UNITED STATES PATENT OFFICE.

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PHOTOGRAPHIC PROCESS FOR COPYING DRAWINGS, &c.

Specification forming part of Letters Patent No. **55,592**, dated June 12, 1866.

To all whom it may concern:

Be it known that I, WILLIAM WILLIS, of Birmingham, in the county of Warwick, England, engraver, have invented or discovered certain new and useful improvements in processes for copying or reproducing by the agency of light drawings, engravings, lithographs, and photographs, and written and printed documents; and I do hereby declare that the following is a full and exact description thereof.

My invention consists of the improved process or processes hereinafter described, by which process or processes a drawing, engraving, or other impression may be copied at one operation—that is to say, a copy may be produced in which the light and dark parts in the original are directly reproduced in the copy, and are not reversed, as in the ordinary methods of photographic printing.

I will describe my invention as applied to the copying of a mechanical drawing. Upon the paper, collodion, or other surface on which the copy is to be produced I spread a solution of bichromate of ammonia or other soluble chromate mixed with sulphuric acid or a metallic or other salt. The surface is coated and dried in the dark. The drawing to be copied is placed upon the prepared surface and exposed under glass to the action of light, similar to the way in which positive photographs are ordinarily printed. The length of exposure to light depends upon the intensity of the light and the transparency of the paper on which the drawing is made, and varies ordinarily from four minutes to half an hour. A faint image is produced by the light, the parts on which the light has acted being bleached, and the parts not acted upon retaining their original color. The impression so obtained is exposed to the action of a solution of a salt of aniline, or to the vapor of aniline, by which treatment it is darkened and made nearly black. By washing with water the paper or other surface on which the copy is made the chemicals employed are sufficiently removed from the said paper or other material. The copy thus produced is finally dried.

Although I prefer to use aniline for the purpose of darkening the impression produced by the action of light, yet other substances having analogous properties may be employed—such, for example, as toluidine, naphthylamine, pyrrol, and salts of these bases.

The essence of my invention consists in obtaining copies or reproductions by the action of light by preparing a surface with a solution containing a soluble chromate mixed with an acid or an acid salt, and after exposing to light darkening the impression thus produced by means of aniline or other organic substance capable of forming a dark and insoluble compound with the said unaltered chromate.

Having explained the nature of my invention, I will proceed to describe the manner in which the same is to be performed. I will describe my invention as applied to the copying of a drawing in ink, such as a mechanical drawing on paper.

I first prepare a solution of thirty grains of bichromate of ammonia in one ounce of water, to which is added about two drams of dilute phosphoric acid of commerce. The adjustment of this acid in proper proportion to the chromate is a matter of great importance, and can only be accomplished by trial on each occasion of making a solution from fresh materials. When too little acid is used the picture develops slowly, and is of a reddish-brown color; when an excess of acid is present the picture develops quickly, and is of a blue or green color. When the proper quantity is present the picture develops of a black color. Sulphuric acid or an acid salt may be used instead of phosphoric acid, and bichromate of potash instead of bichromate of ammonia. I cover the sheet of paper on which the drawing is to be reproduced with this solution, either by floating it on the solution contained in a flat dish, or spreading the liquid over it by means of a sponge. The paper thus coated or covered with the solution is then hung up to dry in the dark. Paper thus prepared will keep several days without injury. When it is to be used it is placed in an ordinary photographic printing frame in contact with the drawing, and is then exposed to light, precisely as in the well-known process of printing positive photographs. The time of this exposure will vary from two minutes to half an hour, according to the intensity of the light.

The impressed paper is then removed from the printing-frame and laid on the bottom of a wooden box which is as long and as wide as the sheet of paper, but not more than two inches deep. To the under side of the cover of this box two or three layers of bibulous paper are fastened by nails, and a dilute solution of aniline in benzole is poured thereon from a dropping-bottle in rows of drops, the rows being about two inches apart. This cover is then laid on the broad and flatly-planed sides of the box, and the vapor of aniline falls therefrom to the surface of the impressed paper, and blackens all those parts which have not been exposed to the action of light. The time required for this development of the picture will vary from ten minutes to half an hour. After the picture has been thus developed it is washed for a few minutes in plain water, or first in water, then in very dilute sulphuric or other acid, and again in plain water. The picture is thus fixed or rendered unchangeable by light.

The strength of the solution of aniline in benzole is not material, but a solution of one ounce of aniline in sixteen ounces of benzole answers very well.

I vary the different stages of the operation occasionally to suit certain peculiar requirements. Thus, instead of the sensitizing-liquid previously mentioned, I sometimes employ thirty grains of chromate of copper dissolved in one ounce of water and fifteen drops of sulphuric acid, to which one dram of the dilute phosphoric acid is also added; or, again, I sometimes employ thirty grains of phosphate of copper dissolved in one ounce of water by the aid of sufficient sulphuric acid to make a clear solution, and then add fifteen drops of a saturated solution of chromic acid; but the process first described I believe to be, on the whole, the best.

Instead of aniline for developing, I occasionally employ toluidine, naphthylamine, or such other volatile organic bases as possess the property of striking a black or dark color with chromic acid or chromates unacted upon by light. Of these I prefer at present the series known as the "pyrrol basis." When these are prepared by the distillation of feathers, bones, and other animal substances, they give a great variety of red, brown, and black tints. They may be used by dilution with benzole, like aniline. That mixture, however, of pyrrol bases with other organic substance which is obtained by the distillation of the mucate or bimucate of ammonia is still better, and gives rise to fine blacks. This last-named mixture is strongly alkaline and will not develop until it has been neutralized with sulphuric acid. Lastly, a mixture of aniline, pyrrol, and other organic products usually produced with these bases, may be used with good result.

Although I prefer applying the aniline or other organic developer in the form of vapor, yet the same may be applied in the state of a dilute solution with nearly the same effect.

Although I have only described my invention as applied to the copying on paper of a mechanical drawing made on paper, by which description I believe the manner of carrying my invention into effect will be fully understood, yet my said invention is applicable to the copying of drawings, engravings, lithographs, photographs, written and printed documents made on any transparent or semi-transparent material.

My invention may be employed to take impressions on silk or other fabric, also on wood blocks for wood-engravings, and generally on such materials as may be used for receiving photographic impressions by the ordinary photographic processes.

Having now described the nature of my invention, and the manner in which the same is to be performed, I wish it to be understood that I do not limit myself to the precise details herein described, as the same may be varied without departing from the nature of my invention; but

I claim as my invention—

The improvements in processes for copying or reproducing by the agency of light drawings, engravings, lithographs, and photographs, and written and printed documents, herein described—that is, preparing the sensitive surface to be acted upon by light by the use of a solution containing a chromate mixed with an acid which will combine with the oxide of chromium, formed by the action of light, and with the organic base used for development, and developing the picture by means of aniline, pyrrol, and other organic bases, which, when applied either in the state of vapor or liquid, are oxidized by the chromic acid and form therewith a dark-colored compound.

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