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Thettu

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[54] **FUSER ROLL CONSTRUCTION**

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[52] **U.S. Cl.** ..... **118/60,** 29/121 R, 29/129.5, 432/60

[51] **Int. Cl.** **G03g 13/08**

[58] **Field of Search** ..... 118/637, 60, 620; 226/191, 226/5; 117/119.6; 271/DIG. 2; 95/89 R, 89 A; 432/60, 62; 219/216

[56] **References Cited**

UNITED STATES PATENTS

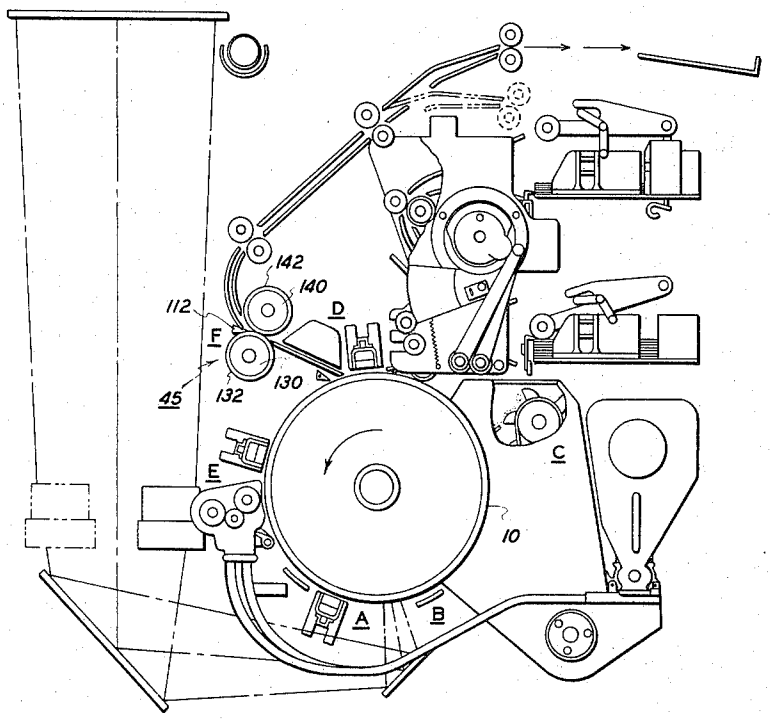
3,256,002	6/1966	Hudson	432/62 X
3,349,222	10/1967	Johnston	219/216 X
3,357,401	12/1967	Wood	118/637
3,588,978	6/1971	Brafford	29/121 R
3,606,309	9/1971	Petrick et al.	271/DIG. 2
3,666,247	5/1972	Banks	432/60

Primary Examiner—Morris Kaplan

[57] **ABSTRACT**

A fusing system for an electrostatic reproduction apparatus in which copy sheets are passed through pressure rollers applying heat and pressure to fuse a powder image on the copy sheets. One of the rotatable members which is heated to an elevated temperature to apply heat and pressure includes a core member which is covered with a layer of elastomeric material formed with undulations. The undulations are several mils in depth and sufficiently wide to accommodate the width of stripper fingers received in each of the undulations to facilitate release of the copy sheet from the fuser roll surface.

