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2,803,177

APPARATUS AND METHOD FOR XEROGRAPHIC PRINTING

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2 Sheets-Sheet 1

FIG. 1

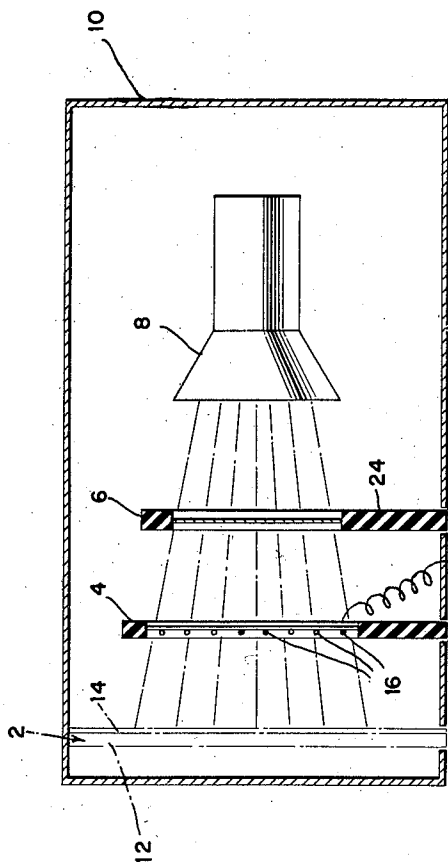
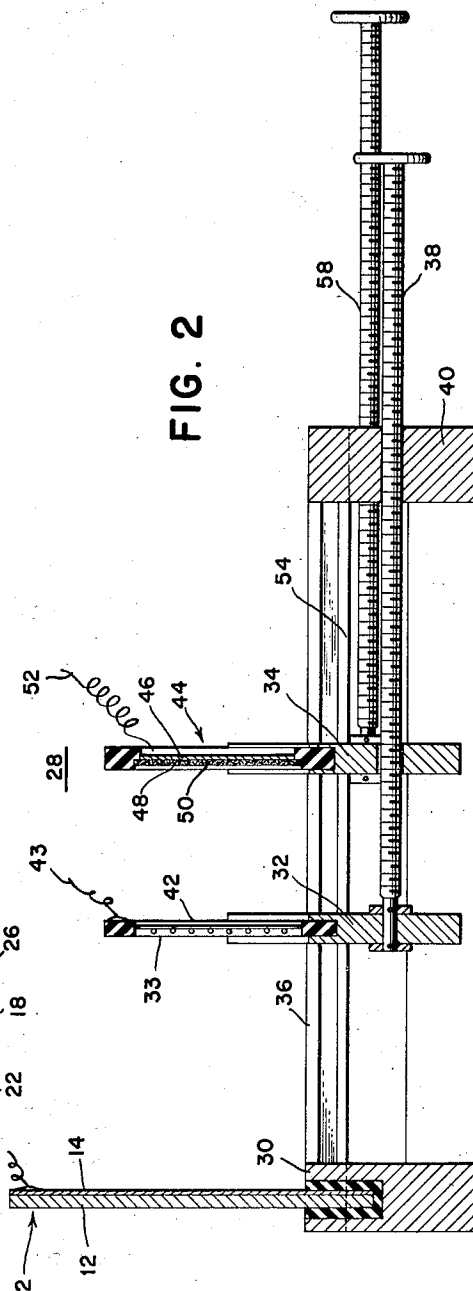


