United States Patent

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[54] WET ELECTROSTATIC TONING APPARATUS

9 Claims, 1 Drawing Fig.

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[50] **Field of Search** ..... 118/637, DIG. 23

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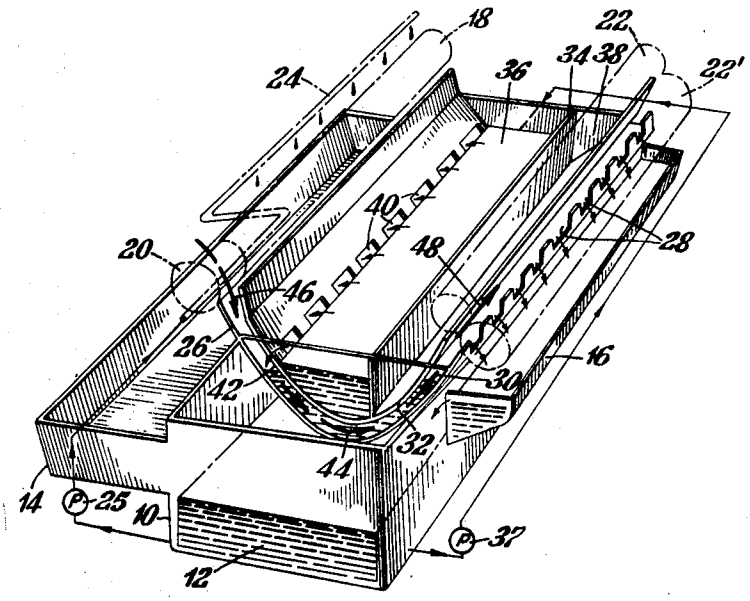
ABSTRACT: Liquid toning solution is sprayed on a wire wound roller to prewet a sheet or web of copy material as the latter is fed downwardly between such roller and a drive roller to squeegee such web or sheet. The web with the face up then enters the arcuate space between upper and lower trays containing liquid toner with the face up. The underside of the upper tray is metallized to provide image intensification by the reinforced lines of force between such metal surface and the electrostatic latent image areas of the copy as web passes through the toner solution in close proximity to the upper tray. The latter is provided with a vertical wall adjacent the rear thereof, and with front wall having a row of rectangular openings through which the toner liquid cascades into the lower tray by first impinging upon the faceup copy of the web, causing the latter to be forced down and away from the underside of the upper tray, inhibiting undesirable copy surface imperfections. The copy web is drawn upwardly from the arcuate space by squeegee rollers located above an elongated pan at the back of a toner reservoir for also receiving liquid overflow from the lower tray, through a horizontal row of recesses in the upper edge of rear wall of such tray. The liquid is returned to the reservoir from such pan, and then pumped back into the upper tray.



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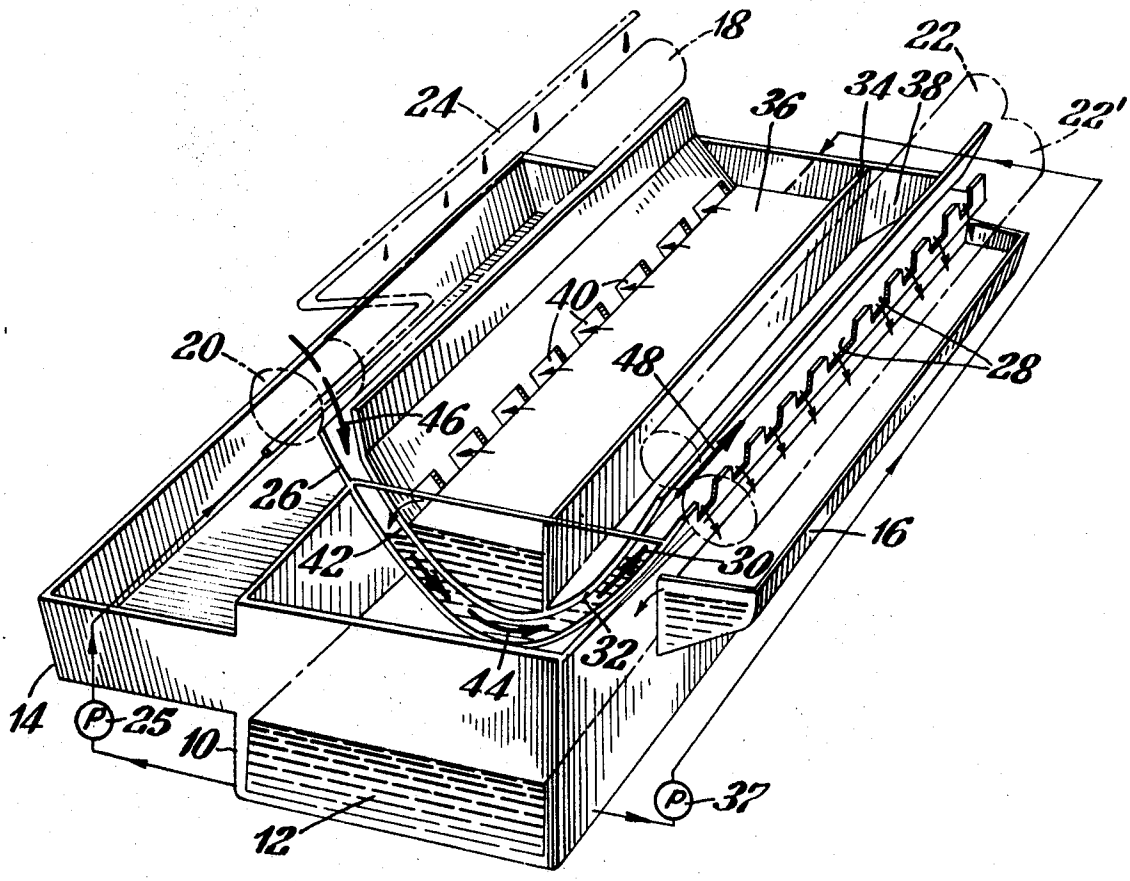

