APPARATUS AND PROCESS FOR MAKING METAL PATTERNS

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Inventor

Arthur K. Laukel

Attorney
This invention relates to the production of metal patterns by electrolytic deposition, such as referred to in Letters Patent Numbers 1,570,634 and 1,570,635, both granted to me January 26, 1926, the object of the present invention being to provide a very desirable control and application of the electrolytic process whereby uniformity of thickness and strength in the shell or plating may be secured and whereby also a higher uniformity than would normally be feasible may be utilized, with consequent heavier deposition of metal per unit of time.

The invention also is intended to enable depressions of greatly varying depth in plate molds to be plated so that shells of a variety of shapes not ordinarily capable or easy of production may be made.

The invention further contemplates the increasing of agitation or circulation of electrolyte within the cavities of a plating mold so as to ensure effective deposition on the surfaces of the cavities and also to provide for such agitation by the freeing of gases from the electrolyte within such cavities, the invention still further providing for the venting of the plating mold to prevent the accumulating of the gases and consequent partial exclusion of electrolyte from surfaces of the mold cavities which would otherwise prevent the complete or even plating of the said surfaces.

Further objects subsidiary to or resulting from the aforesaid objects or from the construction or operation of the invention will become apparent as the said invention is hereinafter further disclosed.

In carrying the said invention into effect, I may adopt a novel form and arrangement of apparatus hereinafter described by way of example, having reference to the accompanying drawings, wherein—

Figure 1 illustrates in section a plating tank equipped with a mold and anodes arranged for the production of a metal pattern of a hand wheel by electrolytic deposition;

Figure 2 is a transverse section taken on the line 2a—2a, Figure 1;

Figure 3 illustrates in elevation the pattern mold used as an example in describing the improved process;

Figure 4 is a similar elevation of the mold equipped for the initial plating operation;

Figure 5 is a transverse section of the same on the line 5a—5a, Figure 4, illustrating partially the positive cutting in the mold;

Figure 6 is a similar view to Figure 4 illustrating the mold equipped for a further stage in the plating operation;

Figure 7 is a transverse section taken on the line 7a—7a, Figure 6;

Figure 8 is an elevation of the mold showing it equipped for a final stage in the plating operation;

Figure 9 is a transverse section of the same taken on the line 9a—9a, Figure 8;

Figure 10 is a transverse section of the mold after completion of the plating operation, anodes being removed;

Figure 11 is a similar view to Figure 1 showing a modified arrangement of the parts; and

Figure 12 is a similar view to Figure 11 illustrating a still further modification of the arrangement.

Similar characters of reference indicate similar parts in the several figures of the drawings.

1 is a pattern mold of suitable material adapted to withstand the action of the electrolyte and may be of plaster of Paris suitably impregnated with wax to prevent decomposition of the carbonate content of the plaster of Paris where such is present by the electrolyte, the surface of the mold to be plated being suitably treated as by coating it with a film of silver sulphide to provide a conducting surface, and this mold is shown as being suspended in an electrolyte 2, such as copper sulphate contained in a plating tank 3, 4 being an anode also suspended in the electrolyte and connected by the wire 5 with a source of electric current.

For the sake of illustration the mold 1 is indicated as having a cavity therein in the form of the impression of a hand wheel pattern, whereby there are more or less shallow depressions a, a deeper central depression b and a still deeper depression c. From the
upper part of the mold cavity is a vent 6 in the form of a groove in the surface of the mold into which groove extends a wire 8 adapted to be connected with the negative wire 9 communicating with a source of electrostatic energy, and in the preparation of the mold to provide the cavity thereof with a conducting surface, such conducting surface is extended into the groove 6 so that proper connection is established between such surface and the wire 8 as required.

The method of providing the conducting surface is not a feature of this invention and is therefore not further dwelt upon herein.

It will be understood that a mold so prepared may be plated in the bath in the ordinary way where the depressions are not deep and do not vary considerably due to the fact that conditions throughout the surface of the mold would not vary greatly, but where the depressions are deep or vary considerably in character the plating conditions also vary and the tendency is to plate the shallow and open areas of the cavity to the neglect of the deeper portions thereof, and it is desirable that means be adopted to overcome this tendency and to ensure the plating of the deeper portions of the impression in a manner tending towards uniformity of thickness and strength of the plate throughout the entire surface of the cavity. The invention therefore especially provides for ensuring electrolytic deposition of metal in those portions of the cavity which due to their depth or disposition do not readily lend themselves to the depositing of metal therein and to provide for concentration of electrolytic action on such areas during periods ensuring the building up of a coating thereon and the controlling of the surfaces lending themselves readily to plating, so that an undue deposit of metal thereon out of proportion to the deposits on other surfaces will not take place.