FIG. 2



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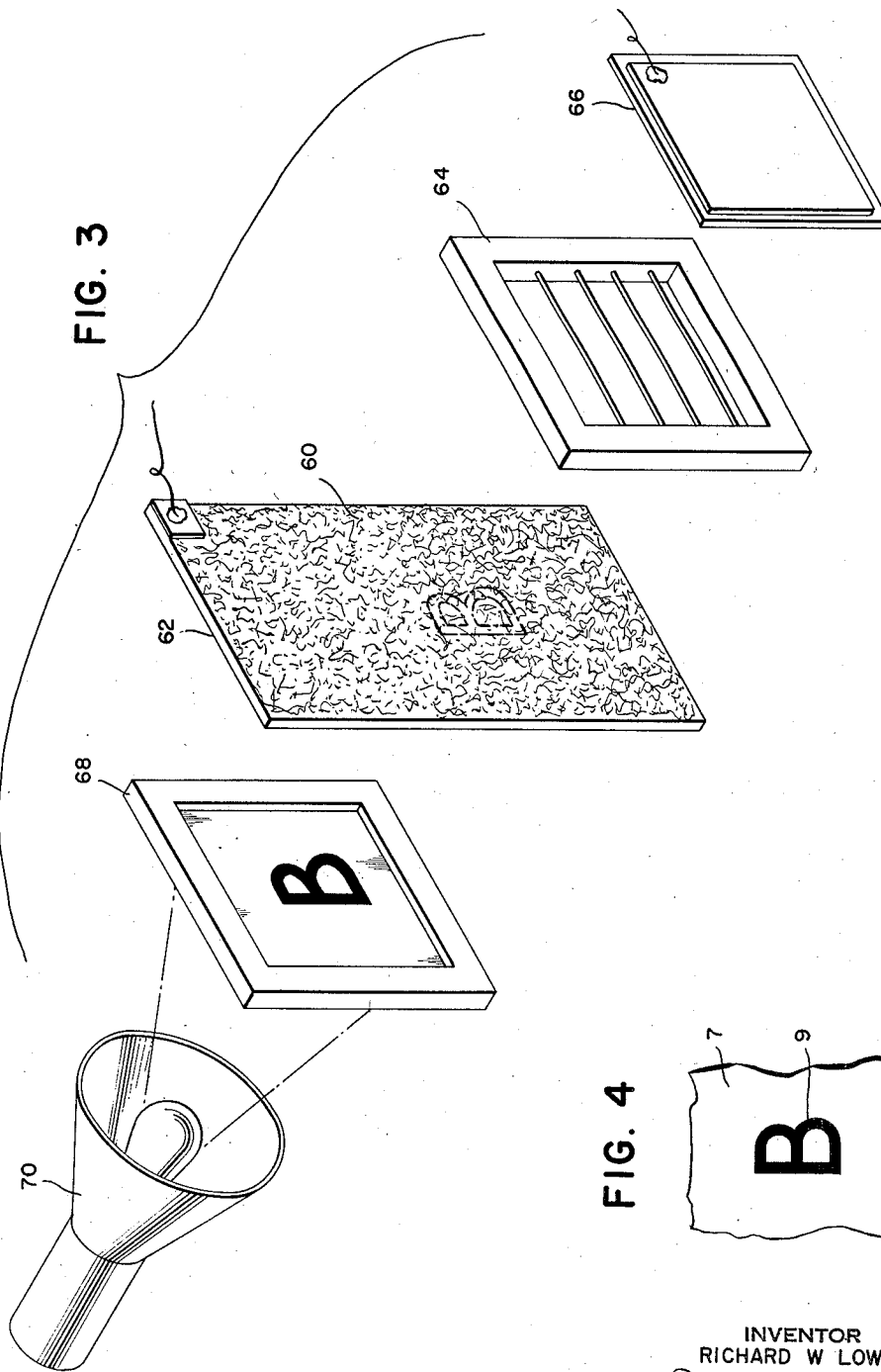
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2 Sheets-Sheet 2



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APPARATUS AND METHOD FOR XEROGRAPHIC PRINTING

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1 Claim. (Cl. 95—1.7)

This invention relates to xerographic printing and more particularly to charging, exposing and dusting operations for forming an image on a photosensitive plate in a xerographic printing process.