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WET ELECTROSTATIC TONING APPARATUS

This invention relates to wet electrostatic copiers, and more particularly to liquid toning systems therefor.

In prior wet electrostatic toning proposals, the resulting copies were subject to undesirable marks, or other copy surface imperfections due to unfilled image areas in passing through the developing device.

The main object of this invention is to provide a liquid toning system for wet electrostatic copiers which solves such problem, producing copies bearing no undesirable marks, or other copy surface imperfections.

Another object is to provide a novel and improved technique for performing the toning function in wet electrostatic office copiers.

A further object is to provide a wet electrostatic toning system that is efficient and effective in operation, simple in its parts, and easy to maintain in proper condition for satisfactory copying.

In the drawing, the single FIGURE is a fragmentary run mainly in perspective of wet electrostatic toning apparatus illustrative of the invention.

As shown in the drawing, an elongated boxlike reservoir **10** is provided for liquid toning solution **12**. The reservoir **10** comprises a relatively large front pan **14** and a somewhat smaller rear pan **16** located under a pair of front copy web drive and metering rollers **18** and **20**, and a pair of rear squeegee rollers **22**, **22'**, respectively. A clear solution of isopar G stored in tray **14** is kept from mixing with solution **12**. Pumping takes place from tray **14** by pump **25**.

Mounted in the upper part of the reservoir **10** is a lower downwardly arcuate trough or tray **26** having a horizontal row of slots **28** in the rear edge thereof for the overflow of liquid from the tray into the rear from **16** thereby maintaining the surface **30** of such liquid at a desired level. Mounted on the reservoir **10** above the lower tray **26**, is a somewhat similarly shaped arcuate upper tray **32**. A wall **34** separates the upper tray **32** into a larger front part **36** for containing a supply of the liquid toning solution, and a rear part **38** that is empty. Liquid **10** is continuously supplied to the part **36** from reservoir **10** by a pump **37** and overflows through a horizontal row of rectangular openings **40** provided for such purpose in the front wall of the upper tray **32**.

The underside **42** of the upper try **32** is either metallized plastic, or a metal member to provide image intensification, and is spaced from the lower tray **26** to provide a downwardly and upwardly curved space or path **44** for the copy paper web (not shown) which enters at the front and exits at the rear, as indicated by the heavy flow arrows **46** and **48**. The space **44** also contains the liquid toner solution which flows in the same direction during the operation of the system.

In operation, a prewetting solution is delivered from tray **14** to the spray tube **24** where it is sprayed directly upon the wire-wound roller **18** therebelow. Copy material (not shown) enters, face up, between the drive roller **20** and metering roller **18**, is thereby prewetted, squeegeed, and then enters directly into toner path **44**. The wire-wound roller **18** provides an important function for the successful operation of the prewetting system. The wire size is so selected as to provide a predetermined quantity of solution while at the same time uniformly distributing a liquid layer of the preconditioning solution over the entire sheet of the copy material. This liquid layer prevents background buildup that would be prevalent without such copy paper preconditioning. The mechanism of this type of system appears to be related to an insulating layer being placed over the entire copy surface to reduce the residual charge level remaining in the background areas after exposure. In conventional systems, the relatively high background level (fog) on the copy is a result of the migration of the very small size toner particle adhering to the background areas carrying the residual charge. The described system also allows the usage of highly concentrated (greater percentage of pigment to carrier) toner solution which results in excellent image fill, especially in the larger solid areas as compared to most

systems currently in use. Without this capability, copy contract would also be poor because of the high-speed short-path system used in the machine. A further advantage is the wide concentration range over which the copy quality remains very acceptable. The system is therefore insensitive to overconcentration as compared to most toning systems.

