

Feb. 21, 1967

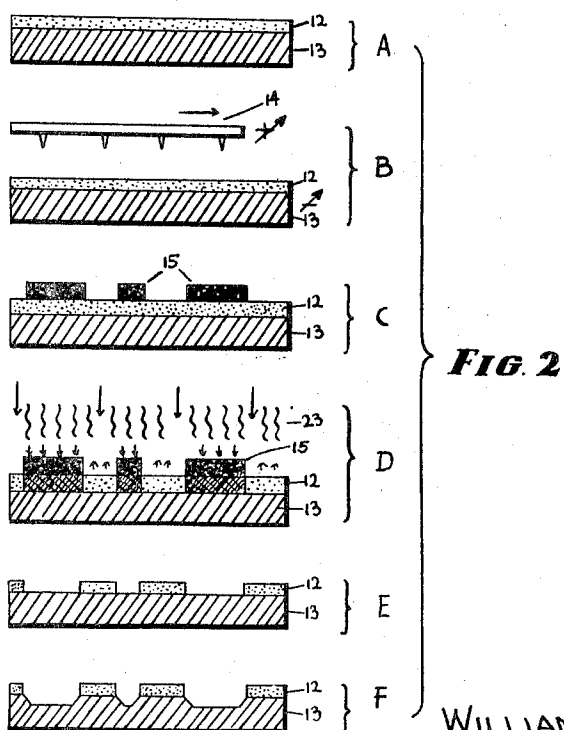
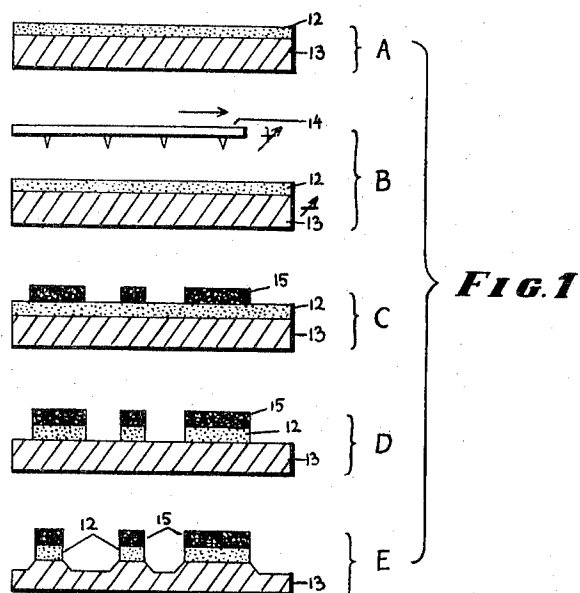
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3,305,359

MANUFACTURE OF PRINTING PLATES

Filed Oct. 4, 1962

4 Sheets-Sheet 1



INVENTOR  
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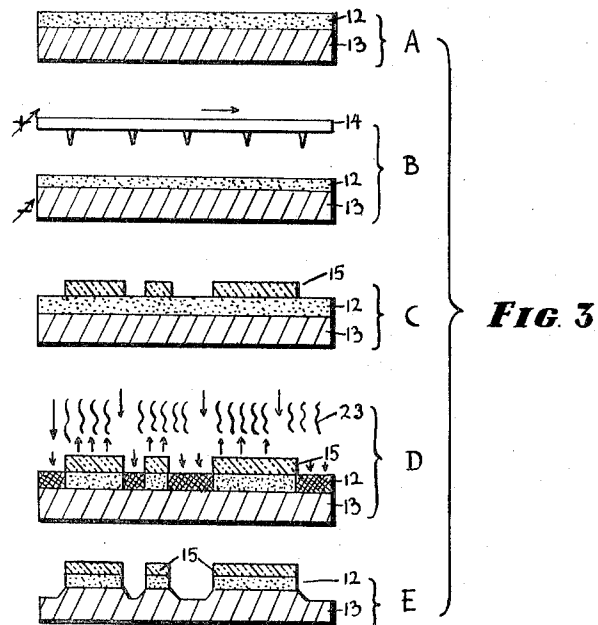
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MANUFACTURE OF PRINTING PLATES

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4 Sheets-Sheet 2



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MANUFACTURE OF PRINTING PLATES

Filed Oct. 4, 1962

4 Sheets-Sheet 3

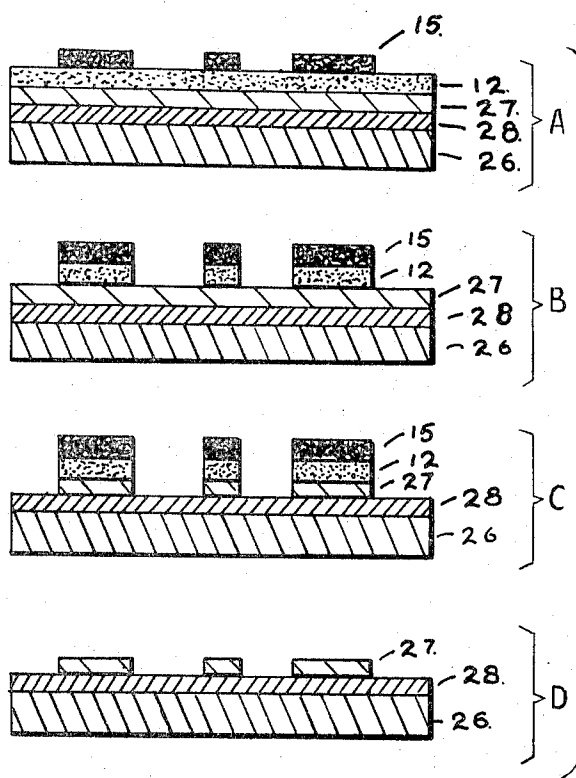


FIG. 4.

