G. E. WERTHEIMER.

PROCESS OF PREPARING STENCIL PLATES, DIE PLATES, AND THE LIKE.

APPLICATION FILED DEC. 24, 1917.

1,376,365. **Patented Apr. 26, 1921.**

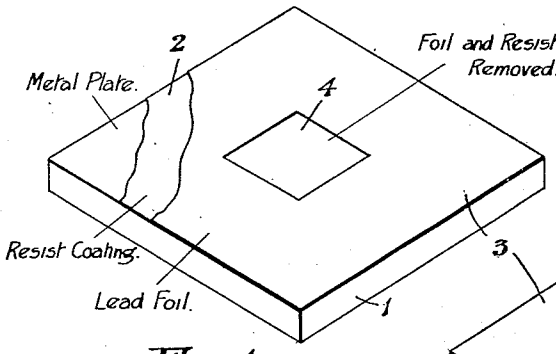


Fig. 1.

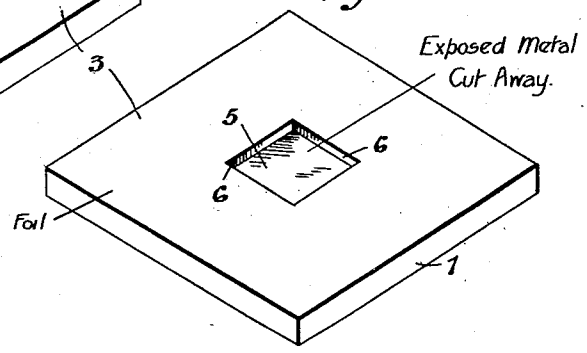


Fig. 2.

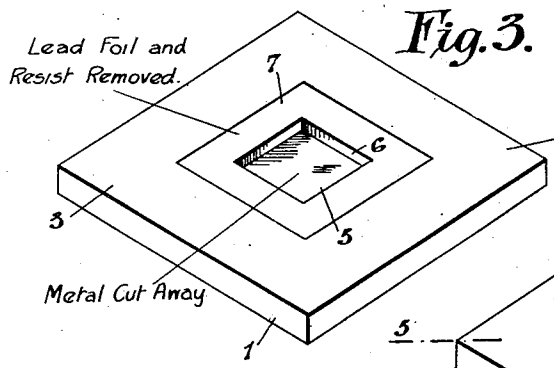


Fig. 3.

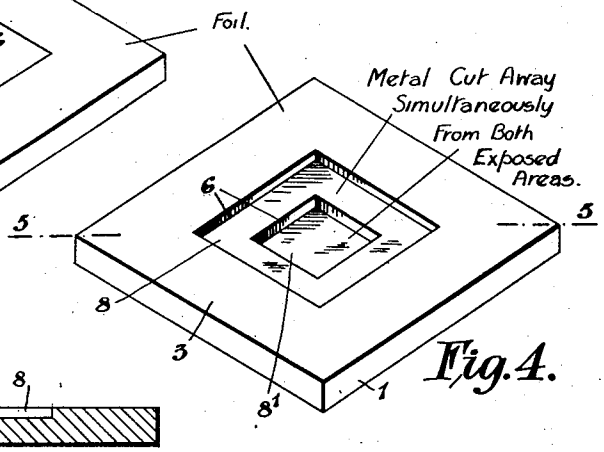


Fig. 4.

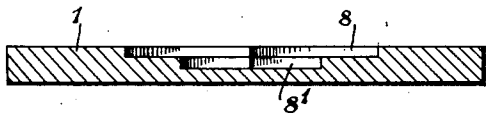


Fig. 5.

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PROCESS OF PREPARING STENCIL-PLATES, DIE-PLATES, AND THE LIKE.

1,376,365. Specification of Letters Patent. Patented Apr. 26, 1921.

Application filed December 24, 1917. Serial No. 208,558.

