

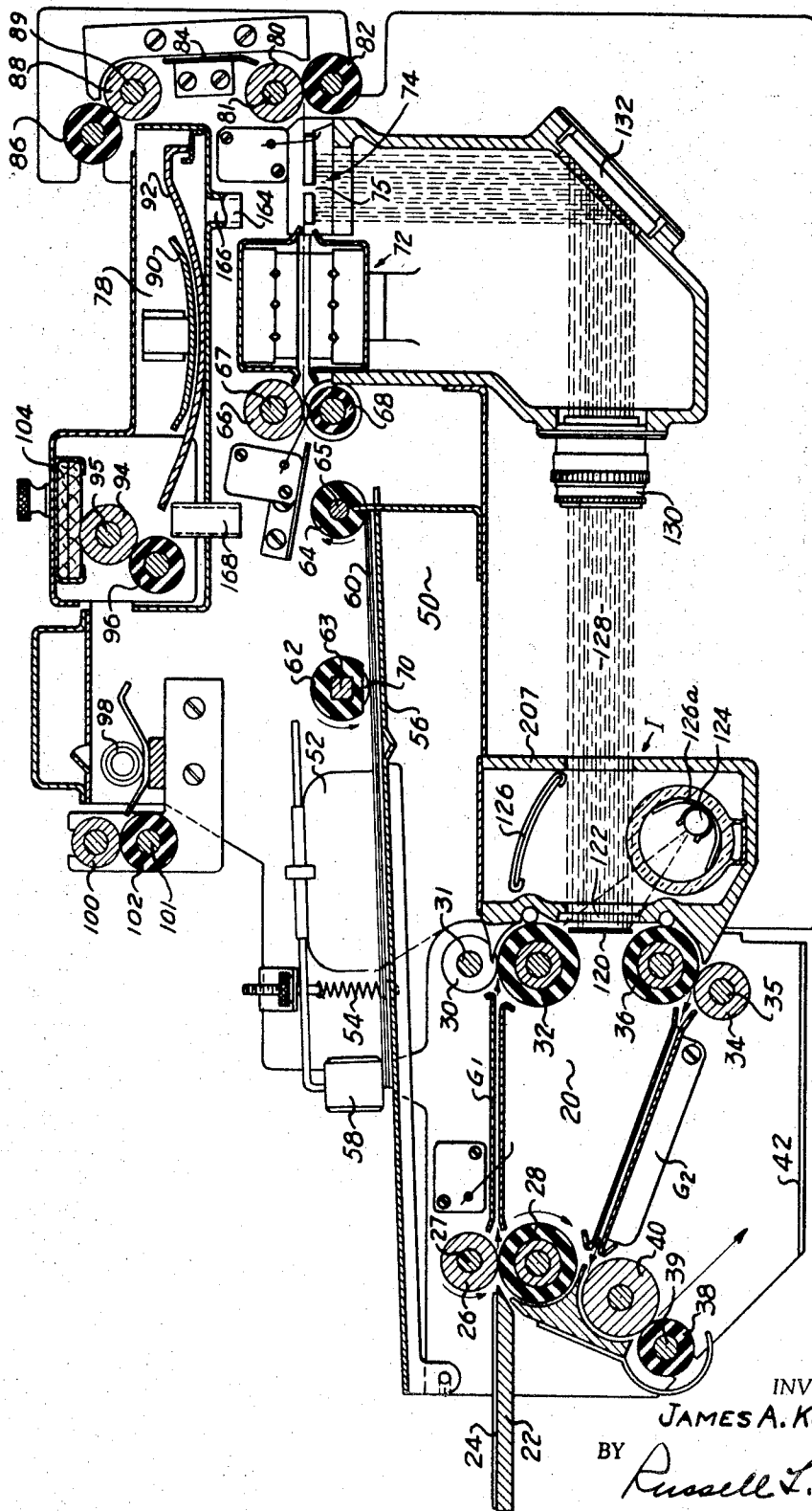
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LIQUID DEVELOPMENT MEANS FOR ELECTROSTATIC COPIERS

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**LIQUID DEVELOPMENT MEANS FOR
ELECTROSTATIC COPIERS**

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Original application May 20, 1963, Ser. No. 281,706, now Patent No. 3,441,345, dated Apr. 29, 1969, Divided and this application Aug. 5, 1968, Ser. No. 750,362

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4 Claims

ABSTRACT OF THE DISCLOSURE

A photocopier of the electrostatic type includes a developing station for developing latent electrostatic images on photoconductive sheets. The developing station provides a tank in which is held a bath of liquid developer comprising a volatile insulating carrier liquid in which are dispersed finely divided pigment particles which are attracted to the image areas on the sheet. The sheet is fed and guided in such a way as to move face upward, dipping down into the bath and then coming up out of the bath, whereupon it passes into the nip of a pair of squeegee rollers which remove excess carrier liquid. The squeegee roller which contacts the unimaged surface of the sheet has a surface of frictional material, such as rubber, and the other squeegee roller is of hard material, such as chromed steel. The latter runs in pressure contact with a wiper pad to prevent return of any accumulated pigment to the face of the sheet. A heater adjacent the squeegee rollers removes most of the balance of the carrier liquid so that the sheet is presented to the operator in dry condition.