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MANUFACTURE OF PRINTING PLATES

Filed Oct. 4, 1962

4 Sheets-Sheet 4

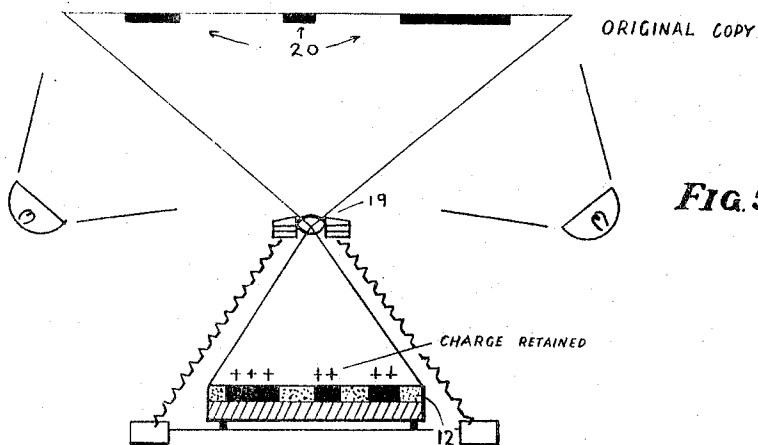


Fig. 5.

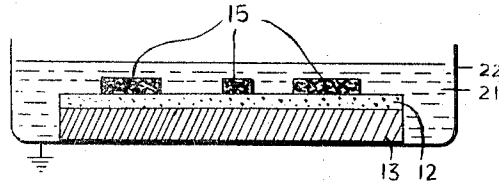


Fig. 6.

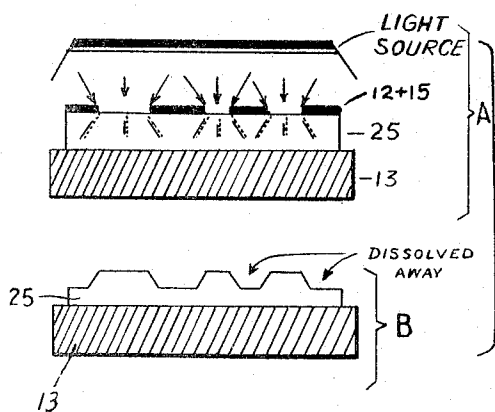


Fig. 7.

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1

3,305,359

## MANUFACTURE OF PRINTING PLATES

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Filed Oct. 4, 1962, Ser. No. 228,407

16 Claims. (Cl. 96—1)

This invention relates to a new and improved method of manufacturing a printing plate or like member comprising a precision differential pattern upon a base. More particularly, the invention relates to a new and improved plate-making method that utilizes a photoconductor film as the basic photographic element and that may be employed to produce either a positive image or a negative image of the original subject matter. This application is a continuation-in-part of the co-pending application of William G. Delmont, Serial No. 800,461, filed March 19, 1959 now abandoned.

The conventional method for manufacturing printing plates or similar differential patterned members begins with the production of a negative image of the original subject, by chemical means, on a silver halide photographic film or plate. This image is subsequently transferred, photographically, to a photosensitive layer of glue or plastic on a metal block. Usually, the block is formed of copper, zinc, magnesium, or aluminum. The photosensitive coating on the block is chemically treated, following exposure, and in some cases is heated, to produce an acid resist layer on the block. The block is then etched or otherwise treated, usually with acid, to serve as the final plate.

This process, although quite successful and in widespread use, requires utilization of expensive silver halide photographic materials and necessitates relatively long processing times for exposure, development, and chemical treatment of the resist. A very strong light source must be used to effect the necessary chemical change in the photosensitive layer used as the resist; the methods employed to prepare the resist coating on the base metal are relatively elaborate. The photosensitive coated plate must be used soon after preparation; moreover, there is always a possibility of loss of definition during the printing down process.

Other methods have previously been proposed for the manufacture of printing plates or similar members, utilizing the techniques of electrostatic photography. In one such proposal, for example, a powdered photoconductor material is suspended in a dielectric film-forming resin and the resulting composition is used to coat a base member. The resulting photoconductive matrix coating on the base member is charged and exposed to afford a latent electrostatic image which is subsequently developed by means of an electroscopic powder. This developed image is then heated or otherwise treated to fuse the powder to the coating, the fused developer and photoconductor affording an acid-resistant image. Thereafter, etching is effected to produce the desired printing plate.

In a process of this kind, there is a substantial tendency for the developer to migrate into the photoconductor matrix used as the photographic coating on the base member. The fusing or fixing of the image on the photoconductive layer tends to spread or smear the same. These two factors result in an inherent limitation upon the precision and clarity of the reproduced image as compared with the original. Furthermore, the fixing process required is time consuming and makes it difficult to carry out the manufacturing process by means of conventional process camera equipment.

It is a principal object of the present invention, therefore, to afford a new and improved method of producing a

2

printing plate or like precision differential patterned member, using electrostatic photographic techniques, that is effective to overcome the disadvantages and difficulties present in previously known methods.

5 A specific object of the invention is to prevent smearing or spreading of the image, in an electrostatic plate-making process, to thereby permit the manufacture of precise fine-mesh images that faithfully reproduce original copy in exact detail.

10 A specific object of the invention is to reduce the number of process steps in an electrostatic manufacturing technique for the production of precision printing plates by using a photoconductor directly as a resist in the process.

15 Another object of the invention is to eliminate entirely any heating, solvent treatment, or other fixing steps of the kind conventionally employed to retain a developed electrostatic image on a surface of a photoconductor in order to permit further processing of the image in the manufacture of a precision printing plate or the like.

20 An additional object of the invention is to afford a process for producing precision printing plates or the like, by electrostatic imaging techniques, in which the developer for the image is prevented from penetrating the photoconductor layer, thereby eliminating any loss of definition from this source.