To all whom it may concern:

Be it known that I, GOTTHOLD EPHRAIM WERTHEIMER, a subject of the Emperor of Austria, and a declarant of the United States, having made my application for first papers in March, 1917, residing at 558 West 36th street, New York, in the county of New York and State of New York, have invented certain new and useful Improved Processes of Preparing Stencil-Plates, Die-Plates, and the like, of which the following is a specification.

This invention relates to a process of producing stencil plates, or die plates or blocks, or like metallic articles by eroding, or eating or cutting away the metal from certain desired parts of the plate or block by the use of electric currents while the plate or block is immersed in a suitable electrolytic solution or bath.

The object of the invention is to provide a process by the use of which embossing dies or plates, dies for making stampings or forgings, stencil plates, and like articles may be rapidly and accurately prepared at a considerably reduced cost and with a minimum expenditure of labor as compared with existing methods of preparing such dies, plates or the like.

Another object of the invention is to provide a process by the use of which metal may be removed from a plate or block to any desired depth, or through the entire thickness of the block or plate over any desired configuration, without any undercutting at the edges of the parts so removed.

A further object of the invention is to provide a process by the use of which metal may be removed or eroded from both sides of a plate or block simultaneously.

A still further object of the invention is to provide a process by the use of which two plates may be simultaneously produced by the use of a single cathode member, said plates being similar but one of them having certain parts in relief and the other having the corresponding parts in intaglio, said plates being adapted for joint use, for example in embossing work.

Further objects of the invention will appear clearly from the following detailed description and from the claims appended hereto.

The accompanying drawings conventionally illustrate the various steps of the process according to this invention. In these drawings, Figures 1 to 4 inclusive show a metal plate after successive treatments or steps of the process, and Fig. 5 is a sectional view of the plate illustrated in Fig. 4, the plane of the section being indicated by the line 5—5 in the latter figure.

Generally speaking, the metallic plate or block to be operated on according to the present invention, is immersed in the electrolytic solution and an electric current is passed from said plate or block, serving as the anode, through the solution to the cathode, the latter when a die plate or block is being prepared having secured thereto or formed in one therewith a pattern of the article to be produced by said die plate or block. The parts of the plate to be cut away are exposed to the solution and the other parts of the plate are protected and the action of said solution and of the current passing from said exposed parts through said solution to the corresponding parts of said pattern results in said exposed parts of the plate or block being eroded or eaten away. In the case where the metal is to be removed to a uniform depth throughout, or is to be removed through the entire thickness of the plate or the like, as for example in the making of a stencil plate, the pattern on the cathode may not be essential, although it may be employed if desired.

I will now describe in detail the various elements necessary in carrying out the process, the method of preparing the same, and the operative steps involved.

The process may be carried into effect by means of a tank of wood or other suitable material having a lead lining and containing the electrolytic solution or bath. This solution is preferably of the nature described and claimed in my companion application Serial No. 208,559 filed December 24th, 1917, such solution comprising the following ingredients in substantially the following proportions by volume, namely, sulfuric acid 1.84 specific gravity 80 parts, nitric acid 1.42 specific gravity 20 parts, copper nitrate 5 parts, iodin 2 parts, acetic acid about 30% 2 parts, ammonium chlorid 200 parts and water 691 parts. The copper nitrate, iodin and ammonium chlorid are of the usual commercial grade of purity. The solution may be employed with or without the ammonium chlorid, in the latter event the water comprising 891 parts of the solution. It is of course to be understood that the invention

is not limited to the use of this particular solution or bath, although it may be stated that excellent results, both in regard to the quality of the work and the time occupied in producing the same have been obtained therewith.

I find it advisable to employ this electrolyte at a temperature of about 83° Fahrenheit for obtaining the maximum efficiency, but the electrolyte can be used at lower temperatures, say at room temperature, if desired. The liquid may be kept at the desired temperature by an electric heater or otherwise.

