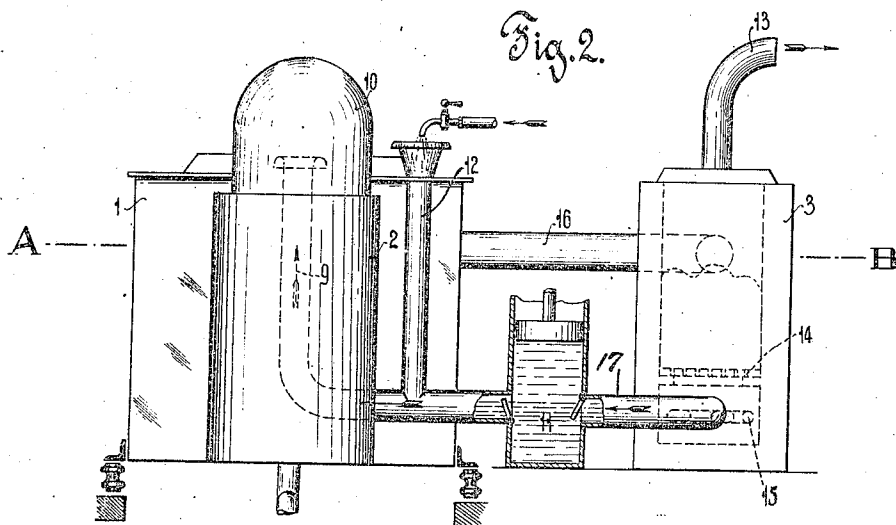
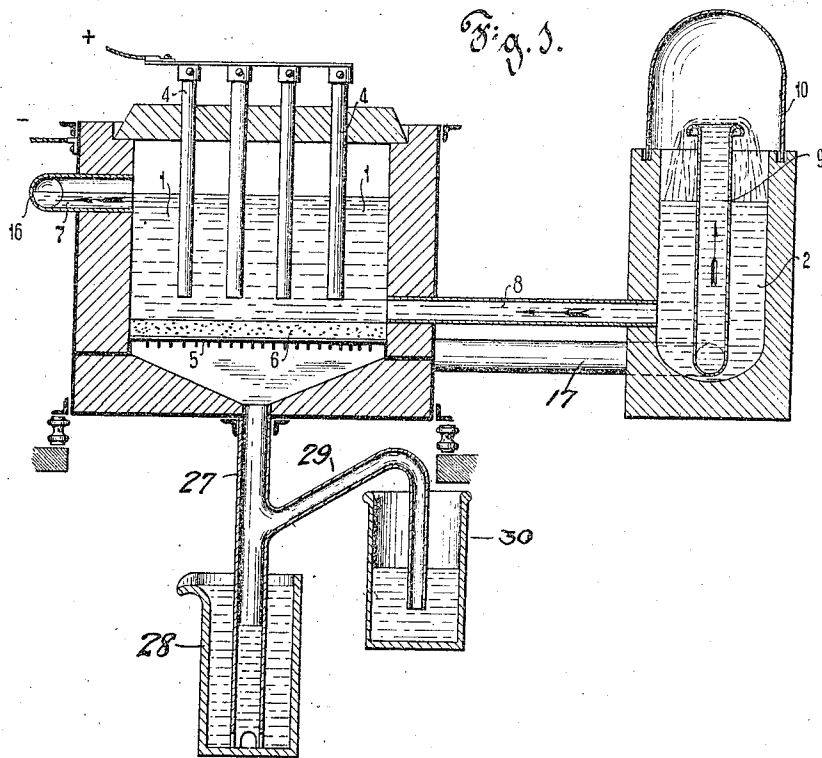