25 A further object of the invention is to utilize a conventional process camera, but without silver halide materials, in an electrostatic process for the manufacture of precision printing plates or the like that is simple, quick, and inexpensive.

30 The method of manufacturing a printing plate or like member having a precision differential pattern on a base, according to the present invention, comprises coating a base with a very thin film of substantially pure photoconductor material preferably selected from the group consisting of selenium, sulphur, and tellurium. The film is preferably applied by vacuum deposition. The film should preferably be in the range of 0.1 to 5 microns in thickness. Selenium is the preferred photoconductor material. After the base is coated, an electrostatic charge image is produced on the surface of the aforementioned film by methods well known in the art of xerography. This image is developed with a developer that is resistant to an agent that attacks and removes the photoconductor in the undeveloped areas such as a solvent for the selenium or other photoconductor. After development, the photoconductor film is removed by said agent in areas not protected by the developer, leaving a photoconductor film image on the base that is a precise reproduction of the charge image. During the removal step, the developer remains on the surface of the photoconductor film as deposited, by electrostatic attraction and without requiring fusing of the developer to the photoconductor or any other additional bonding of a nature tending to increase attachment of the developer image to either the photoconductor or the base. The developer does not penetrate the inherently non-porous photoconductor film, but remains solely on the surface thereof. After removal of the photoconductor, etching or other treatment may be effected with respect to the exposed surface of the base.

60 In a particular embodiment of the present invention, the developer employed is one having a substantially different absorption characteristic, with respect to infra-red radiation, than the photoconductor film, which in this instance, is selenium. After development, the image is irradiated with infra-red radiation to heat the developed and undeveloped portions of the film differentially in accordance with their differing absorption characteristics. Irradiation is continued until the more absorptive of the developed and undeveloped portions is heated to the crystallization temperature of selenium and converted to crys-

3

talline form but is discontinued before the less absorptive portion of the film is crystallized. After irradiation, the developed film is treated with an agent that attacks and removes either the crystalline form or the amorphous form of selenium but that does not attack other form of selenium, leaving a selenium film image on the base that is a precise reproduction of the image pattern.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration show preferred embodiments of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention.

In the drawings:

FIG. 1 is a series of sectional views of an etched relief printing plate at various stages during its preparation according to the first embodiment of this invention;

FIG. 2 is a series of sectional views of an etched printing plate at various stages during its preparation according to a second embodiment of this invention;

FIG. 3 is a series of sectional views of an etched printing plate at various stages during its preparation according to a further embodiment of this invention in which the order of operations is changed;

FIG. 4 is a series of sectional views of an offset plate at various stages during its preparation according to another embodiment of this invention;

FIG. 5 is a partially schematic sectional view of an apparatus for projecting an optical image upon a charged printing base;

FIG. 6 is a partially schematic sectional view of an apparatus for developing an electrostatic image upon the printing base of FIGS. 1, 2, 3 and 4; and

FIG. 7 shows two sectional views of the invention applied by using a plastic base.

Similar reference characters are applied to similar elements throughout the drawings, and the steps in the series of views in FIGS. 1, 2, 3 and 4 are grouped in an alphabetical manner.

#### *Relief printing plates—Method I*

The initial embodiment of the invention may best be understood by reference to FIG. 1, taken in conjunction with FIGS. 5, 6 and 7. In the preparation of a relief printing plate, a metal sheet 13 (see FIG. 1A) of suitable thickness is cleaned of all surface contamination by well known methods, such as solvent cleaning action, to remove grease and the like. Further cleaning follows, using detergents to remove the last traces of grease and oils, stains, dust and grit. After thorough rinsing in filtered water, the excess water is removed by rinsing in acetone and the plate is dried with a warm current of air.

The printing plate can be made from any suitable metal 13 such as zinc, magnesium and the like. After cleaning, as described above, it is ready for application of a photoconductive layer 12.

The photoconductive layer 12 ideally should be a perfect insulator in the dark. In practice, photoconductors with a resistivity within the range of  $10^6$  to  $10^{10}$  ohm centimeters from surface to base plate have been found suitable. Furthermore, an ideal material for photoconductive layer 12 is one which becomes a good conductor on exposure to illumination. Another significant property is the speed with which the resistance drop is obtained on exposure to illumination.

A preferred photoconductor with a suitable combination of dark resistivity, light resistivity and speed when in the form of a thin film is amorphous selenium. Effective results may also be achieved with thin films of amorphous sulphur or tellurium, or mixtures of these elements.

4

The present invention preferably uses a thin selenium coating as the photoconductor medium. On the other hand, photoconductor matrices of the kind comprising photoconductive particles, such as zinc oxide, suspended in a resin or other binder, are not suitable for the present invention. Such photoconductive materials are too porous for the method of the invention, and do not give the high clarity and definition desired.

The selenium film 12 is most advantageously deposited on base 13 by the well-known vacuum deposition method to a thickness just sufficient to afford a continuous photoconductor layer. The film should have a thickness of not greater than 25 microns. To realize the full advantages of the invention with respect to economy, high resolution and consistent results, however, a coating in the order of 0.1 to 5 microns should be used. The extremely thin coating is more economical, it gives higher resolution, is free from artifacts and aids the selective removal by removal of the non-image areas.

The prepared selenium-coated metal plate is now ready for exposure.

As shown in FIG. 1B, the base 13 is grounded and an electrostatic charging device 14 is passed over the selenium film 12, in suitable safe-light conditions, to provide an overall uniform electrostatic charge thereon. The charging device may comprise an array of pointed electrodes 14 mounted on a movable insulated device so that it can be passed back and forth over the grounded selenium-coated metal plate.

