No. 648,854. Patented May 1, 1900.

E. H. DANIEL.

PRODUCING ENGRAVED PLATES.

(Application filed Nov. 11, 1899.)

(No Model.) 2 Sheets—Sheet 1.

FIG. I.

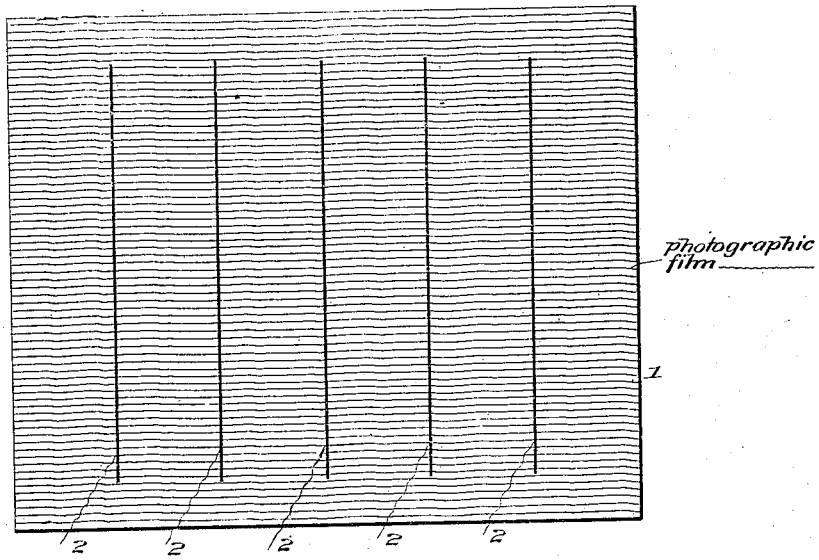
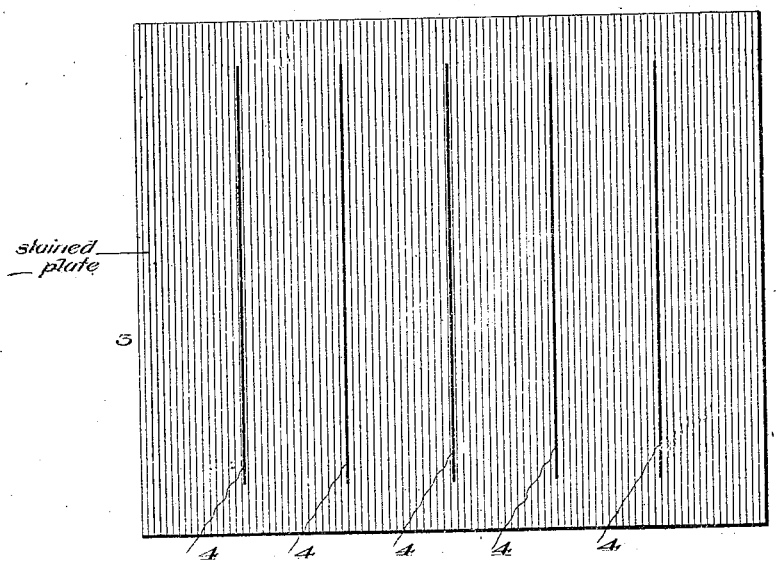


FIG. II.



Witnesses.
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(No Model.) 2 Sheets—Sheet 2

FIG. III.

FIG. IV.

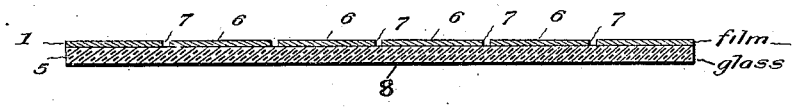


FIG. V.

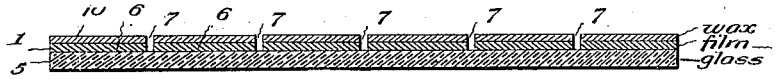


FIG. VI.

