UNITED STATES PATENT OFFICE.

HANNIBAL GOODWIN, OF NEWARK, NEW JERSEY.

PROCESS OF PREPARING PLATES FOR THE PURPOSE OF UTILITY AND ORNAMENT.

SPECIFICATION forming part of Letters Patent No. 509,124, dated November 21, 1893.

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To all whom it may concern:

Be it known that I, HANNIBAL GOODWIN, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Processes of Preparing Plates for the Purposes of Utility and Ornament; 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.

There are at present two agents employed in etching out metal, acids, more commonly used, and galvanic or voltaic electricity. There are serious hinderances to the beneficial employment of either. Acids not only act irregularly on account of alloys found in the plate, but their poisonous fumes are highly injurious to the operator; besides to employ said acids successfully requires close attention and expert and expensive workmen, and further, only a very limited amount of work can be turned out in proportion to the amount of labor employed. On the other hand galvanic etching while not injurious to health and while it works more mechanically and so demands less attention, still it is, as hitherto applied, too slow a process to be employed commercially. It is known that galvanic electricity in high tension decomposes the metal surface with comparative rapidity but then it is not only expensive, but no insulation has hitherto been found sufficient to protect those parts of the plate which are to remain unaffected. Dynamo electricity in high tension can be furnished at less expense, but the same needed insulation has not been found and consequently dynamo electricity is not employed. What is now needed, and it is the object of this invention to supply, is perfect insulation and electricity of high tension so applied that a large number of plates may be etched together at a comparatively small expenditure of time and skill. My invention supplies this need.

My invention as a process relates first to the manner of getting the design upon the plate; second to the manner of insulating the design; and third to the manner and means of applying the electricity, and it consists in the process and the various stages or steps thereof substantially as will be hereinafter set forth and finally embodied in the clauses of the claim.

In carrying the invention into effect, I take a plate, either an ordinary planished plate or one having no added metallic covering, or a coated or covered plate or one having an additional metallic covering secured by electro deposition or any other of the well known methods of plating. To the unsurfaced plate I apply the design in fatty ink by any of the well known transfer methods, and then preferably strengthen the design by either rolling or rubbing on more ink, preferably one having greater insulating capacity. The plate may now receive the insulation in the manner hereinafter to be described; or, I coat the unsurfaced plate with a photographic varnish consisting of a solution of asphaltum which itself is sensitive to light, but, preferably of a solution of organic matter, as albumen sensitized by well known means; and I then place the plate beneath any material having translucent and opaque parts so arranged as to form a design and then expose to the light; and after the light has acted long enough through the translucent parts to chemically change and render insoluble those parts of the photographic varnish corresponding in position to the translucent parts of the overlying design, I next, in the case of the plate covered with an asphaltum varnish, dissolve away the unimpressed parts by means of either of the usual solvents, and then apply to the surface of the impressed asphaltum remaining on the plate a film of ink by well known means. In the case of the plate covered with the sensitized albumen I, immediately after the exposure to light, apply a film of ink to the whole layer of varnish impressed and unimpressed and then by the usual solvent dissolve out all the unimpressed parts of varnish, carrying away their overlying ink and leaving the impressed parts covered with ink. So far the methods of getting the design, in ink, upon the plate are old and well known. If, however, after the exposure of the plate covered with the albumen varnish, I first dissolve away the unimpressed parts, and then, after a proper cleaning of the parts made bare, I apply the ink which is thus placed in direct contact with bare metal, and then place the

plate in a tray containing dilute sulphuric acid or other solvent of the light impressed albumen, and then with a light brushing remove the said impressed parts, leaving the parts that were made bare by the removal of the unimpressed varnish now covered with a film of ink which constitutes the design or the ground of the picture according to whether the plates were exposed under a positive or a negative subject. In this I adopt a new and for some purposes a very useful method. So far I have specified an unfaced plate to be operated on.

