

[54] **METHOD AND APPARATUS FOR  
DEVELOPING FOR DIAZO TYPE COPYING  
MACHINES**

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[30] **Foreign Application Priority Data**

Feb. 22, 1971 Japan..... 46/8506

[52] **U.S. Cl.**..... **95/89 G, 95/89 R, 355/10**

[51] **Int. Cl.**..... **G03d 7/00, G03d 5/00**

[58] **Field of Search**..... **95/89 R, 89 A, 89 G,  
95/94 G; 355/10, 106; 118/48, 49, 49.5**

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**UNITED STATES PATENTS**

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**ABSTRACT**

A method and an apparatus wherein a conveyer device capable of holding liquid is supplied with a developing liquid and heated to vaporize the developing liquid. Photosensitive sheets of the diazo type are exposed to the vaporized developing fluid after being exposed to an optical image of an original, so that latent images formed on them can be rendered visible.

**5 Claims, 5 Drawing Figures**

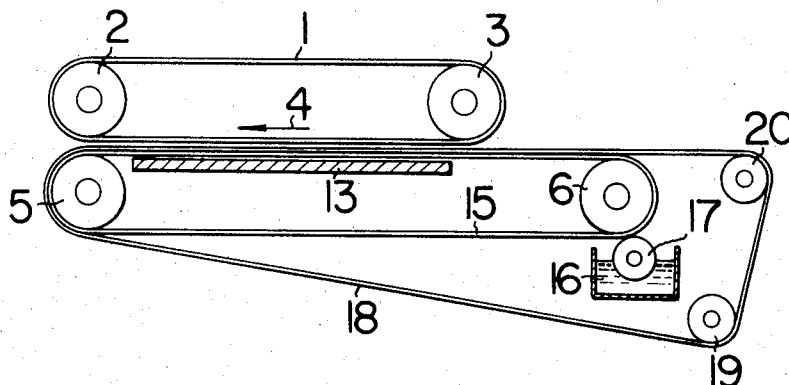


FIG. 1

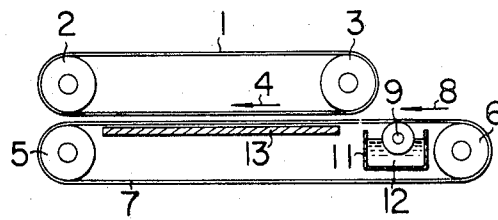


FIG. 2

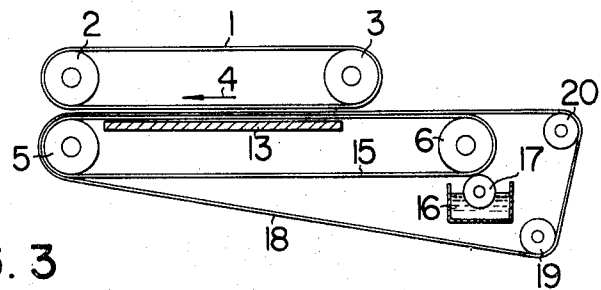


FIG. 3

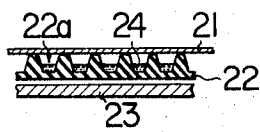


FIG. 4

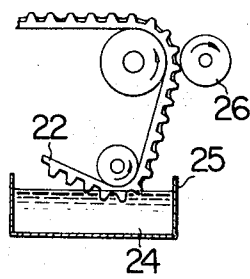
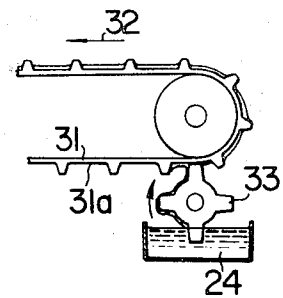


FIG. 5



## METHOD AND APPARATUS FOR DEVELOPING FOR DIAZO TYPE COPYING MACHINES

### BACKGROUND OF THE INVENTION

This invention relates to a method and an apparatus for developing for diazo type copying machines.

A wet developing process and a dry developing process have been known for making duplicates of an original by using photosensitive sheets of the diazo type. In the former, a developing agent containing a coupler therein is applied to the photosensitive layer of each photosensitive sheet consisting of a diazo compound. In the latter, the photosensitive layer of each photosensitive sheet consists of a mixture of a diazo compound and a coupler and the binary photosensitive sheet is treated with ammonia gas for developing a color.

The two processes both have advantages and disadvantages. The wet process offers an advantage in that it can be carried into practice by using a developing device of relatively simple construction. However, its disadvantage lies in the fact that the duplicates made by this process are in wet condition when discharged from the machine.

