July 14, 1959 J. J. SCHULZE 2,894,744

FEED ROLLERS FOR PHOTO-CONDUCTIVE INSULATING MATERIAL

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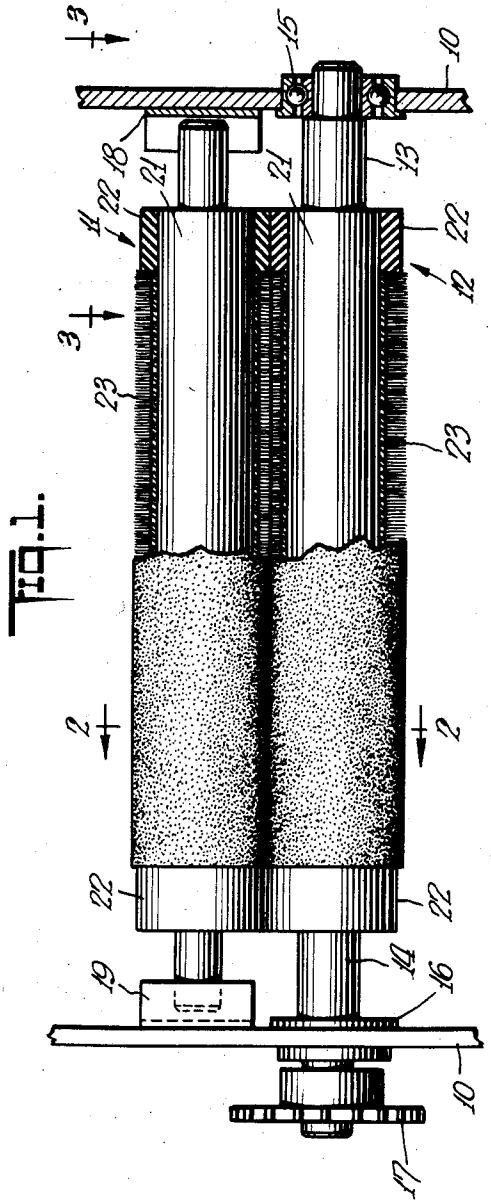


Fig. 1.

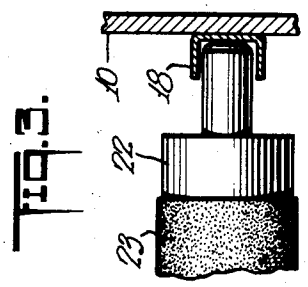


Fig. 3.

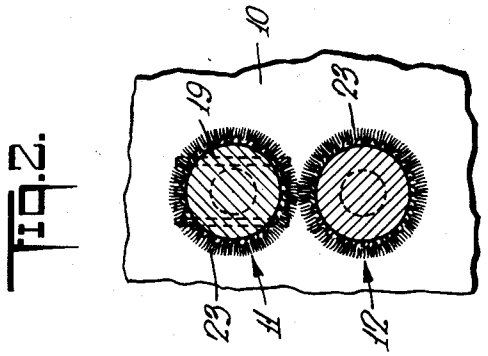


Fig. 2.

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FEED ROLLERS FOR PHOTO-CONDUCTIVE INSULATING MATERIAL

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6 Claims. (Cl. 271—51)

This invention relates to feed rollers for feeding photo-conductive insulating material having developer powder or toner applied to electrostatic, latent images thereon, which developer powder is fixed to produce the desired prints.

Electrostatic printing processes, as is well known, comprise producing a uniform electrostatic charge upon the surface of a photo-conductive insulating material, such, for example, as paper coated with a finely-divided photo-conductor, e.g., zinc oxide, applied to the paper base as a solution or suspension in a dielectric film-forming vehicle. The vehicle may be a resin solution or suspension, such as a solution of a silicone resin in a suitable solvent, or a suspension of a polyvinyl acetate resin in an aqueous medium. Further description of the photo-conductive insulating material is believed unnecessary because the feed rollers of the present invention may be used for feeding all types of photo-conductive insulating materials having latent images covered with developer powder or toner particles.

The latent image is produced, as in also well known, by exposing the charged surface to a light image, thus discharging the portions irradiated by the light rays while leaving the remainder of the surface in a charged condition. The latent image is then developed by applying a developer powder which is held electrostatically to the charged area. This powder is then fixed to the photo-conductive surface, for example, by heat in those cases where the powder is a resin or other material which can be fixed by heat, or by application of a solvent or by other known fixing technique. It is advantageous to feed the insulating material over the roll applying the developer powder with the image face down to provide a clean background and then turn the insulating material having the developer powder thereon over for fixing.