A high voltage D.C. source is connected to the charging device 14 to provide the necessary charge on selenium film 12. The voltage should be sufficient to cause a corona discharge adjacent to the electrodes. The apparatus and process may produce an overall negative or positive charge, depending on the polarity of the electrodes 14 with respect to the base metal 13. The selection of polarity is dependent upon the developer employed in the process.

The next step in the process is to discharge selected parts of the charged surface of film 12 in order to produce an electrostatic image thereon. Referring to FIG. 5, this may be accomplished by exposing the photoconductor layer 12 to an optical image represented by original copy 20. The optical image is focused, by means of a lens 19, on to the charged surface of the selenium film 12. Wherever the light strikes the surface of the photoconductive coating 12, the electrostatic charge thereon is reduced in direct proportion to the light received. This leaves an electrostatic image or pattern of charges corresponding to the light and dark portions of original image 20.

The electrostatic image can now be developed with a material which subsequently prevents the solvents of the photoconductor 12, in this instance amorphous selenium, from removing the photoconductive layer 12 immediately below the image.

Referring to FIG. 6, development is accomplished by immersing the exposed photoconductive plate into a container 22. Container 22 can be of metal or the like and is electrically grounded. Receptacle 22 contains an electrostatic developer liquid 21 having developer particles suspended or dispersed therein.

Any powder which forms a stable suspension in any electrically suitable liquid or mixture of liquids can be used for development. By first grinding these powders with resin or oil binders and then dispersing them in the developer liquids they become the means of producing a visible image that is also a resist for subsequent processing of the printing plate.

The particles of the developer may be between 0.01 micron and 100 microns in diameter. However, when very high resolution is required, the particle size may be within the range of 0.01 micron and 0.5 micron in diameter. With suitable mixtures of powders and resins, agglomerates of particles can be made which give very dense developed images.

5

The electrostatic liquid developer 21 thus can be prepared by grinding a pigment in a suitable resin or the like. The resulting particle mixture is subsequently dispersed in an insulating fluid, for instance, a liquid hydrocarbon or chlorinated hydrocarbon, which has a volume resistivity of greater than  $10^{10}$  ohms centimeters.

The electrostatic liquid developers are now well known; however, for the purpose of illustration of this invention, a useful electrostatic developer may consist of 5 grams of pigment, say carbon black of 200 mesh size, thoroughly ground in 100 grams of rubber solution and then dispersed in a hydrocarbon mixture.

By gentle agitation, development is complete when the electrostatic charges on film 12 have been satisfied.

The developed plate is now removed from the container 22. After rinsing or draining, excess insulating liquid may be removed by a warm current of air. This stage of the process is illustrated in FIG. 1C, with the developer 15 deposited on the surface of selenium film 12.

The non-image areas of the photoconductive layer 12 are now dissolved by means of carbon bisulphide or other suitable solvents, with no further treatment of the developed image required. That is, the removal of non-image portions of the photoconductor is not dependent upon fusing of the developer to the photoconductor or to the base by heat or chemical treatment, as in most previously known photoconductive plate-making processes. Moreover, there is no adherence of the developer by absorption thereof into the photoconductor layer 12, since film 12 is a non-porous elemental coating that the developer cannot penetrate.

Referring to FIG. 1D, the metal base plate 13 is now bared in the non-image areas, due to the removal of the selenium layer 12 from the non-image areas. A surface is now produced which has the image formed, physically, in selenium film 12. However, selenium, in the amorphous form, is resistant to the action of acids such as dilute nitric acid which are suitable for etching zinc-metal 13, assuming that to be the base metal.

The principle of relief plate making in this invention is thus greatly improved, since the image is produced directly on the plate itself and is etched without the need of any transfer of the image from one medium to another. In conjunction with an improved etching technique known as powderless etching, it is possible to etch the plate to completion in one single etch without need for complicated and time consuming hand etching techniques. The fully etched plate is shown in FIG. 1E.

The developer 15, which was deposited in the form of the electrostatic image on the selenium, may be left in place throughout etching or further treatment. Alternatively, the developer can be removed quite readily with a suitable solvent. The developer is not the resist for the etching step in the process; the resist is the selenium film 12.

The process described above for producing printing plates is accomplished simply, quickly and easily with a minimum amount of equipment, skill and effort. In a typical production set-up, excluding the coating process for the selenium or other photoconductor film 12, the steps of charging the photoconductor, producing an electrostatic image thereon, developing the image with liquid developer, and dissolving away the non-image areas ready for the etching bath require only fifteen to twenty minutes.

Because film 12 is a continuous, non-porous coating, the developer does not penetrate the photoconductor, avoiding any tendency toward spreading or migration of the image prior to etching. The developed image adheres to the selenium film primarily by electrostatic attraction, giving a clear, sharp reproduction of the original. Elimination of conventional baking or other fixing procedures avoids "smearing" from this source. The selenium film

6

is both an imaging element and a resist, affording a substantial saving in time and money as compared with conventional photographic processes. Nevertheless, etching can be carried out in conventional process equipment.

#### Relief printing plates—Method II

Referring to FIG. 2, a printing plate or like precision pattern can be prepared along similar lines by the method of this invention. The same kind of base metal 13 is coated in the same way with an elemental photoconductor film 12 (FIG. 2A) and charged by the same charging device 14 as before (FIG. 2B). After exposure and development with a developer containing suitable particles, such as carbon black, which have the property of infra-red radiation absorption (FIG. 2C), infra-red radiations 23 are applied to the developed electrostatic image 15. The radiations are continued long enough to cause the selenium underlying the developed image to change from the amorphous form to the hexagonal or crystalline form, but radiation is discontinued before the non-image areas of the selenium coating are thus converted in form.

The crystalline form of selenium does not act as a resist to the reagents used for the etching of the base metal 13.

