APPARATUS FOR DEVELOPING LATENT ELECTROSTATIC IMAGES

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ABSTRACT OF THE DISCLOSURE

This invention relates to an apparatus, for the development
of latent electrostatic images with a dispersion developer,
which comprises an application roller, wiper means in
engagement with the roller and defining a reser-
voir between itself and the periphery of the roller,
means for maintaining a supply of developer liquid in the
reservoir, and means for passing an image carrier past
the application roller on a side of the latter opposite
the wiper means whereby developer is transferred from
the roller to the image carrier.

Dispersion developers, as used in electrophotography,
are fluid developers and comprise a dispersion of solid
toner particles in a fluid medium having a high specific
resistance and a low dielectric constant. When a developer
of this type is brought into contact with a surface elec-
trostatically charged in the form of an image, the toner
particles are attracted to the surface in accordance with
the charge pattern while the dielectric fluid flows off; a
visible picture is thereby produced. Positive or negative
copies of the image to be reproduced can be obtained de-
pending upon the sign of the charge of the latent elec-
trostatic image to be developed and the sign of the charge
on the dispersed particles.

If the latent image charge and the charge of the dis-
persed particles are of opposite sign, a negative image is
obtained, while if the charges are opposite a positive copy
is produced; the latter case is the usual one. The known de-
velopers for developing latent electrostatic images with
dispersion developers are suited to this method. Conversely,
the present invention preferably relates to an apparatus
for inverse development of latent electrostatic images with
dispersion developers.

In older known devices for developing latent electro-
static images with dispersion developers it is the normal
practice to bring the electrophotographic material into
contact with the developer, and thus develop it, by
immersing it or drawing it through a container containing
developing fluid.

It is a known practice to develop the electrophoto-
graphic material by bringing it into contact with a thin
film of developer fluid on the surface of a rotating roller.
Apparatus of this type has been developed from older
known devices used in the fields of diazo-type and silver
photography.

It is a disadvantage of the older known devices with
rotating rollers that a so-called impression is generally
produced by the rotation of the roller, i.e., the toner
particles still orientated in picture form from the previous
developing process are printed again onto the newly in-
troduced electrophotographic material. It therefore previ-
ously has been proposed that one or more scrapers press-
ing against the surface of the application roller should
be used to create a fresh surface and thus prevent im-
printing. However, as the scrapers easily drag longitudinal
stripes which again can mar the developed picture, it was
suggested that the developer fluid should be sprayed onto
the roller from a nozzle so that it would be clear.

It is a common feature of the known devices for dis-
persion development of latent electrostatic images that
they are designed in such a way that the developer comes
in contact with the surface of the layer in as turbulent a
stream as possible. This means that the greatest possible
number of dispersed particles are available for deposi-
tion per unit time so that no impoverishment of particles
can occur due to diffusion. The turbulence of the developer
fluid is achieved by stirring or spraying and also by rela-
tive motion between the material to be developed and the
application roller.

The known devices are all suitable for positive develop-
ment and some give outstanding copies. However, it is
not possible to use them to produce reverse copies of
satisfactory quality. In the case of reversal development,
the non-charged parts of the image must be made visible,
i.e., the dispersed toner particles must be deposited on
these parts. This can, of course, be achieved only with
the help of the electrostatic field generated by the charged
parts of the image. This must extend as far as possible
into the uncharged portions in order to obtain a sufficient
deposit of toner particles. The field distribution during
the developing process obviously also is influenced by the
components of the developing device. Theoretical ob-
servations as to how the developing apparatus should be
made in order to obtain optimum reversal development
are scarcely possible, however, in view of the complexity
of the question, but it is a fact that the known develop-
ing devices do not offer optimum conditions for reversal
development. Thus in developing apparatus with roller
application in which the coating on the surface of the image
carrier is brought into direct contact with the material
of the roller, very blurred and poor contrast copies
are obtained.

The present invention provides apparatus for the dis-
persion development of latent electrostatic images which
is especially suitable for reversal development. This means
the apparatus must be designed in such a way that the
rear side of the image carrier does not come in contact
with the dispersion developer and the front side should not
be in direct contact with the roller material during
developing.

Wet development of latent electrostatic images is based
on similar considerations. In this case, it has already been
suggested that the development should be performed by
means of an application roller while the carrier is sup-
ported at the rear by a strip with two linear rests. However,
a corresponding device suitable for reversal development
of latent electrostatic images does not entirely fulfill the
above requirements in the case of reversal development
with a dispersion developer since the contact zone be-
 tween the surface of the image carrier and the dispersion
developer is too small and also the contact is irregular.