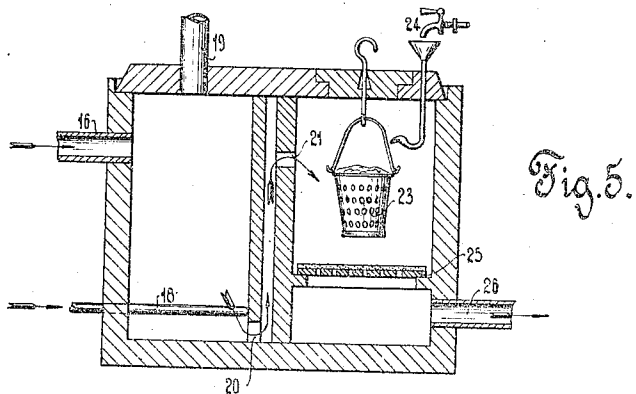
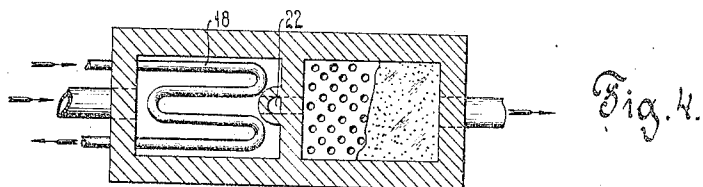
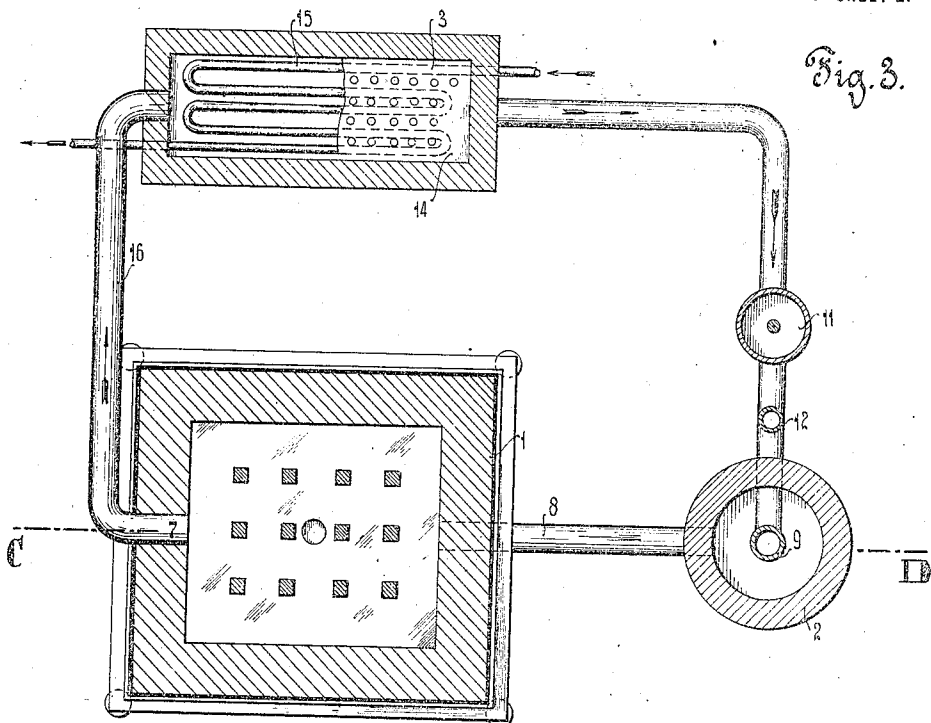
R. VAN HASSELT.
 PROCESS FOR THE ELECTROLYSIS OF ALKALI CHLORIDS.
 APPLICATION FILED OCT. 12, 1916.

1,259,683.

Patented Mar. 19, 1918.
 2 SHEETS—SHEET 1.



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UNITED STATES PATENT OFFICE.

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PROCESS FOR THE ELECTROLYSIS OF ALKALI CHLORIDES.

1,259,683.

Specification of Letters Patent. Patented Mar. 19, 1918.

Application filed October 12, 1916. Serial No. 125,253.

To all whom it may concern:

Be it known that I, ROLF VAN HASSELT, subject of the Queen of the Netherlands, residing at The Hague, Kingdom of the Netherlands, have invented certain new and useful improvements in Processes for the Electrolysis of Alkali Chlorids, of which the following is a specification.

It has been proposed in connection with electrolytic cells having a horizontal porous diaphragm to restrict the impoverishment of the electrolyte in the anode compartment by providing a salt chamber adjacent to that compartment and communicating with it near the bottom. It is clear that such an arrangement can do little good, since the circulation necessary to dissolve the salt and to bring it into the anode compartment where there is poverty of salt, namely in the upper part of the compartment, must be by way of the narrow bottom communication just mentioned. The object of providing such a chamber was not so much to produce a circulation in the anode compartment as to reinforce the layer of electrolyte immediately above the diaphragm.

It has also been proposed to place the salt in the anode compartment itself. In this case, however, the salt may cause much resistance to the current and the liquid may become saturated with salt which may crystallize in the diaphragm, choking the latter and increasing its resistance.

