

- [54] **ELECTROSTATIC REPRODUCTION DEVICE**
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Related U.S. Application Data

- [63] Continuation of Ser. No. 690,113, Dec. 13, 1967, abandoned.
- [52] U.S. Cl.**355/12, 355/16, 355/3, 118/637, 117/17.5**
- [51] Int. Cl.**G03g 15/00**
- [58] Field of Search**355/11, 16, 17, 12; 118/637; 117/17.5**

- [56] **References Cited**
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[57] **ABSTRACT**

An electrostatic reproduction device employing a continuous belt having a charge imparted thereto of a first polarity which is exposed to an image to be reproduced. One surface of a paper web upon which the reproduction will be made is brought in direct contact with the belt after charging and exposure. The second oppositely disposed surface of said paper is subjected to the action of a toner which is attracted to the second surface as a result of a charge imparted to the paper by the charged belt.

6 Claims, 2 Drawing Figures

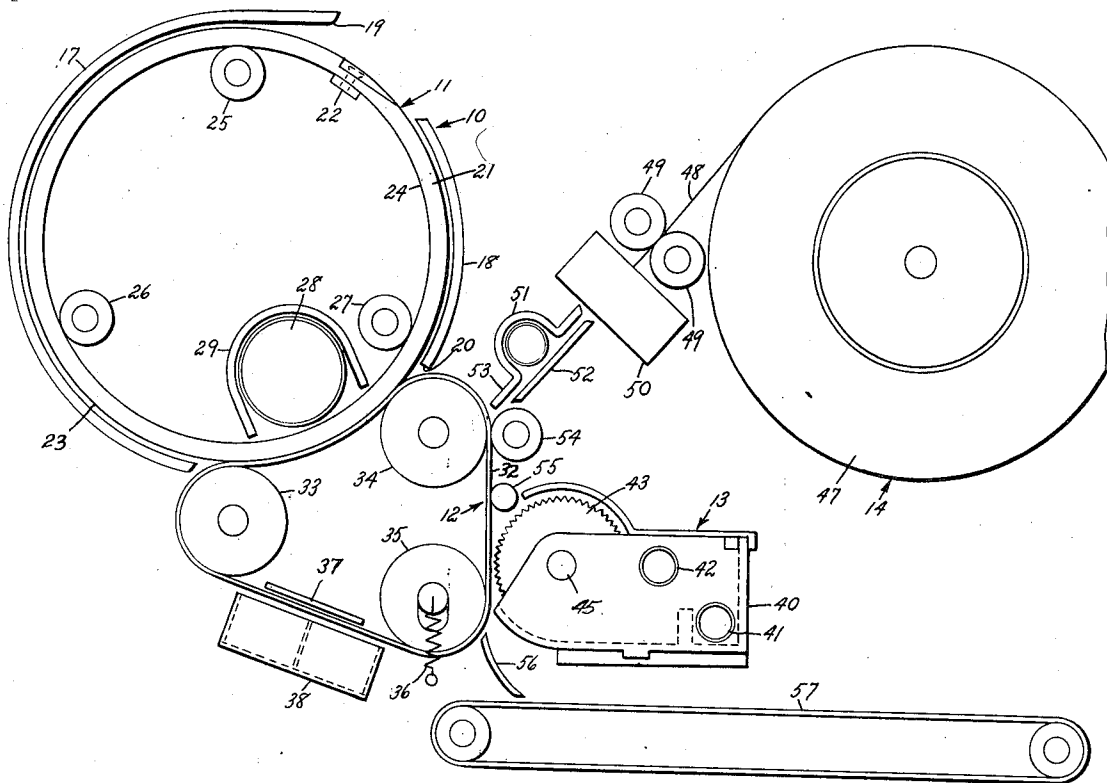


Fig. 1

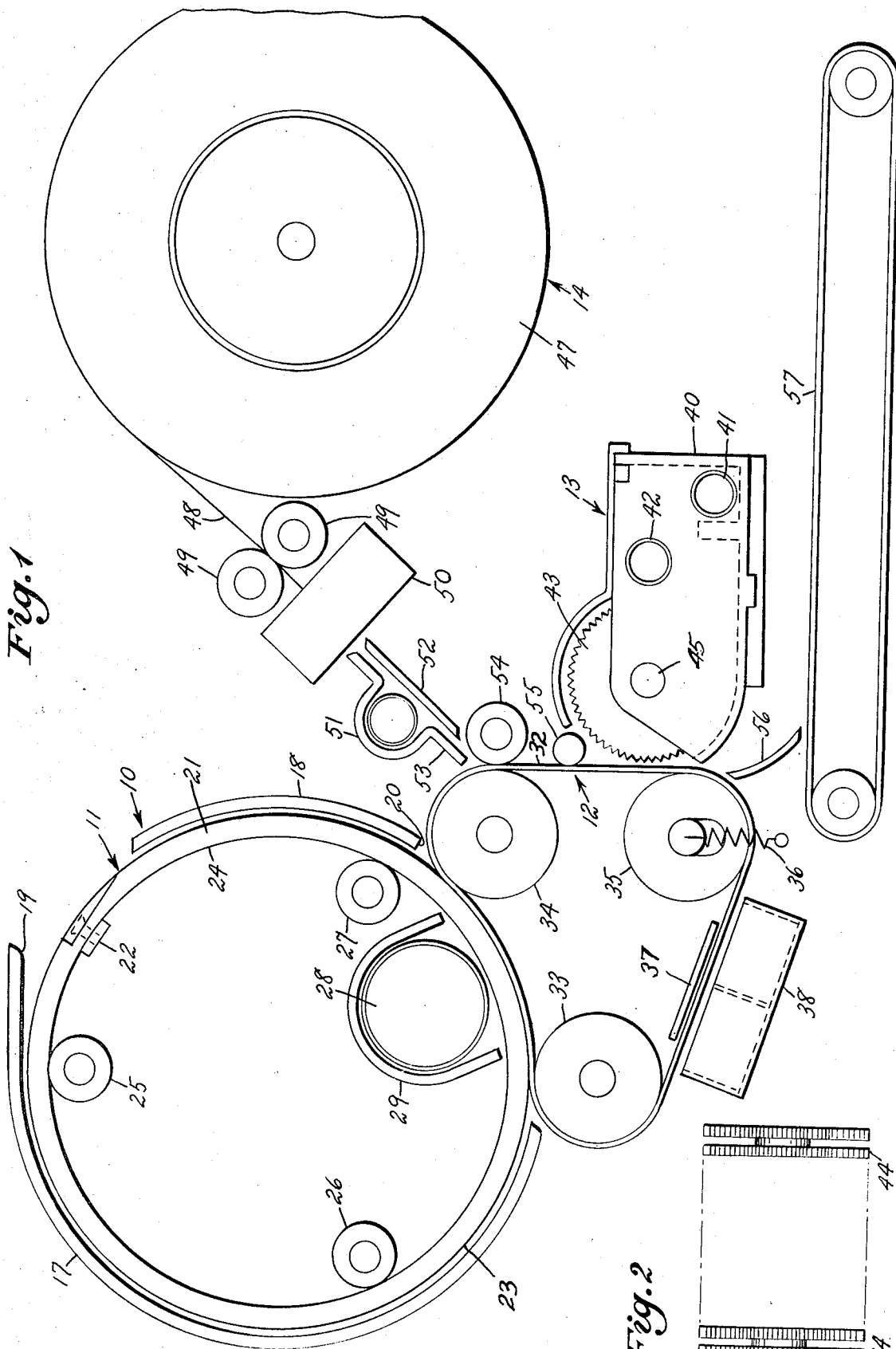
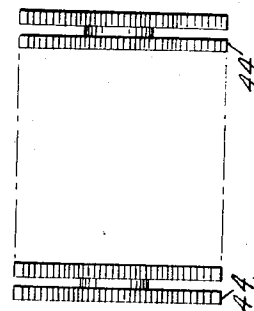


Fig. 2



ELECTROSTATIC REPRODUCTION DEVICE

This application is a continuation of application Ser. No. 690,113, filed Dec. 13, 1967, now abandoned.

This invention relates generally to the field of electrostatic reproduction devices of a type in which a comminuted toner, usually including carbon particles is electrostatically attracted to the surface of a coated paper in predetermined pattern corresponding to the image to be reproduced.

In the prior art, such devices have been embodied in two principal types, a first type of which employs a selenium coated revolving drum which is first positively charged using a corona unit, subsequently exposed to the image to be reproduced, and next mechanically dusted with a quantity of toner in dry powdered form, whereby the darker areas of the image will attract the toner thereto. Subsequently, the drum offsets the attracted toner onto a sheet of paper. The toner includes a thermo-setting agent which is subsequently heated to permanently affix the transfer toner to the paper. Devices of this type are widely distributed under the trademark "Xerox."

