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PROCESS FOR ATTACKING ALUMINUM FOR INCREASING ITS WORKING SURFACE AND APPARATUS THEREFOR
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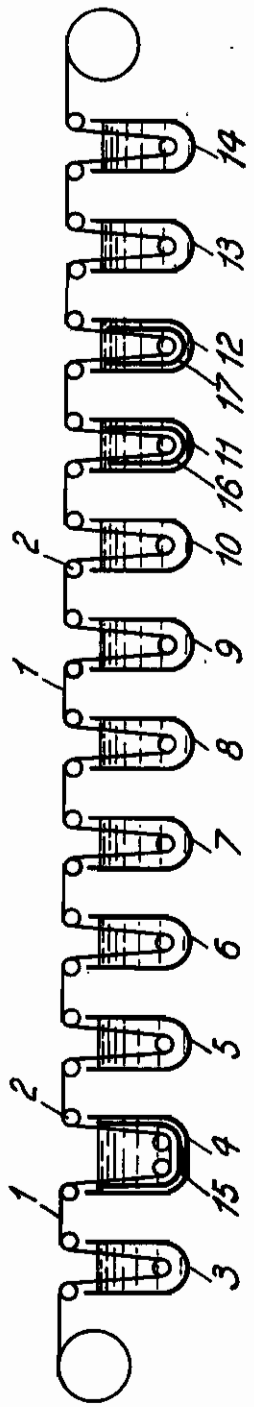

Fig. 1.

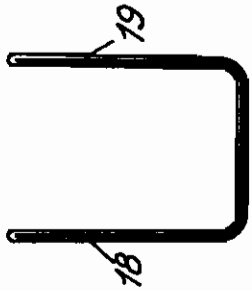

Fig. 2.

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PROCESS FOR ATTACKING ALUMINUM FOR INCREASING ITS WORKING SURFACE AND APPARATUS THEREFOR

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The present invention relates to a process and means for obtaining an increase of the working surface of electrodes such as employed in making alternating-current rectifiers, lightning discharge arresters, electrolytic condensers and the like.

It is an object of this invention to provide on the surfaces of selected metal roughnesses formed by infinity of microscopic concavities and convexities so as to increase these surfaces without changing external dimensions of the treated metal, more particularly without modifying or altering its electrical characteristics.

Several proposals have hitherto been made for increasing the working surface of electrodes either by corrosion or by mechanical or chemical methods. In the mechanical methods heretofore known there is a notable inconvenience consisting in leaving on the treated surface foreign metal traces due to rolling cylinders or stamping dies and extremely difficult to eliminate, because of their being incrustated in the treated metal, in the case where the purity of the metal is one of the required conditions for a good efficiency of the treated electrode. As to known chemical methods, there is generally employed a solution made of distilled water and of chloride of a metal, such for example as iron, copper or nickel. In this case the metal under treatment, for instance aluminum, because of being electro-negative with respect to said metals, an exchange of layers occurs and a metal deposit on the electrode thus treated is formed. No subsequent washing by nitric or sulphuric acid can bring about the elimination of foreign metal electrical characteristics of which frequently totally differ from those of the treated metal intended to constitute the electrode, whereby very poor results and unemployable electrodes are generally obtained.

In electrolytic processes heretofore propounded acid or acidulated baths used or proposed are practically unemployable, because the reaction taking place during the attack in the bath gives rise to a deposit of hydrate for example of aluminum in the form of hydrogel and hydrosol, according to the temperature and other factors used. As the concentration of hydrate increases, the latter becomes polymerized and passes from the hydrate $Al^2O^3(OH)^1$ to $Al^2O^3(OH)^2$, then to $Al^2O^3(OH)^3$ and so on. According to the more or less important quantity of transformed alumina, a concentration is there so rapidly established that at the end of several hours nodules are formed which very rapidly transform the bath into a compact unemployable mass. Basic baths only give rise to a powdery deposit of alumina (precipitation of hydrate in basic medium) constantly remaining in the bath without hindering its action, and such a bath holds good almost endlessly.

In the case of electrodes for lightning discharge arresters or electrolytic condensers the purity of the metal used is quite necessary and in the case of aluminum, for example, has been pushed up to 99.99%.

There is only a very limited number of metals hitherto known which have the property of becoming covered with a light metallic layer of oxide so as to permit the electric current to pass in one direction only and to utilise such property for the construction of apparatuses such as alternating-current rectifiers, lightning discharge arresters and electrolytic condensers.

In the case of electrolytic condensers the alternating current passes through capacity. The latter is extremely high in such condensers owing to the highly reduced thickness of the insulating material which in this case is a layer of oxide of the order of one micron-millimeter, such layer retaining one of the alternations of the current in the case of filtering cells.

The several metals having the said property to a sufficiently high extent are tantalum, aluminum and magnesium. These metals, when treated under the same conditions (same solutions and same temperatures) form layers having electrical characteristics quite differing from one another and determined according to the metal employed. A plate of metal, treated with a convenient solution and after treatment having on its surface any impurity, however small it may be, will give rise in the subsequently operated apparatus provided therewith to a potential difference, due to the impedance difference of the layer between the particle of foreign metal and the remainder of such plate, such as to cause a local current flow, local overheating, rapid clacking and other inconveniences resulting in quickly putting the apparatus out of use.

As to the cathode, it has been proposed to utilise nickel and/or carbon, which both theoretically appear to be susceptible of being used as cathodes without apparent inconveniences. However, these conductors are in reality unemployable.