5 Claims, 4 Drawing Figures



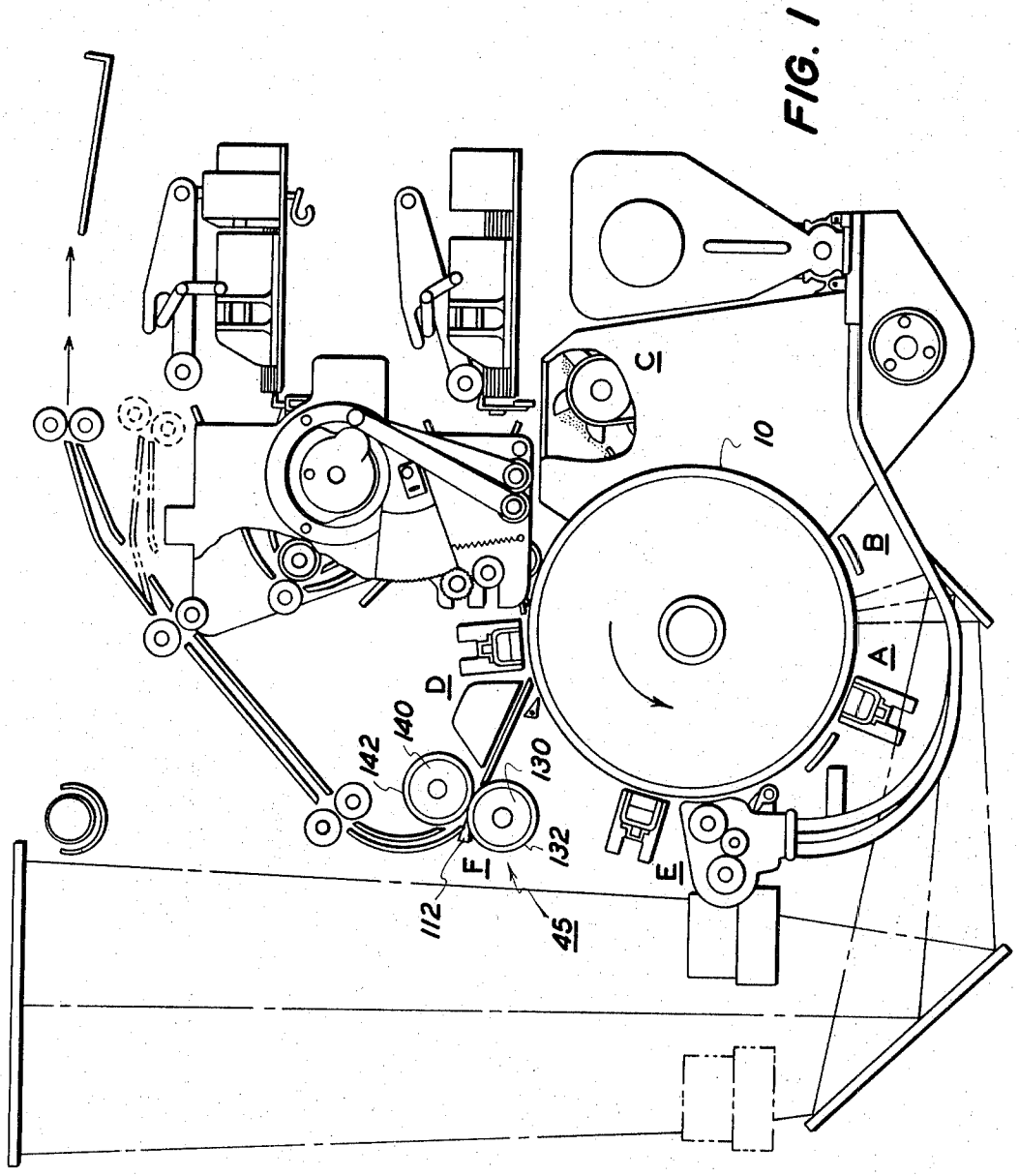


FIG. 1

FIG. 2

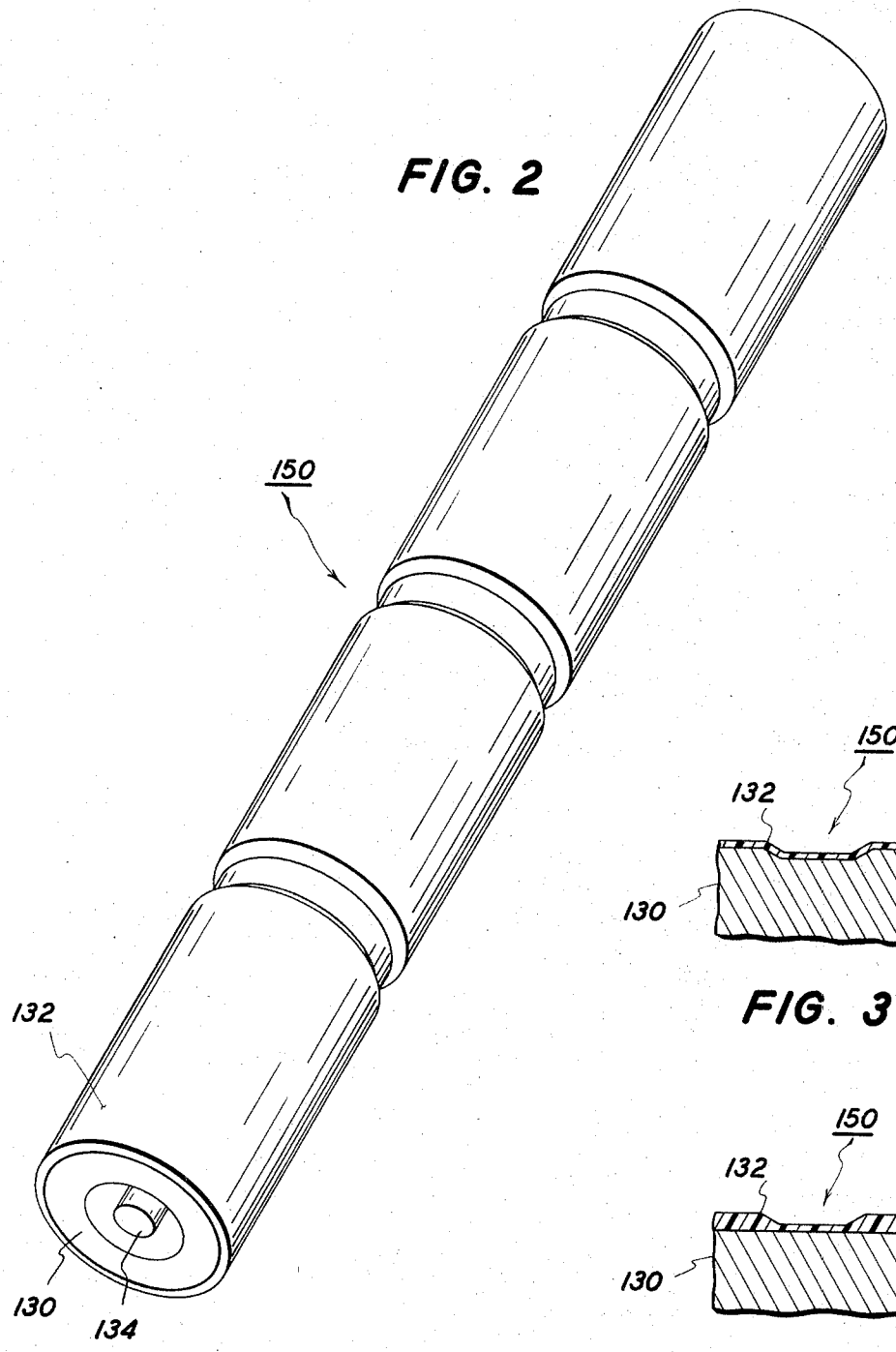


FIG. 3

FIG. 4

FUSER ROLL CONSTRUCTION

This invention relates to an improved fusing apparatus for use with an electrostatic reproduction system and in particular to a heated fuser roll construction to facilitate the release of copy sheets from the heated surface.

It has been recognized that one of the preferred ways for fusing a powder image to a substrate is to bring the powder into direct contact with a hot surface, such as a heated roller. The roller surface may be dry, i.e. no application of a liquid release agent to the surface of that roller as described, for example, in U.S. Pat. Nos. 3,498,596, 3,539,161 and 3,666,247. Alternatively, the fuser roll surface may be melted with a release agent such as silicone oil as described in U.S. Pat. Nos. 3,268,351 and 3,256,002. It has been found that when the copy sheet exits from the nip of the rolls there is some difficulty in the separation of the copy sheet from the fuser roll surface notwithstanding the use of a stripper finger or fingers to facilitate the separation of the sheet from the fuser roll surface. Associated with this problem is that increase pressure and sharpness of the stripper fingers may result in damage to the surface of the fuser roll as well as increased wear on the stripper finger surfaces resulting in frequent replacement thereof.