Though requiring an expenditure of a litte longer time, more material, &c., I prefer to employ a metal plate surfaced with a metal of another nature, especially when finer results are demanded and, also, when the finally finished plate is to be employed in some kinds of color printing. To this end I take a plate, preferably of zinc, though it may be of brass, or copper, and coat or surface it by well known means with a layer of another metal which is electrically opposite to that of the plate, or with two or more layers of metals both or all of which are electrically opposite to the metal of the plate itself; for instance, I surface a zinc plate with a layer of copper, or first with copper and then with silver, both the copper and silver being electrically negative to the zinc of the plate. The advantages of a plate so faced will be briefly referred to at a later stage of the specification. Upon a plate so faced I apply a design in fatty ink either by transfer or by photographic printing and ink, as above described. I next proceed to give to the inked design an insulation against the electric current. Various substances have hitherto been employed for such insulation, but they have all proved incapable of sufficiently resisting a current of high tension. Where only a current of low tension is at my command, requiring considerable time to etch out the plate to the required depth, and where time is not a matter of importance or, especially, when relying upon my special method of applying the current to compensate for the time spent by the amount of work done (as hereinafter to be specified), I may apply to the inked design any of the ordinary insulating materials, as for example, a dust composed of resin and asphaltum. But when I have a current of high tension at my disposal, as I must have, when plates, few or many, are to be etched quickly, then I apply an insulating matter hitherto unemployed.

Paraffine has hitherto been employed as a mold for electrotyping, and for protecting cables; but paraffine has never, as far as I am aware, been employed for insulation when applied to the inked parts of a plate which are to be protected from the dissolving or detaching power of a high tension electric current.

Paraffine, either in its pure state, or as it exists in any of its less purified states and known under such names as ozocerite, cerasine, crystallized naphthaline, &c., possesses two very especial qualities to render it of great service in etching by electricity:—First. It is the best electrical insulator of all the easily fusible and fatty series of matter. Second: It affords, when fused to form a compact, continuous, and impervious layer, the best protection against the admission of electrolytic or other solutions, it being not only more resistant to all chemical action but less porous and therefore less permeable by the electrolytic liquids than any of the easily fusible and fatty series of matter. This paraffine I apply, preferably in the form of an impalpable dust, to the inked parts of the plate and rub the same well in by means of a wad of cotton, and then by a gentle heat fuse it so that, so far as it extends, it becomes a continuous, evenly thick and impermeable layer. But as it is very difficult to grate or rasp down this fatty, crystallizable substance into a dry impalpable powder I pursue the following methods of reducing it: I combine it in proper proportion with other and dry matter that is easy of fracture or that has been previously fractured into a fine powder, as plumbic chromate, resin, coke, copal, lac, amber, sandarac, dragon's blood, benzoin, &c., asphaltum singly or combined, and apply heat till the paraffine melts and permeates as well as envelops every atom of the porous asphaltum. The paraffine to be combined is only in such proportion to the asphaltum that when cold the mass can be easily ground to a comparatively impalpable, dry powder. The paraffine thus reduced I dust on to the inked parts of the plate and rub the same well in with a wad of cotton; and then remove all excess of dust by means of a brush, or, preferably, in addition to the brush, by means of immersing the plate into a suitable mordant till the bare surfaces are etched out to a suitable extent. Often it is advisable to carry this etching nearly through or quite through the layer of metal that was applied to surface the plate. The excess of dust having thus been thoroughly removed from the uninsulated parts of the plate I next apply heat and so far fuse the paraffine as to make a continuous and impermeable covering for the surface and sides of the insulated parts. Or instead of applying the paraffine dust first, I may first strengthen the design with an, ordinary resinous dust and then etch the bare parts down any required depth, and then apply a new film of ink to the protected parts by means known to the lithographer, and then at this stage dust on the paraffine powder, and fuse it. Or having as above, cleaned or etched out the bare parts I may apply paraffine to the design by rolling on an especially prepared ink, with which has been incorporated, all the paraffine consistent with the working condition of the ink, and then fuse this paraffine ink, or before fusing it, apply to it the paraffine dust. In case it should

be deemed expedient I may defer the application of the paraffine to a still later stage in the etching; or to meet the requirements of a higher tensioned current, I may increase at any stage of the etching the insulation already given, by applying more ink, or more ink together with the after addition of the paraffine dust.

This paraffine dust as above described is also the best of dusts to be applied for the protection of designs on plates which are to be etched as in the usual manner with free acids and where no electric current is employed and also when applied for insulation in electro-deposition of metals and this application is so far as I am aware new as well as useful.