The cathode and the plate or block serving as the anode may be suspended in the solution or bath in the usual manner by means of conducting wires or rods from conductors or bars of brass or other suitable material supported upon or above said tank, the electric current from a suitable source being suitably connected to said bars, the current flowing from said source to the bar supporting the plate or block and flowing back to said source from the bar supporting the cathode. The distance between the cathode and anode will of course vary according to the area of the work to be operated on, for example a distance of approximately six inches between anode and cathode will be found suitable for articles up to about six inches in area. The speed of operation is of course controlled to a certain extent by the distance apart of the cathode and anode. Similarly the current employed will vary according to the quantity of work to be operated upon, although it may be stated that in carrying out the process it is necessary to use a current of low voltage and high amperage. Generally speaking a current starting from lowest voltage and amperage and gradually rising to about six or seven volts and about 35—40 amperes will be found suitable.

The cathode may be formed of any suitable conducting material, but it is preferred to make it of a mixture of substantially equal parts of graphite and carbon, the graphite insuring a more uniform flow of current and a smooth surface on the eroded or eaten away parts of the plate or block. The graphite and carbon in powdered form are worked into a pasty mixture with linseed or other suitable oil and said mixture is pressed in the desired form, which may simply be that of a flat plate of considerable area, and dried.

The cathode in the preparation of a die plate or block may, and preferably does, carry a pattern of the article to be produced by said die, and said pattern may be formed integrally with the cathode, or may be made of the same material as the cathode and secured thereto, or it may be of metal or other conducting material and secured to said cathode. The cathode is preferably in the form of a plate of materially greater area than the article or pattern secured to it. The use of the pattern on the cathode increases the speed of operation of the process and also causes the metal to be more uniformly removed from the anode or plate.

The plate or block to be operated upon is of a metal suited to the purpose for which the plate or block is intended to be used. For example, in the manufacture of a die plate or block, said plate or block will be of hardened or annealed steel. In preparing the plate or block, which may be termed the anode, for treatment, the same is first coated all over with a suitable resisting coating to protect the parts which are not to be cut or eaten away. While any suitable resisting coating may be employed, it is preferred to use a material comprising a mixture of the following ingredients, in substantially the proportions stated, namely, asphaltum six parts, beeswax two parts, stearin one part, and varnish one part. I prefer to use the varnish known in the trade as white dammar varnish, but any other similar varnish may be used. The ingredients are mixed together while being slowly heated until the desired consistency and uniformity is obtained. The resisting coating is painted on the bare metal until it is just tacky and then a coating or layer of lead foil, preferably of approximately .002 thickness, is applied over the resisting coating and the whole allowed to properly dry and set.

The portion or portions of the metal of the anode to be removed are exposed by removing a portion or portions of the lead foil and resisting coating of predetermined extent and configuration according to the size and shape of the article to be produced by the die plate or block, or the inscription or design to be embossed or stenciled by the use thereof. The configuration of the portions of the anode to be removed may be indicated on the lead foil coating by laying said article or pattern on said coating and outlining it thereon by the use of a suitable scribing or other tool, or by tracing said outline on tracing cloth or paper and laying the same on said coating. Or the outline of a design or inscription may be drawn on the lead foil by hand by a suitable scriber or tool. The lead foil within such outline or design, or a particular portion or portions thereof as later described, is then cut out by the use of a suitable cutting tool, and the portion cut out removed. This exposes the resisting coating which is then removed in any suitable manner, as by the use of a solvent, such as benzol or naphtha. The removal of both the lead foil and the resisting coating exposes the metal of the die plate or block at the part or parts

which are to be cut or eaten away, while those parts which are not to be removed are strongly protected. The lead foil coating materially facilitates the laying out of the design, or outline of the parts to be removed, as it will be clear that it is much easier to do this on the lead coating than on the resisting material. It also facilitates the removal of the resisting coating within the outline of the article or design and insures regular and even lines at the edges of the coating removed, while at the same time protecting the remainder of the resisting coating from the action of the solvent employed. In some cases of course the lead foil may not be essential, although its use is preferable in all cases for the reasons stated. If desired a second resisting coating may be applied over the entire surface of the lead foil remaining on the plate or block. This may be necessary with some solutions to protect the lead foil from the action thereof, while with other solutions such as that above referred to, this second coating may not be necessary.

