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ELECTROPHOTOGRAPHIC DEVELOPING PROCESS AND APPARATUS

Filed Feb. 4, 1960

FIG. 1

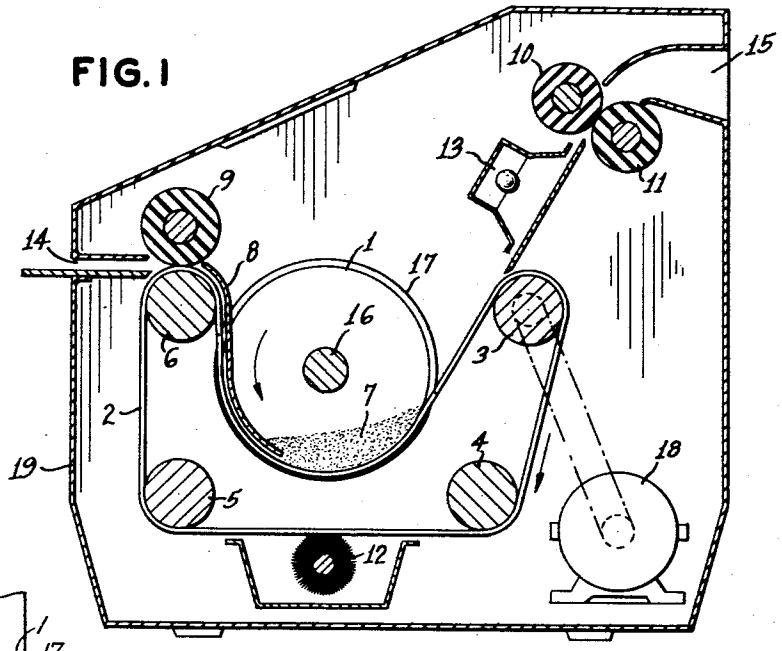


FIG. 3

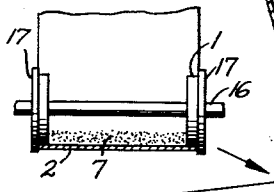
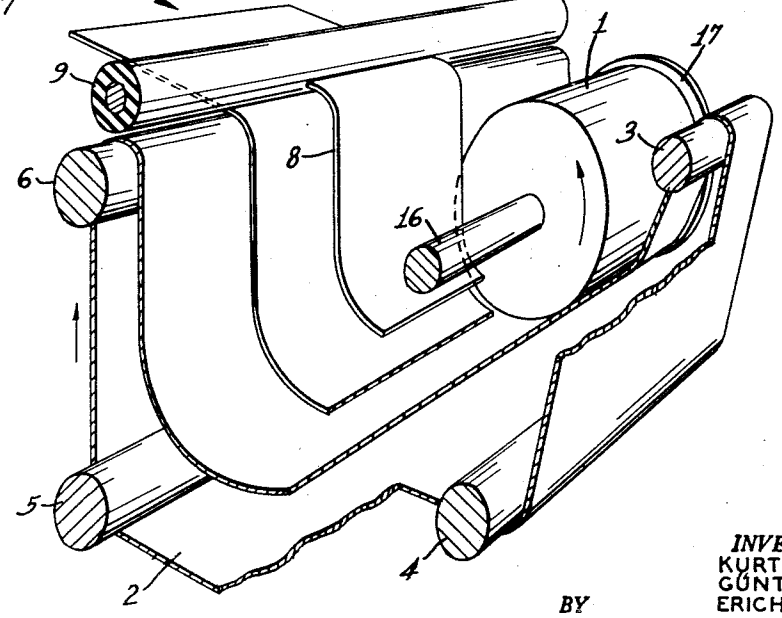


FIG. 2



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ELECTROPHOTOGRAPHIC DEVELOPING PROCESS AND APPARATUS

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It is known to the art that in an electrophotographic process the electrophotographic reproduction material, which consists of a support and a photoconductive layer coated thereon, is charged by means of a corona discharge. After placing a transparent master onto the charged material, it is exposed to light whereby the electric charge is dispersed in the light-struck areas and a latent electrostatic image of the master is produced on the electrophotographic reproduction material. By the application of colored particles, which adhere to the charged areas, this latent image is developed and then fixed, generally by the influence of heat. Thus, non-smearable copies of the master used are electrophotographically produced. As described above, the electrophotographic copying process may be subdivided into the following steps: charging, exposure, development and fixing.

The present invention provides a process and apparatus for effecting the developing step, using cut sheets of electrophotographic reproduction material. For development of the prints, a powder consisting of fine particles, the so-called toner, must be evenly distributed over the electrophotographic reproduction material provided with the electrostatic image and, subsequently, the excess powder must be removed.

It has been suggested to perform this task by manually cascading the developer powder over the image and allowing the excess to trickle off. Alternatively, the developer powder has been mechanically caused to flow over the electrophotographic reproduction material mounted on a drum by conveying, using a dredge-like device, the developer powder from the storage chamber to a distributing device from which the powder trickles down onto the image to be developed. It is difficult to achieve the desired even distribution of the developer powder using this device. Moreover, the developer powder has to be again collected and is whirled about during the process, so that a developer device of this type must be located in a closed cabinet within the electrophotographic reproduction apparatus.

Further, it has been suggested to put the developer powder into rotatable drums provided with an opening corresponding to the size of the electrophotographic reproduction material used. By means of a frame, the reproduction material is clamped over the opening and the developer applied by rotating the drum. This process is complicated because the reproduction material must be clamped onto the drum in a dark-room, so that developing devices of this kind have a very limited range of application.

