

[54] **PHOTOCOPY LIQUID DEVELOPING APPARATUS**

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[56]

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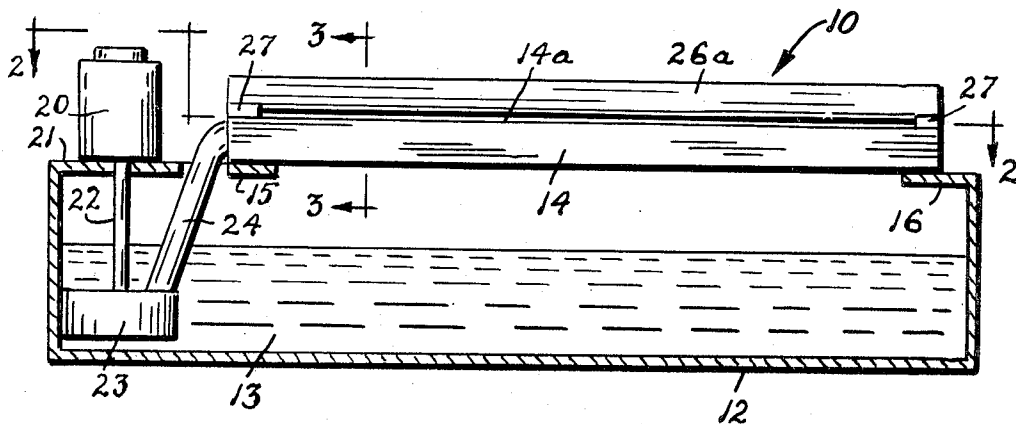
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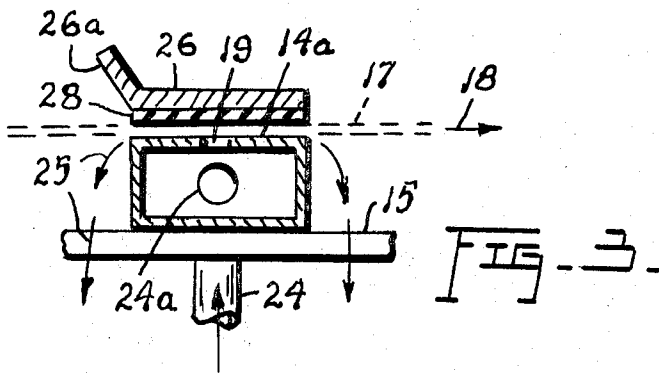
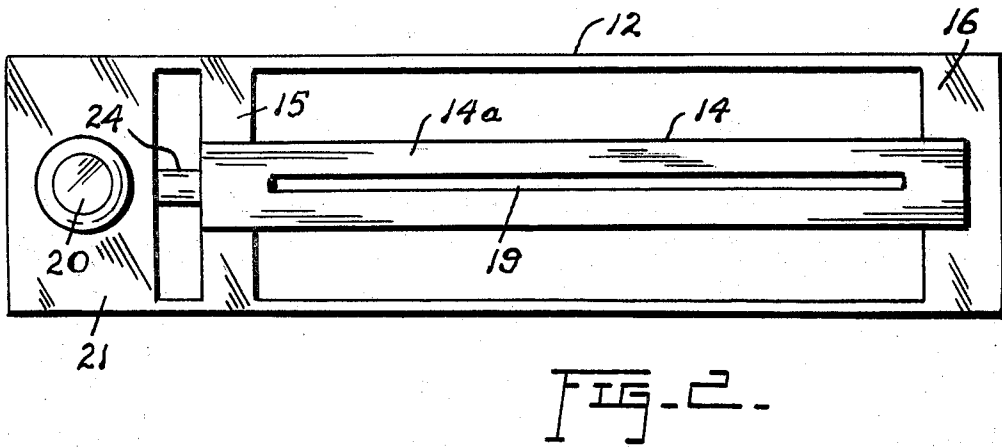
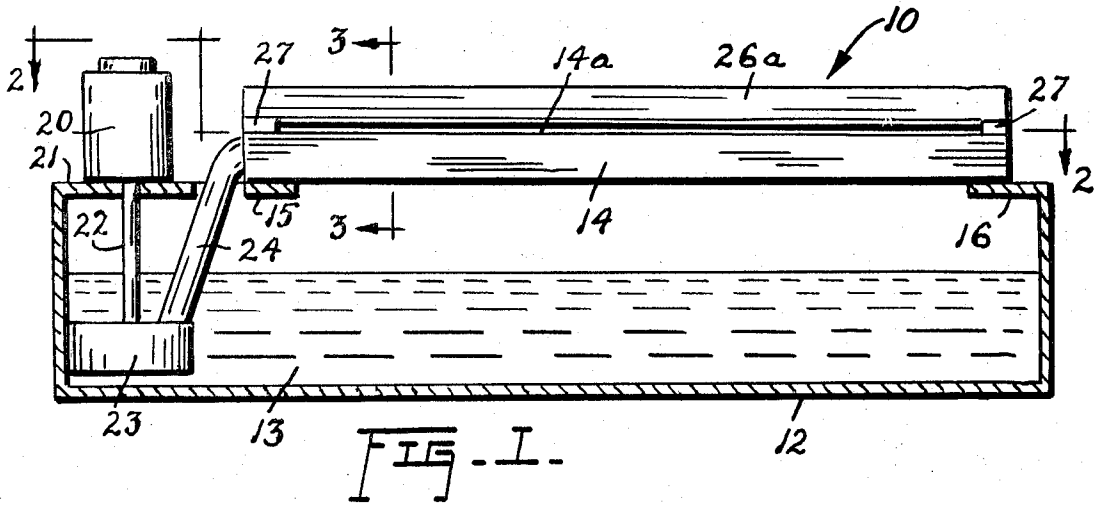
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[57] **ABSTRACT**