I may here state that in English Patent No. 1,835 of 1857, a process is described in which an incrustation of one metal has been imposed on a base plate or body of metal of another variety, gained by electro-deposition after the said body has received a photographically sensitive layer of bitumen or other organic matter, and said layer has been developed so that parts of the said body plate are covered with said organic matter and parts are bare and fit to receive the said incrustation of deposited metal. In said process of 1857, after thus getting the deposit of metal, the sensitive organic layer is removed from the body metal, leaving the same bare at those parts which had been covered by said organic matter. The said plate is then submerged, as an anode, in an electrolytic fluid and the bared portion of the body metal etched out, the incrustation of metal first deposited, serving in some degree, as a resist in the etching operation. But such electro deposited resist, applied as described, is insufficient to withstand the action of dynamo-electricity for the reason that it will not adhere to the surface of the body metal during the time requisite for etching said body metal to any practical depth, because it is deposited on just those parts of said body metal which are not chemically clean, or those parts from which the unimpressed portions of the photographically sensitive matter have been removed, but not so perfectly removed as to leave the surfaces or pores of the metal unimpregnated with remaining particles of said sensitive matter. Such an electro-deposited resist is also insufficient to withstand dynamo electricity because of the well known porosity of such a deposit; and, again, such an electro-deposited resisting film is deficient in value and practically ineffective, in that it is in every case electro-negative to the metal on which it is deposited; and, further, it being unprotected, said deposit of metal forms with the body plate a battery and originates an electric current which loosens and disengages the deposited film during the process of etching. The organic resist described by me above, in my improved process, remains on the anodes during the time that the body plates are subjected to the said action of dynamo electricity and prevents the formation of the secondary battery and the loosening effects described, and especially so when said organic resist is reinforced. Thus by the improved process, greatly improved and practical effects are secured such as cannot be secured by the use of a deposited metal as a resist.

I am now ready, after suitably insulating the back of the plate, to suspend said plate in the electrolytic solution, to be etched out at the unprotected parts, under the action of the electric current, and this brings me to the final part of my process. But before proceeding to it, I may point out some of the special advantages arising from the above given preparation of the plate, first, the plate having received a metallic facing, as of copper, will, when ready for printing, be copper faced, resembling an electrotype; and a coppered surface has the advantage over a zinc surface, in that it is a better distributer of ink, and that in some forms of color printing, it would serve where a zinc surface would be wholly inadmissible because of the effect of said ink on said zinc; second, the final printing surface will be sharper in copper than if in zinc, for the electrical current acts more regularly upon copper than upon zinc; third, the copper or other metal, facing only those parts of the zinc plate which are to remain in relief and being in a state electro-negative to the zinc, gives a new polarization to just those parts faced with the copper, the equivalent of the well known polarization which sets up a secondary current or reverses the main original current and thus relieves the paraffine insulator from much of the loosening effects of the direct current, fourth, the paraffine insulator being so impervious to the electrolytic solution as well as being the best of insulators, in conjunction with the before mentioned reversal of current, allows the employment not only of a very powerful voltaic generator of electricity, but of the dynamo machine, which so far as I am aware has never hitherto been employed in etching by the process of electrolysis, fifth, as a corollary from the foregoing, I obtain a hitherto unknown speed in etching, and sixth, as a further consequence of such insulation and other aforesaid preparation of the plate, I can make such an especial arrangement of plates in the electrolytic solution that a large number can be etched out in the same time and with the same speed that a single plate may be etched and this brings me to the final part of my specification.

Hitherto so far as I am aware, plates, few or many, bearing insulated designs that are to be etched by the process of electrolysis, have been suspended in an undivided electrolytic solution. I suspend them in divided solutions which solutions are of the same nature or composition and connect them in series. The plates bearing the insulated de-

signs are suspended as anodes and closely opposite to them are other plates suspended as cathodes, an anode and a cathode being arranged in a tank or bath, the anode being connected with the cathode of the foregoing bath, and the cathode being connected with the anode of the next following bath or tank. The connection of one tank with another is by wire or similar metallic connection. The tanks connected in series as described are all in connection, electrically, with a dynamo-electric machine.

To give a single illustration of the law of electrolysis in this case:—The first thing to be referred to is the increase of resistance created each time an additional tank is connected in series with one or more other tanks; and this resistance unless overcome by a further special arrangement or by an increased tension of current, would prevent an increase of work. If for example a plate representing, say, one square inch of surface is suspended in one tank and another plate representing the same dimension is suspended in another adjacent tank and the two tanks are then connected in series, that is, the cathode of one with the anode of the other, and further, if the current which runs through both is not increased in tension over what it was when run through the single tank, then the resistance added by coupling the two tanks in series would prevent any material increase of work, and the etching out of the two plates to the given depth, each in its separate tank would require about double the time required for etching the single plate in the primitive tank, but if I arrange two other adjoining tanks in a similar manner and suspend in each a plate representing the above dimension and similarly connected in series and then join the latter two with the former two by what is known as multiple arc the total resistance of the doubled series of tanks will be reduced to the resistance of a single tank, and the quantity of metal etched out under a current of given tension will be double to what would be in a single tank.

