W. S. EATON.

INTAGLIO PRINTING PLATE AND THE METHOD OF MAKING SAME.

APPLICATION FILED MAY 1, 1912.

1,215,354.

Patented Feb. 13, 1917.

2 SHEETS—SHEET 1.

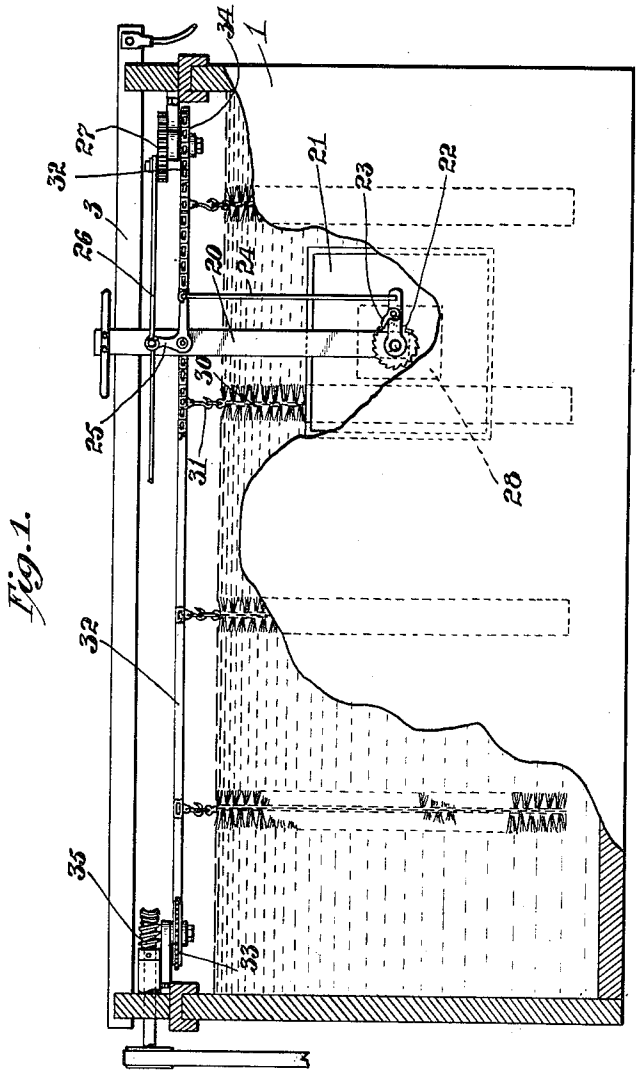


Fig. 1.

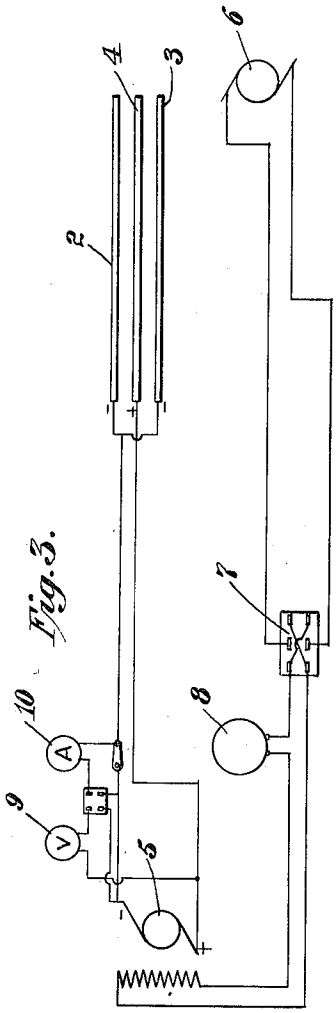


Fig. 3.

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2 SHEETS—SHEET 2.

Fig. 2.