According to the present invention the salt chamber is arranged in such a manner that its object—the maintenance of a large proportion of salt in the anode compartment—is fully attained without any detrimental secondary effects.

The salt chamber is separated from the cell and is used also for expelling the chlorin from the anode liquid and for heating this liquid. For this purpose the anode liquid containing chlorin flows out of the upper part of the anode compartment through a wide pipe into the upper part of the covered salt chamber. The latter consists preferably of a long chamber having near its bottom a grating of chlorin proof material upon which the salt is placed. Under this grating steam pipes are provided to heat the solution. The outlet for the solution is also under the grating. The chamber is covered by a lid having a tube for escape or withdrawal of the chlorin. The solution is saturated with salt, and as it is also heated from be-

low, the chlorin is completely expelled and a saturated chlorin-free solution flows from the lower part of the chamber, whence it returns to the lower part of the anode compartment, preferably at the side thereof opposite the outflow.

This apparatus makes it possible to counteract nearly completely the impoverishment of the anode liquid and at the same time permits accurate adjustment of the quantity and the composition of the liquid fed into the anode compartment. Firstly, during the circulation of the anode liquid it is possible to add such quantity of hydro-chlorid acid as is necessary to convert any hypochlorite which may be formed into NaCl and Cl₂, or to neutralize the NaOH that may pass through the diaphragm into the anode compartment. Secondly, the saturated anode liquid returns free from chlorid into the anode compartment, whereby formation of hypochlorite is avoided. Thirdly, the necessary addition of liquid in substitution for the part which passes through the diaphragm may be made at a convenient place in the circulation of the anode liquid, preferably after the latter has left the salt chamber. Fourthly, the velocity of circulation and therefore the mean composition of the liquid in the anode compartment may be controlled by an inserted circulating pump. Fifthly, the composition of the liquid flowing into the anode compartment can be adjusted. If, for example, it proves necessary in order to prevent crystallization in the diaphragm that the solution should not be saturated when it enters the anode compartment, there may be added to the feeding solution in place of a saturated solution a more or less diluted one. Sixthly, one may keep the anode liquid at a very high temperature, in a simpler way than is otherwise possible, because the heating is not applied within the anode compartment, but exteriorly thereof. Seventhly, it is possible to filter the liquid before it enters the anode compartment, for example by means of a filter in the salt chamber. In the latter case it is preferable to boil off the chlorin in a chamber separate from that for saturating with salt.

The invention is illustrated by the accompanying drawings. Figure 1 is a vertical section of a cell and a feeding chamber, the section being taken on line C—D, Fig. 3; Fig. 2 shows in elevation a salt chamber and a side view of the feeding chamber and cell;

Fig. 3 is a horizontal section on line A—B, Fig. 1; Fig. 4 is a horizontal section of another form of salt chamber; Fig. 5 is a vertical section of Fig. 4.

5 In Figs. 1, 2 and 3, 1 is the cell, 4 are the anodes, 5 is the cathode, 6 the diaphragm, 7 the outlet for the anode liquid and the chlorin, and 8 the inlet for the anode liquid. 2 is a feeding apparatus or chamber covered
10 with a glass bell 10, into the center of which apparatus the salt solution is fed by an overflowing pipe 9 in which there may be an areometer and a thermometer for controlling the composition and temperature of the
15 inflowing liquid. 11 is a circulating pump of any suitable construction; 12 is a pipe for admission of fresh solution. 3 is the salt chamber having a chlorin outlet 13, a grating 14 upon which the salt is placed and heating coils 15; 16 is the pipe for the over-
20 flowing anode liquid and the chlorin, and 17 is the pipe for returning the saturated solution to the pump and thence to the feeding chamber and cell. The cathode liquid is dis-
25 charged in well-known manner by a vertical pipe 27, (Fig. 1) which leads from the bottom of the cell 1 into an overflow vessel 28, said pipe 27 having a branch 29 through
30 which the hydrogen escapes. The branch pipe 29 is immersed in the liquid contained in a tank 30, the extent of such immersion being preferably regulatable in order to regulate the pressure in the cathode compart-
35 ment, which pressure controls the rate of flow of liquid through the diaphragm, and, therefore, the strength of the resulting alkali.