The apparatus of the invention comprises an applica-
tion roller, a wiper member arranged to engage the ap-
plication roller to define between itself and the upper-
most edge of the roller a trough-shaped reservoir, means
for maintaining a supply of developer liquid in the reser-
voir, and means for transporting an image carrier down-
wardly past the lower region of the application roller on
the side opposite the wiper member. The arrangement is
such that, during operation of the apparatus, the image
carrier can be held lightly against the application roller
and the latter can be driven in the same direction and at
the same or approximately the same speed of movement
as the image carrier, developer liquid being carried by
the roller upwardly from the reservoir and over the upper
edge of the roller to pass downwardly onto the image
carrier, while a film of developer liquid is maintained be-
tween the surface of the application roller and the image
carrier.
of the guide element 8 is not critical. All that the element has to do is to ensure that the copy material arriving approximately tangentially to the application roller is guided in a slight curve without being pressed hard against the object. Thus, for example, a curve of the same curvature as the application roller over at least part of it can be used as the guide element. The form of guide element shown in FIGURE 1 is particularly advantageous and therefore is preferred. As shown, a sheet of metal bent in two places is mounted in such a way that the edges 8a and 8b form two guide pads parallel to the roller. The distance of the edges from the roller can be between 2 and 20 mm. It is not necessary for both edges to be at the same distance from the roller. It is even possible to use only a strip of metal, the front edge of which is parallel to the axis of the application roller.

If particularly high quality reproduction is to be achieved, it is recommended that the image be rinsed with the pure dispersion medium after the developer has been applied and before the excess developer is squeezed off. Provided this rinsing is carried out in the dark, developer particles adhering to the background will be washed off while the developer will continue to adhere to the required parts of the image. Fluid hydrocarbons or fluid halogenated hydrocarbons generally are used as the dispersion medium. The rinsing can be carried out simply by immersing the just-developed image in the pure dispersion medium. However, this method is not particularly successful and it is preferable to carry out rinsing with a moving fluid. A device such as that shown in FIGURE 2 is particularly advantageous for this.

In FIGURE 2, a metal roller 13 rotating in the direction of motion of the image carrier is mounted at a small distance above the element 10 over which the carrier slides. In front of the roller in the direction of motion of the image carrier is a nozzle 14 for spraying the pure dispersion medium, the spray being incident both on the image just developed and on the roller 13. The fluid flowing to the sides and over the ends of the sheet is collected in the funnel 15 and fed back to the spraying nozzle 14 by way of a pump and a storage container, not shown.

When the apparatus described above is used for reversal development, very good images with strong contrast are obtained which can be used immediately after leaving the apparatus. The images have only a slight background tint if they are not rinsed after developing. There is none at all if they are rinsed, after developing, with an auxiliary device such as that shown in FIGURE 2. It will be obvious to those skilled in the art that many modifications may be made without departing from the spirit and intent without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. An apparatus for the development of latent electrostatic images with a dispersion developer which comprises an application roller, a wiper means in engagement with the roller and defining a trough-shaped reservoir between itself and the periphery of an upper portion of the roller, means for maintaining a supply of developer liquid in the reservoir, and means for passing an image carrier downwardly past a lower portion of the application roller on a side of the latter opposite the wiper means whereby the image carrier is held lightly against the application roller while the latter rotates in the same direction and at substantially the same speed of movement as the image carrier, the developer liquid being carried by the roller upwardly from the reservoir and over the periphery of the roller to pass downwardly onto the image carrier, and a film of developer liquid being maintained between the surface of the application roller and the image carrier.

2. An apparatus according to claim 1 in which the means for passing an image carrier past the application roller comprises a pair of feed rollers spaced to hold the image carrier against the application roller.

3. An apparatus according to claim 2 in which the
guide means has two spaced guide edges parallel to the axis of the application roller.

4. An apparatus according to claim 1 including a pair of squeeze rolls through which the image carrier is passed after development.

5. An apparatus according to claim 1 in which the means for maintaining a supply of developer liquid in the reservoir includes nozzle means.

6. An apparatus according to claim 1 including means for rinsing the image carrier after development.

7. An apparatus according to claim 6 in which the latter means includes a roller, adapted to contact the surface of the image carrier, and spray nozzle means.

8. An apparatus according to claim 2 in which the guide means has one guide edge parallel to the axis of the application roller.

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