The accompanying drawings illustrate conventionally the various steps of the present process, Fig. 1 showing a metal plate or anode 1 having a coating of resisting material 2 applied to the upper surface thereof and a coating of lead foil 3 superimposed upon the coating 2, the lead foil being cut away and the resisting coating removed at the central portion of the plate to expose the metal of the plate or anode over an area indicated by the numeral 4. It is to be noted that the area 4 is merely indicated for purposes of illustration and that an area of any other configuration may be exposed and that one or more such areas may be produced by cutting different portions of the lead coating away. The anode, prepared in the manner described, and the cathode, with or without an article or pattern thereon, are now placed in the electrolytic solution or bath, supported from the conducting bars above mentioned, or otherwise suitably supported and connected into the electric circuit. The parts such as 4 of the anode left exposed by the removal of the lead foil and resisting coating are arranged directly opposite to and facing the cathode, or the article thereon, or the parts of such article corresponding to said exposed parts, and on the passage of current through said circuit, said current flows to the anode and from the exposed parts thereof through the solution to the cathode or to the article thereon, or the parts of such article, and thence back to the source of supply, the resulting action of the current flow and of the solution or bath causing the exposed parts to be eroded or eaten away. The current flow is continued until the desired depth of cut is obtained, and this may be readily ascertained by removing the anode from time to time and testing by the use of a micrometer gage or other measuring means. The cutting away of the exposed portion of the metal of the anode is indicated at 5 in Fig. 2, the cut away portion corresponding with the area 4 of Fig. 1 and being cut away to a desired depth as shown by the numerals 6 indicating the sides of the recess or depression formed in the plate. The removal of the metal is effected very rapidly, it being found from tests conducted that with the employment of the solution and current above set forth it is possible to cut to a depth of three sixty-fourths of an inch in annealed or hardened steel in one hour over any area of any configuration, and with a solution having the ammonium chlorid omitted it is possible to cut to a depth of one millimeter in about six hours.

The removal of metal may take place up to approximately three sixty-fourths of an inch without undercutting of the edges of the portions removed, but if deeper cuts are desired, the anode is removed from the solution from time to time and the edges of the parts removed for example, the edges 6, Fig. 2, coated with said resisting material, thus preventing undercutting of such edges no matter how deep a cut is made, or whether the cut is made entirely through the block or plate.

Where as is usually the case the article to be produced by the die plate or block has portions which lie at different elevations from the surface of the cathode, the portion or portions of highest elevation on the article or pattern will correspond to portions to be cut in the plate or block to the greatest depth and portions of lesser elevation on the article or pattern will correspond to portions to be cut to lesser depths in the plate or block. I control the removal of metal from the plate or block corresponding to such varying depths, by exposing the different portions of the anode in succession according to their elevations. That is, the portions of the resisting and lead foil coatings are cut away firstly to correspond in extent and configuration to the portions of highest elevation in the article or pattern and the metal is removed from such exposed portions by the action of the solution and current flow in the manner above described, until a depth has been reached which corresponds to the distance between the portions of highest elevation on the article and the portions of next succeeding elevation. Further portions of the resisting and lead foil coatings are then removed corresponding to the portions of next succeeding elevation on the article, this being indicated conventionally in Fig. 3 which shows the plate of Fig. 2 having the cut away portion 5, and having an additional area of lead foil and

