the oscillation is preferably parallel to the direction of advance of the sheet, though it could also be perpendicular to the base of the container.

The device according to the invention operates with extreme simplicity so that it requires very little supervision. At the same time, an extremely compact construction is provided wherein, particularly through the positioning of the guide path 12 beneath the heating device, space is provided for the vibrator 4. This gives the possibility of accommodating the entire developing apparatus in a very small space. It is also possible to mount this assembly in the frame of another apparatus, in which at the same time the illumination and/or charging of the xerographic layer is carried out.

What I claim is:

1. A device for developing, by contact with a granular toner, a latent electrostatic image on a flexible carrier having a xerographic layer, comprising a receptacle adapted to be filled to a predetermined level with said toner, elongated, narrow upper and lower guide elements supported on said receptacle above the bottom thereof, said guide elements fixedly extending with close vertical separation across the top of said receptacle and curving down therewithin to a location below said level, thereby forming a descending branch and an ascending branch adapted to guide said carrier through an accumulation of said toner within said receptacle, and heating means adjacent said ascending branch for fusing adhering toner particles to said carrier.

2. A device according to claim 1 wherein said ascending branch extends on a slope in the region of said heating means.

3. A device according to claim 1, further comprising agitating means positioned at said ascending branch below said heating means for removing loosely entrained particles from said carrier upon emergence of the latter from said receptacle.

4. A device according to claim 3 wherein said agitating means comprises a transverse bar extending across the path of said carrier, rotatable cam means, link means operatively connecting said bar with said cam means, and drive means for rotating said cam means.

5. A device for developing, by contact with a granular toner, a latent electrostatic image on a flexible carrier having a xerographic layer, comprising a receptacle adapted to be filled to a predetermined level with said toner, a lid overlying said receptacle, said lid being provided on opposite sides with a pair of parallel, horizontal slots respectively constituting an inlet slot and an outlet slot for said carrier, narrow, elongated upper and lower stationary guide elements closely vertically separated from each other at their extremities by said slots and maintaining their vertical separation throughout their length, said guide elements depending from said lid and extending between said slots to a location below said level, thereby forming a descending branch and an ascending branch adapted to guide said carrier through an accumulation of said toner within said receptacle, and heating means adjacent said ascending branch for fusing adhering toner particles to said carrier.

6. A device according to claim 5, further comprising an upwardly sloping extension of said guide elements above said outlet slot, said heating means being located adjacent said extension.

7. A device according to claim 6, further comprising agitator means positioned at said extension below said heating means for removing loosely entrained particles from said carrier upon emergence of the latter from said outlet slot.

8. A device according to claim 6 wherein said extension terminates in a gently rounded shoulder at its upper end.

9. A device for developing, by contact with a granular toner, a latent electrostatic image on a flexible carrier having a xerographic layer, comprising a receptacle adapted to be filled to a predetermined level with said toner, a plurality of pairs of downwardly arched, substantially parallel wires supported on said receptacle above the bottom thereof, said wires fixedly extending with close vertical separation across the top of said receptacle and curving down therewithin to a location below said level, thereby forming a descending branch and an ascending branch adapted to guide said carrier through an accumulation of said toner within said receptacle, and heating means adjacent said ascending branch for fusing adhering toner particles to said carrier.

10. A device for developing, by contact with a granular toner, a latent electrostatic image on a flexible carrier having a xerographic layer, comprising a receptacle adapted to be filled to a predetermined level with said toner, a lid overlying said receptacle, said lid being provided on opposite sides with a pair of parallel, horizontal slots respectively constituting an inlet slot and an outlet slot for said carrier, a plurality of pairs of downwardly arched, substantially parallel wires separated from each other at their extremities by said slots and maintaining their vertical separation throughout their length, said wires depending from said lid and extending between said slots to a location below said level, thereby forming a descending branch and an ascending branch adapted to guide said carrier through an accumulation of said toner within said receptacle, and heating means adjacent said ascending branch for fusing adhering toner particles to said carrier.

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