The underside surface **42** of the upper tray **32**, as noted above, is either a metallized plastic or a metal member which provides image intensification. When the copy paper, bearing the electrostatic latent image, is passed through the liquid toner solution in close proximity to the upper tray **32**; reinforced lines of force are generated between the image areas of the copy and the metal surface **42**. The intensified fields provide means for producing well-filled image areas on the copy.

Toner solution **12** is pumped from reservoir **10** to part **36** upper tray **32**. Solution then cascades through openings **40** and impinges upon faceup copy, causing same to be forced down and away from underside surface **42** of the upper tray **32**. This produces a clean copy bearing no marks or other copy surface imperfections. Copy proceeds through and at bottom of the curved path **44** until exiting between squeegee rollers **22** and **22'**.

Squeegeed toner solution is caught by rear pan **16**, and returned to the toner reservoir **10**. Overflow slots **28** allow excess toner solution also to be returned via rear pan **16** to reservoir **10** after flowing through the curved path **44** in the same direction as that of the web of copy paper.

What is claimed is:

1. Wet electrostatic toning apparatus for developing a moving web or sheet of sensitized latent image bearing copy material in a liquid developing solution, comprising:

spaced downwardly curved upper and lower trays providing an arcuate path for the web as the latter moves from the front inlet to the rear outlet thereof;

means providing a metal surface on the underside of said upper tray for intensifying the development of the electrostatic latent image carried by such web;

means for continuously delivering liquid toner solution adjacent the inlet of such web path, including a horizontal row of openings in the front wall of said upper tray;

means for continuously filling the front part of said upper tray with such liquid, whereby the liquid cascades through such openings above the web as the latter moves face up directly under such metal surface, and

means comprising a horizontal row of slots in the rear wall of the lower tray for discharging excess liquid therefrom adjacent the outlet of the web path between the trays.

2. The invention as defined by claim **1**, wherein a reservoir in the form of an elongated rectangular box is provided for a supply of liquid toner solution, which is located directly under said lower tray, and comprises a rear pair for receiving the overflow of excess liquid from the slots in the edge of the rear wall of such lower tray.

3. The invention as defined by claim **2**, wherein

said reservoir also includes a front pan; and

means for prewetting the web with such solution before such web enters such web path, located above said front pan, so that excess prewetting liquid falls therein.

4. The invention as defined by claim **3**, wherein

said web prewetting means comprises a pair of web drive rollers, one of which is wire wound;

a liquid spray tube located above said wire-wound roller; and

means for pumping liquid solution from said reservoir to said spray tube.

5. The invention as defined by claim **4**, wherein

a pair of web drive rolls are located above the outlet of such web path, which squeegee such web above said rear tray, whereby excess liquid falls into such rear tray.

6. The invention as defined by claim **5**, wherein

the direction of flow of liquid toner solution in the web path is the same as that of such web, and

the web passes through such solution in close proximity to the metal surface on the underside of the upper tray, generating reinforced lines of force between the image areas of the copy and such metal surface, thereby producing well-filled images on such copy.

7. The invention as defined by claim 1, wherein

the liquid toner solution cascading through the front wall openings of the lower tray, impinges upon the faceup copy, causing such copy to be forced down and away from the underside metal surface of such tray, resulting in a clean copy bearing no undesirable marks or other copy surface imperfections.

8. An electrostatic toning system for copy machines, comprising:

a wire-wound metering roller;

a spray tube for spraying prewetting solution directly on said roller;

a squeegee roller cooperating with said wire-wound roller;

an upper tray having an electrically charged metallized arcuately curved underside surface facing the copy paper which passes thereunder; and

a toner solution trough having an arcuately curved upper surface in substantially concentric spaced relationship to the underside surface of said tray;

said tray having a horizontal row of liquid overflow openings for delivering liquid toner solution from said tray to the leading side of the arcuate space between said tray and trough, for filling such space with the solution as the copy paper passes therethrough in the same direction as that of the solution;

said trough having a horizontal row of slots for the overflow of the liquid toner solution, located above the level of the liquid in said tray.

9. The invention as defined by claim 8, wherein

a common liquid toner solution reservoir is located under said trough; and

means for returning such overflow to a reservoir including a pan located under squeegee rolls for acting on the paper as it leaves such space.