The dry process has an advantage in that the duplicates made by this process are high in quality, but the developing device used for carrying the process into practice is relatively complex in construction. In addition, the duplicates made by this process have an odor characteristic of ammonia which renders the duplicates rather objectionable.

Proposals have been made to use an amine as an alkaline developing liquid for the diazo type copying method to obviate the aforementioned disadvantages of the conventional developing processes. The use of an amine as a developing liquid offers an advantage in that the quantity of the liquid required for effecting developing is about one tenth the quantity of the liquid required for effecting developing when the conventional wet process is used. In one developing process using an amine developing liquid, the liquid is first attached to the surface of minute powder and then transferred to the photosensitive layer of an exposed photosensitive sheet to provide a duplicate of an original which is well defined, clear and substantially in dry condition when discharged from the machine.

However, some disadvantages are associated with the aforementioned developing process using an amine developing liquid attached to the surface of minute powder. First, suitable minute powder should be selected as a medium and the use of such medium naturally makes it necessary to provide a vessel for containing the same therein and means for agitating the same.

### SUMMARY OF THE INVENTION

This invention has as its object the provision of a method and an apparatus for developing for diazo copying machines wherein an alkaline developing liquid comprising amines is applied to photosensitive sheet conveyer means in such manner that it is kept from being brought into direct contact with photosensitive sheets, and the conveyer means is heated so as to vaporize the developing liquid and expose the photosensitive layer of each exposed photosensitive sheet to the vaporized developing liquid so as to render an invisible image thereon visible.

According to this invention, the photosensitive sheet conveyer means to which the alkaline developing liquid

comprising amines is applied may be either in endless belt form or endless caterpillar band form, and the conveyer means may be made of a semipermeable material or a screen may be interposed between the conveyer means and the photosensitive sheet when the conveyer means is made of an ordinary material so that the photosensitive sheet may be disposed in close proximity to the developing liquid without coming into direct contact therewith. The conveyer means is heated to vaporize the developing liquid and the exposed photosensitive sheet is exposed to the vaporized developing liquid, so that a duplicate of an original of high quality can be produced in dry condition.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of the developing device for diazo copying machines comprising a first embodiment of this invention;

FIG. 2 is a schematic view of the developing device for diazo copying machines comprising a second embodiment of this invention;

FIG. 3 is a fragmentary sectional view of showing the arrangement of the photosensitive sheet, conveyer means, developing liquid and heating means;

FIG. 4 is a fragmentary schematic view showing conveyer means in relation to the developing liquid in the developing liquid tank; and

FIG. 5 is a fragmentary schematic view showing the developing liquid applying gear interposed between the conveyer means and the developing liquid in the developing liquid tank.

### DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 shows a first embodiment of the developing device adapted to carry the developing method according to this invention into practice. In the figure, an endless belt 1 for guiding exposed photosensitive sheets is trained about rollers 2 and 3 supported by shafts connected to an immovable member (not shown) for movement in the direction of an arrow 4. An endless belt 7 for transporting photosensitive sheets trained about rollers 5 and 6 moves in the direction of arrow 8.

The upper run of endless belt 7 and the lower run of endless belt 1 are disposed parallel to and spaced apart from each other a small distance to define a small gap therebetween. A developing liquid applying roller 9 is disposed such that it has a lower half portion of its outer circumferential surface immersed in a developing liquid 12 contained in a developing liquid tank 11 while it is maintained in contact, at the top of its outer circumferential surface, with the underside of the upper run of endless belt 7 so as to apply developing liquid 12 to the underside of the upper run of endless belt 7.

Heating means 13 is mounted below the upper run of endless belt 7 and disposed parallel thereto. Endless belt 7 is heated by heating means 13 as the former moves in the direction of arrow 4.

Endless belt 7 for transporting exposed photosensitive sheets is made of a semipermeable and liquid holding material which permits the vaporized developing agent to pass therethrough but which does not permit the developing liquid itself to pass therethrough. If endless belt 7 is heated to 40° to 80° C by heating means 13 after the developing liquid 12 has been applied to the underside of the upper run of endless belt 7, the developing liquid will be vaporized and the vapor will find

its way into the gap between the upper run of endless belt 7 and the lower run of endless belt 1. Each exposed photosensitive sheet moving in the direction of arrow 4 is exposed to the vapor of developing liquid 12 and developed.