With this end in view I propose to provide the mold with an insulating shield 10 which will control the deposit of metal on the shallow or open surfaces during such time as the building up of a coating on the deeper recesses of the cavity is being accomplished, the said insulating shield being adapted to be cut away from time to time as the work proceeds to progressively expose the surfaces of lesser depth than those of deeper depth are plated, so that the process which would ordinarily result, were the insulating shield not present in the heavy plating of the shallow parts of the cavity and the substantially lighter platting of the deeper recesses of the cavity is virtually reversed and the initial platting is concentrated upon the said deeper portions of the cavity instead of upon the shallow portions, and the platting built up from the bottom of the cavity to the outer parts thereof of instead from the outer parts to the bottom of the recesses as would otherwise occur.

The method of utilizing the insulating shield 10 to effect the control of the deposit in the manner referred to hereinbefore is illustrated in Figures 4, 6 and 8, and the other views associated therewith, from which it will be seen that the said shield 10 is during the early part of the platting process cut away as at 10a in an outline approximating that of the outline of the mold cavity, but with the openings in the said insulating shield substantially restricted so that the edges of the openings extend substantially beyond the edges of the mold cavity, thereby preventing the heavy deposit of metal which would otherwise result on such edges of the mold cavity during the platting process, the openings in the insulating shield 10 being increased in size by further cutting back the edges as at 10b in Figure 6 as the platting proceeds, and finally as shown in Figure 8. The entire insulating shield 10 is then stripped from the face of the mold, thereby fully exposing the edges of the mold cavity and permitting a heavy deposit to accumulate thereon to form a reinforcement or strengthened structure of the electro deposited pattern at such edges and permitting the platting to extend over the face of the mold to some extent to provide a flange 11 which greatly adds to the rigidity and protection of the electro deposited pattern.

That the desirability of this flange will be fully understood, it is explained that in completing a metal pattern by the herein described process the metallic shell resulting from the electro deposition when of sufficient thickness is removed from the mold and is afterwards suitably filled or backed with metal such as white metal and in many cases also mounted upon a suitable plate such as of brass or aluminum; and during the removal of the shell from the mold and also its handling thereafter until it is properly filled or backed, there is danger of the said shell being warped or more especially of the margins of the shell being bent or otherwise injured, which danger is however very greatly minimized by the presence of the reinforcing flange 11.

These insulating shields do not in themselves fully solve all the problems of even plating in the making of metal patterns by electrolytic deposition where the recesses of the mold cavity are very deep or very considerably, and it is very desirable that special provision should be made for promoting the electrolytic action in the deeper recesses of the mold cavity and in the drawings I illustrate a secondary anode 12 supported in any suitable manner such as from the mold itself and having its extremities projected into the mold cavity. In this example this secondary anode 12 is shown as extending into a deep
The depression of the mold cavity, and the effect of the secondary anode is to promote local electrolytic action between it and the walls of the depression into which it extends, so that the plating of the walls of the deep depression is insured. Of course, the secondary anode must be of a material suitable for the purpose and having the required electrical qualities to enable it to act as an anode and in practice I have found lead wire or an alloy of antimony and lead very suitable for this purpose. As will be seen from Figures 1, 11 and 12, the method of utilizing or connecting the secondary anode may be varied.

For instance, in Figure 1, both the primary and secondary anodes 4 and 12 are connected to the positive wire 5 in which case with an electrolyte of say copper sulphate of normal concentration, a current of two to two and one-half volts would suffice to effect the required electrolytic action. In Figure 11 the secondary anode 12 is entirely disconnected, in which case with a somewhat higher voltage, impressed on the primary anode, say four to five volts. The secondary anode becomes electrolytically active in much the same manner as if it were connected with the source of current supply as in Figure 1, and in Figure 12 the secondary anode is indicated as being directly connected with the source of current supply and the primary anode disconnected or omitted. In this case it should be noted that there is a back E. M. F. of approximately one volt and a current somewhat above that voltage is required to overcome this, the higher the acidity of the electrolyte, the lower the voltage required for producing electrolytic action.

It is desirable where a number of deep depressions occur in the mold cavity or where the pattern is very large that further branches 13 of the secondary anodes be provided to extend into different parts of the mold cavity.

The end portions of the secondary anode entering the mold cavity are indicated as being provided with sleeve-like insulators 14 and 15 so as to insulate the electrolytic action being concentrated about the extremities of the secondary anode and consequently insure the proper plating of the deeper parts of the depressions in the manner and for the reasons hereinbefore explained, and it will be seen from Figure 5 that the deepest depression may be specially taken care of during the early part of the plating operation by a secondary anode entered thereto in a substantial extent, and as the plating proceeds, this anode may be gradually withdrawn as shown in Figure 7 and a branch thereof 13 extended into the shallower depression, the withdrawing of the said anode and its branch being progressively effected from time to time until the walls of the depressions are properly plated throughout the full depth of the said depressions, after which the insulating shield 10, or both the shield and the secondary anodes, may be stripped from the mold and the final plating of the mold given which results in the formation of the reinforcing flange 11 about the margins of the pattern as already explained.

