

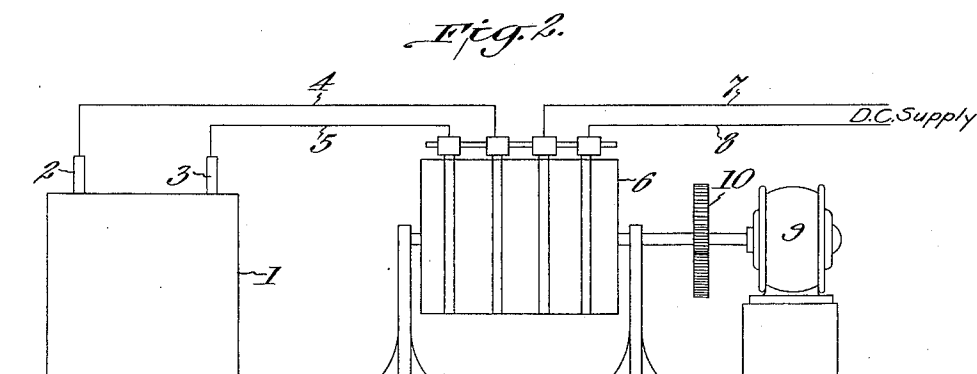
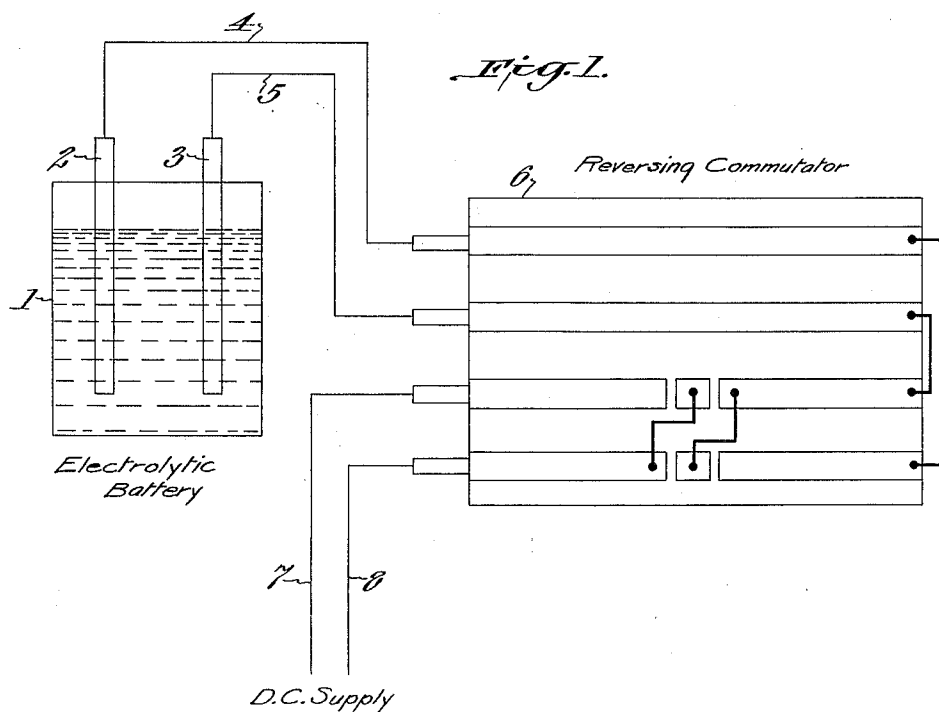
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METHOD OF CONDUCTING ELECTROLYTIC OPERATIONS

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METHOD OF CONDUCTING ELECTROLYTIC OPERATIONS.

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To all whom it may concern:

Be it known that I, FRANCIS A. HOLT, a citizen of the United States, residing at Elmhurst, in the county of Queens and State of New York, have invented certain new and useful Improvements in Methods of Conducting Electrolytic Operations, of which the following is a specification.

This invention relates to electrolytic processes and particularly to improvements in methods of depolarizing the electrodes used therein. The invention is based upon the periodic reversal of the electrolyzing current, and comprises as essential features the regulation of the interval between reversals, and of the duration of the reversed current, in accordance with the requirements of the particular operation involved.

In many electrolytic processes polarization is a serious obstacle. The most common manifestation of this effect is the formation of a gaseous film upon the electrodes. Such films have high electrical resistance and may develop an objectionable counter electromotive force. They may also injure the product, as is generally the case when a hydrogen film forms upon the cathode in the electroplating of copper and other metals.

Numerous mechanical methods have been proposed for counteracting the adverse effects of polarization. For example, air or other gas has been forced about the electrodes, the bath has been agitated, or the electrodes momentarily lifted from the bath, to dislodge the adherent gas bubbles or permit them to escape. Such methods are often inefficient and usually inconvenient, if not impractical in commercial operation.