The process of Method II, like that of Method I, is simple, efficient, and inexpensive. It reduces the handling and processing required by conventional silver halide photographic techniques, yet can be used to produce fine mesh plates with sharp definition that faithfully reproduce the original copy.

#### Relief printing plates—Method III

Referring to FIG. 3, a typographic printing block may be made by the method of this invention. The metal plate 13 is coated as before with a photoconductive selenium film 12 (FIG. 3A). After charging (FIG. 3B) and exposing, the plate is developed with a developer 15 (FIG. 3C) which has suitable particles suspended in the electrically insulating liquid of such kind as to reflect the infra-red radiations 23 (FIG. 3D). Any developer comprising relatively highly reflective particles, such as zinc oxide, can be used.

The developed plate is now exposed to infra-red radiation for a time and at an intensity sufficient to change the non-image areas of selenium coating 12 to the crystalline form. Radiation is cut off, however, before the reflective image areas are so converted. Thus, the non-image areas of selenium film 12 are changed from the amorphous to the crystalline or hexagonal form of selenium and the image areas are protected from the infra-red radiations.

The crystallized non-image areas of the changed selenium are removed by etching, along with the surface portion of the base metal, to form a printing block (FIG. 3E). The detailed steps of this procedure are as described above.

As the crystalline form of selenium is not ordinarily soluble in sulphide solution or the like, these images in FIGS. 2 and 3 can be reversed by dissolving away the unchanged amorphous selenium, using an etching solution, or the like, which does not attack the crystalline form of selenium.

#### Plastic plate—Method IV

In the embodiment illustrated by FIG. 7, a photosensitive plastic plate 25 is used, on which is deposited a selenium layer 12. An electrostatic image is formed on this layer as described under the relief printing plate embodiments.

This is processed to a letterpress or like plate by exposing the photosensitive plastic between the image areas to a strong light source.

The exposed portion of the plate is polymerized and thus becomes insoluble to certain solutions, such as an alcohol solution. When the plate is subsequently sub-

jected to solvent action the unpolymerized portions are removed and the surface remains in a form similar to a conventional letterpress plate.

According to this form of the invention, it is possible, for instance, to have a sheet of photopolymerizable substance coated with an electrophotographic layer, to charge this layer and expose it directly in the camera, thereby eliminating the usual step of producing a silver halide or other transparency to make the copy. Further, this layer may be developed very rapidly, in the manner of electrophotography, with liquid developers.

It is possible, for instance, to develop the electrophotographic image directly on the photopolymerizable layer to form a patterned light mask or heat mask 12, 15 (FIG. 7A) and then to expose the layer to more intense light or heat to cause polymerization in the selected areas.

The layer is then treated with solvents which preferentially remove the unpolymerized material, in some cases with electrostatic fields to assist in removal. A precision relief image results which may be used for decorative or for printing purposes.

The photopolymerizable element 25 may comprise a polymerizable ethylenically unsaturated compound, capable of forming a high polymer, and a polymerization activator. Developing solvents may be a blend of ethyl acetate and ethanol. An element may comprise nylon glue, or other photopolymerizable plastics.

The photoconductor, as in the previous embodiments may comprise amorphous selenium, sulphur, or tellurium or mixtures thereof, deposited in a very thin film in amorphous elemental form. Matrix photoconductors, such as zinc oxide or other particles in a resin binder, are not desirable. The selenium may be vacuum-evaporated on to the surface of the photopolymerizable element so as to provide the necessary electrophotographic property in a thin non-porous, continuous film.

It is possible to develop the electrophotographic image with a catalyst or activator which will activate polymerization in the image areas. It is possible also to use the electrophotographic image as a mask for solvent vapour or droplet attack on the element 25 so as to obtain selective removal of the element.

The process has the specific advantage of forming a dot or line tapering to a broad base within the photopolymerizable element, thus reinforcing the dot or line and giving it longer life than was possible heretofore. A further advantage, common to the other embodiments, is high resolution because of the close contact of the selenium film image with the base element 25 and because of direct exposure in the camera. A further advantage is increased speed because of direct exposure in the camera and use of the electrophotographic process.

#### Offset plate—Method V

In the embodiment shown in FIG. 4 a selenium or other amorphous elemental photoconductor film 12 is deposited, as described above, on to a laminated plate, consisting of a sheet of metal 26 such as steel, having a layer of chromium 27 or the like formed on a layer of copper 28 or the like to bond it to the sheet of metal 26, the materials being selected to be suitable for off-set work (see FIG. 4A).

An electrostatic image is produced on this plate and developed in the same way as the previous images. The non-image areas are removed by solution, as in Method I, to produce the configuration shown in FIG. 4B. The selenium image then becomes the grease or ink receptive area and the chromium 27 the water receptive area. The resulting plate meets the basic requirements of offset printing.

Alternatively, the selenium can be used as an acid resist, while the upper layer 27 is etched or dissolved away (FIG. 4C). The selenium can then be removed by solu-

tion and the finished plate (FIG. 4D) prepared for offset printing.

#### Offset plate—Method VI

The etched plate of Method V can be further treated to make it suitable for off-set printing by filling in or otherwise treating the etched areas. Instead of etching, those portions where the selenium or other photoconductor has been removed may be treated with a hydrophilic or a hydrophobic agent, or the selenium-protected areas may be so treated.

From the foregoing description, it will be seen that there are a number of important features that are common to all of the described embodiments of the present invention. First and foremost, the photoconductor coating on the base member must be a thin continuous film. Such a film is inherently non-porous and prevents penetration by the developer in the subsequent development step. This characteristic of the invention may conveniently be achieved with any of the three photoconductors, selenium, sulphur, and tellurium, suitable for use in the inventive process. Of these three photoconductors, the best results are achieved with selenium, but selenium can be used in a mixture with one or both of the other photoconductors, or other photoconductors can be employed if desired.