A second type of reproduction device has also found wide acceptance. Machines of this classification are distributed by a number of manufacturers, and are characterized in the elimination of the above mentioned selenium coated drum, and the substitution therefor of reproduction paper which has been coated with a negatively chargeable oxide applied to a paper substrate. The reproductive paper itself is charged prior to the reception of the image to be reproduced, and the paper is subsequently subjected to the action of a liquid toner containing comminuted carbon particles, either by spraying the same upon the coated surface, or by emerging the entire sheet in a bath of toner. Prior to exiting from the device, the volatile solvent which carries the carbon particles in suspension is evaporated, so that a dry copy is received by the user.

The former of the above described types has many disadvantages. Because the toner is used in powder form, the selenium drum must be continuously wiped clean after each impression, and the addition or replacement of toner is an inherently messy operation. Further, with passage of time, the selenium coated drum becomes damaged through direct contact with the toner and the subsequent wiping operations, and must be replaced, an operation involving considerable expense and labor. Because the toner will not permanently adhere to the paper without the presence of the thermo-setting plastic resin incorporated therein, the operation temperature of the device is relatively high.

The later form described hereinabove does not have the above disadvantages, but employs a reproduction paper which is many times more costly than that of the former, owing to the necessity of employing a paper which is not only oxide coated, but one which is relatively impervious to the dispersant fluid.

It is therefore among the principal objects of the present invention to provide an improved form of electrostatic reproduction device, in which the above mentioned disadvantages have been substantially eliminated.

Another object of the invention lies in the provision of an improved electrostatic reproduction device which eliminates the necessity of provision of a selenium

coated drum, and which may be employed with either dry or liquid toning mediums.

Yet another object of the invention lies in the provision of a electrostatic reproduction device in which the charged and exposed surface is shielded from direct contact with the toning medium, so as to have a substantially indefinite useful life.

A further object of the invention lies in the provision of a electrostatic reproduction device, which, owing to an inherently faster cycle of operation, is capable of producing copies at a rate far in excess of conventional copies as presently known in the electrostatic reproduction art.

A feature of the disclosed embodiment lies in the ready adaptability of the same to use as a substitute for photo offset and other reproduction methods employed where relatively large numbers of copies of a single impression are required.

Another feature of the embodiment lies in the fact that it may be used with relatively low cost uncoated papers.

These objects and features, as well as other incidental ends and advantages, will more fully appear in the progress of the following disclosure, and be pointed out in the appended claims.

In the drawing, to which reference will be made in the specification, similar reference characters have been employed to designate corresponding parts throughout the several views.

FIG. 1 is a schematic view of an embodiment of the invention.

FIG. 2 is a fragmentary view in elevation of a toner supply wheel comprising a part of the embodiment.

In accordance with the invention, the device, generally indicated by reference character 10, comprises broadly: an exposure drum element 11, a chargeable photo-sensitive element 12, a toner supply element 13, and paper supply means 14.

The exposure drum element 11 is enclosed within light shield members 17 and 18, which define a first interstice 19 permitting the insertion of copy material (not shown) and a second interstice 20 permitting contact of the copy material with the charged belt element 12. A copy retaining drum 21 is of transparent or translucent material, and is provided with copy engaging means 22 of well known type to engage one edge of the copy material on an outer surface 23 thereof. The inner surface 24 is supported on roller bearing members 25, 26 and 27 for rotation about a fixed axis. Positioned to illuminate the inner surface 24 is a florescent lamp 28 enclosed within a shield 29, and provided with brilliance control means of well known type (not shown).

The belt element 12 includes a negatively chargeable belt member of flexible synthetic resinous material capable of retaining a substantial charge of this polarity. I have found belts of fluorocarbon resins, polypropylene and polyesters, such as Mylar and Dacron to be particularly suitable. The belt member may be of a woven type, in which case it is preferably coated to obtain a smooth surface with a compatible photo-sensitive material such as metallic oxide, or the like. Owing to contamination problems, such coating is not able to be applied by vacuum deposition, but is best accomplished by so called sputtering techniques.

The belt member 32 is supported for continuous movement over fixed rollers 33 and 34, as well as a tension roller 35 incorporating resilient means 36. Disposed in the continuous segment of the member 32 disposed between the fixed roller 33 and the tension roller 35 is an electrically grounded plate 37 cooperating with a high voltage corona charging unit 38 of well known type.

The toner supply element may be adapted to operate with either powdered toner (in which case a separate heating element must be provided), or preferably with liquid toner of a type used in conjunction with the second type of prior art device discussed hereinabove. The toner concentrate is used directly, in the absence of a mineral spirit dispersant. The small amount of mineral spirit present in commercially available toners dries relatively rapidly, so that normally separate fan or other blower means incorporated in conventional devices is not necessary. The element 13 includes a casing element 40 which houses a recirculating scavenger pump 41 to supply a continuous flow of toner to a spray unit 42. The spray unit 42 continuously resupplies a quantity of toner on the peripheral surface of a continuously revolving toothed wheel unit 43 including a plurality of individual toothed wheels 44 (see FIG. 2) mounted for rotation on a common shaft 45. Shaft rotation is such that the peripheral speed of the wheels 44 is in excess of that of the belt element 12.