It has also been suggested to pass the reproduction material, provided with the electrostatic image, through an accumulation of developer powder. However, it proved difficult to guide the electrophotographic reproduction material through the accumulated developer powder and special guide elements had to be provided. Moreover, the developer must be loosened by a shaking action in order to enable the reproduction material to be transported therethrough. Further, both sides of the electrophotographic reproduction material are in contact with the developer powder, which is undesirable in most cases.

In accordance with the present invention, a process

has been found for developing electrostatic images in which cut sheets of electrophotographic material, carrying an electrostatic image, are guided through a channel formed by a conveyor belt and a guide element, with the image sides thereof facing the guide element, into a trough containing the developer powder, the trough being formed by a shaft, provided at both end with discs, and an endless conveyor belt guided by guide rollers.

The electrophotographic reproduction material, in the form of cut sheets carrying the electrostatic image, is gripped by rollers when it leaves the exposure zone and is conveyed by means of an endles belt.

While with reproduction material in web form no difficulties arise and it is possible to form a developing trough between the electrophotographic reproduction material and a shaft provided with discs, without using a conveyor belt, development of cut sheets is more difficult because they are not readily passed under the developer powder. In the process according to the present invention, passage of the cut sheets under the developer powder is achieved by the use of a guide element preferably consisting of metal or plastic material and being of such shape that it extends substantially parallel to the conveyor belt, thus forming a channel which advantageously ends under the surface of the developer powder. The rotation of the disc-roller keeps the developer powder constantly agitated. Since the channel ends under the surface of the developer powder, the cut sheets of electrophotographic reproduction material are held against the conveyor belt until the weight of the developer powder presses them against the conveyor belt. In this way, the electrophotographic reproduction material is easily passed under the developer powder and no substantial quantities of the latter penetrate to the back of the electrophotographic reproduction material; hence no conveying difficulties are encountered.

Advantageously, after leaving the developing trough the electrophotographic material is immediately fixed, and fixing is generally effected by means of a heat source. Subsequently, the electrophotographic reprodction material leaves the device by means of further conveying elements. The conveyor belt is freed from developer powder residues by means of a brush roller, so that even during long periods of operation no developer powder is collected on the conveyor belt.

Referring to the accompanying drawings,

FIGURE 1 is a side view, in section, of one embodiment of the apparatus of the present invention,

FIGURE 2 is a fragmentary view, in perspective, of one portion of the embodiment of FIGURE 1, and

FIGURE 3 is a fragmentary view in elevation illustrating a plurality of rotatable discs **17**.

One embodiment of the apparatus for effecting the process of the present invention consists of a shaft **16** having the rolls **1** and discs **17** mounted at each end thereof; the distance between the rolls **1** and the discs **17** depends upon the material employed.

A belt conveyor **2**, fabricated from a suitable flexible material, for example a metal, rubber or plastic material, is passed around the rolls **1**, and is supported by means of the guide rolls **3**, **4**, **5** and **6**, at least one of these latter rolls, for example roll **3**, being driven by the motor **18**. In order to impart the required tension to the belt conveyor, one of the guide rolls, for example roll **5**, is mounted in such a manner that the position thereof may be shifted in order to take up the slack in the belt.

A quantity of developer powder **7** is confined in a trough formed between the belt conveyor **2**, the rolls **1** and the discs **17**. A channel is formed by the guide plate **8** and the belt conveyor **2**, and the electrophotographic reproduction material is passed through this channel, and under the surface of the mass of the developer powder **7**,

due to the counterclockwise rotation of the rolls **1** and the discs **17**. The movement of the electrophotographic reproduction material, in the form of cut sheets, is primarily effected by the friction between this material and the belt conveyor, but movement is also facilitated by two pairs of rolls, one pair of which, **6** and **9**, are mounted in front of the developing trough and the other pair, **10** and **11**, are mounted at the discharge end of the developing device. One or both sets of these rolls may be driven, if desired.

The developing powder **7** is continuously agitated by the movement of the belt conveyor **2** and it rolls over the charged electrophotographic reproduction material passing therethrough, adhering to the charged areas of the material while failing to adhere to the uncharged areas.

A cleaning means for cleaning the belt conveyor, for example the brush roller **12**, is provided between the guide rolls **4** and **5**. The entire developing device is mounted in a light-impervious casing **19** provided with the inlet slot **14** and the discharge slot **15**.

A fixing device consisting of a heat source **13** and a reflector is mounted before the pair of rolls **10** and **11**, whereby the developed image may be securely anchored to the base material.

In FIGURE 2, the trough formed by the conveyor belt **2**, the rolls **1** and the end disc **17**, is shown in greater detail. Further, the guide element **8** is shown extending into the bottom of the trough formed by the conveyor belt **2** and the rolls **1**.

It will be obvious to those skilled in the art that many modifications may be made within the scope of the present

invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. An apparatus for developing electrostatic images which comprises a belt conveyor for cut sheets, a trough containing developer powder, the trough being formed by the belt conveyor and a plurality of rotatable discs, means for introducing the cut sheets under the surface of the developer powder, and means for advancing the belt conveyor.

2. An apparatus for developing electrostatic images which comprises a belt conveyor for cut sheets, a trough containing developer powder, the trough being formed by the belt conveyor and a plurality of rotatable discs, guide means for introducing the cut sheets under the surface of the developer powder, and means for advancing the belt conveyor.

3. An apparatus according to claim 2 in which the guide means is a plate mounted adjacent the belt conveyor and extending beneath the surface of the developer powder.

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