A hollow bar is mounted above a horizontally elongated reservoir containing a liquid toner. The toner is circulated from the reservoir into the bar and outwardly through a slot in the top of the bar, to develop an image on the coated underside of photocopy paper which passes above the bar. Excess liquid is returned to the reservoir. The bar is made of metallic material, so that its contact with the electrically conductive liquid and its proximity to the electrostatically charged paper strengthens the electrostatic lines of force during development, thus producing a sharp image.

4 Claims, 3 Drawing Figures





PHOTOCOPY LIQUID DEVELOPING APPARATUS

This invention relates to new and useful improvements in photocopier machines of the liquid developing type in which photocopier paper is provided at one side thereof with a photo-sensitive, electrically charged coating. After exposure, the paper is usually passed through a liquid bath such as an electrically conductive toner, where the image is developed.

In conventional machines of this general type it is customary to provide a tray or the like, containing the liquid toner, the paper being guided by rollers, et cetera through the bath. While this arrangement is generally satisfactory, it does have some disadvantages in that guiding of the paper through the bath is somewhat cumbersome from the structural standpoint and involves the use of numerous parts or components in order to bring the paper into, through and out of the bath.

The principal object of the invention is to provide a simplified developing apparatus in which the photocopier paper, instead of passing through a toner bath, passes above a hollow bar containing the toner under pump pressure, the bar having a slot at the top thereof through which the toner is discharged against the coated underside of the paper in order to develop the image thereon. As such, the invention avoids a complicated arrangement of parts such as is necessary in prior art devices where the paper passes through a liquid bath by actually being immersed therein.

Also, I have found that the sharpness of the developed image can be substantially enhanced if, during contact of the electrically conductive toner with the electrically charged coating on the paper, there also is a contact of the toner with a metallic substance which in itself is not electrically charged. This shortens and thereby strengthens the lines of electrostatic force during development, with the result that a much sharper image is produced than is possible by using conventional developing trays.

Therefore, another important object of the invention is to provide a developing apparatus utilizing the aforementioned developing bar which is made of metallic material and which thus provides a metallic contact with the electrically conductive toner and therefore with the electrically charged coating on the paper, in order to produce a sharper image as noted above.

The apparatus of the invention is simple in construction, highly efficient in operation, and lends itself to embodiment in photocopier machines of various new and conventional liquid developing types.

With the foregoing more important objects and features in view and such other objects and features which may become apparent as this specification proceeds, the invention will be understood from the following description taken in conjunction with the accompanying drawings, in which like characters of reference designate like parts, and in which:

FIG. 1 is a view, partly in side elevation and partly in vertical section, showing the developing apparatus of the invention;

FIG. 2 is a top plan view, taken substantially in the plane of the line 2—2 in FIG. 1; and

FIG. 3 is an enlarged fragmentary cross-sectional detail, taken substantially in the plane of the line 3—3 in FIG. 1.