When minute powder is used as a medium for effecting developing, difficulty is encountered in maintaining the powder in uniformly moist condition at all times by supplying an additional quantity of developing liquid to the powder when its humidity is lowered. In the developing device according to this invention, the quantity of developing liquid applied to the underside of the upper run of the endless conveyor belt is substantially constant, so that it is possible to make duplicates of substantially uniform quality. Besides, since the photosensitive sheet to be developed is not brought into direct contact with the developing agent in carrying out developing, though it is disposed close to the developing liquid, the duplicate made is very low in humidity.

The temperature of vaporized developing liquid is at a high level because it is disposed near heating means 13. This promotes the color development of the diazo compound and at the same time expedites drying of the duplicate made.

When no developing operation is performed, heating means 13 is rendered inoperative and heating means 13 and developing liquid applying roller 9 are moved away from the underside of the upper run of endless belt 7. This precludes the waste of the developing liquid by vaporization when no developing operation is performed.

FIG. 2 shows a second embodiment of the developing device according to this invention. Like reference characters designate similar parts in FIG. 1 and FIG. 2.

In the embodiment shown in the figure, an endless belt 15 made of an ordinary heat resisting material is trained about rollers 5 and 6 in place of the endless belt 7 made of a semipermeable material described with reference to FIG. 1. A developing liquid applying roller 17 having a lower half portion of its outer circumferential surface immersed in a developing liquid 16 is maintained in contact, at the top of its outer circumferential surface, with the underside of the lower run of endless belt 15. Interposed between the lower run of endless belt 1 for guiding photosensitive sheets and the upper run of endless 15 is a screen 18 made of a material hard to wet with an amine developing liquid which is trained about rollers 5, 19 and 20 for rotation in the direction of arrow 4.

Each exposed photosensitive sheet is introduced between the lower run of endless belt 1 and the upper surface of screen 18 for movement in the direction of arrow 4. The developing liquid applied to the underside of the upper run of endless belt 15 is heated by heating means 13 and converted into vaporized developing liquid which passes through screen 18, so that the exposed photosensitive sheet moving between screen 18 and endless belt 1 is exposed to the vaporized developing liquid and developed. The results achieved by the developing device of FIG. 2 are similar to those achieved by the developing device of FIG. 1 in that an invisible image formed on each exposed photosensitive sheet can be developed into a well-defined and clear visible image without the photosensitive sheet being brought into direction contact with the developing liquid.

The use of the developing device constructed as shown in FIG. 2 permits the ordinary heat resisting belt 15 to be used in place of the endless conveyor belt 7

made of a heat resisting and semipermeable material used in the developing device shown in FIG. 2. By arranging developing liquid applying roller 17 to be disposed below the underside of the lower run of the aforementioned endless belt 15 made of an ordinary material, it is possible to reduce the diameter of rollers 5 and 6 about which the endless belt is trained and to facilitate the retraction of liquid applying roller 17 so that it can be moved away from the under run of endless belt 15 when no developing operation is performed.

To effect developing of an exposed photosensitive sheet without bringing it into direct contact with a developing liquid, one has only to heat the developing liquid and vaporize it while the photosensitive sheet is disposed in close proximity to the developing liquid being heated. As a means for transporting exposed photosensitive sheets, a caterpillar band may be used in this invention in place of the conveyor belt 7 made of a heat resisting and semipermeable material shown in FIG. 1 and the combination of endless belt 15 made of an ordinary heat resisting material and the screen 18 shown in FIG. 2.

FIG. 3 shows an exposed photosensitive sheet 21, a caterpillar band 22 and heating means 23. Caterpillar band 22 is formed on its surface with a number of projections equidistantly spaced apart from one another and defining spaces 22a therebetween. Amine developing liquid 24 is applied to spaces 22a and retained therein while the projections on caterpillar band 22 are free from the developing liquid. By placing photosensitive sheet 21 on the projections, it is possible to dispose the sheet in close proximity to the developing liquid without bringing it into direct contact with the developing liquid. The developing liquid is heated by heating means 23 and vaporized, so that exposed photosensitive sheet 21 can be developed by the vaporized developing liquid in the same manner as the exposed photosensitive sheets described with reference to the embodiment shown in FIG. 1 and the embodiment shown in FIG. 2.

The projections formed on the surface of caterpillar 22 may be of any shape as desired. They may be straight and disposed perpendicularly to the direction of movement of exposed photosensitive sheets or disposed inclined with respect to the direction of movement of exposed photosensitive sheets. Alternatively, they may be curved and curved upper portions thereof may be disposed parallel to the direction of movement of exposed photosensitive sheets. The conveyor means shown in FIG. 3 is a caterpillar band, but any other suitable means formed on its surface with a number of projections disposed equidistantly from one another may be used in place of the caterpillar band.