In etching partly stopped-off plates, or plates bearing ornamental designs, in series, the anodes bearing the designs being each alone in a tank or separate bath with a cathode, I am enabled to secure greater uniformity of result than in the processes in which several anodes are arranged together in a single tank or bath. In the former case, the anodes may be placed each directly opposite the cathode and so that the line of force from anode to cathode is at right angles to the face of the plate bearing the design, while in the latter case, the lines of force vary in direction and thus the lines of the design are more or less undercut, and in some plates more than in others, so that the product lacks in uniformity, and, where the lines of force acting on the plate have been very oblique, the product is quite defective because of the entire cutting away of the lines of the design.

Referring back to the preparation of the anode before subjecting it to the electrolytic fluid, I would state that while I prefer to employ paraffine as a resist, in lieu of the same, as equivalents, I may employ other waxen or fatty matters such as ocuba wax, palm wax, Japan wax, myrica wax, spermaceti stearin, cerotine, &c., and in lieu of the pulverizable substances mentioned I may employ coke, copal, lac, amber, sandarac, dragon's blood, benzoin and various other substances that may be readily reduced to powder.

When the powdered mixture is applied to the design in fatty ink or in sensitive matter covered with ink and heated to cause the waxen or fatty matter to flow, and produce a continuous protecting film, said film not only covers the body portions of the underlying ink or sensitive matter but also spreads laterally to and around the edges of said underlying matter, which are the portions most exposed to the electrolytic agencies and thus the edges of the lines in photographic varnish and ink or in ink alone are given greater smoothness, and a more equal value.

I am aware that Napier in his publication, *A Manual of Electro-Metallurgy*, has described a process in which anodes and cathodes are arranged in series in separated electrolytic fluids. Such a process I do not claim nor does my invention inhere therein. In my improved process, I simultaneously subject the plurality of anodes having partial coverings of resisting matter in artistic designs, to the influence of a single electric current, the anodes being arranged in separated electrolytic fluids in series with suitable cathodes whereby I secure a plurality of artistic etchings simultaneously.

By arranging the several individual anodes of the series in separate tanks or solutions, as distinguished from arranging the series of anodes in a single tank or solution, with corresponding cathodes, I produce a new and beneficial result. By this arrangement, I protect or screen the plates (anodes) operated upon, from those oblique or diverging lines of force necessarily acting upon any extended or widely separated surfaces exposed in unseparated fluids and thus I guard the plates against undercutting by which fine lines of resisting matter are undermined and finally detached from the plate, rendering the latter imperfect. On the other hand, by separating the anodes of the series, the lines of electric or galvanic force are all in a direction at or nearly at right angles to the surface of the plate and thus the undercutting or undermining of the resisting matter is prevented and perfectly uniform results are secured on all the plates of the series.

Having thus fully described my invention, what I claim as new is—

1. The process herein described which consists essentially in first facing in any suitable manner a series of plates with a different metal imposing on said plates, films sensi-

tive to light, impressing said films by means of suitable negatives or positives and developing pictures on said plates by removing the unimpressed parts of said films, then applying ink to the whole surface of each of said plates thus covering both the bare parts and the parts that remain covered by the impressed portions then removing by a proper solvent said impressed parts together with their overlying ink thus leaving parts of the plate bare and parts covered by films of ink which correspond with the opaque parts of said positives or negatives, then reinforcing said ink remaining on said plates with a dust consisting of a waxy or fatty substance suitably mixed or combined with a friable or pulverizable substance, and brought to the form of a dust, and then subjecting to heat the last application on each plate, and finally suspending said plates as anodes with suitable cathodes in series, in separated electrolytic fluids, substantially as set forth.

2. The process of preparing plates for purposes of utility or ornament, which consists in imposing a picture on a plate in ink and applying to said ink a reinforcing film consisting of a mixture of a fatty or waxy substance such as paraffine, combined with a pulverizable substance such as plumbic chromate, and reduced to an impalpable powder and finally subjecting said powder to heat to form a film, substantially as set forth.