The present invention is an improved construction for the fuser roll surface formed with an undulating pattern to facilitate the release of the copy sheet therefrom and to reduce significantly the wear on the fuser roll surface and stripper fingers. On the prior art device forming a single deep groove in a fuser roll as described in U.S. Pat. No. 3,357,401 this is merely for stripping a sheet electrostatically tacked on the roll surface. Also the print-out shows forming grooves in a coating roller as described in U.S. Pat. No. 1,331,463, but this is for avoiding damage to a wet sheet rather than facilitating separation of a fused copy sheet from a heated pressure roll fusing apparatus.

It is therefore the principal object of the present invention to improve heated pressure fusing roll devices.

It is a further object of the present invention to facilitate the release of copy sheets from the surface of a heated pressure fuser roll.

It is a further object of the present invention to reduce significantly the wear on stripper fingers stripping copy sheets from the surface of the fuser roll.

It is a further object of the present invention to increase manufacturing tolerances in the construction of a heated roll fusing device in which sheets are stripped from the surface of a fuser roll.

These as well as other objects of the invention and further features thereof will be better understood upon reference to the following detailed description of the invention to be read in connection with the accompanying drawings wherein:

FIG. 1 illustrates schematically a xerographic reproducing apparatus incorporating a heated pressure fuser roll apparatus constructed in accordance with the present invention;

FIG. 2 is an isometric view of the fuser roll construction;

FIG. 3 is an enlarged portion of FIG. 2 illustrating details of the invention; and

FIG. 4 is a view similar to FIG. 3 illustrating an alternative embodiment.

Referring now to the drawings, there is shown in FIG. 1 an embodiment of the subject invention in a suitable environment such as an automatic xerographic reproducing machine. The automatic xerographic reproducing machine includes a xerographic plate or surface **10** formed in the shape of a drum. The plate has a photoconductive layer or light receiving surface on a conductive backing, journaled in a frame to rotate in the direction indicated by the arrow. The rotation will cause the plate surface to sequentially pass a series of xerographic processing stations. For the purpose of the present disclosure the several xerographic processing stations in the path of movement of the plate surface may be described functionally as follows:

A charging station A, at which a uniform electrostatic charge is deposited on the photoconductive plate;

An exposure station B, at which light or a radiation pattern of copies to be reproduced is projected onto the plate surface to dissipate the charge in the exposed areas thereof to thereby form a latent electrostatic image of the copy to be reproduced;

A developing station C, at which xerographic developing material, including toner particles having an electrostatic charge opposite that of the latent electrostatic image, is cascaded over the latent electrostatic image to form a toner powder image in configuration of the copy being reproduced;

A transfer station D at which the toner powder image is electrostatically transferred from the plate surface to a transfer material or a support surface; and

A drum cleaning and discharge station E at which the plate surface is brushed to remove residual toner particles remaining thereon after image transfer and at which the plate is exposed to a relatively bright light source to effect substantially complete discharge of any residual electrostatic charge remaining thereon.

The preceding description of the xerographic process is sufficient for an understanding of the instant invention. Further details may be had by reference to U.S. Pat. No. 3,578,859 filed July 3, 1969 and commonly assigned herewith.

In accordance with the invention at the fusing station F the fusing assembly **101** comprises a fuser roll **103** and pressure roll **105** through which the copy sheet to be fused is advanced through the nip formed by contact of the fuser roll and pressure roll. The copy sheet is stripped from the fuser roll **103** by stripper fingers **112.** The fuser roll comprises a rotating member **130** having an elastic compressible coating **132** made of silicone rubber or any suitable heat resistant compressible material as described, for example, in the aforementioned patents. The rotating member may be internally heated by a heat source **134** as described in U.S. Pat. No. 3,666,247 or externally heated as described in U.S. Pat. Nos. 3,498,596 and 3,539,161. The pressure roll comprises a rotating member **140** which is covered with an elastic layer **142** or a slightly higher durometer and the fuser roll coating **132** as described in the aforementioned patents.

