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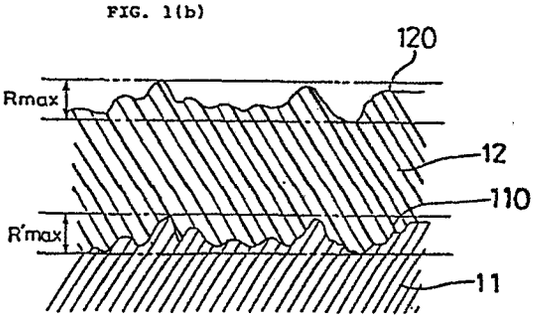
(54) **Photoreceptor drum for electrophotography.**

(57) A photoreceptor drum for electrophotography comprising a cylindrical conductive substrate (11) and an organic or inorganic photosensitive layer (12) covering the outer surface of said substrate, wherein the maximum roughness, Rmax, of the surface of the photoreceptor drum is in the range of 0.3 S to 2.0 S.

FIG. 1(b)



EP 0 200 468 A2

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PHOTORECEPTOR DRUM FOR ELECTROPHOTOGRAPHY

This invention relates to a photoreceptor for electrophotography. More particularly, it relates to a photoreceptor drum which is very resistant to abrasion and with which vibration of the cleaning doctor blade is avoided.

The maximum surface roughness of an inorganic photoreceptor made from Se, etc., and an organic photoreceptor made from an organic photoconductor, which are used in copying machines for electrophotography, is usually set to be less than 0.3 S so as to promote the image quality. In order to obtain this value for the surface roughness of the photoreceptor, the base tube made of an aluminum substrate is treated before the construction of the photoreceptor by grinding to give surface roughness of less than 0.3 S, and a finishing treatment achieves a mirror-like surface. The more precise the step of polishing the surface, the more expensive is the construction.

With a photoreceptor constructed by forming a photosensitive layer on the surface of the base tube that has gone through the above-mentioned polishing step achieving a mirror-like surface abrasion of the photoreceptor increases greatly when the cleaning doctor blade and the surface of the photoreceptor come into contact by 80% or more during the step of cleaning. This is particularly the case when the surface is soft, as is true for organic photoreceptor drums. Moreover, the abrasion coefficient between the cleaning doctor blade and the photoreceptor is so high that vibration of the cleaning blade occurs and the cleaning of the surface of the photoreceptor becomes unsatisfactory. Due to such an abrasion phenomenon, nonuniformity of charging characteristics and inadequate cleaning arise in the photoreceptor drum, and distinct copy images cannot be obtained.

This invention was completed on the basis of the

observation of the inventor that superior resistance to abrasion by the cleaning doctor blade and the prevention of the vibration of this blade can be achieved without deterioration of the image quality when moderate limits for the roughness of the surface of a photoreceptor drum are set, unlike the conventional situation in which there is excessive polishing of the base tube at the time of construction of the photoreceptor drum.

Thus, according to the present invention, there is provided a photoreceptor drum for electrophotography comprising a cylindrical conductive substrate and an organic or inorganic photosensitive layer covering the outer surface of said substrate, wherein the maximum roughness, Rmax, of the surface of the photoreceptor drum is in the range of 0.3 S to 2.0 S.

The cylindrical conductive substrate is, in preferred practice, made of aluminum.

The cylindrical conductive substrate is, in preferred practice, polished using a grinding machine such as a cylindrical grinder.

Thus, the invention described herein makes possible the objects of (1) providing a photoreceptor drum for electrophotography that has superior resistance to abrasion by the cleaning doctor blade; (2) providing a photoreceptor drum for electrophotography that has a lowered coefficient of friction against the cleaning doctor blade, thereby attaining the prevention of vibration of the cleaning doctor blade; (3) providing a photoreceptor drum for electrophotography, the charging characteristics of which are stable for a long period of time and which attains an excellent cleaning effect, resulting in distinct copy images; and (4) providing a photoreceptor drum for electrophotography in which an excess of polishing of the base tube of the drum is unnecessary, which enables the cost to be greatly decreased.