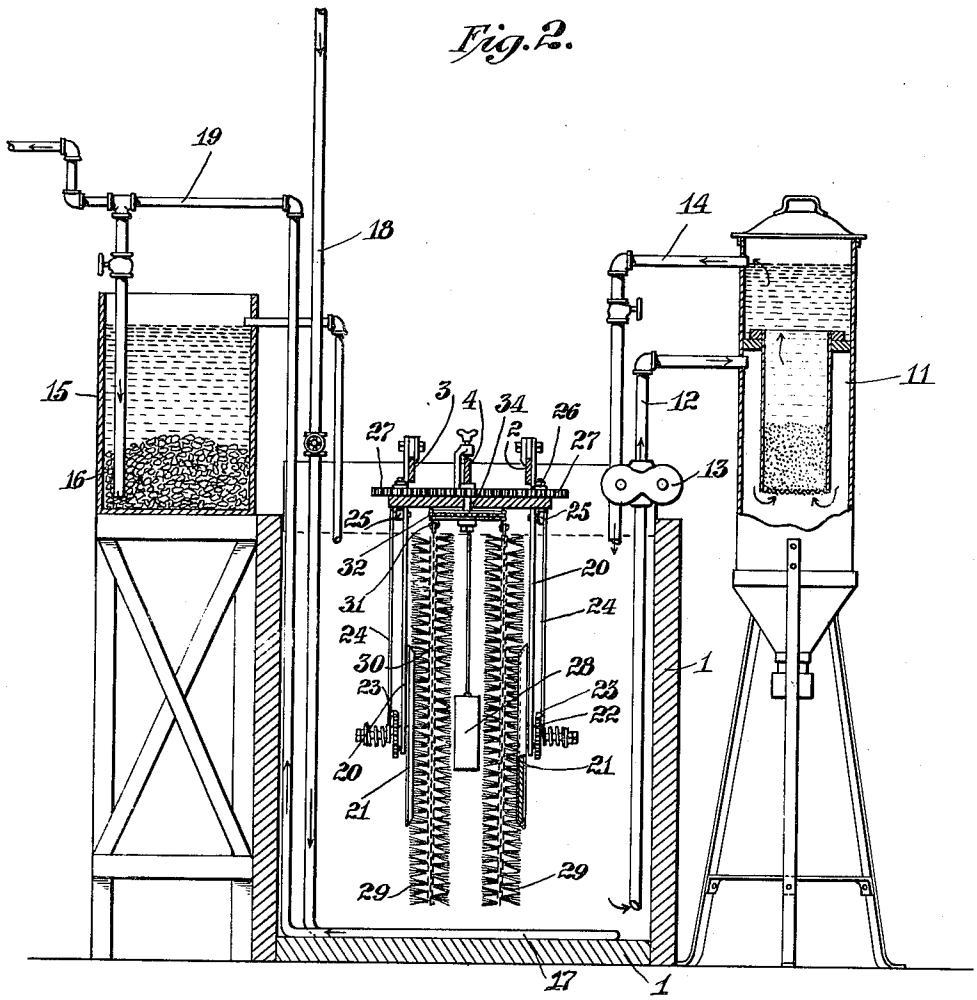
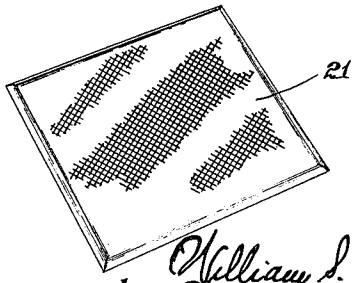


Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM S. EATON, OF SAG HARBOR, NEW YORK, ASSIGNOR TO AMERICAN BANK NOTE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

INTAGLIO PRINTING-PLATE AND THE METHOD OF MAKING SAME.

1,215,354. Specification of Letters Patent. Patented Feb. 13, 1917.

Application filed May 1, 1912. Serial No. 694,366.

To all whom it may concern:

Be it known that I, WILLIAM S. EATON, a citizen of the United States, residing at Sag Harbor, in the county of Suffolk and State of New York, have invented certain new and useful Improvements in Intaglio Printing-Plates and the Methods of Making Same, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

My invention relates to intaglio printing plates, and the art or method of making same, and more particularly to a type of plate and art and apparatus, adapted to economically and readily produce plates which may be used in lieu of the hand and mechanically engraved steel plates now in use.