In Figs. 4 and 5 the salt chamber comprises two compartments. It has coils 18, a
40 chlorin outlet 19, an outflow 20 at the lower part of one compartment and an inflow 21 to the second compartment at the same height as the inlet into the first compartment. A conduit 22 constructed in the first compart-
45 ment connects the outflow 20 with the inflow 21; a perforated basket 23 contains the salt. At 24 fresh solution may be added. 25 is a filter and 26 the outlet for the saturated solution.

50 In the construction shown in Figs. 1, 2 and 3 the liquid flows from the anode compartment to the salt chamber 3 where it is heated and at the same time saturated with salt. The chlorin escapes at 13, the satu-
55 rated solution through the pipe 17. The pump 11 forwards it into the bell 10. Between the bell and the salt chamber is arranged the supply pipe 12 through which is added fresh solution, more or less concen-
60 trated, according to the strength shown by the solution in the bell. In the cell the height of the liquid must be visible which is attained most simply by making pipe 16 of glass, or by providing a sight glass. The
65 faster the circulation, the higher the tem-

perature and concentration in the anode compartment. The addition of fresh solution at 12 must correspond with the quantity of liquid passing through the diaphragm, augmented by the loss by evapora-
70 tion.

In Figs. 4 and 5 the chlorin is expelled before the solution is saturated with salt. In this case one may use the salt obtained during the evaporation of the caustic lyes, 75 which salt is more or less alkaline, so that the liquid becomes alkaline and impurities are precipitated which must be removed by filtration. In this case it is advisable to add the fresh solution to the salt chamber itself 80 in order to filter it also. Before returning the salt solution to the anode compartment, preferably a little hydrochloric acid is added to neutralize the alkaline reaction; at the same time care may be taken that the solu- 85 tion is not so far saturated that crystallization in the diaphragm is to be feared.

The foregoing description shows that there is movement in the anode compartment in both a horizontal and a vertical direc- 90 tion, besides the descent of a part of the liquid through the diaphragm. The heavier, chlorin-free, inflowing liquid spreads itself above the diaphragm, flows upward along the anodes, becoming a little impoverished 95 and saturated with chlorin, and leaves the cell in this condition. Care must be taken that the movement of the liquid in the anode compartment does not enhance mechanical diffusion of cathode liquid through the diaphragm. To prevent this, the diaphragm 100 should be sufficiently thick and homogeneous. Preferably a rather thick, yet porous diaphragm of low resistance is selected. A thin diaphragm may also be used, protected by a layer of a coarse-grained material or the like. 105

Several cells may be connected with a single salt chamber.

What I claim is:

110 1. The herein-described process for the electrolysis of alkali chlorids in a cell containing a horizontal diaphragm, consisting in passing the anode liquid, in a slightly impoverished condition, from the upper 115 part of the anode compartment of the cell containing the diaphragm, to a salt chamber removed from the cell; heating said liquid in the salt chamber to expel the chlorin; re-saturating it therein with salt; and return- 120 ing the re-saturated liquid to the lower part of said compartment.

2. The herein-described process for the electrolysis of alkali chlorids in a cell con- 125 taining a horizontal diaphragm, consisting in passing the anode liquid, in a slightly impoverished condition, from the upper part of the anode compartment of the cell containing the diaphragm, to a salt chamber re- 130 moved from the cell; heating said liquid in

the salt chamber to expel the chlorin; re-saturating it therein with salt after the chlorin has been expelled; and returning the re-saturated liquid to the lower part of said compartment.

3. The herein-described process for the electrolysis of alkali chlorids in a cell containing a horizontal diaphragm, consisting in mechanically circulating the anode liquid from the upper part of the anode compartment of the cell containing the diaphragm, to a salt chamber removed from the cell, and thence back to the lower part of said compartment; heating the said liquid, while in the salt chamber, to expel the chlorin; and re-saturating it with salt in said salt chamber.

4. The herein-described process for the electrolysis of alkali chlorids in a cell containing a horizontal diaphragm, consisting in passing the anode liquid, in a slightly impoverished condition, from the upper part

of the anode compartment of the cell containing the diaphragm to a salt chamber removed from the cell; heating said liquid in the salt chamber to expel the chlorin; re-saturating it therein with salt; returning the re-saturated liquid to the lower part of said compartment; supplying fresh salt solution to said re-saturated liquid during such return passage to compensate for the liquid passing through the diaphragm; and regulating the velocity of flow and the strength of the added fresh salt solution, thereby to regulate the strength and quantity of the liquid returned to said compartment.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ROLF VAN HASSELT.

Witnesses:

I. I. HELSDOR RIX,
THOMAS L. VESHAL.