Referring specifically to FIGS. **2–4** the fuser roll is arranged with undulations **150** to enhance the release of the copy sheet from the fuser roll. In this manner, the stripper fingers **112** which are located in close proxim-

ity to the undulations are able to take advantage of the positive release characteristics of the undulations.

The undulations **150** may be formed by machining the core member **130** of the fuser roll to the prescribed outer diameter with an undulated or grooved profile. The core member is then prepared for the elastic coating **132** and the required thickness of elastomer is sprayed onto the surface. The coating uniformly follows the surface of the core member to form the undulated profile. Alternatively, the undulations may be formed by spraying the coating onto a uniform or straight surfaced core member by selectively masking areas during spraying to be undulated. This alternative embodiment is shown in FIG. **4.**

The depth and width of the undulations are designed such that for a given pressure the elastomeric coating deforms and the copy sheet conforms uniformly to the entire surface of the undulations. Typically the depth of the undulations range from about **.003** inches smaller than the major diameter of the roll surface but not more than **.010** inches smaller than the major diameter of the roll surface. In other words the depth of the undulations is from about 0.0015 inches to about 0.005 inches. The width of the undulations range from about 0.050 inches to about 0.500 inches and preferably about 0.250 inches. It has been found that relatively narrow undulations does provide good fusing contact and detracts from overall image quality.

By this structure it has been found that there is an increased mechanical release of the copy sheet from the fuser roll. When the copy sheet is exiting the nip, the undulation offers increased separation to the image as compared with the adjacent areas, thus causing the sheet to release more easily. Normally, the exit temperatures are low and the viscous forces are strong and the wetting adhesion forces are weak at the paper fuser roll surface interface. The slight variation in the nip pressure in the undulated area makes the sheet assume the shape of the undulation and become stiff while exiting a corrugated type paper sheet as opposed to a flat sheet. In other words, while the sheet is exiting from the nip one can visualize a cantilever effect with the increased length and increased deflection.

A further result of the invention is that the increased separation in the undulated area provides more room for the stripper fingers to accommodate the deflection. Deflection is very small and approaches zero with small overhangs. As the sheet is already off the fuser roll, it will not contact the tip of the stripper finger. Instead it will strike the finger about one-eighth inch beyond the tip. This distance, of course, depends upon several factors, such as the contamination on the fuser roll and the exit temperature of the roll. Since the sheet will not see the tip, the tip can be set up a few thousandths of an inch forward of the perpendicular position. This eliminates the tip digging on the fuser roll surface. It will be appreciated that the tip can be more blunt rather than sharp to afford the stripping operation and manufacturing tolerances can be relaxed. It will be further appreciated that wear on the fuser roll is considerably reduced due to the fact that the sheet impaction on the finger is closer to the pivot point so that the reaction force component on the stripper tip is relatively low and can be therefore expected to reduce wear on the finger tip and roll surface. Moreover, since the stripper finger tip is only relatively lightly loaded for a short duration, the life of the finger is also enhanced.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions, and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In an electrostatic reproduction machine in which the fusing device for fusing powder images to copy sheets is accomplished by passing the powder images on the sheets through the nip of compressible rotatable members which apply heat and pressure, an improved fuser roll comprising;

a rigid core member;

a layer of elastomeric material overlying said core member;

said elastomeric layer being formed with at least one undulation in the surface thereof,

said undulation being sufficiently wide and deep and conforming to the powder image surface under operating conditions to impart sheet rigidity to facilitate release of the sheet from the roll surface,

wherein each undulation has a depth ranging from about 0.0015 inches to about 0.005 inches,

wherein each undulation has a width ranging from about 0.050 inches to about 0.500 inches.

2. A roll device according to claim **1** wherein said core member is formed with an undulating pattern.

3. A roll device according to claim **1** wherein said core member has a uniform diameter.

4. A roll device according to claim **1** including at least one stripper finger, said finger being positioned in close proximity to said undulation.

5. A roll device according to claim **1** wherein said undulation is about 0.250 inches wide.

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