The developer powder or toner may be composed of granular carrier particles admixed with pigmented or dyed powder, the granular carrier particles functioning to carry and to generate triboelectric charges on the elecscopic developer powder. Where a negative electrostatic charge forms the latent image, the electrostatic powder and carrier particles should be selected so that the developer powder is triboelectric positive to the carrier particles. In the event the latent image is constituted of a positive electrostatic charge, an electroscopic powder and granular carrier should be selected in which the developer powder is triboelectrically negative to the carrier particles. Preferably, the carrier particles are spherical in shape and may be iron, glass or polyethylene beads having a diameter of approximately .015". The pigmented or dyed developer powder may be a suitable resin, such as vinyl chloride, vinyl acetate copolymers, phenol formaldehyde, vinylidine chloride resin, butadiene polymers, etc. As noted above, the carrier and the powder are chosen so that they have the desired triboelectric relationship which, of course, will depend on their relative positions in the triboelectric series. It is desirable to select a developer powder and a carrier which when mixed results

in a marked electrostatic charge on the developer powder. As such mixtures of carrier particles and developer powders are well known (being described, for example, in United States Patent No. 2,618,551), it is believed further description thereof is unnecessary.

Alternatively, the developer powder may consist of a mixture of finely-divided magnetic carrier material, such as iron, or other magnetic material and resin powder, e.g., thermoplastic resins composed of styrene polymers or polymers of styrene homologs. Such magnetic developer powders are well known in the electrostatic printing art.

The use of conventional feed rollers for feeding the photo-conductive insulating material during or between the developing and image-fixing operations is objectionable for a number of reasons. The photo-conductive insulating material leaving the developer operation has the developer powder thereon, which powder has not as yet been fixed. This powder tends to stick to the rollers and is transferred back onto the photo-conductive insulating material resulting in blurred and smeared backgrounds.

It is among the objects of this invention to provide feed rollers for handling photo-conductive insulating material, including sheets or webs having unfixed images thereon, which rollers do not deleteriously affect the background and result in prints having clean backgrounds.

In accordance with this invention, feed rollers are employed for feeding photo-conductive insulating material having unfixed images thereon, which rollers have a peripheral portion, preferably at the opposite edges of each roller of suitable material having a high coefficient of friction to provide a positive drive between the rollers and have the intermediate or roller feeding periphery of a nap or pile material. The high coefficient of friction material portions of the rollers hold the rollers parallel to each other, maintain even pressure across the width of the insulating material, and further maintains the desired pressure on the insulating material fed by the rollers, i.e., the friction material peripheries maintain the longitudinal axes of the rollers spaced apart the desired distance at all times to exert the desired feeding pressure. Stated otherwise, the friction material holds the center-to-center dimensions of the feed rollers.

As noted, the periphery of the rollers which engage the unfixed image areas and feed the insulating material are constituted of a nap or pile material. The diameter of the nap or pile portions of each roller is slightly greater than that of the friction material periphery of the rollers. The nap or pile material is soft enough to provide a firm drive for the insulating material and firm enough to prevent pressing loose developer particles into the insulating material by mechanical action.

The nap or pile material is made of a substance that has a strong triboelectric attraction for the developer particles. When the feed rollers come in contact with the unfixed image, occasionally small amounts of excess developer particles may be released and collect on the periphery of the rollers. However, in view of the triboelectric attraction between such particles and the nap or pile material, such developer particles will not be released by the roller to the almost neutral background. As the nap or pile material, as indicated above, is soft enough to prevent pressing loose developer particles into the insulating material, such particles are not ground into the background and a clean print results.

In operation, the feed rollers of the present invention give excellent results, even when a large amount of developer particles has accumulated on the nap or pile material of the feed rollers. If there is a deficiency of developer particles on the image, as is sometimes the case, the strong electrostatic charge defining the im-

age attracts developer particles present on the nap or pile material to satisfy the charge and thus improve the prints when the image is developed. Occasionally, it may be desirable to clean the feed rollers to remove large excesses of developer particles.

For best results, the nap or pile material should be of a material in the triboelectric series, which is located in this series remote, preferably at the opposite end, from the location in this series of the material of which the developer particles are composed. Thus, for developer particles carrying a positive charge the nap or pile material of the feed rollers should be of Orlon, Dacron, Saran fiber, polyethylene or acetate rayon. For developer particles having a negative charge, the nap or pile materials should be of nylon, fine glass wool, wool, or animal furs, such as rabbit or cat.

In the accompanying drawing forming a part of this specification and showing, for purposes of exemplification, a preferred form of this invention, without limiting the claimed invention to such illustrative instance:

Figure 1 shows partly in section and partly in elevation a preferred embodiment of this invention;

Figure 2 is a fragmentary section taken in a plane indicated by line 2—2 on Figure 1; and

Figure 3 is a fragmentary plan view taken in a plane indicated by line 3—3 on Figure 1.