resisting coating cut away or removed around the cut away portion 5 as indicated by the numeral 7. The area 7 is of course merely indicative of an area or areas of any desired configuration which may be exposed, as above stated. The block or plate is again immersed in the solution and metal removed simultaneously from the portions previously exposed and the new portions exposed. This is indicated by Fig. 4 which shows the plate or anode 1 having metal removed from the portion of the plate corresponding to the area 7 of Fig. 3, this removed portion being indicated by numeral 8 and the sides of the cut by the numeral 6. Simultaneously additional metal has been removed as indicated by the numeral 8′ corresponding to the original area 4, Fig. 1, and in continuation of the cut away portion 5 of Figs. 2 and 3. This removal of metal is continued to a depth corresponding to the distance between the portions of the article of said next succeeding elevation and the portions of next lower elevation, and then portions of the resisting coating are removed corresponding to said portions of next lower elevation and the metal removed from the newly exposed portions simultaneously with the removal of metal from the portions previously exposed, the process being repeated until all elevations of the article have been dealt with. It will be seen that the various portions removed have their depth increased with each succeeding operation and the depth of such portions depends upon the order of their exposure and the time of subjection to the action of the solution and current. Fig. 5 shows in section a plate or anode as illustrated in Fig. 4 and clearly showing the depth of the cut away portion 8 and the increased depth of the portion 8′ due to the fact that the former is the result of a single operation while the latter is the result of two successive operations.

For removing metal to form curved or conical or inclined surfaces, a similar procedure is followed, the portions of resisting and lead foil coatings corresponding to portions of highest elevation in the curve, or cone or incline, being first removed and then the portions of succeeding elevation bordering on the first portions successively removed, the extent of the exposed surface being gradually increased and the depth of cut at each operation varying, according to the form of the curve or inclination. Any lines or edges of metal left between successive removals may be readily removed by means of a suitable tool.

It will be clear that by mounting an article or pattern on each side of a single cathode and locating the same between a pair of plates or blocks, and exposing portions of each block or plate corresponding to certain portions of the pattern on the side of the cathode facing said block or plate and removing the exposed metal in the manner above set forth, a pair of plates may be simultaneously produced with a single cathode. This is of particular use in preparing embossing plates for example, in which the parts of one plate are to be in relief and the corresponding parts of the other plate are to be in intaglio. The patterns employed will in this event be exactly similar to each other but the portions which are exposed on one anode will correspond with portions which are in relief on the patterns, while the portions which are exposed on the other anode will correspond with portions which are depressed on said patterns. Thus one plate will be in relief and the other in intaglio. It will be clear that a single plain cathode without patterns thereon might also be used to make two plates simultaneously.

Also by employing a pair of cathodes with or without articles mounted thereon, metal may be simultaneously removed from selected portions of each side of a single plate or block located between such cathodes. The portions removed may be identical or different, although the depth of cut at each side will generally be the same.

What I claim and desire to secure by Letters Patent is:—

1. A process of the character described, which consists in coating a metallic anode with a coating of lead foil, removing a portion or portions of said coating of predetermined extent and configuration to expose the metal of the anode therethrough, immersing the anode in an electrolytic solution together with a cathode, and removing metal from said exposed portion or portions by causing electric current flow from the anode through said exposed portion or portions and through the solution to the cathode.

2. A process as claimed in claim 1, wherein the anode is first coated with the resisting material, and a coating of lead foil is then applied over said material, a portion of said lead foil being first removed to expose the resisting coating therethrough and the exposed portion of said coating being then removed to expose the metal of the anode.

3. A process as claimed in claim 1, wherein a coating of resisting material is applied over the coating of lead foil remaining on the anode prior to the immersion of the anode in the electrolytic solution.

4. A process of the character described, which consists in immersing a cathode in an electrolytic solution together with an anode having a portion of its surface exposed to the action of said solution and the remainder of its surface protected by a resisting coating, removing metal from said exposed portion by causing electric current flow

from the anode through said exposed portion and through the solution to said cathode, continuing said current flow until a predetermined depth of metal has been removed from said exposed portion, and then removing at successive intervals other portions of said resisting coating, the anode being immersed in the solution after each such removal of resisting coating, and metal removed simultaneously from all of the portions of the anode then exposed by causing current flow from said anode through all of the exposed portions and through the solution to the cathode.

5. A process as claimed in claim 4, wherein a coating of lead foil is applied to the anode over the resisting coating and first the foil and then the resisting coating are removed at each of said successive intervals to expose the metal of the anode.