It is also important to note that, in each embodiment of the invention, the developer remains on the surface of the selenium or other photoconductor film by static adherence and is not fused or otherwise bonded to the photoconductor film. Elimination of the conventional fusing or other bonding steps prevalent in the prior art avoids substantial loss of definition that frequently occurs as a result of melting or flowing of the developer material. Furthermore, if an error is detected in the incomplete plate, prior to final etching or other final processing, it is a simple matter to wipe off the developed image and re-process the plate. This gives a substantial saving in many instances and also makes it possible to re-touch the plate quickly and conveniently. Of course, this can be done only because the photoconductor is a continuous, non-porous film not penetrated by the developer.

In any of the foregoing processes, any suitable developer material that does not attack the photoconductor chemically and does not dissolve it or dissolve in it can be utilized. In the production of etched plates, of course, the various embodiments of the process afford an inherent saving with respect to conventional chemical manufacturing techniques, since the only photographic image required is the electrostatic image on the photoconductor, which is itself used as the resist for the final etching or similar treatment. Furthermore, the above processing can be carried out with conventional process equipment already available in most photoengraving shops.

Hence, while preferred embodiments of the invention have been described and illustrated, it is to be understood that they are capable of variation and modification.

What I claim is:

1. A method of producing a printing plate or like member having a precision differential pattern in a base, comprising:
  - coating a base with an extremely thin, impermeable, continuous film of substantially pure elemental photoconductor material;
  - producing an electrostatic charge image on the surface of said film by selectively exposing said film in accordance with a desired image pattern;
  - developing said charge image by contacting said film with a suspension of fine developer particles and a binder in an insulating fluid to deposit said developer particles electrostatically on said image, said developer particles being resistant to an agent that attacks said elemental photoconductor, to afford a dense coating for said charge image that adheres to but does not penetrate said film;

and pre-etching the photoconductor coating by removing the photoconductor coating by means of said agent, in areas not protected by said developer, leaving a photoconductor image on said base, said developer remaining on said photoconductor coating as deposited, and without any additional bonding of a nature tending to increase attachment of the developer image to the photoconductor or the base, during pre-etching.

2. A method of producing a printing plate or like member according to claim 1, including the additional step of removing the developer from said photoconductor image following pre-etching thereof.

3. A method of producing a printing plate or like member having a precision differential pattern in a base, comprising:

- coating a base with an extremely thin, impermeable, continuous film of substantially pure elemental photoconductor material;
- producing an electrostatic charge image on the surface of said film by selectively exposing said film in accordance with a desired image pattern;
- developing said charge image by contacting said film with a suspension of fine developer particles and a binder in an insulating fluid to deposit said developer particles electrostatically on said image, said developer particles being resistant to an agent that attacks said elemental photoconductor, to afford a dense coating for said charge image that adheres to but does not penetrate said film;
- pre-etching the photoconductor coating by removing the photoconductor coating by means of said agent, in areas not protected by said developer, leaving a photoconductor image on said base, said developer remaining on said photoconductor coating as deposited, and without any additional bonding of a nature tending to increase attachment of the developer image to the photoconductor or the base, during pre-etching;
- and thereafter chemically treating the exposed areas of said base with a reagent that reacts with said base but to which said photoconductor is substantially resistant, to produce a differential pattern in said base that is a precise reproduction of said image pattern.

4. A method of manufacturing a printing plate or like member having a precision differential pattern on a base, comprising:

- coating a base by depositing thereon an extremely thin, impermeable, continuous film of substantially pure elemental photoconductor material;
- producing an electrostatic charge image on the surface of said film;
- developing said charge image by contacting said film with a suspension of fine developer particles and a binder in an insulating fluid to deposit said developer particles electrostatically on said image, said developer particles being substantially insoluble in a given solvent for said elemental photoconductor, to afford a dense coating for said charge image that adheres to but does not penetrate said film;
- and dissolving away the photoconductor film in said solvent, in areas not protected by said developer, leaving a photoconductor film image on the surface of said base that is a precise reproduction of said charge image, said developer remaining on the surface of said film as deposited, by electrostatic attraction and without any additional bonding of a nature tending to increase attachment of the developer image to the photoconductor or to the base, during the dissolving step.

5. A method of producing a printing plate or like member having a precision differential pattern on a base, comprising:

- coating a base with an extremely thin impermeable continuous film of substantially pure elemental photoconductor material;

- producing an electrostatic charge image on the surface of said film by selectively exposing said film in accordance with a desired image pattern;
- developing said charge image by contacting said film with a suspension of fine developer particles and a binder in an insulating fluid to deposit said developer particles electrostatically on said image, said developer particles being substantially insoluble in a given solvent for said elemental photoconductor, to afford a dense coating for said charge image that adheres to but does not penetrate said film;
- pre-etching the photoconductor film by dissolving away the photoconductor film in said solvent, in areas not protected by said developer, leaving a photoconductor image on said base, said developer remaining on the surface of said photoconductor film as deposited by electrostatic attraction and without any additional bonding of a nature tending to increase attachment of the developer image to the photoconductor or the base, during pre-etching;
- and thereafter treating the exposed areas of said base with an agent that is effective to alter the exposed surface of said base but to which said photoconductor is substantially resistant, to produce a differential pattern on said base that is a precise reproduction of said image pattern.