By definition, xerographic printing comprises the steps of (1) charging a photosensitive plate (hereinafter called selenium plate for illustrative purposes only) with a static voltage in the order of 3,000 volts; (2) shielding the selenium plate with a light pervious layer carrying an opaque image that is to be recorded; (3) exposing the combination to a light source that is directed through the shield to the selenium plate whereby all the parts of the plate not covered by the opaque image give up their charge; (4) dusting (called developing in the art) the plate with carbon or other powder toner (the carbon will adhere to charged portions); (5) transferring the carbon image to paper through the application of electrostatic field or other methods.

One of the major problems in the xerographic printing art is the dusting of the exposed selenium plate. Specifically, there are two conventional methods; one wherein carbon mixed with sand or glass particles is cascaded over the selenium plate; and the other, the carbon cloud method, wherein a quantity of fine carbon power is floated against the selenium plate.

Unfortunately, each of the above specified methods has its disadvantages. The cascading method soon deteriorates the plate to a degree of uselessness by wearing off and abrading the very thin, highly polished, selenium coating; while the carbon cloud method is prone to leave a residual carbon background on the uncharged portions of the selenium plate.

Accordingly, it is a prime object of this invention to provide a new and improved method of dusting a charged selenium or other photosensitive film.

It is a still further object of this invention to provide an improved method and structure for dusting a selenium plate wherein either a positive or a negative image may be formed on the photosensitive film.

It is a still further object of this invention to provide an improved method and structure for simultaneously charging, exposing and dusting a photosensitive film.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated of applying that principle.

Briefly, this invention relates to a dusting process wherein an exposed, photosensitive film, a charging grid, and a carbon dust covered metal plate are arranged in spaced apart relationship. Voltage sources are applied to the film, the grid, and carbon plates whereby carbon powder is caused to fly from the carbon plate, through the grid to the exposed photosensitive film to form an image on the charged portions. Further, this invention relates to a combined charging, exposing and dusting process and structure for a photosensitive film wherein simultaneously, the photosensitive film is charged, exposed and dusted.

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Referring to the drawings:

Fig. 1 is a front elevation view showing the conventional form of charging and exposing a selenium plate.

Fig. 2 is a front elevation view showing the apparatus for dusting an exposed selenium plate.

Fig. 3 is a perspective exploded view showing the structure used for simultaneously charging, exposing, and dusting a selenium plate.

Fig. 4 is a plan view of a portion of an image shield used for exposing a charged selenium plate.

Referring to the drawings, and particularly to Fig. 1, a plate 2 having a high resistance electrical conducting photosensitive film such as selenium deposited thereon, a grid 4, an image plate 6, and a light source 8 are shown mounted in an opaque box 10.

The selenium plate 2, in a preferred embodiment comprises an aluminum backing strip 12 on which there has been deposited a thin coating (about 20 microns) of photosensitive material such as selenium 14. While for the purpose of simplicity, this application as described with reference to the high resistance photosensitive material, selenium, similar materials such as germanium, silicon and copper oxide, will serve the purpose equally well.

Grid 4, which functions to charge the selenium coating 14, comprises a plurality of interwoven wires 16, formed into an open mesh and having a pigtail 18 for electrical connection. A voltage source (not shown) in the order of 3,000 volts is applied through pigtail 18 to grid 4 while selenium plate 2 is held at ground potential. The charging voltage is applied for a few milliseconds until the selenium coating 14 is electrostatically charged, then grid 4 may be removed, if desired, through an appropriate slit 22 which preferably is of the type used with photographic plates so that light cannot enter box 10.

Image plate 6 simply functions to position a light pervious shield 7 (Fig. 4) bearing an opaque image 9, and accordingly, its specific structure is not significant, but preferably includes a frame 24 that can be slid into box 10 through a slit 26.

Light source 8, of course, can be of any conventional structure, provided it can direct a light beam through image plate 6 onto selenium plate 2.

With this structure, and after charging selenium plate 2, the light emanating from source 8 is passed through the image plate 6 causing selenium coating 14 to give up its charge at all positions, except where light is blocked by the opaque image 9.