6. A process of the character described, which consists in providing a cathode with a pattern of predetermined configuration, coating a metallic anode with a resisting coating, removing portions of said coating at successive intervals to successively expose different portions of the metal of the anode, the portions of the coating removed at said successive intervals corresponding in extent and location to portions of said pattern of different elevations, immersing the cathode and the anode in an electrolytic solution after each such removal of resisting coating from the anode, and at each such immersion causing current flow from the anode through all of the portions thereof then exposed and through the solution to the corresponding portions of the pattern on the anode.

7. A process of the character described, which consists in providing a cathode with a pattern of predetermined configuration, coating a metallic anode with a resisting coating, removing portions of said coating at successive intervals to successively expose different portions of the metal of the anode, the portions of the coating removed at said successive intervals corresponding in extent and location to portions of said pattern of different elevations and shapes, immersing the cathode and the anode in an electrolytic solution after each such removal of resisting coating from the anode, and at each such immersion causing current flow from the anode through all of the portions thereof then exposed and through the solution to the corresponding portions of the pattern on the anode, and continuing such current flow for a period sufficient to cause removal of metal from said exposed portions to a depth equal to the distance between successive elevations on the pattern.

8. A process as claimed in claim 6, wherein a coating of lead foil is applied to the pattern over the resisting coating, and first the foil and then the resisting coating are removed to expose the metal of the anode at each of said successive intervals.

9. A process as claimed in claim 8, wherein a second coating of resisting material is applied over the surface of the lead foil and portions thereof are removed together with the lead foil and first coating to expose the metal of the anode.

10. A process of the character described, which consists in providing a cathode on each side thereof with a pattern of predetermined configuration, said patterns being similar to each other, coating one face of each of a pair of metallic anodes with a coating of resisting material, removing from each anode a portion or portions of said coating corresponding in extent and configuration to particular portions of the patterns on the cathode to expose the metal of the anodes through the portions so removed, immersing said anodes and cathode in an electrolytic solution with the anodes upon opposite sides of the cathode and with their coated surfaces facing the patterns on said cathode, and removing metal from the exposed portions of both anodes simultaneously by causing electric current flow from said anodes through the exposed portions thereof and through the solution to said cathode.

11. A process of the character described, which consists in coating one face of each of a pair of metallic anodes with a coating of resisting material, removing portions of said coatings of predetermined extent and configuration to expose the metal of the anodes therethrough, immersing said anodes in an electrolytic solution on opposite sides of a single cathode with the coatings of the anodes facing opposite sides of the cathode, and removing metal from the exposed portions of both anodes simultaneously by causing current flow from both anodes through the exposed portions thereof and through the solution to said single cathode, said cathode carrying on each side thereof a pattern of predetermined configuration, said patterns being similar to each other, and the portions of the resisting coating removed from one anode corresponding with raised portions of said pattern, and the portions of the resisting coating removed from the other anode corresponding with depressed portions of said pattern.

12. A process of the character described, which consists in providing a cathode with a pattern of predetermined shape or configuration, immersing said cathode in an electrolytic solution together with and facing a metallic anode, and removing metal in successive steps from predetermined portions of said anode corresponding in shape and extent to particular portions of said cathode pattern, by exposing said portions

of the anode to the action of the solution and protecting the remainder of the anode by a coating of resisting material applied thereto, and causing electric current flow from the anode through the exposed portions thereof and through the solution to the corresponding portion of the cathode.

13. A process of the character described, which consists in coating a metallic anode on both sides thereof with a coating of resisting material, removing portions of both coatings of predetermined extent and configuration to expose the metal of the anode on both sides thereof through the portions so removed, immersing the anode in an electrolytic solution between a pair of cathodes, and removing the metal from both sides of the anode simultaneously by causing electric current flow from the anode through the exposed portions on both sides thereof and through the solution to said cathodes.

14. A process as claimed in claim 13, wherein each cathode carries on the face thereof facing the anode a pattern of predetermined configuration, and the portions of the resisting coating removed from the adjacent side of the anode correspond in extent and location to particular portions of said pattern.