The main object of the invention is to provide an intaglio printing plate of sufficient thickness composed of a solid homogeneous body of iron or other ferruginous material having a smooth surface and having under surface printing lines therein, formed through electro-deposition. A further object is to provide a plate of this character formed of such material in combination with a hardening agent. A still further object is to provide an art or method of making intaglio printing plates whereby a number of printing plates may be readily and economically produced in their entirety, from a master plate, thus permitting exactitude in the characteristics of all plates of the same design. A still further object is to provide an art or method of making intaglio printing plates by means of which plates of a thickness and homogeneity sufficient to withstand the wear of use, may be produced. A still further object is to provide an art or method of making intaglio printing plates by electro-deposition, wherein imperfections in the plate due to the presence of bubbles of hydrogen upon the surface of the cathode, which when completed constitutes the plate, will be obviated. A still further object is to provide such an art or method wherein all parts of the plate during its formation by electro-deposition will have the iron or other ferruginous material deposited under uniform conditions throughout the entire plate. A still further object is to provide an art or method of making intaglio printing plates by electro-deposition, wherein the time required to complete the plates will be reduced to a minimum. A still further object is to provide an art or method of making intaglio printing plates by electro-deposition, wherein the conditions in the bath will be maintained substantially uniform at all times during the production of a plate. And a still further object is to provide an apparatus for carrying on my aforesaid art or method of producing intaglio printing plates, wherein the matrix upon which the plate is formed by electro-deposition will be supported in the bath in a manner to permit the cleansing of the surface of the matrix and of the plate as it is gradually built up thereon, in order to avoid the presence of hydrogen bubbles and resultant defects in the completed plate.

The invention consists in an intaglio printing plate formed in its entirety of an electro-deposition of ferruginous material upon a cameo matrix formed from a master plate, and the novel art or method of making such plates, all as hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

Referring to the drawings:—

Figure 1 is a side elevation of the tank or cell used in connection with the art or method of making the intaglio printing plate in accordance with my invention, portions of said tank being broken away to disclose the interior arrangement thereof;

Fig. 2 is a vertical section of such apparatus in its entirety;

Fig. 3 is a diagrammatic showing of the circuits utilized in the practice of my art or method; and

Fig. 4 is a perspective view of a finished intaglio plate embodying my invention, the

under surface lines being indicated merely conventionally.

Like letters refer to like parts throughout the several views.

At the present time, postage stamps, stock certificates, bonds, banknotes, checks, drafts and other commercial paper, in order to minimize the dangers of counterfeiting, are as a rule printed from steel intaglio or under surface printing plates, this method being used because of the eccentricities or personalities which enter into the production of these plates and which make reproduction thereof difficult.

In most types of presses for using steel plates of this character, more than one plate of a kind is used, so that in order to make a commercial run, it is necessary to duplicate the plates, which duplication is done to-day by hand or by mechanical means supplemented by hand retouching or finishing.

By the methods now used, the conditions of production are such as to make it practically impossible for two plates, or corresponding parts of the same plate, to be identical as to the eccentricities of workmanship, so that exactitude in the different impressions taken from the same or duplicate plates is most difficult, if not impossible, to secure. Furthermore, the present methods are slow and expensive, both as to machine equipment and the labor involved.

By my invention, I aim to secure and do secure, an intaglio printing plate of the desired thickness, approximately one quarter of an inch, which is capable of being produced simultaneously in its entirety, and which is formed of a material which may be readily hardened or tempered by those processes which are now commonly used in this art. This plate, which I have shown conventionally in Fig. 4 of the accompanying drawings, is composed of a homogeneous mass of pure iron in alloy with vanadium or nickel, which metals through electro-deposition upon a cameo plate, form a solid homogeneous mass of uniform quality throughout, that surface of the plate which engages the matrix, possessing all of the characteristics and eccentricities of the matrix, excepting that the cameo lines upon the matrix become intaglio or under surface lines upon the printing surface of the plate.

A plate of the character described may be readily hardened or tempered, and as any number of matrices may be made from the same master plate, the number of plates produced from a single master plate may be increased indefinitely, and each plate will possess characteristics and eccentricities identical with those of every other plate made, which characteristics and eccentricities will also be identical with those of the master plate. Furthermore, the master plate may, if desired, be made entirely by hand, thus permitting this plate to be kept perfectly smooth and level as to its printing surface, with corresponding conditions in the reproduced plates.

By the methods now commonly employed in duplicating designs in plates, or portions of designs of the same plate, there is slight distortion of the plate from a true plane, thus necessitating a refinishing of the plate after the design has been cut therein, which refinishing is nonessential to a plate embodying my invention.

In producing plates of the character herein described, I make an impression from a master plate upon some ductile metal such as lead, by means of a hydraulic or other power press, which metallic matrix I use as a cathode in an electrolytic bath, using an anode consisting preferably of pure iron. The anode and cathode are sustained in the bath from suspension rods in the usual manner in electro-plating.