For a better understanding of the invention and to

show how the same can be carried into effect, reference will now be made to the accompanying drawings, wherein:

Figure 1(a) is a perspective view showing a photoreceptor drum of this invention.

Figure 1(b) is a sectional side view showing, to an enlarged scale, a portion of the photoreceptor drum shown in Figure 1(a).

Figure 2 is a graph showing the changes over time in the surface potential of a photoreceptor drum of this invention and of a reference standard photoreceptor drum.

As shown in Figures 1(a) and 1(b), the photoreceptor drum 1 of this invention comprises a cylindrical conductive substrate 11 and an organic or inorganic photosensitive layer 12 covering the outer surface 110 thereof.

The conductive substrate 11 is made of, for example, aluminum that is 1.2 μm thick. The maximum roughness, R'max, of the outer surface 110 of this conductive substrate 11 is established within the limits of 0.3 S to 2.0 S. If R'max were less than 0.3 S, the effects to be provided by this invention would not be obtained. If it were more than 2.0 S, the bit notches of the polishing step would appear on the outer surface 110 of the substrate, and when the photosensitive layer 12 was formed on this outer surface 110, the uniformity of the outer surface 120 of the photosensitive layer 12 would be damaged. Therefore, the charging characteristics of the photosensitive layer 12 would not be uniform. The above-mentioned polishing step is carried out as is usual in this field, using, for example, a cylindrical grinder. A sandblaster or such equipment can be used for the finishing of the surface.

The photosensitive layer 12, which covers the outer surface 110 of the above-mentioned conductive substrate 11, is made of an inorganic or organic photosensitive material that is ordinarily used for photoreceptors for electrophotography. Examples of organic photosensitive materials are compounds of high molecular weight such as polyvinyl carbazole (PVK), etc., and

compounds of low molecular weight such as pyrazoline derivatives, etc. Examples of suitable inorganic photosensitive materials are amorphous selenium (Se), zinc oxide (ZnO), cadmium sulfate (CdS), etc. Such a photosensitive material is applied to the outer surface 110 of the conductive substrate 11 using a blade coater, etc., and then it is treated at 100°C for one hour, resulting in a photosensitive layer 12 with a thickness of about 12 μm. The surface 120 of this photosensitive layer 12 is made so as to lie along the outer surface 110 of the conductive substrate 11 as if they were one piece, so the maximum roughness, Rmax, of the surface of the photosensitive layer 12 is approximately equal to the maximum roughness, R'max, of the outer surface of the substrate 11. When the photoreceptor drum 1 obtained by the formation of the photosensitive layer 12 on the conductive substrate 11 is installed and used in a copying machine to make copies, the true contact of the photoreceptor drum 1 with the cleaning doctor blade is from 5% to 70%. This true contact of the photoreceptor drum 1 with the cleaning doctor blade is represented by the formula $(S/S_0) \times 100$, wherein S is the true contact of the photoreceptor drum 1 with the cleaning doctor blade, and S_0 is the effective surface area of the cleaning doctor blade to come into contact with the photoreceptor drum 1.

Example

When copies were made using a photoreceptor drum 1 of this invention having the maximum surface roughness of 0.6 S, the true contact of the photoreceptor drum 1 with the cleaning doctor blade was 30%. The changes over time in the surface potential of this photoreceptor drum 1 was measured and the results are shown in Figure 2, indicating that there is almost no decrease in the surface potential, which means that

the resistance to abrasion of the photoreceptor drum is excellent. Also, vibration of the cleaning doctor blade did not take place, and distinct copies were obtained over a long period of time.

