UNITED STATES PATENT OFFICE.

ANTOINE JOSEPH OUTHENIN CHALANDRE AND LOUIS JEAN BAPTISTE AUGUSTIN COLAS, OF PARIS, AND CHARLES JULES GÉRARD, OF SEVEUX, FRANCE.

PROCESS OF ELECTROLYZING SOLUBLE SALTS.

SPECIFICATION forming part of Letters Patent No. 665,953, dated January 15, 1901.

Original application filed March 21, 1899, Serial No. 709,939. Divided and this application filed April 16, 1900. Serial No. 13,282. (No specimens.)

To all whom it may concern:

Be it known that we, ANTOINE JOSEPH OUTHENIN CHALANDRE and LOUIS JEAN BAPTISTE AUGUSTIN COLAS, residents of the city of Paris, and CHARLES JULES GÉRARD, a resident of Seveux, in the Republic of France, have invented a new and useful Improvement in Processes for Electrolyzing Soluble Salts, which invention is fully set forth in the following specification.

This application is a division from our application filed March 21, 1899, Serial No. 709,939, (Patent No. 647,217, dated April 10, 1900,) which shows apparatus suitable for carrying out the process herein described and claimed.

As an example of the application of our process which may be employed for electrolyzing all soluble salts we will describe the same herein with reference to chlorid of sodium, the object being to obtain sodium hydroxid on the one hand and pure chlorin gas on the other hand in quantities substantially the same, as these products are combined in the chlorid of sodium, or, in other words, without loss of sodium hydroxid or chlorin by reason of the electrolytic action.

It is well known that in the electrolyzation of chlorid of sodium the electric current will have the effect of forming, first, at the cathode (*a*) a solution of caustic soda produced by the sodium of the salt combining with hydroxyl which is furnished by the water of the electrolyte, while the corresponding hydrogen is set free, and (*b*) the liberation of hydrogen in consequence of the decomposition of part of the water of the electrolyte, and, second, at the anode (*c*) the liberation of chlorin caused by the decomposition of the salt, (*d*) the liberation of oxygen corresponding to the hydrogen liberated, as stated in (*b*). It will be seen, therefore, that there takes place in particular a liberation of chlorin and of hydrogen.

Under the ordinary conditions of operation the chlorin-oxygen compounds, generally in the form of hypochlorous acid, which form in the apparatus act to greatly diminish the output of chlorin, and, furthermore, it is necessary under these conditions to maintain a low temperature, so as to prevent the transformation of the hypochlorous acid into chlorate. It is known that at about 45° centigrade hypochlorous acid becomes changed into chloric acid and from this, in presence of sodium hydroxid, into chlorate. Hence to avoid this transformation it is necessary to advance with a comparatively low temperature, under which conditions the resistance of the bath is great and the amount of the product small.

The object of the present invention is to completely recuperate the chlorin issuing at the anode while destroying the oxygen compounds of the chlorin, and in this manner to obtain the maximum yield of chlorin.

To this end the invention consists in combining a part of the chlorin issuing at the anode with the hydrogen released at the cathode to form hydrochloric acid, which is then introduced into the apparatus to break up the chlorin-oxygen compounds which form therein. The combination of the chlorin and hydrogen to form hydrochloric acid may be effected by burning the hydrogen in contact with the chlorin in the manner set forth in our above-mentioned patent. As soon as the hydrochloric acid comes into contact with the anodic liquid the chlorin-oxygen compound is decomposed in accordance with the following equation:

$$2HCL+ClO=3Cl+H_2O.$$

It is to be understood that the hydrochloric acid is produced in quantity just sufficient to effect this decomposition. If too much is formed, the excessive amount would accumulate in the apparatus and be detrimental to the operation, while diminishing the production of chlorin, part of which would remain in the apparatus in the accumulated hydrochloric acid. It will therefore be seen that all of the chlorin is recuperated, even that which has been momentarily converted into hydrochloric acid for the purpose above indicated, the hydrochloric acid existing only from the point of its formation outside of the

apparatus to the point of its introduction into the same, none of it accumulating thereon.

An important feature of the process is the continuity of its cycle and the use of hydrochloric acid formed from the hydrogen and chlorin liberated from the electrolyte itself, no other reagents being employed.

The regulation of the flame of the burner, and consequently the quantity of hydrochloric acid which it is expedient to form momentarily and to reintroduce into the apparatus, varies essentially—first, according to the nature of the electrolyte, and, secondly, according to the alkali concentration adopted as a regulating measure at the cathode-compartment. For example, in the case of the electrolysis of sodium chlorid according to the caustic-soda concentration at the cathode adopted as a regulating measure the quantity of hydrochloric acid which is momentarily formed may vary practically from about five to forty per cent. of the equivalent quantity of caustic soda produced in the same space of time.

What we claim is—

1. The herein-described process of electrolyzing a soluble salt the electrolyzation of which causes detrimental secondary reactions in the electrolyzer, and which salt is capable of yielding at the anode and cathode gases which when combined form an acid, said process consisting in passing an electric current through said soluble salt from an anode to a cathode, combining outside of the apparatus part of the gases from the cathode and anode compartments to form an acid, then introducing the acid thus formed into the anode-compartment where it immediately decomposes to counteract or annul detrimental secondary reactions and liberate or recuperate the gas evolved at the positive pole which has served in the formation of the acid.

2. The herein-described process of electrolyzing an aqueous solution of chlorid of sodium for the purpose set forth, consisting in passing an electric current therethrough from an anode to a cathode, combining hydrogen liberated at the cathode with a portion of the chlorin liberated at the anode to form hydrochloric acid, then introducing the acid thus formed into the anode-compartment to decompose the chlorin-oxygen compounds which form therein and to liberate or recuperate the chlorin evolved at the positive pole which has served in the formation of the acid.

In testimony whereof we have signed this specification in the presence of the subscribing witnesses.

ANTOINE JOSEPH OUTHENIN CHALANDRE.
LOUIS JEAN BAPTISTE AUGUSTIN COLAS.
CHARLES JULES GÉRARD.

Witnesses as to A. J. O. C. and L. J. B. A. C.:
EDWARD P. MACLEAN,
EMILE LEOTOD.
Witnesses as to C. J. G.:
JULES ROUSSET,
GEORGES CARRIÉRE.