To insure the deposition of the iron upon all parts of the plate under similar conditions, I impart to the cathode or matrix such movement while in the bath as to repeatedly bring all portions thereof into contact with that portion of the bath having the highest specific gravity, this movement also serving to slightly agitate the electrolyte adjacent to the cathode. In electro-plating, particularly with iron, there is a tendency for the hydrogen disassociated from the oxygen in the solution, to form in bubbles upon the surface of the cathode, which condition I have found in practice, leads to a tendency toward the formation of holes, similar to blow holes, in the printing plate. To obviate this difficulty, I clear the surface of the cathode or of the plate being formed thereon by electro-deposition, at frequent intervals, this being accomplished by mechanical means or by means of a pole changer for reversing the flow of the electric current.

I have found that there is a tendency toward the formation of oxids in the bath which reduce the strength of the solution, and that in view of the fact that to build up a plate of the desired thickness requires considerable time, this variance in the strength of the electrolyte has an injurious effect upon the quality of the plate produced. These oxids fall as precipitates in the bottom of the tank, and there is also a tendency of the salt in solution to settle toward the bottom of the tank. To obviate these difficulties, I maintain a substantially constant circulation of the electrolyte through a filter, to remove such impurities, and thus secure more uniform conditions throughout the entire tank by agitation; and furthermore constantly supply to the

tank either pure water or water containing in solution salts to replace those lost through oxidization.

I have found by experiment and in actual use of my art or method, that the rapidity with which the metal may be deposited upon the matrix is much increased by raising the temperature of the electrolyte to substantially 160 degrees F. Temperatures in excess of this however, have a tendency toward the formation of bubbles upon the cathode and do not, I have found, seem to increase the effective action of the solution.

I have also found that the raising of the temperature of the electrolyte produces a more homogeneous mass of metal in the plate, avoiding a soft or spongy deposit, which in practice is undesirable.

In the practice of my invention, I have found that iron sulfate is highly efficient in the solution, and that this efficiency may be increased by the addition of a neutralizing agent such as sodium bicarbonate. I have also secured good results in the plates, as to density and quality of the deposit, by adding to this solution a small percentage (about 1%) of vanadium chlorid. The solution should have a specific gravity of at least 21 degrees Baumé.

I have also used nickel salts in about the same percentage as a substitute for the vanadium chlorid. I have found that the quantity of sodium bicarbonate may be varied without materially affecting the efficiency of the bath.

After the plate has been properly built up through electro-deposition, I remove it from the bath, strip the matrix therefrom and after leveling the back of the plate and hardening or tempering it in its entirety in the manner now commonly used with steel plates, the plate is ready for use in the same manner as an ordinary hand or mechanically made intaglio printing plate.

To produce a more perfect printing surface, I have found that a thin coating of copper, deposited upon the matrix prior to taking an impression of the master plate therewith, gives good results. The copper, however, remains upon the matrix when it is stripped from the completed plate.

In the apparatus shown in the accompanying drawings, 1 indicates a suitable tank or container for the electrolyte, extending across the top of which are the electrode supporting bars 2, 3 and 4, two of which as 2 and 3 are of similar polarity, and the other of which as 4, is of dissimilar polarity to the other two. These supporting rods are in circuit with a low potential dynamo 5, the field of which is energized from a high potential dynamo indicated at 6, the pole changing switch 7 and the resistance 8 being arranged in the circuit to the dynamo 6. Arranged in the low potential circuit are an ordinary volt meter and ammeter indicated respectively at 9 and 10. The arrangement of the suspension bars 2, 3 and 4 is such as to permit the suspension of a number of electrodes therefrom, the bars 2 and 3 being parallel with and upon opposite sides of the bar 4, so as to permit the use of a plurality of cathodes with a single anode for the purpose of permitting the multiplication of the number of plates simultaneously produced.

Arranged adjacent to the tank 1 is a filter 11 to which the electrolyte is delivered through a pipe 12, the inlet of which is adjacent to the bottom of the tank 1, an ordinary pump 13 being used to maintain the proper circulation of the electrolyte. After filtration, the electrolyte is delivered to the top of the tank 1 through a pipe 14 leading from adjacent to the top of said filter. This arrangement permits the withdrawal of the impurities and precipitates from adjacent to the bottom of the tank, and also of a portion of the electrolyte having the highest specific gravity, thus insuring a more uniform condition of the electrolyte throughout the entire tank.