In the drawing 10 indicates the frame of the machine in which the feed rollers 11 and 12 are mounted. In the embodiment of the invention shown in the drawings, feed roller 12 has at its opposite ends shafts 13 and 14 journaled for rotation in ball bearings 15 and 16 mounted in the frame 10. Shaft 14 has pinned thereto a sprocket 17 which is driven by a suitable chain not shown to effect rotation of the roller 12 from the drive for the machine.

Roller 11 is mounted in channel-shaped guides 18 and 19 fixed to the frame 10. Each roller 11 and 12 may consist of a hollow cylindrical portion 21 of a suitable material of construction, e.g., metal. At the opposite ends of each roller is provided a narrow annulus 22 of a material having a high coefficient of friction, such as rubber, natural or synthetic, knurled steel, or suitable plastic material having a rough surface. Annuli of rubber or in which one annulus is of rubber and the other cooperating annulus is of knurled steel have been found eminently satisfactory. The periphery of the annulus 22 at each of the ends of the roller 12 is in frictional engagement with the corresponding annulus 22 on roller 11. Thus, rotation of roller 12 effects the drive of the roller 11 through the frictional contact between the annuli 22 and these annuli maintain the longitudinal axes of rollers 11 and 12 spaced at all times the desired distance to maintain the proper pressure on the insulating material fed by these rollers. In other words, the annuli 22 of frictional material, such as rubber, maintains the desired center-to-center dimensions of the rollers 11 and 12.

The periphery of the rollers 11 and 12 between the annulus 22 at the opposite ends of each roller is constituted of a nap or pile material 23. For example, a pile fabric may be adhesively bonded to the cylindrical portion 21 of each roller to form the nap peripheries. The rollers are dimensioned so that the longitudinal extent of the nap material 23 covering each roller is slightly greater than the width of the portion of the insulating material bearing the latent image having developer powder thereon. As best shown in Figures 1 and 3, the diameter of the nap material peripheries of the rollers 11 and 12 is somewhat greater than the diameter of the annuli 22. The nap material thus provides a soft, firm drive for the insulating material.

It will be noted the present invention provides feed rollers for feeding the insulating material having unfixed images thereon, which rollers do not deleteriously affect the background. Hence, prints having a clean background result. Moreover, the feed rollers of the present invention automatically supply the necessary developer powder to images having a deficiency of such powder, resulting in better prints.

Since certain changes in the feed rollers embodying this invention and described above may be made without departing from the scope of this invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A pair of cylindrical feed rollers for feeding photo-conductive insulating material having an image covered with a developer powder, said rollers each having at least one peripheral portion of material having a high coefficient of friction in frictional engagement with said peripheral portion on the other roller and each having peripheries constituted of a nap material, which material is located in the triboelectric series remote from the location in said series of the material of which said developer powder is composed.

2. A pair of feed rollers for feeding photo-conductive insulating material having an image covered with a developer powder, said rollers having near one end a relatively narrow peripheral portion of material having a high coefficient of friction maintaining the said rollers in driving engagement with the longitudinal axes of said rollers spaced apart the desired distance to maintain pressure on the insulating material fed by said rollers, the periphery of said rollers adapted to engage said insulating material being of a nap material to provide a soft, firm drive for the said insulating material, the said nap material being of a material in the triboelectric series which is located in said series remote from the position in said series of the material of which said developer powder is constituted.

3. A pair of feed rollers as defined in claim 2 in which the nap material is from the group consisting of Orlon, Dacron, Saran fiber, polyethylene and acetate rayon, where the feed rollers are employed to feed photo-conductive insulating material having an image covered with developer powder carrying a positive charge.

4. A pair of feed rollers as defined in claim 2 in which the nap material is from the group consisting of nylon, glass wool, wool and animal furs, where the said feed rollers are employed to feed photo-conductive insulating material having an image covered with developer powder carrying a negative charge.

5. A pair of feed rollers for feeding photo-conductive insulating material having an image covered with a developer powder, each roller having at its opposite ends a relatively narrow annulus of rubber and the periphery of the intermediate portion of each of said rollers being constituted of nap material to provide a soft, firm drive for the photo-conductive insulating material, the said nap material being of a material in the triboelectric series which is located in said series remote from the position in said series of the material of said developer powder.

6. A pair of feed rollers as defined in claim 5 in which the diameter of the periphery of said nap material portion of said roller is slightly greater than that of said annuli and the peripheries of the said rubber annuli on one roller are in frictional driving engagement with the peripheries of said annuli on the other roller.

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