Control

Copies were made in the same manner as in the above-mentioned example, except that a photoreceptor drum polished to a mirror-like surface with a maximum roughness of 0.1 S was used. The true contact of the photoreceptor drum with the cleaning doctor blade was 90%. The changes over time in the surface potential of this photoreceptor drum were measured, and the results are shown in the same figure as for the Example (Figure 2). Figure 2 indicates that the surface potential decreased markedly, and that the durability of the photoreceptor drum was much worse than that of the above example. Vibration of the cleaning doctor blade occurred, and cleaning of the photoreceptor surface was unsatisfactory.

Claims:

1. A photoreceptor drum for electrophotography comprising a cylindrical conductive substrate and an organic or inorganic photosensitive layer covering the outer surface of said substrate, wherein the maximum roughness, Rmax, of the surface of the photoreceptor drum is in the range of 0.3 S to 2.0 S.

2. A photoreceptor drum for electrophotography according to claim 1, wherein said cylindrical conductive substrate is made of aluminum.

3. A photoreceptor drum for electrophotography according to claim 1 or 2, wherein said cylindrical conductive substrate is polished using a grinding machine such as a cylindrical grinder.

FIG. 1(a)

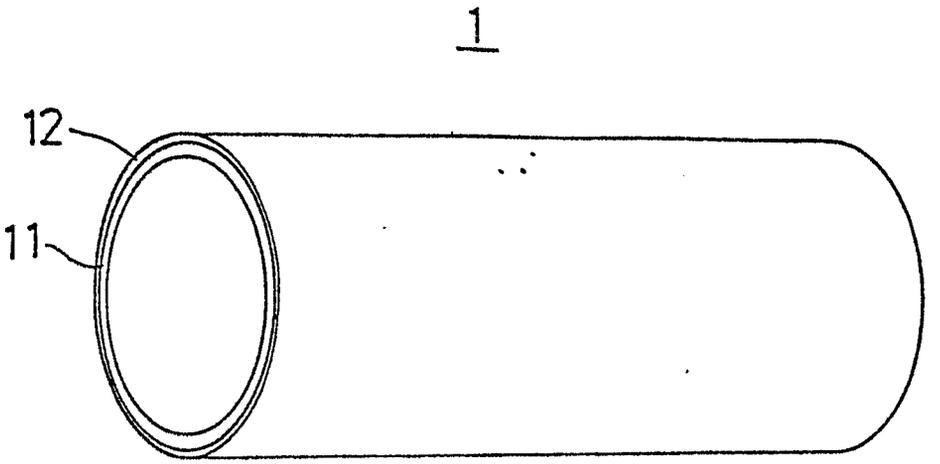


FIG. 1(b)