15. A process of the character described, which consists in coating a metallic anode with a coating of resisting material, removing a portion of said coating of predetermined extent and configuration to expose the metal of the anode therethrough, immersing the anode in an electrolytic solution together with a cathode, removing metal from the exposed portion of the anode to a predetermined depth by causing electric current flow from the anode through the exposed portion and through the solution to the cathode, gradually increasing the extent of said exposed portion by removing at successive intervals additional portions of said coating bordering on the previously exposed portion, and removing metal from the entire portion of the anode exposed at each successive removal of resisting material by re-immersing the anode in the electrolytic solution and causing current flow from the anode through the exposed portion and through said solution to the cathode, the extent of the additional portions removed and the depth of metal removed varying according to the surface to be produced in the anode.

16. A process of the character described, which consists in manually applying a resisting coating to a metallic plate exposing portions of said plate of predetermined extent and configuration, immersing said plate in an electrolytic solution to serve as an anode, causing current flow from said anode through the portions exposed and through the solution to a cathode also immersed in said solution, and continuing said current flow until the metal of said exposed portions is removed entirely through the thickness of the plate.

17. A process of the character described, which consists in coating a metallic plate with a resisting coating, applying a coating of lead foil over the resisting coating, outlining on said lead foil a portion or portions of predetermined extent and configuration, cutting out the lead foil within said outline or outlines, removing the resisting material thereby exposed, immersing said plate in an electrolytic solution to serve as an anode and causing current flow from said anode through the portions exposed by removal of the lead foil and resisting coating and through the solution to a cathode also immersed therein.

18. A process of the character described, which consists in coating a metallic plate with a resisting coating, applying a coating of lead foil over the resisting coating, outlining on said lead foil a portion or portions of predetermined extent and configuration, cutting out portions of the lead foil within such outline or outlines at successive intervals, removing at said intervals the resisting material exposed, immersing said plate after each removal in an electrolytic solution to serve as an anode and causing current flow from said anode through the portions exposed by removal of the lead foil and resisting coacting and through the solution to a cathode also immersed therein.

19. A process of the character described, which consists in manually producing a design in a resisting material upon the surface of a metallic anode to protect portions of said anode and expose other portions thereof of predetermined extent and configuration, immersing said plate in an electrolytic solution to serve as an anode, causing current flow from said anode through said exposed portions and through the solution to a cathode also immersed in said solution, and continuing the current flow until a predetermined depth of metal has been removed from said exposed portions.

20. A process of the character described, which consists in coating a metallic anode with a coacting of resisting material, removing a portion of said coating of predetermined extent and configuration to expose the metal of the anode therethrough, immersing the anode in an electrolytic solution together with the cathode, removing metal from said exposed portion in successive steps of predetermined depth by causing electric current flow from the anode through said exposed portion and through the solution to said cathode, and coating the edges of the exposed portion after each step with resisting material, for the purpose specified.

21. A process of the character described, which consists in manually applying a resisting coating to the surface of a metallic anode, manually producing a design in a lead foil coating applied to said anode over said resisting coating to expose portions of the latter coating and protect the remainder thereof, removing the exposed portions of the resisting coating to expose the metal of the anode, immersing said plate in an electrolytic solution to serve as an anode, causing current flow from said anode through the portions exposed and through the solution to a cathode also immersed in said solution, and continuing said current flow until the metal of said exposed portions is removed to a predetermined depth.

22. A process of the character described, which consists in manually producing a design in a resisting material upon the surface of a metallic anode to protect portions of said anode and expose other portions thereof of predetermined extent and configuration, immersing said plate in an electrolytic solution to serve as an anode, causing current flow from said anode through said exposed portions and through the solution to a cathode also immersed in said solution, continuing the current flow until a predetermined depth of metal has been removed from said exposed portions, and then manually removing other portions of the resisting coating at successive intervals, the anode being immersed in the solution after each such removal of resisting coating, and metal removed simultaneously from all of the portions of the anode then exposed, by causing current flow from said anode through all of the exposed portions and through the solution to the cathode.

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

GOTTHOLD E. WERTHEIMER.

Witnesses:

CHAS. B. CROMPTON,

MAY G. LUTTRELL.