This application is a division of my copending application S.N. 281,706, filed May 20, 1963 now Patent No. 3,441,345.

This invention relates to development of electrostatic images, such as images formed on photoconductive sheets in electrostatic photocopiers, and more particularly pertains to liquid development of such images.

One form of liquid development sometimes used is the dipping of the imaged sheet into a bath of liquid developer comprising an insulating carrier liquid with pigment particles dispersed therein, and this is the form to which the present invention is addressed.

It is an object of the present invention to provide means for a liquid development treatment in accordance with the aforementioned type in which there is means for removing excess carrier liquid from the sheet and returning such excess to the bath in order to hasten the drying of the sheet.

It is another object of the invention to provide such means for removing excess liquid, without disturbing or impairing the developed image on the sheet surface.

It is still another object of the invention to provide a combined sheet treating means which will present the sheet to the operator in an essentially dry condition.

The foregoing objects are attained, according to the present invention, by leading the sheet down into and up out of the developer bath and into the nip of a pair of squeegee or squeeze rollers. One of these rollers has a frictional driving surface for moving the sheet, and the other has a hard smooth surface for contact with the imaged surface of the sheet so as to provide minimum disturbance of the image pigment. The latter roller runs in pressure contact with a wiper pad which keeps the surface clean and pigment free to prevent any pigment set-off back onto other portions of the face of the sheet. As the sheet emerges from the squeegee rollers, it passes adjacent

a heater which drives off most of the balance of the volatile vehicle and is delivered to the operator substantially dry.

The foregoing and other objects, features and advantages of the invention will be apparent from the following description of a preferred embodiment of the invention as illustrated in the accompanying drawing, in which the single figure is a longitudinal section of copying machine embodying a liquid development station in accordance with the invention.

With reference to the drawing, numeral 20 generally designates a feeding device having associated therewith a feed tray 22 adapted to receive an original document 24 which is to be copied. When a copy of the document 24 is desired, the travel of the document through the feeding device 20 is as indicated by the arrows, i.e., between the rollers 26 and 28, through a guideway G-1, between rollers 30 and 32, between rollers 34 and 36, through a guideway G-2, and between rollers 38 and 40, and thence into an outlet tray 42. The rollers 26, 30, 34 and 38 are mounted on shafts 27, 31, 35 and 39 respectively, and are driven rollers, whereas the rollers 28, 32, 36 and 40 are idle rollers.

The device or hopper for storing and feeding of photoconductive copy sheets which are to receive an image from an original document is designated generally as 50 and comprises side guides 52, one at each side of the feeder, although for brevity of description only one such side guide is shown. A spring 54 is connected at one end to the frame of the copying machine and at its other end to a feed table 56 to thus retain the feed table in its uppermost position. A weighted member 58 rests on the trailing edge of the topmost copy sheet 60 and assists not only in holding the copy sheets in alignment but also in acting as a retarding means for the pile of copy sheets as the topmost sheet 60 is fed from the pile.

Copy sheets 60 are fed from the pile by the starter roller or segment 62, mounted on shaft 63. The segment 62 preferably has a surface of rubber or the like, and is driven by a one-revolution clutch. By this means the copy sheet is caused to buckle against the roller 64, mounted on shaft 65. The roller 64 rotates in a direction opposite to that of segment 62. The copy sheet is thus forced to ride on top of the roller 64 and into the bight of driven roller 66, mounted on shaft 67, and idler roller 68 for processing at subsequent operating station. A series of idler rollers 70 are mounted on the same shaft as segment 62 and serve to hold down and guide copy sheets 60.

As mentioned hereinabove, the copy sheet 60 is charged in an electrode assembly, which may take the form of corona generating device or the like, comprising an upper unit and a lower unit generally indicated at 72. Such a corona discharge device is well known in the art and is of the type which utilizes three approximately .002 inch diameter hard, stainless steel wires.

