

UNITED STATES PATENT OFFICE.

EMANUEL SPITZER, OF MUNICH, GERMANY.

ART OF ETCHING.

No. 865,276.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, EMANUEL SPITZER, a citizen of Germany, residing at Munich, Bavaria, Germany, have invented certain new and useful Improvements in the
5 Art of Etching; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the art of producing etched
10 objects and in particular to the manufacture of photo-mechanical printing plates or surfaces.

The object of this invention is to produce by a simplified photo-chemical and mechanical method etched
15 objects of any suitable material fit for the etching process such as metal, stone, glass and the like, both for printing purposes of any kind as well as for purposes of artistic and industrial decoration and for other purposes.

Besides simplifying the process, the present invention offers great advantages for the etching of reproductions from autotypic reticulated plate (screen) pictures, from hand drawings, wood cuts, copper plate and gravings and the like, and in particular where it is desired to reproduce niceties of reticulated plate effects
20 (screens) not obtained heretofore.

The essential feature and the novelty of the present invention consists in exposing directly to the action of the etching agent, the copy of an original which is produced in the sensitive coating or layer of the object to
30 be etched, said original being, for instance, a drawing or any suitable photographic negative or diapositive or other original capable of being copied. In other words, the copy is introduced into the etching bath directly, that is to say, in the state of hardness acquired through
35 the exposure to the light, without such accompanying or previous use of artificial protecting and hardening processes being necessary as rolling in or melting on of asphaltum dust upon the coating or layer, "enameling", or similar means of procedure. In this process
40 great attention has to be paid in the first place, to the retaining of the porosity of the parts sometimes extraordinarily fine which have remained unexposed to light between the exposed elementary divisions of the copied picture in the copying layer so that these parts or passages allow the passage of the etching agent; and secondly it is important that also those portions exposed to light are retained in the condition in which their
45 different parts offer in different degrees resistance to acids and possess in different degrees the capability to become etched, which condition has been imparted to them by the exposure to light.

The use of the above mentioned protecting and hardening agents would make it impossible to obtain these two results of such paramount importance for the
55 present process.

In order to obtain a progressive etching of the mate-

rial during the etching process, care has to be taken that those places which are becoming developed are not attacked too much or entirely spoiled. This object may be accomplished in a most simple manner by
60 allowing the deposits of the etching process, the etching "slime" or "sludge," to remain on the already attacked places, the etching slime protecting the places covered thereby against any further excessive action of the etching agent and thus against spoiling and destruction of the etching.
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The process may for instance be carried out as follows: To the well cleaned plate or other object to be etched, a coating of a substance, sensitive to the action of light, such as chrome albumen, chrome gelatin, or
70 the like, is applied. This may for instance be effected by putting the plate, before or after pouring on the solution, upon a centrifugal apparatus, in order to produce by rotation and simultaneous warming, a thoroughly well dried copying coat or layer which is as uniform as possible and free from grain.
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In the manufacture of the copying coat or layer, the wrinkling of the same, similar to that used heretofore in phototype work, should be avoided by all means, this wrinkling having been tried by several experimenters for photomechanical reproductions with but only slight success, in as much as such an artificial graining interferes with the permeability of the pores to acid, and also with the desired action of the acid on the elementary divisions. Dusting and melting asphaltum dust grain on the etching plate, as hitherto used particularly for engravings, should likewise be avoided, as well as the admixture of any substances to the sensitive layer, which would produce a firm clearly defined grain in the same. Upon such a smooth, and
80 as nearly as possible uniform ungrained layer, any original which admits of copying, such as a drawing or any photographic negative or diapositive (half-tone, reticulated (screen), line drawing, Röntgen rays or other kind) is copied. It is useful to determine the required degree of copying by means of a photometer. If the copy is too faint, the etching of the plate is easily spoiled or over-etched, in the case of the copying having been carried on too far, the permeability of the pores to acid is impaired as well as the aforesaid capability of the elementary divisions to become progressively etched. This capability to become progressively etched may be explained as follows:—When copying a negative for instance, the light enters rapidly and perfectly at the transparent and glassy portions of the negative and the corresponding portions of the copying layer of the plate to be etched will thoroughly harden, whereas the delicate and very fine points, corresponding to the covered portions of the negative, will copy through only gradually and faintly. These faintly
85 lighted parts of the copying layer, will therefore get a cover, the less hardened, the less light they have re-
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ceived, so that the entire copy will not present a thorough hardening of uniform strength but a progressive hardening of the different parts in different degrees and consequently also the elementary divisions possess a progressive resistance to acids varying in degree. To this progressive resistance varying in degree corresponds a proportionate progressive etching of the material, so that in the etching process here described, the etching itself will proceed as follows:—The copy on the object to be etched, obtained according to the directions heretofore pointed out, after being washed and dried if desired, is exposed, without the necessity of using any additional protecting means, to the action of an etching agent and particularly an etching agent which will have a hardening action on the gelatin or other coating, such as chlorid of iron or nitric acid with alcohol or the like, the etching being finished in one or more baths of different concentrations in accordance with the richness in half-tones or with the purposes for which the plate is intended. In the case of copies from strong negatives for instance, four or even five baths may be used. It is well known, that as regards the selection of the kind of etching baths and as regards the concentration and the temperature of the same, a variety of conditions has to be taken into account and the etching operation itself requires a certain delicate and artistic sentiment besides experience and training.