Developing liquid 24 may be applied to caterpillar band 22 immersing the caterpillar band in the developing liquid 24 in a developing liquid tank 25 and wiping the upper surfaces of the projections formed on the caterpillar band with a roller 26 made of felt or a like material and maintained in contact with the caterpillar band as shown in FIG. 4. If the developing liquid is applied to the caterpillar band in this way, the developing liquid is kept from coming into direct contact with the exposed photosensitive sheets transported by the caterpillar band.

FIG. 5 shows another means for applying the developing liquid to the caterpillar band. The caterpillar

band 31 shown in the figure is formed on its surface with projections which are spaced equidistantly from one another as the projections formed on the surface of the caterpillar band shown in FIG. 4 but the projections shown in FIG. 5 have a greater pitch than the projections shown in FIG. 4. A developing liquid applying gear 33 is provided which is adapted to rotate in timed relation with caterpillar band 31 moving in the direction of an arrow 32 while a portion of gear 33 is immersed in developing liquid 24. As gear 33 rotates in the direction of an arrow, outer peripheral portions of teeth of gear 33 are brought into contact with spaces 31a between the projections so as to apply the developing agent to the band.

If, in developing exposed photosensitive sheets by applying a developing liquid to a caterpillar band, each sheet to be developed is moved at a rate differing from the rate at which the caterpillar band is moved so that, for example, the distances covered by sheet and caterpillar band during the time from the initiation to the termination of developing of one sheet differ from each other by at least on pitch of the projections on the caterpillar band, it will be possible to expose the entire surface of each photosensitive sheet uniformly to the vaporized developing liquid.

What I claim is:

1. A diazo type copying machine in which diazo type photosensitive sheets are exposed to form thereon a latent image of an original and the latent image is developed to render it visible, wherein the improvement is in a developing device comprising conveyor means including movable endless belt means for conveying exposed diazo type photosensitive sheets over a developing run, said endless belt means including material capable of retaining developing liquid, means for applying developing liquid to a portion of the endless belt means which is away from said developing run and means for heating the endless belt means over at least a portion of said developing run to evaporate thereby developing liquid retained by the endless belt means and to expose the diazo type photosensitive sheets conveyed by the conveyor means to developing liquid vapors, and including screen means disposed between the outer periphery of the endless belt means and sheets conveyed adjacent said endless belt means.

2. A copying machine as in claim 1 wherein said screen means comprise a vapor permeable endless belt rotating with the conveyor means endless belt means over said developing run and made of material which is substantially nonwetttable by said developing liquid.

3. A diazo type copying machine in which diazo type photosensitive sheets are exposed to form thereon a latent image of an original and the latent image is devel-

oped to render it visible, wherein the improvement is in a developing device comprising conveyor means including movable endless belt means for conveying exposed diazo type photosensitive sheets over a developing run, said conveyor means including material capable of retaining developing liquid, means for applying developing liquid to a portion of the endless belt means which is away from said developing run and means for heating the conveyor means over at least a portion of said developing run to evaporate thereby developing liquid retained by the conveyor means and to expose the diazo type photosensitive sheet conveyed by the conveyor means to developing liquid vapors, wherein said endless belt means comprises a caterpillar belt with projections facing the diazo type photosensitive sheets conveyed thereby and wherein the developing liquid applying means comprise means for applying developing liquid only to the wells between said projections but not to the projections themselves.

4. A copying machine as in claim 3 wherein said developing liquid applying means comprise a developing liquid container, developing liquid applying gear partly immersed in said container and adapted to rotate in synchronism with the motion of the endless belt, said gear having gear-teeth contacting in sequence the wells between projections in the endless belt to apply developing liquid thereto.

5. A diazo type copying machine in which diazo type photosensitive sheets are exposed to form thereon a latent image of an original and the latent image is developed to render it visible, wherein the improvement is in a developing device comprising conveyor means including movable endless belt means for conveying exposed diazo type photosensitive sheets over a developing run, said movable endless belt means including material capable of retaining developing liquid, means for applying developing liquid to a portion of the endless belt means which is away from said developing run and means for heating the conveyor means over at least a portion of said developing run to evaporate thereby developing liquid retained by the conveyor means and to expose the diazo type photosensitive sheets conveyed by the conveyor means to developing liquid vapors, wherein said endless belt means comprises a caterpillar belt with projections facing the diazo type photosensitive sheets conveyed thereby and wherein the developing liquid applying means comprise means for applying developing liquid to the entire outer periphery of a portion of the caterpillar belt and means positioned before said developing run or removing developing liquid applied to said projections of the caterpillar belt.

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