3. The process of preparing plates for purposes of utility or ornament, which consists in covering a plate or surface with a metal in an electrical state opposite to that of said plate, imposing a design or picture in ink on the facing of said plate, parts of said plate remaining bare, then reinforcing said ink with a mixture of a fatty or waxen substance combined with a friable or pulverizable substance and then subjecting to heat the said mixture to form a homogeneous layer and finally etching the bare portions of said plate substantially as set forth.

4. The process of preparing plates for purposes of utility or ornament, which consists in imposing a picture or design in an inky or other sticky or tacky film, on a plate, parts of the plate remaining bare, covering or reinforcing said film with a mixture of a fatty or waxen and a friable or pulverizable substance, in the form of powder or dust and then fusing said substances to form a homogeneous film, then subjecting the bare portions of the plate to the action of dynamo-electricity substantially as set forth.

5. The process of preparing plates for purposes of utility or ornament, which consists in imposing pictures in tacky films on a series of plates, reinforcing said films by imposing a mixture of a fatty or waxy substance and a friable or pulverizable substance thereon, and arranging said plates as anodes in separated electrolytic solutions with suitable cathodes the same being connected in series, substantially as set forth.

6. The process of securing uniformly etched designs, which consists in partly stopping off, or partly insulating, the surfaces of a plurality of metal plates, each plate thus bearing a design in insulating matter and being in part bare, connecting said plates in series with suitable cathodes and immersing the same simultaneously in separate electrolytic fluids, each pair being in a separate bath and the anode of one pair being in metallic connection with the cathode of the next and the whole series subjected to dynamo-electricity, and thus etching out the bare parts of the plates, substantially as set forth.

7. The process of preparing plates for purposes of utility or ornament which consists in imposing a picture on a plate in inky or sticky or tacky matter and reinforcing said inky, sticky or tacky picture with a powder consisting of paraffine and asphaltum and fusing said powder, substantially as set forth.

8. The process of preparing plates for purposes of utility or ornament, which consists in imposing a picture on a plate in inky, sticky or tacky matter and reinforcing said picture with paraffine substantially as and for the purposes set forth.

9. The process herein described which consists essentially in first giving the surfaces of a series of plates new or additional surfaces or coverings, imposing on said plates films sensitive to light, impressing said films by means of suitable photographic negatives or positives and developing pictures on said plate by removing the unimpressed parts of said films, then applying ink to the surfaces of said plates, thus covering both the bare parts and the parts that remain covered by the impressed portions, then removing by a proper solvent said impressed parts together with their overlying ink, thus leaving parts of the plate bare and parts covered by films of ink which correspond with the opaque parts of said positives or negatives, then reinforcing said ink remaining on said plates with a dust consisting of a fatty or waxen substance suitably mixed or combined with a friable or pulverizable substance and brought to the form of a dust, and then fusing the last application to form a solid and impervious film on each plate, and finally suspending said plates as anodes with suitable cathodes in series in separated electrolytic fluid, substantially as set forth.

10. The process herein described which consists in first facing a series of plates with a different or electrically opposite metal, imposing on said plates films sensitive to light, impressing said films by means of suitable negatives or positives and then, before or after developing the impressed film, applying ink to the surface, then developing a picture in said ink by removing parts of said ink together with portions of the underlying sensitive film, leaving parts of the metallic surface bare, then reinforcing said ink with dust of resisting matter, then suspending said

plates as anodes with suitable cathodes in series in separated electrolytic fluids substantially as set forth.

11. The process herein described which consists in imposing on a series of plates films sensitive to light, impressing said films by means of suitable negatives or positives, and then, before or after developing the impressed film applying ink to the surface of the plate, then developing a picture in said ink by removing parts of said ink together with portions of the underlying sensitive film, leaving parts of the metallic surface bare, then reinforcing said ink with dust of resisting matter, then suspending said plates as anodes with suitable cathodes in series in separated electrolytic fluids substantially as set forth.

12. The process herein described which consists in imposing pictures in ink on a series of metallic plates, parts of said plates remaining bare or exposed, reinforcing said ink with resisting matter, then suspending said plates as anodes with suitable cathodes in series in a circuit of dynamo-electricity, and in separated electrolytic fluids substantially as set forth.

13. The process herein described which consists in imposing on a metal plate, first a film of electrically different metal, then a picture in ink parts of said film of metal remaining bare, then reinforcing said ink with a resisting dust and finally suspending said plates as an anode in an electrolytic fluid in a circuit of dynamo-electricity, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 26th day of January, 1887.

HANNIBAL GOODWIN.

Witnesses:
CHARLES H. PELL,
WM. S. CORWIN.