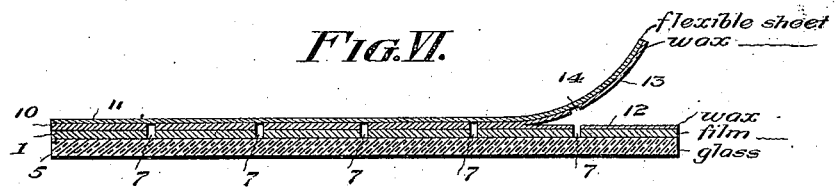


FIG. VII.

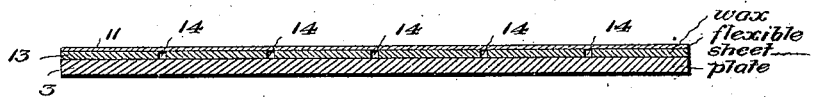


FIG. VIII.

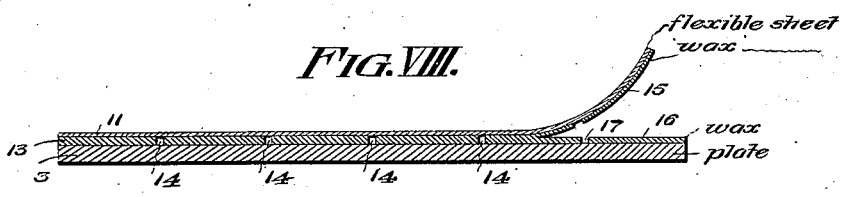
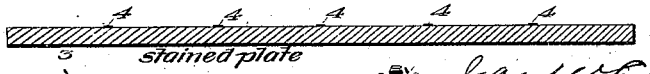


FIG. IX.



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THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ERNEST H. DANIEL, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE DANIEL PROCESS COMPANY, OF SAME PLACE.

PRODUCING ENGRAVED PLATES.

SPECIFICATION forming part of Letters Patent No. 648,854, dated May 1, 1900.

Application filed November 11, 1899. Serial No. 736,707. (No specimens.)

To all whom it may concern:

Be it known that I, ERNEST H. DANIEL, of Washington, District of Columbia, have invented certain new and useful Improvements in the Art of Producing Engraved Plates for Printing, of which the following is a complete specification, reference being had to the accompanying drawings.

The object of my invention is to produce a process of practically reproducing upon a plate to be engraved or other plate an exact copy of an original design, drawing, or picture.

My invention relates especially to the art of printing and engraving generally, and, although not exclusively, more particularly to the art of engraving upon metals. I shall therefore for the sake of brevity hereinafter employ the unqualified term "plate" to designate any body properly surfaced for engraving, whether of metal or other material.

Heretofore in order to engrave upon a plate a copy of a design, drawing, or picture the only practicable method known in the art to which my invention relates has been to corrode upon the surface of the plate a negative copy of the original design (that term to include any picture, drawing, or other representation of an object) and afterward by the aid of an engraving-tool to cut the corroded or guide lines of the copy into the face of the plate. The only method of corroding the lines of the original design in the copy upon the surface of the plate requires as an initial step the tracing and scratching by hand of the lines of the original upon thin flexible transparent material—such, for example, as a sheet of celluloid laid upon the design to be copied—the result being the production of a scratched design upon the celluloid sheet, from which the design can be conveyed to the plate by filling in the scratches with sulfur and laying the scratched side, with the sulfur in the scratches, against the surface of the plate to be engraved. The sulfur corrodes the surface of the plate along the scratched lines and reproduces a copy of the design over which the scratches were traced. This method is objectionable on account of the expense and inaccuracy of hand-tracing, as well as on account of the unequal and excessive corrosion by the sulfur of the surface of the plate. A plate engraved after this method when first cut by the engraving-tool usually presents rough and uneven lines, it being impracticable always to cut out the bite made by the sulfur. Consequently before the plate so made is ready for the press it must be rubbed down until all marks of the sulfur are obliterated by abrasion.