Following the charging operation, the moving copy sheet is exposed to a light and shadow image of the original which is at that time traversing the scanning or illumination station defined by a backing plate 120 and an object glass 122, between which the document is fed. Illumination is provided by a lamp 124, excellent results having been obtained through the use of a 1200 watt segmented quartz iodine lamp for this purpose. Reflectors 126 and 126a are employed to utilize the lamp 124 to its fullest extent by redirecting the stray light onto object glass 122. The image on the document is conducted via light path 128 and projected via lens 130, mirror 132 and slit 75 at exposure station 74 upon the surface of the copy sheet, the rollers being driven at appropriate speeds, by conventional driving means (not shown), such that

the document and copy sheet move in synchronism with each other.

The copy sheet is subjected to developing action in the developer supply tray 78 by a liquid developer solution, of the nature disclosed in Metcalfe et al. Pat. No. 2,907,674, granted Oct. 6, 1959. The copy sheet 60 is then dried and ejected from the machine. In the course of travelling from the exposure station to completion, the copy sheet 60 is caused to pass between rollers 80 and 82, through guideway 84, between rollers 86 and 88, and through the developer solution in developer tray 78 by passing between plates 90 and 92. Plate 90 is a biasing plate which is grounded to the machine frame and serves to assist in the deposition onto the photoconductive surface of copy sheet 60 of the pigment particles carried by the developer. Rollers 86 and 88 and plates 90 and 92 constitute a guide and transport means for moving the sheet down into and up out of the bath of liquid developer. The level of liquid developer in tray 78 is maintained by pumping the material into the tray via passage 166 from a pump (not shown), and allowing it to overflow through duct 168 to a sump (not shown). Copy sheet 60 then continues between a pair of squeezing or squeegee rollers 94 and 96, and then rides over the top of heating element 98 and is ejected by rollers 100 and 102. Rollers 80, 88, 94 and 102 are mounted on shafts 81, 89, 95 and 101 respectively, and are driven rollers, whereas rollers 82, 86, 96 and 100 are idler rollers. It will be noted that the squeezing or squeegee roller 94, which is in contact with the image-bearing surface of the copy sheet, is preferably formed of chromed steel and is in contact with a pad 104, such as felt or the like. The pad removes excess moisture from the roller and thus assists in drying of the copy sheet 60 prior to contact of the copy sheet with heating element 98. It also cleans roller 94 of any excess pigment particles which it may pick up to prevent these from being returned to the copy sheet surface at an undesired location. Roller 96 has a frictional surface of rubber or rubber-like material as does one roller of each sheet forwarding pair, for reliably forwarding the copy sheet 60.

The heating element 98 is preferably of about 250 watts capacity and is effective to dry off excess liquid from the copy sheet 60 and to set, or harden, the developed image so that the copy is delivered to the operator by rollers 100, 102 in substantially dry condition.

While a preferred embodiment of the invention has been described and illustrated, it is to be understood that this is capable of variation and modification. Accordingly, the aim in the appended claims is to cover all such variations and modifications as may fall within the true spirit of the invention.

What is claimed is:

1. In combination with means for forming an electrostatic latent image on one surface of a carrier member, a developer station for converting the latent electrostatic image to a visible image by use of a liquid developer containing pigment particles, which includes: means for ap-

plying the liquid developer to the image containing surfaces of said carrier; a pair of squeezing rollers mounted so that the carrier passes therebetween as it leaves the developer station for removing excess liquid from the carrier; one of said squeezing rollers having a hard, smooth, metallic surface and the other of said squeezing rollers having a surface of rubber-like friction material; said one roller being adapted to contact said image containing surface; means for guiding said wetted carrier to pass between said rollers; and a wiper pad for contacting said one roller effective to erase substantially all pigmented images from said one roller to prevent overprinting on said carrier.

2. A device as set forth in claim 1 which further includes a heater member extending transversely of the sheet path as it leaves the squeezing rollers for contact with an emerging sheet to present the same to the operator in substantially dry condition.

3. In combination with means for forming an electrostatic latent image on one surface of a carrier member, a developer station for converting the latent electrostatic image to a visible image by use of a liquid developer containing pigment particles which includes: a tank containing a bath of liquid developer; guide and transport means for moving the sheet, image face upward, first down into the developer bath and then up out of the same; a pair of squeezing rollers which are positioned to receive the sheet therebetween as it leaves the developer bath; the one of said rollers which contacts the imaged surface of the sheet having a hard, smooth metallic surface and the other of said squeezing rollers having a surface of rubber-like friction material; and a wiper pad for contacting said one roller to remove any pigment deposited thereon by the image on the sheet to prevent image set-off onto other portions of the sheet or subsequent sheets.

4. A device as set forth in claim 3 which further includes a heater member extending transversely of the sheet path as it leaves the squeezing rollers for contact with an emerging sheet to present the same to the operator in substantially dry condition.

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