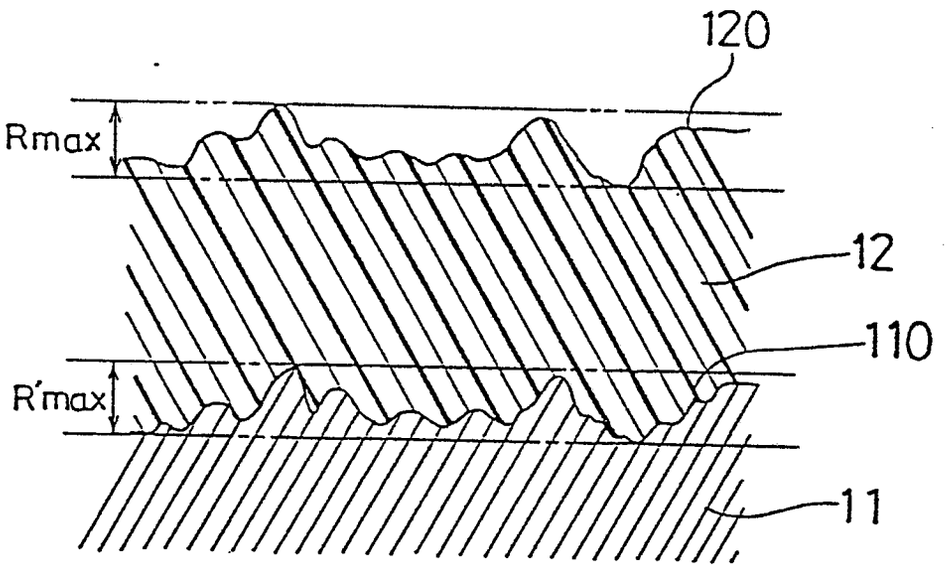
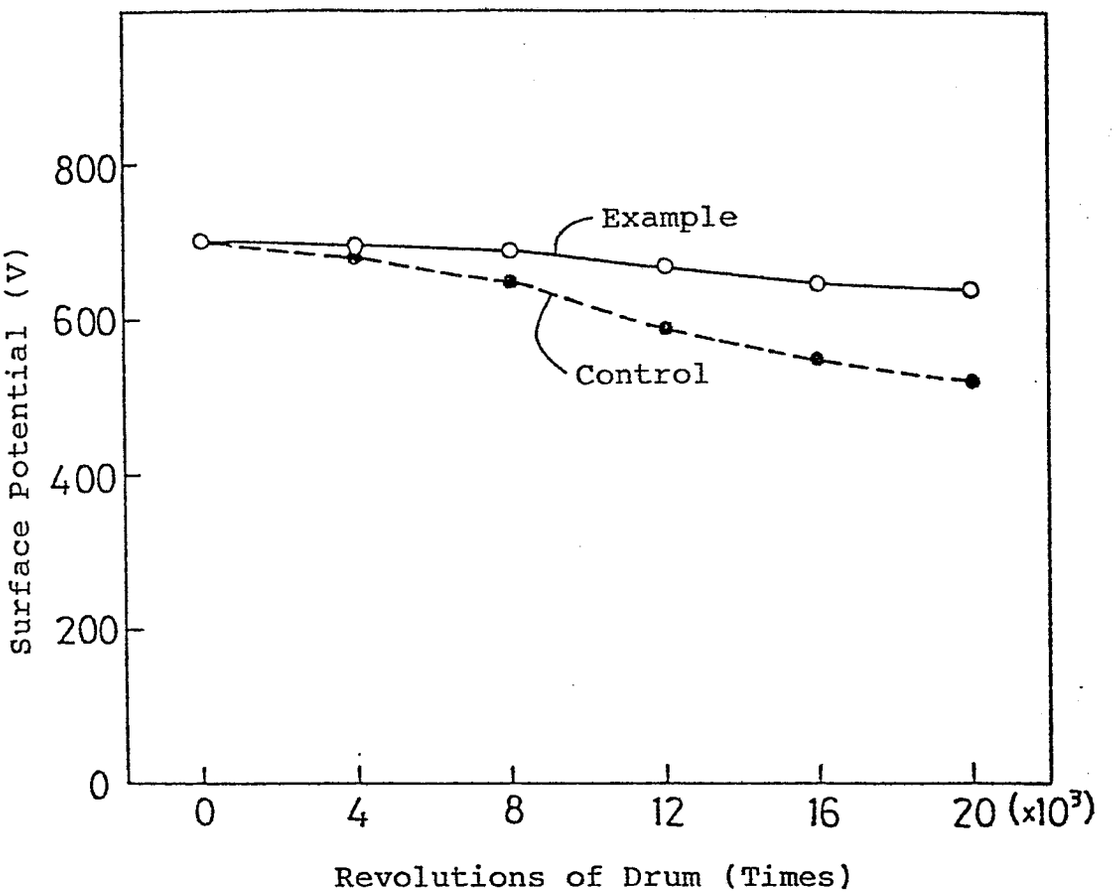


FIG. 2


800
600
400
200
0
Surface Potential (V)
Example
Control
0
4
8
12
16
20 (×10³)
Revolutions of Drum (Times)