Also adjacent to the tank 1 is a tank 15 for distilled water, this tank containing therein iron surfate shown in bulk at 16 for combining with the water sufficient salts to replace those expended in the plating operation in the tank 1 or through oxidization. In the bottom of the tank 1, is a steam coil 17 preferably composed of lead pipe, to which steam is admitted through the steam pipe 18 and from which the water of condensation is delivered to the tank 15 through the pipe 19.

The pole changing switch above referred to is for the purpose of changing the poles of the supports 2, 3 and 4 in a manner to cause the current to flow from the cathode to the anode for the purpose of removing any hydrogen bubbles accumulated upon the surface of the former.

Detachably mounted upon the supporting bars 2 and 3 are hangers 20, the lower ends of which have rotatably mounted therein electro conductive, thin platens 21 by means of which a metallic matrix may be secured thereto by crimping the edge thereof about the platen. Carried by each said platen is a ratchet wheel 22, adapted to be actuated by a pawl 23, which in turn is actuated by means of a rod 24 connecting it with the bell crank lever 25, mounted adjacent to the upper end of the hanger 20. Ordinarily a plurality of such hangers are used, and all the bell crank levers upon the hangers carried by the same support are simultaneously actuated by an oscillatory rod 26 actuated from the disk 27.

The object of this mechanism is to im-

part to the platen 21 and the cathode mounted thereon, continued movement in the electrolyte in order to successively bring substantially all portions of the plate into that portion of the electrolyte having the greatest density or specific gravity, thus causing the treatment of substantially the entire surface of the plate to be under such conditions as will insure uniformity in the product.

The anodes shown at 28 are suspended from the bar 4, and constantly moving between the anodes and the cathodes upon opposite sides of the former are a series of wipers 29, the function of which is to repeatedly clear the surface of the cathode and the printing plate being built up, of hydrogen bubbles, and thus avoid the presence of imperfections in the completed plate.

To permit the desired intimate contact of the wipers 29 with the entire surface of the plate, I form these wipers of a plurality of flexible disks 30, strung upon a flexible core 31, a construction which permits the wiper to assume any position. A series of such wipers are mounted upon sprocket chains 32 passing about sprocket wheels 33, 34, the diameters of which wheels are such as to position these wipers between the anode and cathodes in the manner described. The sprockets 33 34 are driven by a worm and worm wheel mechanism 35, at a low rate of speed. The gears 27 are driven from the sprocket 34.

The manner of practising the herein described art or method, and the operation of the herein described apparatus are substantially as follows:—

The tank 1 is filled with a solution containing sulfate of iron and a neutralizing agent, and having a specific gravity of at least 21 degrees Baumé. Steam is admitted to the coils 17 in order to bring the temperature of the solution to substantially 160 degrees F. If desired, a small percentage of vanadium chlorid may be added to the composition. The pump 13 is operated from time to time, to withdraw the sediment and the solution from the bottom of the tank 1, passing it through the filter 11 and restoring it to said tank in a manner to agitate the solution and preserve a more or less uniform condition, and specific gravity of the solution, throughout the tank, while at the same time removing by filtration the sediment adjacent to the bottom of the tank. The water condensed in the coil 17 is delivered to the tank 15 containing iron sulfate, which tank as it overflows, gradually delivers this distilled water with a trace of iron sulfate in solution, to the tank 1.

The master plate having been prepared, an impression thereof is taken in lead or other ductile electro-conductive material, the design of the plate appearing upon this material in relief, this impression constituting a cameo matrix upon which the body of the printing plate is gradually built up through the electro-deposition of iron thereon. When a copper faced matrix is used, the lead sheet is plated before having the design impressed thereon.

This matrix is mounted upon one of the thin platens 21, the edges thereof being crimped about the edge of this platen to retain the matrix thereon. A number of platens 21 are suspended from the supporting bars 2 and 3, upon opposite sides of the anode 28, which is suspended from the supporting bar 4. The various rods 24 are then connected to the rod 26, so that all of the platens 21, through the pawl and ratchet mechanism connecting each of them with its rods 24, will be gradually turned in a manner to gradually vary the position of the matrix thereon with relation to the solution in the tank, the specific gravity of which varies at different levels.

Any number of matrices may be made from a single master plate, and the method may be carried on by the apparatus herein described in the production of a number of plates simultaneously, so that unlike other methods of reproducing intaglio printing plates, a number of such plates may be simultaneously reproduced in much less time than is ordinarily required by the methods now commonly employed, in the production of a single plate.