The above-described process being the only one known and generally employed for the purpose specified, the object of my invention is not only to eliminate entirely from that process of marking a plate the slow, expensive, and inaccurate step in the process of manually tracing the design, but also to substitute therefor a process new as well as expeditious, cheap, and accurate.

The reproduction of plates from drawings or from prints from engraved plates is very largely employed for the engraving and printing of maps and charts, in which the utmost accuracy obtainable is sought after; but in work of that description, though the most skilful workmen be employed, it is difficult by the process above described, although that has been heretofore esteemed the best, to avoid discrepancies between the original design and the engraved plate.

It is a fact recognized among engravers that in engraving a reproduction of an original design there are two chances of error—one in the tracing of the design and the other in the manipulation of the engraving-tool. By the employment of my method the first of those chances of error is wholly eliminated, and with ordinary care and skill it is practicable to make in the engraved plate an exact reproduction of a design. I effect the elimination of the first chance of error—namely, the hand-tracing step of the process above described—in first producing, by employment of any known or suitable photographic process, a photographic-plate copy of the design, and through means afforded in that photographic plate am enabled to produce a stained copy of the design upon the smooth or polished surface of the plate to be engraved. It should be observed in this connection that the term "stained" as applied to the copy upon the plate obtained through the employment of my method is used in contradistinction to the term

"corroded," as descriptive of the action of the sulfur-charged scratched sheet above described, because the copy produced upon a plate by my method is wholly free from all objectionable corrosion and only produces a stain, which may be instantly removed by attrition of a buffing-pad. It is proper here also to note that attempts have been heretofore made to substitute for the stained copy upon a polished plate a photographic reproduction of a design upon a coated plate—that is, one coated with a film sensitized for the reception of a photographic copy of the design. This method, however, is unreliable and impracticable on account of the presence of the sensitized coating, which under the action of the engraving-tool breaks away irregularly from the surface of the plate and either obliterates the design altogether or renders it uncertain as a guide. That method is clearly distinguishable from my process by one fact, among other distinguishing characteristics, that in the practice of my process a copy is stained upon or corroded, although only to a degree perceptible to the eye, by discoloration upon the surface of an otherwise clean, smooth, and polished plate. The terms "smooth" and "polished" in this connection or wherever they may appear in this specification are employed to denote that degree of smoothness which is or may be recognized in the art of engraving as a prerequisite condition of the surface of the plate to be engraved.

In the accompanying drawings I have endeavored to illustrate diagrammatically the successive steps of a preferred mode of practicing my process, the film and coating being shown on a highly-magnified scale.

In the drawings, Figure I is a top plan view of a film-coated glass plate exhibiting five vertical lines as examples of lines which may be produced in a sensitized photographic plate by exposure and development. Fig. II illustrates a plate, as of metal, to be engraved, bearing upon its surface an exact reproduction of the design—to wit, the five vertical lines shown in Fig. I. Fig. III is a transverse section of the film-coated glass shown in Fig. I before exposure. In this figure, as in all subsequent figures, the proportions of the parts are much distorted in order to illustrate the various steps of the process. Fig. IV is a section corresponding to Fig. III, showing reproduced and depressed below the remaining surface of a sensitized film the lines of a design against which the film has been exposed to light. In this figure it may be specially observed that the width of the lines is highly magnified. Fig. V is a view corresponding to Fig. IV, with the addition to the raised lines of that figure of a wax or like coating. Fig. VI illustrates the subject-matter of Fig. V after the application to the wax face thereof of a flexible sheet, one end of the flexible sheet being raised, and cleaving away a portion of the wax coating whose upper surface adheres to the sheet. Fig. VII illustrates a section of a plate, as of metal, against the surface of which is applied the flexible sheet with its wax coating shown in Fig. VI. The thickness of the wax coating in this figure is for the purpose of illustration shown as of double that upon the uplifted end of the sheet in Fig. VI. Fig. VIII is a view in all respects similar to Fig. VII, except that one end of the flexible sheet is lifted from the metal plate. This figure shows a second cleavage of the wax coating, part remaining on the face of the metal plate, upon which it constitutes a resist. Fig. IX is a view of the subject-matter of Fig. VIII, showing the metal plate thereof after removal of the flexible sheet, the application of a mordant against the face of the plate through the broken lines of the resist or wax coating, and the final removal of the wax coating.

