Aug. 31, 1926. 1,598,018

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PROCESS OF ELECTROLYTIC DECOMPOSITION OF CHLORIDES

Filed Sept. 17, 1925

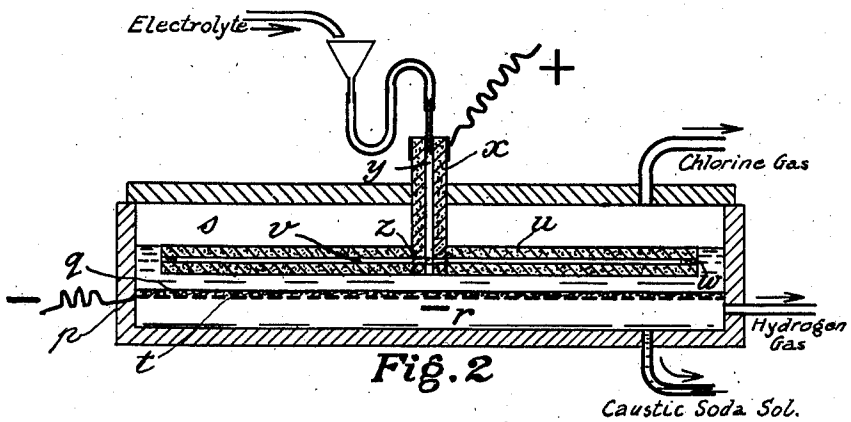


Fig. 2

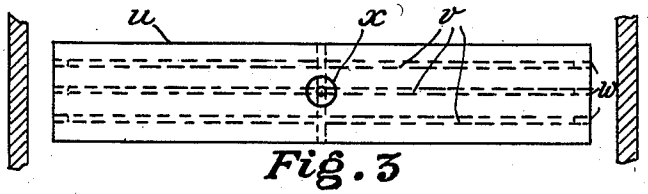


Fig. 3

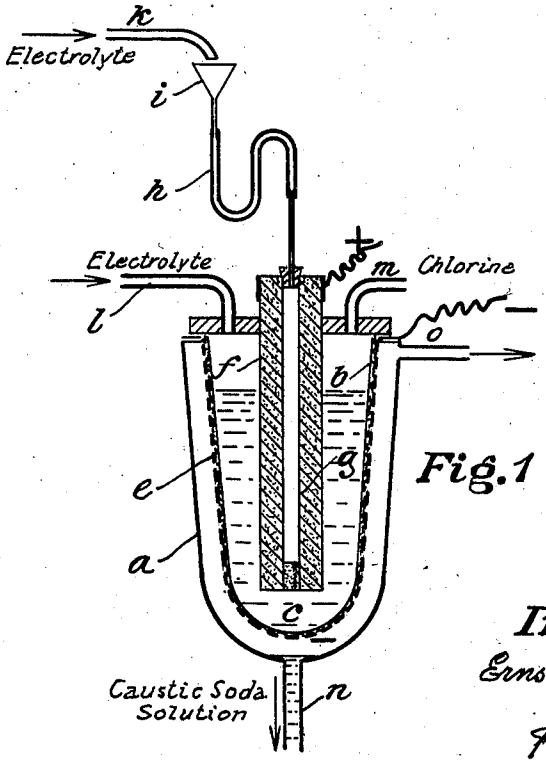


Fig. 1

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Patented Aug. 31, 1926. 1,598,018

UNITED STATES PATENT OFFICE.

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PROCESS OF ELECTROLYTIC DECOMPOSITION OF CHLORIDES.

Application filed September 17, 1925, Serial No. 56,941, and in Germany July 28, 1924.

This invention relates to improvements in the production of alkali and chlorine by electrolytic decomposition of alkali metal chloride solutions. In this process, anodes made of carbon or plumbago are generally used, but such anodes are subject to a considerable drawback, inasmuch as they are more or less attacked by the electrolytic action and must be renewed after a relatively short time. It has been known for a long time that this attack is attributable to the porosity of the electrodes, and therefore it has been proposed to do away with the porosity of the electrodes by impregnating them with tar, paraffin, linseed-oil or the like.

Now I have found that the attack of the carbon or plumbago electrodes may be reduced to a considerable extent without any impregnation, if care be taken that the pores of the electrodes are permanently kept filled with fresh salt solution. This end may be attained by conducting the salt solution into the electrolytic cell wholly or partially through the pores of the electrode. As everybody knows, the different electrodes manufactured for electrolytic purposes by baking, possess a smaller or greater degree of porosity due to this baking process; I have found that this porosity suffices to pass through the pores the whole of the salt solution required. The solution may be passed through flat electrodes from one side to the other; but the best method of introducing the solution is to provide the carbon anodes with suitable borings or hollow spaces through which the electrolyte is introduced. For the purpose of uniform distribution the said borings or hollow spaces are formed in such a manner that nearly equally sized ways are traversed by the solution in the interior of the electrode.

I am aware that a process for decomposing salts by electrolysis has been proposed, in which "filter electrodes" are employed, but in this case the electrodes used act simultaneously as electric conductors and as a filtering device and their purpose is to separate the ions formed from the electrolyte after the electrolysis has been effected, that is to say they act like a porous diaphragm. However, according to this known method the electrolyte is introduced into the bath in the ordinary way, that is to say by letting it simply flow in. In contradistinction to this, according to my improved process electrolysis takes place after filtration. Strictly speaking, there is no question of filtration at all, as the porous electrode only serves to introduce the undecomposed electrolyte into the bath proper, without the necessity of separating the different components. Only after the passage does electrolysis take place. Thus the two processes differ in principle.