Referring now to the accompanying drawings in detail, the developing apparatus of the invention is designed

generally by the reference numeral 10 and is intended for use in a photocopier machine of the liquid developing type, which may be of any conventional construction. Such machines usually use a photocopier paper which is provided at one side thereof with a photo-sensitive, electrically charged coating, and after exposure, the paper is passed through a liquid bath such as an electrically conductive toner, where the image is developed. The liquid bath is usually in a tray, and a complicated arrangement of parts is necessary for guiding the paper into, through and out of the bath.

The invention employs a much simpler arrangement comprising a horizontally elongated tank or reservoir 12 which contains the developing toner, indicated at 13. A horizontally elongated hollow bar 14 is mounted on top of the reservoir, the ends of the bar being suitably supported by cross members 15, 16 at the top of the reservoir. The hollow bar 14 has an upper surface 14a, and a photocopier paper 17 is arranged to pass over or above the bar, for example in the direction of the arrow 18 as shown in FIG. 3. The upper surface 14a of the bar is provided with longitudinally extending opening means, such as a slot 19. However, in place of a single slot, a number of longitudinally aligned slots or apertures may constitute such opening means.

An electric motor 20, mounted on a top member 21 of the reservoir 12, has a drive shaft 22 connected to a pump 23 which is immersed in the liquid toner 13 in the reservoir, the inlet of the pump communicating with the liquid. The pump also has a liquid delivery or outlet line 24 which extends upwardly through the top of the reservoir and communicates through an opening 24a with one end of the hollow bar 14 for circulating the toner from the reservoir into the bar.

As the photocopier paper 17 passes over the bar, the liquid toner is discharged under pump pressure through the slot 19 against the coated underside of the paper, thus developing the image thereon. Excess liquid drops back into the reservoir, as indicated at 25 in FIG. 3. It is to be noted that to prevent smearing of the image, the paper 17 does not actually contact the bar 14, but passes above it in close proximity, on the order of a few thousandths of an inch.

The developing bar 14 is made of metallic material. While in itself the bar is not electrically charged, its contact with the electrically conductive toner and, through the toner, with the electrostatically charged coating of the paper, effectively shortens and thereby strengthens the lines of electrostatic force during development, with the result that a much sharper image is obtained than is otherwise possible.

Although it is not necessary for purposes of the invention, a paper guide 26 may be provided above the developing bar 14. The guide 26 has an upturned front edge portion 26a facing the direction of travel 18 of the paper 17, the guide being conveniently supported on top of the bar 14 by suitable mounting blocks 27 at the ends. A resilient pad 28 may be secured to the underside of the guide 26 and the paper 17 may be biased against this pad so that the underside of the paper is spaced from the upper surface 14a of the bar 14 by a few thousandths of an inch, as already mentioned.

It may be also noted that while for purposes of a compact arrangement which enables the overall size of the photocopier machine to be substantially reduced, the developing bar 14 may be mounted on top of the reser-

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voir 12 as shown in the drawings, if desired the developing bar may be at a remote location from the reservoir and connected thereto by suitable toner feed and drain tubing.

Thus, while in the foregoing there has been described and shown the preferred embodiment of the invention, various modifications and equivalents may be resorted to, within the spirit and scope of the invention as claimed.

What is claimed as new is:

1. A developing apparatus for a liquid developing photocopy machine, said apparatus comprising an elongate hollow bar having a length much longer than its width adapted to have photocopy paper bearing electrically charged areas pass above the same, said bar being provided in its upper surface with longitudinally extending opening means, a reservoir for a liquid developer comprising an electrically conductive toner, and means for circulating liquid from said reservoir into said bar and outwardly through said opening means against a coated underside of the paper, the upper surface of said bar adjacent said opening means being metallic electrically conducting material, said device being free of means for applying an electrical charge to

said surface whereby said surface is free of applied electrical charge during operation of said developing apparatus, said device further including means for guiding said photocopy paper in a path of motion directly above said bar with said bar extending across said path, said guided photocopy paper being spaced from the upper surface of said bar such that said photocopy paper is out of contact with said metallic surface, and means adjacent said elongate bar for returning excess liquid to the reservoir whereby the developing area of said device is confined to the area of said hollow bar and is thus short in the sense of said path of motion.

2. The device as defined in claim 1 wherein said liquid circulating means include a motor-driven pump having an inlet communicating with said reservoir and a liquid delivery line communicating with the hollow interior of said bar.

3. The device as defined in claim 1 together with a paper guide mounted in spaced relation above the upper surface of said bar.

4. The device as defined in claim 1 wherein said reservoir is horizontally elongated and has said bar mounted longitudinally on top thereof.

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