Repeating that the drawings above referred to illustrate the successive steps of a preferred mode of practicing my process, I shall now proceed to define the steps of such a process and also to indicate such modifications or variations in the mode of procedure as I deem to be properly embraced within the scope of my invention.

Referring, therefore, to the numerals on the drawings, 1 indicates a sensitized covering or photographic film in which by exposure and development may be produced a photographic reproduction of any original design, drawing, or picture. Such a reproduction is conventionally and diagrammatically exhibited in the lines 2, shown as extended upon the film in Fig. I.

In Fig. II a plan of a plate 3, as of metal, to be engraved is illustrated, and upon the face thereof are lines 4, which constitute an exact copy of the lines 2 on the film 1, and therefore of the original design, of which the lines 2 are a reproduction.

The lines 2 and 4 in actual use represent a design—as, for example, a map or picture—and the lines 4, if exhibited upon the plate to be engraved, would be the negative of the lines of the original design. Since, therefore, there is no difference between the positive and the negative of vertical lines, the vertical lines are selected for the purposes of this specification to represent the lines of a design in order to simplify the illustration in the drawings; but it is proper to bear in mind the fact as above stated.

In Fig. I only the surface of the film is exhibited; but in the preferred mode of practicing my invention that film is carried upon a suitable rigid body, preferably a glass plate 5, as shown in Fig. III. That figure illustrates the film-coated glass plate before exposure, the upper surface of the film extending in a smooth unbroken plane.

The first step of the preferred mode of practicing my process consists in producing a photographic copy of the original design, which is characterized by different levels of sur-