The paper supply means 14 includes a paper supply roll 47 dispensing a continuous web 48 to a pair of driven rollers 49. Optional knife means 50 may be incorporated where the copied material is to be in sheet form. Adjacent the knife means 50 is a paper web heater unit 51, preferably of infra-red type, and including guide plates 52 and 53 between which the web may pass. Rollers 54 and 55 serve to urge the web into direct contact with the outer surface of the belt member 32, where it will remain owing to static attraction until it reaches the lower guide 56, and subsequently a continuous belt 57 which transports the finished copy outwardly of a housing for the entire device (not shown).

OPERATION

In the embodiment described, and illustrated in the drawing, the device is set up for continuous reproduction of a single page or sheet which is secured to the outer surface 23 of the drum element 11. It will be readily understood by those skilled in the art to which the invention pertains, that means can also be substituted whereby the material to be copied is returned to the user after a single reproduction of the same has been made.

As the drum element 11 revolves, light from the florescent lamp tube 28 passes through the surface of the drum 21, and in the darkened areas of the image to be reproduced the light is prevented from reaching the belt element 12. In other areas, the light destroys the negative charge thereon provided by the corona charging unit 38, so that normally the toner will be attracted only to the areas which remain charged, as is well known in the art. The belt member 32 moves clockwise as shown in FIG. 1 about the roller 34, wherein it comes into contact with the heated web of paper 48 exiting from the heater unit 51. Owing to the negative

charge remaining on the belt member 37, the paper is immediately attracted thereto, and stays in intimate contact therewith over the continuous segment of the belt member 32 disposed between the roller 34 and the roller 35. The charge remaining on the belt member 32 penetrates the web of paper, and attracts toner directly from the wheeler unit 43 which impinges upon the oppositely disposed surface of the paper. As the paper web 48 is of an uncoated relatively porous type, the toner immediately penetrates the same to be absorbed thereby, and upon exiting upon the belt 57, the finished copy is substantially dry to the touch. Where necessary, to prevent complete penetration of the paper, the surface contacting the belt member 32 may be provided with a light coating of resinous material to seal that surface, and thus protect the belt member 32 from contamination by the toner.

Owing to the fact that the toner will normally not come into contact with the belt member 32, there is no necessity to wipe excess toner therefrom, with possible damage to the outer surface thereof. Thus, the useful life of the belt is limited only by its mechanical strength and factors affecting normal wear of the same as it passes about the rollers 33, 34 and 35.

I claim:

1. An electrostatic reproduction device comprising a movable belt member having a chargeable surface, means for charging said surface to a first polarity, a rotatable drum for receiving an original thereon and placing it in direct contact with said chargeable surface, means for exposing said surface to an image of the original to be duplicated, paper supply means for presenting a first surface of a web of paper to direct contact with said chargeable surface, and means for subjecting a second oppositely disposed surface of said paper web to the action of a toner having a charge of polarity opposite that of said first polarity while the first surface of said paper web is in direct contact with said chargeable surface.

2. An electrostatic reproduction device in accordance with claim 1 wherein said movable belt member is supported by spaced-apart first, second and third rollers, and wherein said charging means is located between said first and second rollers, said exposing means is located between said second and third rollers, and said means for subjecting said paper to the action of a toner is located between said first and third rollers.

3. An electrostatic reproduction device in accordance with claim 2 wherein said original is placed in direct contact with said chargeable surface between said second and third rollers, and the first surface of said paper web is presented in direct contact with said chargeable surface between said first and third rollers.

4. An electrostatic reproduction device in accordance with claim 3 wherein said means for subjecting said paper to the action of a toner includes a toothed wheel defining a periphery having a plurality of interstices, means for placing a supply of toner in said interstices, and means for driving said wheel at a surface velocity in excess of that of said paper supply means.

5. An electrostatic reproduction device in accordance with claim 4 wherein said rotatable drum is transparent and said exposing means is located within

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said transparent drum to expose said original while it is in direct contact with said chargeable surface between said second and third rollers.

6. An electrostatic reproduction device in accordance with claim 4 wherein said rotatable drum is

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translucent and said exposing means is located within said translucent drum to expose said original while it is in direct contact with said chargeable surface between said second and third rollers.

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