6. A method of producing a printing plate or like member having a precision differential relief pattern in a base, comprising:

- coating a base with an extremely thin, impermeable, continuous film of substantially pure elemental photoconductor material;
- producing an electrostatic charge image on the surface of said film by selectively exposing said film in accordance with a desired image pattern;
- developing said charge image by contacting said film with a suspension of fine developer particles and a binder in an insulating fluid to deposit said developer particles electrostatically on said image, said developer particles being substantially insoluble in a given solvent for said elemental photoconductor, to afford a dense coating for said charge image that adheres to but does not penetrate said film;
- pre-etching the photoconductor film by dissolving away the photoconductor film in said solvent, in areas not protected by said developer, leaving a photoconductor image on said base, said developer remaining on the surface of said photoconductor film as deposited by electrostatic attraction and without any additional bonding of a nature tending to increase attachment of the developer image to the photoconductor or the base, during pre-etching;
- and etching said base, using an etchant to which said photoconductor is substantially resistant, to produce a differential relief pattern in said base that is a precise reproduction of said image pattern.

7. A method of producing a printing plate or like member having a precision differential pattern on a base, comprising:

- coating a base with a thin, continuous film of amorphous photoconductive selenium;
- producing an electrostatic charge image on the surface of said film by selectively exposing said film in accordance with a desired image pattern;
- developing said charge image with a developer having a substantially different absorption characteristic with respect to infra-red radiation than said selenium film;
- irradiating the developed image with infra-red radiation to heat the developed and undeveloped portions of the selenium film differentially in accordance with their differing absorption characteristic, and maintaining such irradiation until the more absorptive of the developed and undeveloped portions is heated

11

to the crystallization temperature of selenium and converted to crystalline form;  
 discontinuing said irradiation before the less absorp-  
 tive portion of the film is crystallized;  
 said developer remaining on the surface of said sele-  
 nium film as deposited, by electrostatic attraction and  
 without any additional bonding of a nature tending  
 to increase attachment of the developer image to the  
 selenium or to the base throughout the foregoing  
 steps;  
 and thereafter treating the developed film with an agent  
 that attacks and removes one of the crystalline and  
 amorphous forms of selenium but that does not at-  
 tack the other form of selenium, leaving a selenium  
 image on said base that is a precise reproduction  
 of said image pattern.

8. A method of producing a printing plate or like mem-  
 ber according to claim 7, including the additional step of  
 treating the exposed uncoated areas of said base with an  
 agent that is effective to alter the exposed surface of the  
 base but to which said selenium image is substantially re-  
 sistant.

9. A method of producing a printing plate or like mem-  
 ber having a precision differential pattern on a base, com-  
 prising:  
 coating a base with a thin, continuous film of amor-  
 phous photoconductive selenium;  
 producing an electrostatic charge image on the surface  
 of said film by selectively exposing said film in ac-  
 cordance with a desired image pattern;  
 developing said charge image with a developer substan-  
 tially more absorptive with respect to infra-red  
 radiation than said selenium film;  
 irradiating the developed image with infra-red radia-  
 tion to heat the developed image, including the un-  
 derlying portions of the selenium film, at a more  
 rapid rate than the non-image portions of said film,  
 and maintaining such irradiation until the devel-  
 oped portions of said film are heated to the crystal-  
 lization temperature of selenium and converted to  
 crystalline form;  
 discontinuing said irradiation before the non-image por-  
 tions of the film are crystallized;  
 said developer remaining on the surface of said sele-  
 nium film as deposited, by electrostatic attraction and  
 without any additional bonding of a nature tending  
 to increase attachment of the developer image to the  
 selenium or to the base throughout the foregoing  
 steps;  
 and dissolving away the crystallized image portions of  
 the selenium film, and the developer, in a solvent  
 that does not attack the amorphous selenium, leav-  
 ing a selenium image on said base that is a precise  
 reproduction of said image pattern.

10. A method of producing a printing plate or like  
 member according to claim 9, including the additional  
 step of etching said base, using an etchant to which amor-  
 phous selenium is substantially resistant, to produce a  
 relief pattern in said base that is a precision reproduc-  
 tion of said image pattern.

11. A method of producing a lithographic printing  
 plate, having a precision differential pattern on a base,  
 comprising:  
 preparing a laminar base structure comprising a sur-  
 face layer superimposed upon a base layer, one of  
 said layers being hydrophobic and the other being  
 hydrophilic;  
 depositing an extremely thin, impermeable, continu-  
 ous film of substantially pure photoconductive sele-  
 nium on said surface layer;  
 producing an electrostatic charge image on the surface  
 of said film by selectively exposing said film in ac-  
 cordance with a desired image pattern;  
 developing said charge image by contacting said film  
 with a suspension of fine developer particles and a

12

binder in an insulating fluid to deposit said developer  
 particles electrostatically on said image, said devel-  
 oper particles being substantially insoluble in a given  
 solvent for said selenium, to afford a dense coating  
 for said charge image that adheres to but does not  
 penetrate said film;  
 pre-etching the selenium film by dissolving away the  
 selenium film in said solvent, in areas not protected  
 by said developer leaving a selenium image on said  
 surface layer, said developer remaining on the sur-  
 face of said film as deposited by electrostatic attrac-  
 tion and without any additional bonding of a nature  
 tending to increase attachment of the developer im-  
 age to the selenium film or to the surface layer,  
 during pre-etching;  
 etching said surface layer with an etchant to which  
 the selenium is substantially resistant, to expose said  
 base layer in non-image areas;  
 and thereafter removing said developer and the re-  
 maining image areas of said selenium film to ex-  
 pose the remaining image areas of said surface layer.