faces. Such a photographic copy is illustrated in Fig. IV, in which the broader surfaces 6 of the exposed and developed film 1 are shown as elevated above the lines 7. This illustrates a preferred kind of photographic plate; but it should be observed in this connection that the lines 7 may be elevated and the broader surfaces 6 depressed. A photographic plate such as I have described may be produced in a variety of ways; but in order to enable others skilled in the art to practice my process with certainty I here specify a preferred process for producing such a plate as is illustrated in Fig. IV. Assuming that I have an original design in black on a white ground to be photographed, I prepare an albumenized glass plate and evenly float the surface thereof with collodion, which may be obtained in accordance with the following formula: alcohol, (C_2H_6O,) forty-eight ounces; ether, ($C_2H_3O_2$,) forty-eight ounces; guncotton, $C_6H_7(NO_2)_3O_3$, one and three-fourths ounces; iodid of ammonium, (NH_4I,) one ounce; bromid of cadmium, ($CdBr_2$,) one-half ounce. The said plate is next placed for five to eight minutes in a very acid nitrate-of-silver bath having from forty-five to fifty grains of nitrate of silver to the ounce of water, after which the photographic plate, as illustrated in Fig. III, is ready for the camera. Being placed in the camera, the said plate is exposed to the design to be photographed, care being taken that the exposure be for the full time, with a small stop and in a good light. The photographic plate is now developed, preferably in a solution made in accordance with the following formula: iron protosulfate, ($FeSO_4$,) two ounces; acetic acid, ($C_2H_4O_2$,) three ounces; water, (H_2O,) sixteen ounces. It may then be intensified by the old copper and silver formula. The developed photographic plate will be found to exhibit a reproduction of the original design in transparent lines somewhat depressed below an opaque and elevated surrounding ground. Such a photographic plate is comprehended within the terms of the definition of the plate shown in Fig. IV and may be employed for certain kinds of work. For other kinds of work it is desirable to increase the difference between the levels of the surfaces—that is to say, with reference to the subject-matter of Fig. IV, to make the lines 7 relatively deeper than the broader surfaces 6. It is essential to the performance of accurate work that the lines 7 should remain clear-cut accurate reproductions of the lines of the original design and that the elevated surfaces should be firm and rigid. For that reason in doing accurate work the swelled gelatin process of producing intaglio plates is impracticable as a first step in carrying out my process. I prefer to make the plate now under consideration by upbuilding the elevated surfaces 6. The process of upbuilding may be accomplished in more ways than one—as, for additional example, by repeated treatment of the copper and silver intensifier; but I prefer to accomplish the required object in the following manner: I soak half an ounce of Nelson's No. 1 gelatin in eight ounces of water for fifteen minutes at a temperature of 70° Fahrenheit. I then place a vessel containing the soaked gelatin and water into a hot-water bath until the gelatin is dissolved. I then add to this solution ferric sulfate, $Fe_2(SO_4)_3$, three grains; perchlorid of iron, (Fe_2Cl_6,) seven drams; tartaric acid, ($C_4H_6O_6$,) three grains, and filter the solution. The "negative," by which term for convenience I shall designate the developed photographic plate above described, being slightly warmed, the solution just described is flowed over it evenly, and the negative so treated is then dried in an oven at about 120° Fahrenheit. Upon removal from the oven the negative already described appears covered with a hardened coating formed by the application of the solution last described. A dark cloth is next placed against the coated side and the glass side (indicated by 8 in Fig. IV) is exposed to the sun for from six to eight minutes. By such exposure those portions of the coating which are in the transparent depressed lines 7 will be affected by light. The exposed negative is then developed in a solution consisting of gallic acid, ($C_7H_6O_5$,) seven drams; alcohol, (C_2H_6O,) seven ounces; water, (H_2O,) thirty-three ounces. The action of the light upon the added coating of the negative is found to have disintegrated the gelatin of which the coating is composed along the lines 7, where alone the light struck it, and to have rendered the gelatin thus exposed to light soluble in the developer. The effect upon the negative after drying is not only to upbuild the surfaces 6, but to depress the lines 7. By proper manipulation and removal, as in the developer of the soluble gelatin, the lines 7 may be depressed, even through the albumenized coating, if required, to the very surface of the glass plate 5 itself.

The foregoing description comprehends the preferred method of producing a suitable photographic plate which constitutes the first step of the preferred mode of practicing my invention; but it should always be borne in mind that the method described is but one of a variety of methods by which the required plate may be produced and, as specified, that the surfaces of the photographic plate itself, as shown in Fig. IV, may be transposed so that the lines 7 shall be elevated above the depressed broader surfaces 6.

With the above precautionary observation I next proceed to describe the second step of the preferred mode of practicing my invention. Upon the elevated surfaces, in the present example the surfaces 6, I apply a continuous coating 10 of wax and in this connection employ the term "wax" to denote any smeary, sticky, or tacky substance, such as beeswax, Burgundy pitch, tallow, or any substance which in rolling upon a surface with

mate object of my invention, intermediate, the stain final.

While I now regard and have described my invention as being especially applicable to the art of preparing engraved plates for printing, yet in view of the fact that my invention comprehends, essentially, a process of producing a stained or corroded copy upon any suitable surface I deem myself to be entitled to a claim broad enough to cover my invention within its fullest scope and with a view to utilizations which may hereafter suggest themselves, particularly such as may be accomplished by any development in the arts which may be suggested or fostered by my invention.

What I claim is—

1. The process of producing a copy of a design upon any suitable surface, which consists in preparing a plate with a sensitized coating, adapted, after exposure and development, to exhibit different levels of surfaces; placing said photographic plate in a camera and making exposure of it therein to the original design; treating said photographic plate, after exposure, so as to make a reproduction of the original design with firm and rigid elevated surfaces and other surfaces on lower levels, said treatment including development of the sensitized plate; applying a suitable material to said surfaces of one level and not to those of another; and finally conveying a copy of the design, in the material so applied, to the surface desired.