The deposition of the iron upon the matrix is effected by means of an electric current, the circuit of which is shown in Fig. 3 of the drawings, said matrix acting as a cathode.

The hydrogen gas released through the decomposition of the electrolyte, has a tendency to collect upon the surface of the cathode, and to avoid the presence of bubbles upon the cathode, which bubbles would gradually be bridged by the metal being deposited about same, the pole changer 7 may be thrown over from time to time to reverse the direction of flow of the current to free the bubbles from the cathode, and in addition thereto I provide the traveling wipers 29 which rub across the face of each cathode and remove any bubbles or sediment thereon. These wipers travel continuously between the anode and the cathode or cathodes, and by reason of the flexibility of the core 31 thereof, they will readily conform to the surface of the cathode, and thus secure the desired intimate contact of the flexible disks 30 with such surface.

The operation of the actuating means for said wipers and for the mechanism imparting the desired movement to the platens 21 will be clearly understood by a reference to Figs. 1 and 2 of the accompanying drawings.

The particular circuits shown in Fig. 3 of the drawings are to adapt the apparatus for use with ordinary dynamo circuits now commonly used, and are largely matters of convenience.

The matrix upon which the metal is deposited will be an exact duplicate of the master plate, the raised portions thereof, forming the intaglio portion of the completed plate, being of a height coinciding with the depth of the cuts in the master plate, and the depressed surfaces of this matrix being as smooth and bright as the top, or non-printing, surface of the said master plate. The deposition of the iron upon this matrix being in the most minute particles, the surface conditions of the matrix will impart to the reproduced plate conditions substantially the same as those which are found upon the top or non-printing surface of the master plate.

The apparatus is kept in continuous operation until the thickness of the material deposited upon the cathode approximates one quarter of an inch, or that of the ordinary steel intaglio engraved printing plate.

The manner of depositing the iron and of keeping the surface of the plate being built up free of bubbles and sediment, will produce a plate having fine grain, and great density of material, and one which will readily withstand the ordinary conditions of use. Furthermore, a plate may be produced from a master plate in much less time than is required by hand and mechanical methods, and in addition to this, every plate produced from the master plate will be an exact replica of every other plate thus produced.

Furthermore, the depth of each cut in every reproduced plate will be identical with that of the corresponding cut of the master plate, and the number of plates necessary to equip one or more presses for a run upon the same work may not only be quickly and economically produced, but all plates will be identical so that the eccentricities in the workmanship of the engraver producing the master plate will be accurately reproduced in each duplicate plate made.

When the desired thickness of material has been deposited upon the cathode, the matrix is removed from the platen 21 and stripped from the plate, the printing surface of the plate being "finished" and the only additional operation required being the possible grinding off of the bottom of the plate to level it up and bring the plate to size, and the finishing of the edges of the plate. The copper plating will remain on the matrix, having served to impart the desired finish to the reproduced plate.

In under surface printing, or printing from intaglio engraved plates, steel plates are required to secure the desired finish upon the work, and this invention is therefore limited to the production of plates of this character. In a plate capable of being used in this class of work, it is necessary that the plate should possess characteristics which will enable it to withstand heavy pressures, as in machine wiping and polishing, and I have found that a plate having a homogeneous body of an electro-deposition of ferruginous material, is suitable for this class of work.

It is not my intention to limit my invention to the precise details herein described, it being apparent that such may be varied without departing from the spirit and scope of the invention.

Having described my invention, what I claim as new, and desire to have protected by Letters Patent, is:—

1. An intaglio printing plate consisting in its entirety of a highly tempered electro-deposition of a ferruginous material having thereon a design formed of a plurality of shallow depressed lines, the surfaces of these lines having the same granular formation as the top or non-printing surface of the plate.

2. An intaglio printing plate consisting in its entirety of a highly tempered homogeneous mass of ferruginous material containing a hardening agent having thereon a design formed of a plurality of shallow depressed lines, the surfaces of these lines having the same granular formation as the top or nonprinting surface of the plate.

3. The herein described art or method of making intaglio printing plates embodying therein the steps of making a design, upon a master plate, formed of a plurality of shallow depressed lines, forming a metal matrix from said master plate and electro-depositing upon said matrix a mass of ferruginous material to a depth to form the entire plate whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface of said last named plate and of the depressed lines therein will be of the same character.

