

UNITED STATES PATENT OFFICE.

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CANADA.

PROCESS OF OBTAINING CHLORATES OF THE ALKALIES OR OF THE ALKALINE EARTH METALS BY
ELECTROLYSIS.

SPECIFICATION forming part of Letters Patent No. 493,023, dated March 7, 1893.

Application filed August 29, 1892. Serial No. 444,437. (No specimens.)

To all whom it may concern:

Be it known that we, WILLIAM T. GIBBS, a British subject, and STANISLAUS P. FRANCHOT, a citizen of the United States, both of Buckingham, in the county of Ottawa and Province of Quebec, in the Dominion of Canada, have invented certain new and useful Improvements in Processes of Obtaining Chlorates of the Alkalies or of the Alkaline Earth Metals by Electrolysis; and we do hereby declare that the following is a full, clear, and exact description of the same.

Our invention, which will be hereinafter fully set forth and claimed, relates to the manufacture of chlorates of the alkalies or of the alkaline earth metals, such as chlorate of potash, by electrolytic action.

The object of our invention is to reduce the cost of manufacture.

In the electrolytic processes hitherto used, provision was not made for getting rid of the hydrogen evolved and for that reason such processes were always useless, the product being reduced again by the hydrogen which came off at the cathode. This objection was overcome in one process by the use of a porous diaphragm between the anode and the cathode at the expense of an increase in the voltage of the electric current necessary for the process. In our improved process the hydrogen is consumed at the cathode in the nascent state furnishing some of the heat required and the necessity of a diaphragm is dispensed with, thus permitting the use of a current of low voltage and thereby reducing the cost.

Our process for the manufacture of chlorate of potash consists in passing an electric current through a solution of potassium chloride, contained in an electrolytic cell of ordinary construction, having an anode of carbon, platinum or other substance which will not be acted upon by a chlorine, and a cathode consisting of a metallic oxide which will readily yield up its oxygen in the presence of nascent hydrogen. Such a one we find oxide of copper to be and which we use by preference, forming the same into a plate by means of plastering it on to wire netting or in some other convenient manner. Chlorine being

set free at the anode and the metal potassium at the cathode, the potassium at once reacts upon the water, displacing one atom of hydrogen and forming potassium-hydroxide or what is commonly called caustic potash. The displaced hydrogen immediately combines with the oxygen of the copper oxide to form water, reducing the cathode to metallic copper and thus never allowing the hydrogen to become actually free and it can therefore never exert a reducing action on the hypochlorite or chlorate which is formed. When the whole of the oxide of copper in the cathode has been reduced to metallic copper, the cathode is removed from the cell and washed in water until it is perfectly free from all traces of potassium salts, then dried and heated to a dull red heat in a current of atmospheric air, by which means the copper at once becomes re-oxidized, *i. e.* converted into oxide of copper again and is again ready to be replaced in the electrolytic cell. This operation of reduction and re-oxidation may be repeated an infinite number of times. The proportion between the cell and cathode is so arranged that by the time the cathode is reduced to metallic copper, about one half of the potassium chloride in solution has been converted into potassium chlorate. The solution is then drawn off from the cell and run into crystallizing tanks. On cooling, the potassium chlorate separates in crystals, leaving the undecomposed potassium chloride in solution. This solution is then drained off from the crystals, made up to its original strength again with fresh potassium chloride and returned to the cell which has been fitted with the re-oxidized cathodes and again subjected to the action of the electric current.

The reactions during the process are as follows: On the passage of the electric current the potassium chloride is decomposed into potassium and chlorine, thus: $2\text{KCl} = \text{K}_2 + \text{Cl}_2$. The potassium at the cathode at once reacts upon the water thus: $\text{K}_2 + 2\text{H}_2\text{O} = 2\text{KHO} + \text{H}_2$. This hydrogen at once reacts upon the oxide of copper of the cathode thus: $\text{H}_2 + \text{CuO} = \text{H}_2\text{O} + \text{Cu}$. The caustic potash in solution then comes in contact with the chlorine which is being evolved at the anode and the follow-

ing reaction takes place: $2\text{KHO} + \text{Cl}_2 = \text{KCl} + \text{H}_2\text{O} + \text{KClO}$. When the solution in the cell attains the necessary temperature, the hypochlorite of potassium (KClO) decomposes as follows: $3\text{KClO} = 2\text{KCl} + \text{KClO}_3$, thus forming potassium chloride and potassium chlorate.

It is to be noted that in other processes the heat necessary to decompose the hypochlorite of potassium into potassium chloride and chlorate was generated by forcing through the cell a large current of electricity, or was supplied from an external source whereas in our process this necessary heat is generated by the combustion of the hydrogen which takes place when combining with the oxygen of the oxide of copper cathode. The hydrogen which therefore would in other processes be wasted is thus utilized and made to reduce the quantity of electricity otherwise necessary to produce heat, and as the electrodes are placed close together, a current of less intensity or of lower voltage will suffice, a distinct saving being thus effected.

The above describes the process of manufacture of potassium chlorate, which has been chosen as an example for illustration. The process is however not confined to potassium chlorate but is equally applicable to the manufacture of the chlorates of any of the alkalies or alkaline earth metals.

We claim as our invention—

1. A process of obtaining chlorate of an alkali or alkaline earth metal by electrolysis, consisting in subjecting a solution of its chloride to the action of an electric current in a cell having an oxide of copper cathode until about one half of the chloride in said solution is decomposed and converted into chlorate, drawing off the solution into crystalliz-

ing tanks and allowing it to cool and crystallize, then drawing off the remaining liquor, making up its strength with fresh chloride and returning it into the cell, removing the cathode from the cell, washing, drying reoxidizing and replacing it, substantially as set forth.

2. As part of a process for the manufacture of chlorate of one of the alkalies or alkaline earth metals by electrolysis, the subjecting of a solution of chloride of said alkali metal to the action of an electric current in a cell having a cathode composed of an oxide which readily yields up its oxygen in the presence of nascent hydrogen, substantially as set forth.

3. A process of manufacturing chlorate of potassium by electrolysis, consisting in subjecting a solution of chloride of potassium to the action of an electric current in a cell having an oxide of copper cathode until about one half of the potassium chloride in said solution is decomposed and converted into potassium chlorate, drawing off the solution into crystallizing tanks and allowing it to cool and crystallize, removing the cathode from the cell, washing, drying, reoxidizing and replacing it, drawing off the remaining liquor from the crystallizing tank, making up its strength with fresh chloride and returning it into the cell to repeat the process, substantially as set forth.

In testimony whereof we have signed in the presence of the undersigned witnesses.

W. T. GIBBS.
S. P. FRANCHOT.

Witnesses:

A. HARVEY,
A. TROWSE.