2. The process of producing a copy of a design upon any suitable surface, which consists in making a photographic reproduction of the design, characterized by different levels of surfaces, the elevated surfaces being firm and rigid; increasing the differences between the levels of the surfaces; applying a suitable material to said surfaces of one level and not to those of another; and finally conveying a copy of the design in the material so applied, to the surface desired.

3. The process of producing a copy of a design upon any suitable surface, which consists in making a photographic reproduction of the design, characterized by different levels of surfaces, the elevated surfaces being firm and rigid; increasing the difference between the levels of the surfaces by upbuilding the elevated surfaces; applying a suitable material to the surfaces of one level and not to those of another; and finally conveying a copy of the design in the material so applied, to the surface desired.

4. The process of producing a copy of a design upon any suitable surface, which consists in making a photographic reproduction of the design, characterized by different levels of surfaces, the elevated surfaces being firm and rigid, increasing the difference between the levels of the surfaces, by upbuilding the elevated surfaces and depressing the depressed surfaces; applying a suitable material to said surfaces of one level and not to those of another; and finally conveying a copy of the design in the material so applied, to the surface desired.

5. The process of producing a copy of a design upon any suitable surface, which consists in making a photographic reproduction of the design, characterized by different levels of surfaces; applying a coating of wax to those of said surfaces which are elevated; applying a sheet to the exposed wax surface; removing the sheet and thereby cleaving the wax; applying the sheet with its wax coating to a plate; removing the sheet and again thereby cleaving the wax; and applying a mordant to the plate where its surface is exposed, through the breaks in the wax.

6. The process of producing a copy of a design upon a plate to be engraved, which consists in making a photographic reproduction of the design, characterized by different levels of surfaces; removing to a required degree the material along the light-struck lines of said reproduction; coating the elevated, but not the depressed surfaces thereof with a suitable material; applying the coated reproduction to the surface to be engraved, thereby conveying to the said last-named surface a copy of the design, the material in which the design is so produced upon the said plate constituting a resist thereon; and finally staining the surface of the said plate where it is exposed through the resist, with a suitable mordant.

7. The process of producing a copy of a design upon a plate to be engraved, which consists in making a photographic reproduction of the design, characterized by different levels of surfaces; removing to a required degree the material along the light-struck lines of said reproduction; coating the elevated, but not the depressed surfaces thereof with a suitable material; applying a flexible sheet to the coated reproduction, thereby coating the flexible sheet; applying the coated flexible sheet to the surface of the said plate, thereby conveying to the surface of the said plate a copy of the design, the material in which the design is so produced upon the said plate, constituting a resist thereon; and finally staining the surface of the said plate where it is exposed through the resist, with a suitable mordant.

8. The process of producing a copy of a design upon a plate to be engraved, which consists in making a photographic reproduction of the design, characterized by different levels of surfaces; removing to a required degree the material along the light-struck lines of said reproduction; applying upon the elevated surfaces of the reproduction a coating of wax, continuous except where it is broken by the presence of the depressed surfaces; conveying a wax copy of the design from the coated reproduction to the surface to be engraved, the wax constituting upon the said plate a

resist; and finally staining the surface of the said plate where it is exposed through the resist, with a suitable mordant.

9. The process of producing a copy of a design upon a plate to be engraved, which consists in making a photographic reproduction of the design characterized by different levels of surfaces; removing to a required degree the material along the light-struck lines of said reproduction; applying upon the elevated surfaces of the reproduction a coating of wax, continuous except where it is broken by the presence of the depressed surfaces; conveying a wax copy of the design from the coated reproduction to the surface to be engraved, the wax constituting upon the said plate a resist; reinforcing the resist; and finally staining the surface of the said plate, where it is exposed through the resist, with a suitable mordant.

In testimony of all which I have hereunto subscribed my name.

ERNEST H. DANIEL.

Witnesses:

CHAS. E. RIORDON,

JOSEPH L. ATKINS.