In as much as in this etching process, the dividing passages which have remained unexposed to light and which are between the exposed and consequently hardened elementary divisions, are unprotected against the action of the etching agent, the latter will penetrate through these dividing passages first of all, and will attack the material of the object to be etched at these places. This beginning of the etching process takes place at those parts of said object which were least exposed to light, because they are fewer and smaller elementary divisions and wider dividing passages present in these places as contrasted with the strongly lighted portions, in which, on the contrary, the elementary divisions are in excess as compared with the dividing passages not exposed to light and not hardened. While in this manner the etching of the dividing passages which have not been exposed to light proceeds, and while the etching cavities or sockets become hollowed out and the small cones form, the heads of which constitute the elementary divisions or minute (microscopic) particles of the picture, the already mentioned capability of these elementary divisions to become progressively etched will become apparent after a while in correspondence with the progressive hardening of the same which had taken place. The small particles or points at the places least exposed to the light, with only a small head of hardened chromate layer are attacked very readily and the parts of the object to be etched just below them begin to be etched. This etching action is now taking place in such a manner that at the termination of the etching process this wearing away is most pronounced in the case of the parts which have been less exposed to light, while it is least pronounced in the case of the parts, which have been more exposed to light, and by these means the proportionate deepening of the elementary divisions or minute (microscopic) particles is produced. This etching ac-

tion would however finally become excessive in cases in which delicate results are desired, unless the etching product (slime or sludge) formed simultaneously in the process, which in such cases should not be removed by brushing out or the like, protected the small heads beginning to be attacked from further action. This progressive etching action which is the characteristic feature of the present invention, may be varied to meet the various purposes intended and it may even be so delicate that it is hardly perceptible to the naked eye, and yet it is efficacious for use, especially for printing purposes. In the case of a printing block etched from such plates, the lower-lying points will take up less ink and will also give off less ink and therefore produce a more delicate impression than the more elevated points of the printing block; the reverse will apply in the case of printing from engraving plates.

For the practical operation of the etching process, attention has also to be paid to the following points:— If it is desired to produce very delicate etchings, it is recommendable to avoid washing and then drying the copy after exposure to light, but to introduce it, on the contrary, directly into the etching bath. The washing out of the copy, for the purpose of removing the chrome, and the subsequent drying, causes a coarseness in the division of the picture; wherever this coarseness is desired, in the case for instance of coarser reproductions, the washing out and drying may take place before the etching.