In the accompanying drawing I have illustrated two types of electrolytic cells provided with anodes embodying my invention. Fig. 1 is a vertical cross-section through an electrolyser of the Nelson type. Fig. 2 is a vertical longitudinal section through a cell of the well-known Billiter type, and Fig. 3 is a plan view of the anode of this cell.

In Fig. 1 *a* is the outer wall of the electrolytic cell which is divided by a porous diaphragm *b* into the anode chamber *c* and the cathode chamber *d*. *e* is the cathode formed of perforated sheet iron and *f* is a graphite or plumbago bar prepared according to my invention and forming one of the anodes. It is provided with a longitudinal central boring *g* closed at its lower end and communicating by a flexible connection *h* with a funnel *i*. The electrolyte is introduced through pipe *k* and, if required, an additional quantity of electrolyte may be supplied through pipe *l*. The chlorine gas developed at the anode escapes through pipe *m*. The alkali solution is drawn off by pipe *n*, and the hydrogen gas is carried off by pipe *o*.

During the constant course of the electrolytic process the quantity of salt solution supplied by pipe *k* to the interior of the graphite anode is made equal to the quantity of electrolyte which is desired to pass through the porous diaphragm. This quantity is regulated either by controlling the hydrostatic pressure in the interior of the anode, i. e. by suitable adjusting the level of the salt solution in the funnel *i* or by correspondingly dimensioning the width of the boring *g*. As under stationary conditions the streaming velocity of the electrolyte remains practically constant, both the hydrostatic pressure and the width of the boring *g* can easily be determined by a preliminary trial.

The durability of the electrode is considerably increased, as shown by the following facts:—

Two cells of the same construction were

connected in series so that the intensity of the electric current was the same in both cells. The anode in both cells was formed of cylindrical graphite bars provided with a central boring. The weight of the anode of the first cell was 51.7 grams before the trial. However the electrolyte was not passed through the boring of the anode but was directly introduced into the anode chamber. The weight of the anode in the second cell was 41.7 grams before the trial. The electrolyte was introduced through the boring of the electrode.

Both anodes were immersed to equal depth and the current density at their surfaces was exactly the same. After the passage of about 800 ampere hours, the anode of the first cell which had not been traversed by the electrolyte, had lost about 8 grams, whereas the loss of the anode in the second cell only amounted to 2.5 grams. The contours also of both electrodes presented a different appearance. The second electrode which had been traversed by the electrolyte, had preserved its original dimensions, especially the corners at its lower end had retained their sharpness, whereas the other electrode showed distinct wear and tear and especially the corners were rounded off.

Figs. 2 and 3 illustrate in diagrammatic longitudinal section and in plan view a cell of the Billiter type. The cell p is divided by a porous diaphragm q into a lower, cathodic chamber r and an upper, anodic chamber s. t is the cathode made of perforated sheet iron or netting work, and u is the graphite anode constructed and arranged according to my present invention. The anode plate is provided with a number of parallel longitudinal borings v, the ends of which are closed by exactly fitting plugs w. The plate is supported by a graphite bar x provided with a longitudinal central boring y, which however does not wholly penetrate the bar. The end of the bar x is screw-threaded, so that it may be screwed into a corresponding opening in the anode plate, which is provided with a corresponding female screw-thread. As an alternative, the end of the bar x may be tapered by grinding off and may be driven into a corresponding conical boring of the anode plate. In any case the end of the bar x is provided with radial borings z which are made to communicate with the longitudinal borings v in the anode plate.

As seen from the foregoing statements, the carbon anodes are not absolutely protected against attack by passing the salt solution through the pores of the anodes in the direction of the positive electric current. The attack was only diminished to about one third. On further investigation I have found that the attack of the electrodes can further be diminished to a considerable extent by acidifying the electrolyte introduced into the bath, preferably by the addition of a suitable acid. In some cases, the acid, preferable diluted hydrochloric acid, may be passed alone through the pores of the anode, whereas the neutral electrolyte itself is introduced into a cell in the ordinary way. As the attack of the anodes is probably due to the oxidizing action of the immigrating OH-ions, according to my present process a sufficiently acidity is always maintained in the anode pores to neutralize immediately the arriving OH-ions, so that they cannot injure the electrode by anodic discharge.

I claim:—

1. In the process of electrolytic decomposition of chlorides by means of carbon or graphite anodes the method of introducing an electrolyte into the bath through the pores of the said anodes.

2. Process in accordance with claim 1, in which the electrolyte is introduced through hollow spaces or borings suitable arranged in the interior of the anodes.

3. Process in accordance with claim 1, in which the electrolyte is introduced through hollow spaces or borings arranged in the interior of the anodes in such a manner that the distances traversed by the electrolyte in the interior of the anodes are approximately equal in length.

4. Process in accordance with claim 1, in which an acid electrolyte is introduced through the pores of the anode.

In testimony whereof I affix my signature.

ERNST SCHLUMBERGER.