

UNITED STATES PATENT OFFICE.

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METHOD OF ELECTROLYSIS.

No Drawing.

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To all whom it may concern:

Be it known that I, URLYN CLIFTON TANTON, a subject of the King of Great Britain, residing at Johannesburg, Transvaal Province, Union of South Africa, have invented new and useful Improvements in Methods of Electrolysis, of which the following is a specification.

In the electrolysis of aqueous solutions with insoluble anodes it frequently happens that incrustations or insoluble deposits are formed over the active surface of the anode which is in contact with the electrolyte. Such deposits or incrustations are frequently a source of serious trouble, causing as they do the intervention of a poorly conducting medium between the anode and the electrolyte and thus raising the ohmic resistance of the circuit. Moreover, since these deposits possess usually a lower overvoltage than the anode material itself it sometimes happens that desirable reactions which depend for their continuance upon the maintenance of a high overvoltage are interfered with or even completely inhibited.

As an example of the conditions above described we may take the case of the electrolysis of solutions derived from the leaching of zinc ores with sulphuric acid. These solutions, after the ordinary processes of purification have been carried out, usually contain manganese sulphate in addition to the zinc sulphate and frequently carry small quantities of antimony and cobalt. The two latter elements exert a prejudicial effect upon the character of the deposited zinc, while the manganese, if not removed, eventually accumulates to such an extent as to interfere with the operations of the process. If the electrolysis of such a solution be carried out with an anode of lead or lead peroxide, all of the three metals in question are precipitated as insoluble oxides in the vicinity of the anode and are thus removed from solution. This effect is very desirable, but it is found that with continued electrolysis a dense hard scale composed mainly of manganese dioxide forms over the face of the anode and as the oxygen overvoltage at the surface of this scale is considerably lower than that at a surface of pure lead peroxide, the further precipitation of the oxides of manganese, cobalt and antimony is thus prevented. Moreover, since the resistance of this layer of scale is considerable, a substan-

tially higher voltage must be employed with consequent loss of power.

The object of this invention is to provide means whereby the above mentioned disadvantages can be obviated without the necessity of mechanical cleaning of the anodes by hammering or scraping which is the method usually used. According to the present invention, this effect may be accomplished by making use of the expansive effect of the bubbles of gas liberated at the surface of an electrode during electrolysis. By so arranging the conditions that bubbles of gas are liberated behind the scale at the true anode surface, the scale is broken off and the anodes thus kept continuously in good condition.

In order to attain this result it is necessary, firstly, to surround the anode with a solution of high electrical conductivity. Since the adhering scale is always to some extent porous the electrolyte will permeate it and come in contact with the anode surface beneath. Secondly, there must be employed a current of great intensity in proportion to the area of the anode surface.

If these two conditions are carried out it is found that the evolution of gas occurs not only at the surface of the scale but also to some extent behind it, with the result that the adhering scale is detached and falls away leaving the anode surface clean.

A solution of suitably high conductivity is one containing a considerable percentage of free acid, for example 10% or more. The density of current at the anode should be 50 amperes per square foot or higher. As an example of the application of the invention to the case mentioned above. That of the electrolysis of zinc sulphate solutions, the free acid concentration in the electrolyte may conveniently be 250 grams of sulphuric acid per litre and the current density at the anode 100 amperes per square foot. It is understood that these figures are given merely in illustration and the invention is not limited to their use.

These conditions may be applied intermittently in order to remove adhering scale which has formed, or they may be used continuously and the anode thus kept permanently clean. The latter case is preferable since the ohmic resistance of the circuit is thus kept low and, moreover, objectionable constituents of the electrolyte such as anti-

mony, cobalt and manganese are continuously precipitated and removed from solution.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. In the electrolysis of aqueous solutions with insoluble anodes, the surrounding of the anode with a solution containing a high percentage of free acid, the acid content approximating 10 per cent or more, and the simultaneous application to the anode of a current of high density in proportion to its surface the current density approximating 50 amperes or more per square foot of anode surface immersed.

2. In the electrolysis of zinc sulphate solutions with insoluble anodes, surrounding the anode with a solution containing a high percentage of free sulphuric acid, the acid content approximating 100 grams or more of free acid per litre, and the simultaneous application to the anode of a current of high density in proportion to its surface, the current density approximating 50 amperes or more per square foot of anode surface immersed.

3. In the electrolysis of aqueous solutions containing manganese, a method of keeping the anode free of encrustations, which consists in surrounding the anode with a solution containing a high percentage of free acid, the acid content approximating 10 per cent, or more, and the simultaneous application to the anode of a current of high density in proportion to its surface, the current density approximating 50 amperes or more per square foot of anode surface immersed.

4. In the electrolysis of aqueous solutions containing manganese, a method of removing encrustations formed on the anode surfaces, which consists in intermittently surrounding the anode with a solution of high

electrical conductivity, and simultaneously applying to the anode a current of high density in proportion to its surface, the current density approximating 50 amperes or more per square foot of anode surface immersed.

5. In the electrolysis of aqueous solutions containing manganese, antimony and cobalt, a method of continuously precipitating said metals as insoluble oxides during the electrolysis of the solution, which consists in surrounding the anode with a solution containing a high percentage of free sulphuric acid, the acid content approximating 100 grams or more of free acid per litre, and simultaneously applying to the anode a current of high density in proportion to its surface, the current density approximating 50 amperes or more per square foot of anode surface immersed.

6. In the electrolysis of aqueous solutions containing manganese, antimony and cobalt, a method of continuously precipitating said metals as insoluble oxides during the electrolysis of the solution, which consists in surrounding the anode with a solution containing approximately 10 per cent or more of free sulphuric acid, and simultaneously applying to the anode a current of high density, approximating 50 amperes or more per square foot of submerged surface.

7. In the electrolysis of zinc sulphate solutions containing manganese, a method of preventing encrustation of the anode, which consists in surrounding the anode with a solution containing a high percentage of free sulphuric acid, the acid content approximating 100 grams or more of free acid per litre, and simultaneously applying to the anode a current of high density in proportion to its surface, the current density approximating 50 amperes or more per square foot of anode surface immersed in the electrolyte.

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