4. The herein described art or method of making intaglio printing plates embodying therein the steps of making a design upon a master plate formed of a plurality of shallow depressed lines, forming a metal matrix from said master plate and electro-depositing upon said matrix a mass of ferruginous material to a depth to form an entire plate by submerging said matrix in an electrolytic bath containing iron sulphate whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface

of said last named plate and of the depressed lines therein will be of the same character.

5. The herein described art or method of making intaglio printing plates embodying therein the steps of making a design, upon a master plate, formed of a plurality of shallow depressed lines, forming a metal matrix from said master plate and electro-depositing upon said matrix a mass of ferruginous material to a depth to form an entire plate by submerging said matrix in an electrolytic bath containing iron sulfate and a neutralizing agent whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface of said last named plate and of the depressed lines therein will be of the same character.

6. The herein described art or method of making intaglio printing plates embodying therein the steps of making a design, upon a master plate, formed of a plurality of shallow depressed lines, forming a metal matrix from said master plate and electro-depositing upon said matrix a mass of ferruginous material to a depth to form an entire plate by submerging said matrix in an electrolytic bath containing iron sulfate, and a hardening agent whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface of said last named plate and of the depressed lines therein will be of the same character.

7. The herein described art or method of making intaglio printing plates embodying therein the steps of making a design, upon a master plate, formed of a plurality of shallow depressed lines, forming a metal matrix from said master plate and electro-depositing upon said matrix a mass of ferruginous material to a depth to form an entire plate by submerging said matrix in an electrolytic bath containing iron sulfate, a neutralizing agent and a hardening agent whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface of said last named plate and of the depressed lines therein will be of the same character.

8. The herein described art or method of making intaglio printing plates embodying therein the steps of making a design, upon a master plate, formed of a plurality of shallow depressed lines, forming a metal matrix from said master plate and electro-depositing upon said matrix a mass of ferruginous material to a depth to form an entire plate by submerging said matrix in an electrolytic bath containing iron sulfate while constantly varying the position of said plate in said bath, whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface of said last named plate and of the depressed lines therein will be of the same character.

9. The herein described art or method of making intaglio printing plates embodying therein the steps of making a design, upon a master plate, formed of a plurality of shallow depressed lines, forming a metal matrix from said master plate and electro-depositing upon said matrix a mass of ferruginous material to a depth to form an entire plate by submerging said matrix in an electrolytic bath containing iron sulfate and intermittently cleaning the surface of said matrix and metal deposited thereon while the matrix is in the bath, whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface of said last named plate and of the depressed lines therein will be of the same character.

10. The herein described method or art consisting of making a design in shallow depressed lines upon a steel plate, tempering said plate, polishing the top surface thereof, placing a soft metal sheet upon said plate and subjecting said plate and said sheet to great pressure whereby the density of said sheet will be increased and that surface thereof adjacent said master plate will receive the same surface characteristics as to smoothness as said master plate and the depressed lines of said master plate will be reproduced in cameo upon said soft metal sheet and electro-depositing upon said matrix a mass of ferruginous material to a depth to form the entire plate whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface of said last named plate and of the depressed lines therein will be of the same character, removing said soft metal matrix from said electro-deposited mass and tempering said mass.

11. The herein described method or art consisting of making a design in shallow depressed lines upon a steel plate, tempering said plate, polishing the top surface thereof, plating a soft metal sheet with a thin stratum of copper, placing said sheet upon said plate with the copper surface in contact with the surface of said plate bearing the design and subjecting said plate and said sheet to great pressure whereby the density of said sheet will be increased and

that surface thereof adjacent said master plate will receive the same surface characteristics as to smoothness as said master plate and the depressed lines of said master plate will be reproduced in cameo upon said soft metal sheet and electro-depositing upon said matrix a mass of ferruginous material to a depth to form the entire plate whereby the design of said master plate will be reproduced upon said plate of electro-deposited ferruginous material and the granular formation of the top or non-printing surface of said last named plate and of the depressed lines therein will be of the same character, removing said soft metal matrix from said electro-deposited mass and tempering said mass.

In witness whereof, I have hereunto affixed my signature, in the presence of two subscribing witnesses, this 19th day of April, 1912.

WILLIAM S. EATON.

Witnesses:
F. T. WENTWORTH,
EUGENE WENING.