In the disclosed embodiment, the charged plate 2 is then transferred (in a darkened room) to a dusting apparatus 28.

The dusting apparatus 28 comprises a holder 30 for the charged selenium plate 2, a grid clamp 32 and a carbon plate 34 all spaced apart in parallel planes. For experimental purposes, each of the latter two elements is adjustably positioned so that its relative distance with respect to the selenium plate 2 may be controlled.

The grid clamp 32 is mounted on a guide 36 which controls its lateral displacement in response to the turning of a screw 38 carried by screw base block 40. The grid clamp 32 is designed to position a grid 42 which comprises in a preferred embodiment an open mesh ($\frac{1}{16}$ – $\frac{1}{8}$ ") of Nichrome wires 33 of a fine diameter (preferably no greater than .003 inch). The grid 42 is provided with an electric lead 43 so that it may be connected in an electrical circuit.

Carbon clamp 34 is arranged to position a dusting plate 44 which comprises a flat, metal backing plate or electrode 46 covered by a silk or other cloth 48 saturated with a layer of carbon powder 50. The silk cloth 48 is employed since it aids in producing a uniform carbon coating

on the metal backing plate 46 thereby preventing localized corona from taking place.

In order for this apparatus to operate to perform a dusting function, the carbon powder must be charged, and accordingly, the backing electrode is provided with pig-tail 52 which may be connected to a potential source (not shown).

Carbon clamp 34 is mounted on a guide 54 which guides its lateral displacement in response to the turning of screw 53 by which it is threaded through the screw base block 40.

While in Fig. 2, the grid clamp 32 and the carbon clamp 34 are shown spaced a relatively great distance from the selenium plate, it should be pointed out that such expanded spacing has been used simply to show more clearly the operating features and principles of this invention, and that in practice, the best results are obtained when the selenium plate 2 is spaced about $\frac{1}{16}$ – $\frac{1}{4}$ inch from grid clamp 32, which in turn is held about $\frac{1}{16}$ – $\frac{1}{4}$ inch from carbon clamp 34.

This apparatus calls for the application of voltage to the carbon plate 44 and the grid 42. This voltage may be regulated through conventional electrical devices, and it has been found in a preferred embodiment, that very excellent results were obtained when the carbon plate 44 was held at -4000 volts while the grid 42 was held at 0 volt. Under these conditions, after charging voltage had been applied for approximately five milliseconds, the carbon powder was transferred to and through the grid 42, whereupon the powder would fly to the selenium plate and form a carbon image on the charged portions of the plate. (This is called a positive image.)

This method of dusting offers some marked advantages over the conventional dusting methods. Besides the advantages of good definition; low percentage of background dust; and, most important, a very rapid operation; this method avoids abraiding of the selenium plate, and in addition, no moving parts are involved, once the apparatus has been adjusted for optimum results.

With this structure, it is also possible to form a negative image on the charged selenium plate 2. Specifically, if the carbon plate is held at +4000 volts while the grid is held at 0 volt, then after the prescribed voltages have been applied for a few milliseconds, the carbon dust will fly from carbon plate to grid and then to selenium plate where the charged portion of the plate will repel the carbon dust while the uncharged portion will collect it, thereby forming a negative image.

It is important to note that with the structure described, the voltage differential between the carbon plate and the grid causes the carbon particles to be accelerated towards the grid, and to be driven through it to bombard the charged plate. Therefore, this structure provides a means for instantaneously dusting (developing) an exposed photosensitive plate. It should be noted further that carbon particles will fly toward the grid, and through it to the charged plate irrespective of whether the grid potential is higher or lower than that of the carbon plate.