The utilizing of the insulating sleeves such as 14 and 15 is not always necessary especially in cases where the walls of the depressions of the mold cavity do not closely approach the sides of the secondary anodes, but where such depressions are constricted and there is danger of short circuiting between the secondary anode and the walls of the depression such as would prevent or render ineffective the electrolytic activity about the extremities of the secondary anodes some such insulating means are very desirable.

Where the cathode coating of the mold is not absolutely conductive throughout its entire area, as is very often the case where such coating is more or less of a granular nature in which the particles are not always in electrical contact, the plating usually commences around the outer edges and especially in the vicinity of the conductor connecting said coating with the negative pole of the source of current supply, and this plating creeps over the conductive coating of the mold until the entire surface of the cavity is plated, whereupon the high local decomposition of the electrolyte produced by the secondary anodes in the deep recesses is then effective in building up the heavier deposit from the depths of the depressions in the manner already explained. This ionization within the depressions also hastens the completion of the continuous initial plating of the surface of the mold cavity so that the operation of the secondary anodes in bringing about the localized activity in the depressions is not long delayed.

Although these secondary anodes are of a special benefit in insuring the proper plating of deep recesses in the mold cavity, it should not be understood that their use is confined solely to such depressions, as they may be utilized in connection with practically any nature of mold with substantial benefit due to their action in speeding up the plating operation throughout the entire surface, especially due to the fact that a higher amperage than would otherwise be feasible may be utilized without resulting in an unstable, imperfect or badly distributed plating. As a matter of fact, as already explained, a feature of the use of secondary anodes in this manner is the better distribution of the plating than is otherwise obtained, even to the extent of obtaining distribution at points which in some forms of mold would be impossible without the use of such secondary anodes.

It will also be understood that said secondary anodes may be used in cases where it
is not thought necessary or desirable to use insulating shields such as 10 described, as their action is not dependent upon the use of such shields which are auxiliary thereto in protecting the edges or prominent parts of the mold against their tendency to accumulate a deposit too fast relative to the other parts of the mold and may be dispensed with where the formation or shallowness of the mold does not lend itself to such selective plating about the margins of the cavity to an undesirable extent, or where, for any reason, such selective plating is not considered objectionable.

The effect of the secondary anodes is to produce gas bubbles in the electrolyte within the mold cavity which results in an agitation of the electrolyte therewithin which is quite desirable, but it is necessary that this liberated gas be not permitted to accumulate in the mold cavity otherwise no plating could take place where this gas was present, and it is for this reason that the vent 6 is provided extending from the uppermost part of the mold cavity to permit the escape of gas therefrom. This is especially necessary where the insulating shield 10 is used, as this shield naturally would trap such gas in the mold cavity if no means for venting the cavity were provided.

It will be understood that the term "pattern" as used herein and in the claims is susceptible of including core boxes and similar devices readily lending themselves to production to the described process.

The number of secondary anodes, their disposition and the method of mounting the same may be varied according to the dictates of necessity or desirability as may also be the method of bringing the secondary anodes into active operation as indicated by the different arrangements shown in Figures 1, 11 and 12; and as the invention may be developed within the scope of the following claims without departing from the essential features of the said invention, and it is desired that the specification and drawing be read as merely illustrative and not in a limiting sense, except as necessitated by the prior art.

What I claim is;

1. A process for producing patterns by electro deposition which comprises utilizing a mold having a cavity therein which is a counterpart of the pattern to be produced, rendering the surface of said mold cavity conductive, providing the face of said mold with an insulating shield so cut out that the edges of said shield project substantially over the edges of the cavity of said mold, subjecting said mold to the electrolytic action of a plating bath, assisting the plating of the deeper portions of the mold cavity by means of anodes extending into such deeper portions while said insulating shield deters the excessive plating of the margins of the mold cavity over which it projects.

2. A process according to claim 1 wherein the edges of said insulating shield overlapping said mold cavity are progressively cut-back towards the margins of the cavity as the plating thereof proceeds.

3. A process according to claim 1 wherein said insulating shield is eventually removed to permit plating to extend over the face of the mold proximate to the margins of said mold cavity to form a reinforcing rim about the margin of the electro deposited shell formed in said mold cavity.

4. An electrolytic apparatus comprising, in combination, a bath, a recessed cathode supported therein, a soluble anode mounted in the bath, secondary anodes extended into the recesses of the cathode, said secondary anodes being substantially insoluble in the bath during the passage of current therethrough and adapted to decompose the bath, and an insulating shield mounted on the face of said cathode and cut out at the recesses of the cathode but overlapping the outward edges of said recesses and partially obstructing the recesses.

5. An electrolytic apparatus comprising, in combination, a bath, a recessed cathode supported therein, a soluble anode mounted in the bath, and secondary anodes extended into the recesses of the cathode, said secondary anodes being substantially insoluble in the bath during the passage of current therethrough and adapted to decompose the bath, said cathode having a vent structure communicating with the recessed portion thereof and extending upwardly, whereby to permit escape of gases formed in said recessed portion by said insoluble anodes.

In testimony whereof I affix my signature.

ARTHUR K. LAUKEL.