Thus, nickel when used as cathode in the attacking bath would itself be attacked. During the working period of the bath this inconvenience need not be feared for, but it may become effective when the respective apparatus be at rest, or while its electrodes be changed, or for any other reason. In the case of a nickel cathode, for example, a layer of greenish colour would be formed on the surface of the electrolyte and in the close vicinity of the cathode. A band of pure aluminum under such treatment would, therefore, be infected by deleterious impurities.

On the other hand, carbon would separate from the cathode in the form of brownish particles which would mix with the electrolyte and

then deposit themselves onto the metal under treatment, from which they could no more be withdrawn, thus resulting in the same inconveniences as those inherent to hereinbefore mentioned mechanical and chemical methods.

Several known processes prior to the present application have proved to be merely theoretical and unable to resist to their carrying into practical effect.

The present invention has for its main object to dispense with the hereinbefore mentioned inconveniences by employing an electrolytic process permitting the metal under treatment to conserve all of its initial purity, owing to the use of alkaline metals, such as sodium and potassium, hydrates of which constitute strong bases and the dissolution of which in a suitable simple washing bath presents no difficulty, whereby all impurities become fully eliminated.

According to the invention, the electrode to be treated is immersed into a solution made of distilled water and of a halogen of sodium and potassium, several grams of potash or caustic soda being preliminarily added thereto. Such electrode is adapted to constitute the anode, while a second electrode forms the cathode. The tension at the electric terminals of the bath is adjusted according to the intensity of the available current. The aspect of the attack is, therefore, adjustable in accordance with desirable concavities of diminsions reduced or not. Such aspect depends on the current intensity and on the period of immersion of the metal in the electrolyte, and on the quantity of salt incorporated into the electrolyte.

In this way there is effected an attack by means of electrolysis of metallic surfaces forming the electrodes, the electrical capacity being function of the surface of such electrodes.

In order to show how the invention may readily be carried into practical effect, the same will now be described, by way of example only, with reference to the accompanying drawing in which:

Figure 1 diagrammatically shows a longitudinal sectional view of an apparatus designed for embodying the process according to the invention;

Figure 2 is an enlarged sectional view of a cathode arrangement for effecting an electrolytic attack according to the invention.

In the drawing, I designates a band of metal to be treated, adapted to be displaced longitudinally of the apparatus by means of rollers 2 adapted to lead the band successively into and through tanks 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14. The tanks 4, 11 and 12, which contain baths for the electrolytic attack of the band I, are provided each with a cathode 15, 16, 17, respectively. Such cathodes may be constituted by a thin platinum sheet or plate 18 closely surrounding a nickel sheet or plate 19.

The band I of a metal, such for example as aluminum, to be attacked is guided by rollers 2 adapted to displace the band successively into and through the baths contained in the tanks 3 to 14.

The tank 3 contains a solution of about 10% soda in distilled water, such bath being provided therein for cleansing the metal band I under treatment, this band then passing into and through the tank 4 containing the first bath for electrolytically attacking the band. The tank 4, preferably of glass, contains for example the following solution:

Distilled water	liter	1
Bromide of potassium	grams	50
Potash or caustic soda	do	5 to 10

in which is also immersed the electrode 15 constituting the cathode.

The band I of metal to be treated passes then into and through the baths contained in washing tanks 5 and 6 each of which contains distilled water, whereafter the band passes into and through the tank 7 containing nitric acid for dissolving hydrate remaining on the band. From the tank 7 the band I passes into and through the tank 8 containing a solution of distilled water and ammonia at 22° for neutralising the nitric acid. The tanks 9 and 10 contain distilled water for a further washing. The tanks 11 and 12 are electrolytic attack tanks for depositing the stop layer onto the metal under treament with a view to constructing electrolyte condensers, current rectifiers and the like. Finally, the tanks 13 and 14 are final washing tanks containing distilled water.

For the attacking bath in the tank 4 preferably platinum will be employed to constitute the cathode 15, other metals, such as nickel, being liable to be attacked. A cathode of good quality may be constituted by a very thin sheet of platinum firmly affixed to a nickel support by any suitable mechanical means. Such a cathode when properly protected against infiltrations of the electrolyte between the platinum and nickel will be practically unconsumable.

It will be advantageous to conveniently adjust the intensity of the current in order to obtain a normal attack and treatment of the metal so as to impart to the latter the best possible qualities of utilisation. If the attack is violent, very deep concavities of very large dimensions will be obtained, but the attack will be irregular resulting in a plurality of spots disseminated all over the surface. As the violence of the attack will be attenuated, the depth of concavities accordingly will decrease, while the frequency of spots on the surface of the treated metal will increase until uniformity of colour on the entire surface will have been reached.

The distance between the electrodes will be about 10 centimeters, while the tension applied to the terminals will be about 20 volts under 0.35 to 0.5 amperes per square centimeter.

It will be evident that modifications of detail, such as may be dictated by practical considerations, may be made in the process and apparatus hereinbefore described and shown, without departing from the scope of the invention, for the proportions and combinations given are susceptible to vary.

It will be further understood that for carrying the process of this invention into practical effect, without departing from its scope, recourse may be had to any and all technical means and mechanical, electrical and other devices, constructional details of which may vary according to circumstances, necessities of manufacturing and applications.

Thus, the solutions of alkaline metals hereinbefore referred to may vary in order to obtain attacks suitably variable.

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