In conventional xerographic printing installations, the photosensitive film (selenium in the disclosed embodiment) is deposited on an opaque metal backing plate, such as aluminum. Accordingly, the electrostatic charging, the exposing and the dusting operations must all be performed from the same, or film side of the backing plate. It follows that in conventional installations, the operating steps must be performed in sequence with some slight delay between steps. For example, with reference to Fig. 1, if the grid 4 were used for both the charging of plate 2, and as the charged grid during dusting, and it may be so used, then, in order for the apparatus to function, the grid 4 would be used to electrostatically charge plate 2, and then light would be directed from source 8 through image shield 6 to expose the plate 2. Incidentally, these operations could be performed si-

multaneously; i. e. plate 2 could be charged and exposed at the same time. In either event, image shield 6 would have to be slid out of slit 26 to be replaced by a carbon plate, such as plate 44, in order for the dusting operation to take place; hence a time delay.

With the embodiment of the invention as shown in Fig. 3, however, all three operations, that is, the charging, exposing and dusting operations can be performed simultaneously, since the photosensitive selenium coating can be charged and dusted from one side, and exposed from the other. This is accomplished, for example, by forming a coating 60 of selenium on a sheet of electrically conducting glass 62 (in one instance, a film of selenium thirty microns thick was evaporated in a vacuum onto conducting glass). A grid 64, effectively the same as grid 42 of Fig. 2, is placed between the selenium coated side of glass 62 and a carbon plate 66 which is substantially the same as the plate 44 shown in Fig. 2; and the image plate 68 is positioned on the glass side of the selenium coating, while a light source 70 is positioned to be directed through the image holder 68, and through the conducting glass 62 to strike the selenium layer 60.

With this structure, the selenium layer is simultaneously electrostatically charged by grid 64; exposed by light passing from source 70 through image shield 68, through conducting glass 62; and dusted by the carbon particles passing from carbon plate 66, through grid 64 to bombard the selenium and thereby form an image.

In the embodiment of Fig. 3, the number of wires in grid 64 should be a minimum; preferably parallel wires spaced not over $\frac{1}{8}$ inch apart. During the simultaneous charging, the exposing and dusting process, 3000 volts were applied to grid 64, while the carbon plate 66 and the selenium plate 60 were held at ground potential.

This glass backed selenium plate worked nearly as well as the metal backed sheet, except for a slightly higher background coating of carbon on the plate after dusting. However, this slight disadvantage is more than offset by the fact that the selenium can be exposed from either side.

It will be understood that in Fig. 3, a device such as the mounting frame 28 of Fig. 2 may be provided for adjusting the relative positions of the selenium plate 60, the grid 64, and the carbon plate 66 whereby the spacing of the members can be regulated in accordance with the voltage applied to them. In Fig. 3, for example, the selenium plate 60 should be spaced about $\frac{1}{4}$ inch from grid 64 which in turn should be spaced about $\frac{1}{4}$ inch from carbon plate 66.

With reference to the simultaneous process described, it should be understood that a conventional aluminum backed photosensitive film can be employed in place of the light pervious sheet 62; provided the image is directed at a slant towards the photosensitive film so as not to interfere with the charging and dusting apparatus.

While the term carbon powder has been used extensively in this specification, it should be understood that any other powder that could be moved by electrostatic means could be used.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a particular 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. It is the intention, therefore, to be limited only as indicated by the scope of the following claim.

What is claimed is:

70 A device for simultaneously electrostatically charging, exposing and developing a high resistance electrically conducting photosensitive film which has been deposited on one side of an electrically conducting light pervious sheet; comprising a light source positioned on the sheet side of said photosensitive film; an image plate positioned

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between said light source and said sheet whereby when light is directed through said image plate, a shadow may be directed through said sheet and onto said photosensitive film to form an image thereon; electrically conducting plate means positioned parallel to said photosensitive film and on the side thereof opposite said light source; means holding a supply of loose carbon particles on said plate; an electrically conducting grid positioned between said photosensitive film and said carbon particle means; and electrical connecting means for said sheet, said plate, and said grid so that said sheet and said plate may be held at ground potential while said grid is held at a higher potential whereby when light is passing from said source through said image holder and through said light pervious sheet onto said photosensitive film, carbon particles will be caused to fly from said carbon particle means through said grid to be deposited on the image portions of said film.

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