It is well known that if the electrolyzing current be reversed, the polarizing film will be dissipated, and several methods based upon this principle have been suggested. The mechanical effect of dislodging gas bubbles by periodic reversal of the current has been taken advantage of in the electrolytic pickling or "scrubbing" of sheet metal. Also, a transformer has been so connected in the circuit that when the current from the battery or generator is reduced or interrupted by formation of a polarizing film, an induced current of relatively high

voltage will pass in the reverse direction. This method maintains a rather constant battery current, but it does not permit regulation of the current reversal with the advantages referred to hereinafter.

A method analogous to that just described is the use of a direct current upon which an alternating current is superposed. This procedure is relatively inefficient and the rapidity of alternation of all commercially available A. C. currents makes it impractical to obtain the best results.

In accordance with the present invention, the electrolyzing current is passed until the polarization begins to be detrimental, and is then reversed for a period just sufficient to restore the system substantially to its initial electrical condition. In applying the invention to particular operations it is necessary to determine the optimum periods for reversal and for the duration of the reversed current. Observation and experiment will give the desired information. The present invention is applicable to a wide variety of processes and it is obviously impracticable to give precise details for all.

The following example, which is illustrative of one application of the invention, will suffice to show the principles involved.

In the art of electroplating with copper it has long been known that if currents of high density are used the deposited metal is liable to be spongy, dark, and poorly adherent. It appears that such "burnt" deposits are frequently caused by simultaneous deposition of metal and hydrogen upon the cathode. Up to the point where this effect begins, the density and adherence of the deposited metal increase with the increase of the current density.

I have discovered that the advantageous effects of high current density may be obtained in an enhanced degree, and without polarization difficulties, if the current is passed at well above the normally permissible rate, for a short period, and then momentarily reversed. Thus in depositing copper from an acidified copper sulfate solution, I may pass a current from three to four times the normal rate for about ten seconds and then reverse the current for about one-tenth second only. This cycle of alterna-

tions can be kept up as long as desired and a bright deposit of high quality will be obtained.

In the accompanying drawing, illustrating one embodiment of the invention,

Fig. 1 is a wiring diagram of an installation for electroplating or analogous purposes; and

Fig. 2 is a side elevation of a similar installation.

Reference numeral 1 denotes an electrolytic bath having electrodes 2 and 3 connected by conductors 4 and 5 with current reversing means 6. This means as shown is a reversing commutator of standard type, but various other equivalent devices are known in the art and may be used. The period of reversal of the commutator may be regulated by properly proportioning its conductor segments, in the usual manner. Current is supplied through conductors 7 and 8, connected to a suitable D. C. supply.

In Fig. 2 a motor 9 is shown as connected through reduction gearing 10 to the commutator 6. The commutator may of course be rotated by other suitable means, or manually, if desired.

An especially important feature of the regulated reversal of the current in accordance with the present invention, is the speeding up of the process which results from the high current rate which it permits. It will be noted, further, that there is only a small wastage of current in the short reversed phase and that this is much more than compensated for by the substantially reduced depolarizing resistance and counter electromotive force.

The invention may be applied also to various other purposes, as in the electrolytic production of materials in aqueous or other liquid baths, or in fused baths. A further application is in the forming or subsequent charging of storage battery plates.

As distinguished from prior methods, the present invention provides for the accurate regulation of the period and duration of

the direct and reverse currents. The result obtained is not merely the removal of a polarizing film, but increased efficiency and production of better materials.

I claim:

1. In an electrolytic operation, the method which comprises passing a direct electrolyzing current through the electrolytic bath at about the optimum rate until polarization begins to be detrimental, reversing the current only until the polarizing effect is substantially removed, and continuing this cycle of operations until electrolysis has taken place to the desired extent.

2. In an electrolytic operation, the method which comprises passing a direct electrolyzing current through the electrolytic bath at a rate substantially in excess of that which normally would lead to detrimental polarization, and reversing the current whenever necessary to counteract the effect of polarization, whereby a current of relatively high density may be used with advantage.

3. An electroplating method comprising passing a direct electrolyzing current through an electrolytic bath, reversing the current for a brief period at regulated intervals to prevent formation of a polarizing deposit, and continuing the cycle of reversals until the desired thickness of deposited metal is obtained.

4. A method of electroplating copper from an acidified solution of a suitable copper salt, comprising passing a direct electrolyzing current of relatively high density through the solution, whereby a dense, adherent deposit is formed at a rapid rate, and periodically reversing the current when necessary to dissipate the polarizing film which tends to form upon the cathode.

5. Method according to claim 4, in which the direct electrolyzing current is passed for about ten seconds and the reverse current for about one-tenth second.

In testimony whereof, I affix my signature.

FRANCIS A. HOLT.