Another novel and important auxiliary means for assisting in bringing out the niceties of a picture in accordance with the present invention consists in subjecting the etching bath with the object to be etched contained therein, to a gradual and progressive warming or to a gradual and progressive cooling. By reason of this gradual change of temperature of the etching bath, a progressive dilution or thickening respectively of the acid is produced. The more liquid the acid is, the more delicate are the pores of the copying layer which it is able to permeate; and the larger the pores are, the more concentrated and consequently the more viscous should the acid be, in order to etch to a sufficient depth. Thus the progressive warming or cooling of the etching agent serves the same purpose as an infinite number of baths of continuously varying concentration. The gradually progressing warming is, for instance, effected by introducing a copy which has been produced on the plate to be etched in accordance with the explanations given above, into an etching bath which appears suitable for the first permeation, such as chlorid of iron of about 42 degrees, (or more or less), Baumé, according to the desired depth of the etching. It depends entirely upon the discretion of the operator whether the gradually progressive warming is to take place with this first bath, or beginning with another second or third or with still other weaker baths of for instance 40, 38, 35 degrees Baumé etc. This should be governed by the appearance of the original, by the condition of the negative or diapositive and especially also by the intended purposes of the etching. The more concentrated a solution for the progressively warmed bath is taken, the deeper are the furrows of the etching; hence for printing blocks which are intended for printing in rotary presses, stronger baths will for in-

stance have to be used at the beginning of the progressive warming than in the case of printing blocks which have to be used for printing in ordinary printing presses for more delicate effects. It is not possible to
 5 fix a degree of concentration which would be suitable for all cases, in as much as the selection of the paper, of the printing ink and other conditions are also of great influence in determining the depth of the etching required.

10 The gradually progressing warming is effected by placing the etching bath or baths employed into a hot or gradually heated sand bath or water bath or by any other gradually operating warming device, until the image on the object contained in the etching bath ap-
 15 pears etched down to the nicest details; the object is then taken out, cleaned and made ready for use.

A progressive thickening of the acid which is desirable for some purposes is produced by placing the etching bath of a certain concentration, of about 40 or 42
 20 degrees Baumé for instance, or more or less, with the plate to be etched contained therein, in cold or gradually cooled water which if desired, might be cooled with ice, or by using any other gradually operating cooling device.

25 A further novel and important auxiliary means for assisting in bringing out the niceties contained in the original in accordance with the present invention, consists in submitting the object to be etched to an etching bath the concentration of which is gradually lessened
 30 by introducing into the etching bath more or less slowly an acid of a lower degree of concentration. If, for instance, the object to be etched has undergone part of the etching process in a bath of iron chlorid of say 42° Baumé, a dilution of iron chlorid of 41, 40, 39 or less
 35 degrees Baumé is more or less slowly introduced into said bath. This more or less slow progressive reduction of the dilution of the acid of the etching bath produces similar effects, eventually even to a higher degree, as the gradual and progressive warming described
 40 above.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The process of etching, which consists in applying directly to the surface of the body to be etched a sensitized
 45 coating, then photographically printing an image upon said sensitized coating, and then exposing directly all portions of the surface of the sensitized coating to the action of an etching agent.

2. The process of etching which consists in applying directly to the surface of the body to be etched a sensitized
 50 coating, then photographically printing an image upon said sensitized coating, then exposing directly all portions of the surface to the sensitized coating to the action of an etching agent, and leaving the deposits formed by the
 55 etching action undisturbed until the completion of the etching action.

3. The process of etching which consists in applying directly to the surface of the body to be etched a sensitized
 60 coating, photographically printing an image upon the sensitized coating, introducing said body to be etched into an etching bath and regulating the etching operation by modifying the temperature of the bath.

4. The process of etching which consists in applying directly to the surface of the body to be etched a sensitized
 65 coating, photographically printing an image upon the sensitized coating, introducing said body to be etched into an etching bath and then into progressively modifying the temperature of the bath to regulate the etching.

5. The process of etching which consists in applying directly to the surface of the body to be etched a sensitized
 70 coating, photographically printing an image upon the sensitized coating, introducing said body to be etched into an etching bath and introducing additional etching fluid of a lower degree of concentration during the etching opera-
 75 tion, whereby the etching bath is progressively diluted.

6. The process of etching which consists in applying directly to the surface of the body to be etched a sensitized
 80 coating, drying said coating by centrifugal action, photographically printing an image upon the sensitized coating, and directly exposing all portions of the surface of said coating to the action of the etching agent.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

EMANUEL SPITZER.

Witnesses:

PAUL PHILIPSON,
 ULYSSES J. BYWATER.