12. A method of producing a lithographic printing  
 plate, having a precision differential pattern on a base,  
 comprising:  
 coating a base having an ink-receptive surface with a  
 continuous layer of hydrophilic material;  
 vacuum-depositing an extremely thin, impermeable,  
 continuous film of substantially pure photoconduc-  
 tive selenium on said hydrophilic layer;  
 producing an electrostatic charge image on the surface  
 of said film by selectively exposing said film in ac-  
 cordance with a desired image pattern;  
 developing said charge image by contacting said film  
 with a suspension of fine developer particles and a  
 binder in an insulating fluid to deposit said developer  
 particles electrostatically on said image, said devel-  
 oper particles being substantially insoluble in a given  
 solvent for said selenium to afford a dense coating  
 for said charge image that adheres to but does not  
 penetrate said film;  
 pre-etching the selenium film by dissolving away the  
 selenium film in said solvent, in areas not protected  
 by said developer, leaving a selenium image on said  
 base, said developer remaining on the surface of said  
 film as deposited by electrostatic attraction and with-  
 out any additional bonding of a nature tending to  
 increase attachment of the developer image to the  
 selenium film or to the hydrophilic layer, during pre-  
 etching;  
 etching said hydrophilic layer using an etchant to  
 which the selenium is substantially resistant, to ex-  
 pose said ink-receptive surface of said base in non-  
 image areas;  
 and thereafter removing said developer and the remain-  
 ing image areas of said selenium film to expose the  
 remaining image areas of said hydrophilic layer.

13. A method of producing a printing plate or like  
 member having a precision differential relief pattern in a  
 base, comprising:  
 coating a base by depositing thereon an extremely  
 thin, impermeable, continuous film of substantially  
 pure photoconductive selenium, said base comprising  
 a photopolymerizable plastic;  
 producing an electrostatic charge image on the surface  
 of said film by selectively exposing said film in  
 accordance with a desired image pattern, the in-  
 tensity and duration of exposure being insufficient to  
 effect substantial polymerization of said base;  
 developing said charge image by contacting said film  
 with a suspension of fine developer particles and a  
 binder in an insulating fluid to deposit said developer  
 particles electrostatically on said image, said devel-  
 oper particles being substantially insoluble in a  
 given solvent for said selenium, to afford a dense

13

14

- coating for said charge image that adheres to but does not penetrate said film;
- pre-etching the selenium film by dissolving away the film in said solvent, in areas not protected by said developer, leaving a selenium image on said base, said developer remaining on the surface of said film as deposited by electrostatic attraction and without any additional bonding of a nature tending to increase attachment of the developer image to the selenium or to the base, during pre-etching;
- exposing the developed and pre-etched image to relatively intense radiation to polymerize the non-image portions of said plastic base;
- and thereafter treating said base with a solvent to remove the unpolymerized portions thereof, and removing the remaining portions of said selenium film, and the developer, to produce a differential relief pattern in said base that is a precision reproduction of said image pattern.
14. A method of producing a printing plate or like member having a precision differential pattern on a base, comprising:
- coating a base with a thin, impermeable, continuous film of substantially pure photoconductor material from the group consisting of selenium, tellurium and sulphur, in an amorphous elemental form, said film having a thickness of the order of 5 microns or less;
- producing an electrostatic charge image on the surface of said film by selectively exposing said film in accordance with a desired image pattern;
- developing said charge image by contacting said film with a suspension of fine developer particles and a binder in an insulating fluid to deposit said developer particles electrostatically on said image, said developer particles being substantially insoluble in a given solvent for said elemental photoconductor material, to afford a dense coating for said charge image that adheres to but does not penetrate said film;
- pre-etching the photoconductor film by dissolving away the photoconductor film in said solvent, in areas not protected by said developer, leaving a photoconductor image on said base, said developer remaining on the surface of said photoconductor film as deposited by electrostatic attraction and without any additional bonding of a nature tending to increase attachment of the developer image to the photoconductor, or the base, during pre-etching;
- and thereafter treating the exposed areas of said base with an agent that is effective to alter the exposed surface of said base but to which said photoconductor is substantially resistant, to produce a differential pattern on said base that is a precise reproduction of said image pattern.
15. A method of producing a printing plate or like member having a precision differential relief pattern in a base, comprising:
- coating a base with a continuous, impermeable film of amorphous selenium to a thickness of the order of 0.1 to 5 microns;
- producing an electrostatic charge image on the surface of said film by selectively exposing said film in accordance with a desired image pattern;
- developing said charge image by contacting said film with a suspension of fine developer particles and a

- binder in an insulating fluid to deposit said developer particles electrostatically on said image, said developer particles being substantially insoluble in a given solvent for said selenium, to afford a dense coating for said charge image that adheres to but does not penetrate said film;
- pre-etching the film by dissolving away the film in said solvent, in areas not protected by said developer, leaving a selenium image on said base, said developer remaining on the surface of said selenium film as deposited by electrostatic attraction and without any additional bonding of a nature tending to increase attachment of the developer image to the selenium or the base, during pre-etching;
- and etching said base, using an etchant to which amorphous selenium is substantially resistant, to produce a differential relief pattern in said base that is a precise reproduction of said image pattern.
16. A method of producing a printing plate or like member having a precision differential pattern on a base, comprising:
- coating a base by vacuum-depositing thereon a thin, continuous film of substantially pure amorphous elemental selenium having a thickness of less than 5 microns;
- producing an electrostatic charge image on the surface of said film by selectively exposing said film in accordance with a desired image pattern;
- developing said charge image with a developer having a substantially different absorption characteristic with respect to infra-red radiation than said selenium film;
- irradiating the developed image with infra-red radiation to heat the developed and undeveloped portions of the selenium film differentially in accordance with their differing absorption characteristics, and maintaining such irradiation until the more absorptive of the developed and undeveloped portions is heated to the crystallization temperature of selenium and converted to crystalline form;
- discontinuing said irradiation before the less absorptive portion of the film is crystallized;
- and thereafter treating the developed film with an agent that attacks and removes one of the crystalline and amorphous forms of selenium but that does not attack the other form of selenium, leaving a selenium image on said base that is a precise reproduction of said image pattern,
- said developer remaining on the surface of said selenium film without penetration thereof and without fixing thereto throughout the process.

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