PUBLISHED

MAY 18, 1943.

BY A. P. C.

P. ACHILLE

ELECTROLYTIC SYSTEM

Filed Oct. 7, 1941

Serial No.

414,022

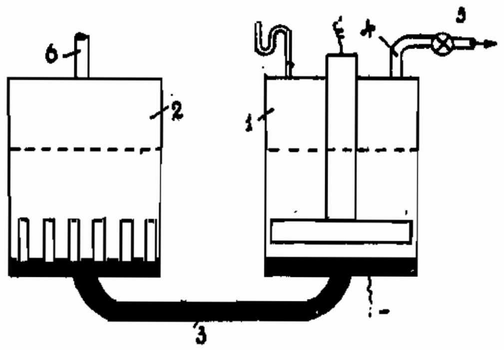

Fig. 1

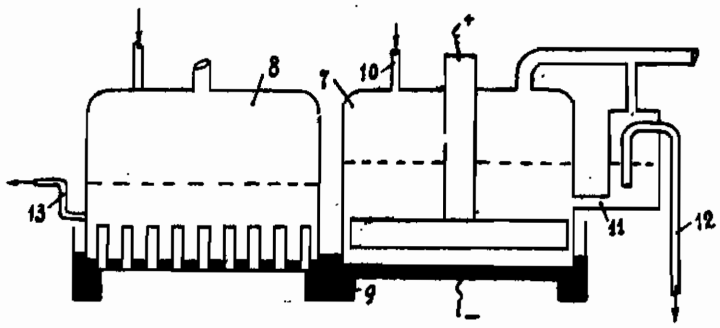

Fig. 2

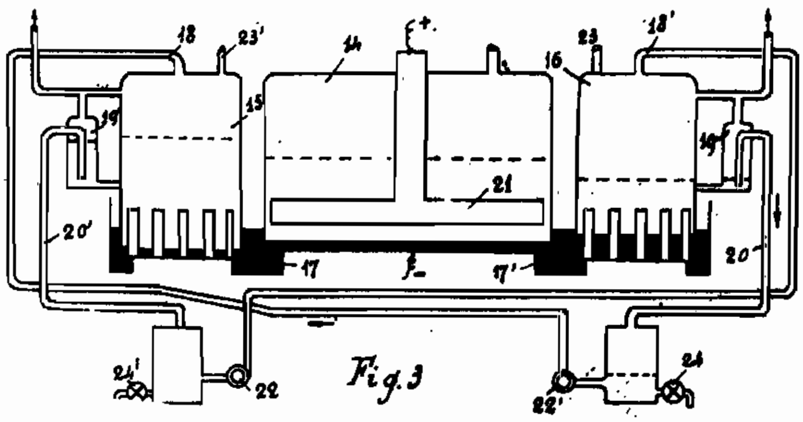

Fig. 3

Inventor

Pietro Achille

By Young, Emery & Thompson

Attorneys.

Published May 18, 1943 **Serial No. 414,022**

ALIEN PROPERTY CUSTODIAN

ELECTROLYTIC SYSTEM

Pietro Achille, Milan, Italy; vested in the Alien Property Custodian

Application filed October 7, 1941

This invention relates to electrolytic systems comprising cells having a mercury cathode and more particularly to systems comprising electrolytic cells of the above said type in communication with compartments where the mercury amalgam formed in said cell is decomposed, the flow of said amalgam and the regenerated mercury from one of said containers into the other being obtained by increasing and decreasing the pressure in one of them.

It is known that in the electrolytic systems having a mercury movable cathode, a continuous or discontinuous substraction of amalgam from the electrolytic compartment is necessary in order to maintain the percentage of the alkaline metal within the limits affording a good stability of the amalgam, so as to make possible the use of the amalgam and the regeneration of the mercury.

For such a purpose in the cell arrangements now in use, the flow of the mercury or of the amalgam from one of the two containers disposed side by side, into the other, is obtained by gravity, while the passage of the amalgam, or regenerated mercury from the latter container into the former is obtained by means of elevators, lifting worms, pumps or the like.

The main object of the present invention is to obtain the necessary flow of amalgam and regenerated mercury without requiring any mechanical device for lifting them.

Another object of the invention is to provide an electrolytic system comprising an electrolysis compartment and a decomposition compartment connected with each other in such a way as to constitute a system of communicating tubes, so that by means of a pressure increase in one of said compartments, a flow of amalgam or mercury from said compartment into the other takes place, and when the pressure in said compartment decreases the liquid flows in the other direction.

A further object of the invention is to provide means for obtaining the desired pressure variations in said compartments. Such variations may be obtained for instance, by varying the pressure of a gaseous means which is extraneous to the electrolytic process which takes place in the cells or compartments, or by varying the pressure of the gas developed in the chemical reaction which occurs in said compartments, or by varying the levels of the liquids upon the amalgam contained in said compartments.

These and other objects and advantages are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a diagrammatic sectional view of an electrolytic system where the pressure variations are effected controlling the discharge of gas developed in one of the containers.

Fig. 2 is a diagrammatic sectional view similar to that of Fig. 1, where the pressure variations are effected by controlling the discharge of the liquids contained in the cell.

Fig. 3 is a diagrammatic sectional view of another arrangement of electrolytic cells and compartments according to the invention.

Referring to the drawing and more particularly to Fig. 1, **1** is an electrolytic cell, **2** the compartment in which the mercury amalgam is decomposed, and **3** a pipe connecting the bottom sections which contain mercury of both said containers.

The cell **1** contains a saturated solution of sodium chloride, where by electrolysis a sodium amalgam and development of chlorine are obtained.

The pipe **4**, discharging chlorine from the cell, is provided with a stopping device **5** for opening and closing, intermittently, the chlorine discharge. Such a controlling discharge device may be constituted by a rotary or Corliss valve having its movable member, rotating at a predeterminated speed, or by a piston device having predeterminated stroke and speed, or the like.

Said controlling device may also be arranged on a chlorine discharging pipe connecting many electrolytic cells.

The operation of the described system is as follows: the electrolytic process is started when the controlling device **5** is in its closed position and compartment **2** at a constant pressure. By electrolysis, sodium amalgam is formed and gaseous chlorine developed in cell **1**; as said gas cannot flow out cell **1**, pressure in said cell increases and an amount of amalgam is pushed from cell **1** into compartment **2**. In said compartment **2** said amalgam is decomposed, sodium hydroxide and hydrogen are formed and regenerated mercury is obtained. The controlling device **5** is so adjusted that it allows chlorine passage in pipe **4**, when a certain amount of amalgam is decomposed in compartment **2**; then pressure in cell **1** decreases so that some mercury flows through pipe **3**, from compartment **2** into cell **1** so that new amalgam will be obtained during the opening of controlling device **5**.

The process then continues as above described.

The greater is the speed of the movable member of the controlling device 5, and the smaller are the pressure variations in cell 1.

The same results may be obtained arranging the controlling device 5 on the pipe 6 which discharges hydrogen from compartment 2, instead on said pipe 4.

In Fig. 2, 7 is the electrolytic cell and 8 the compartment where the amalgam formed in cell 1, is decomposed. Both said compartments 7 and 8 have their lower sections connected with a trough 9 having a mercury sealing. In Fig. 2 only two compartments are shown but they may be more than two and arranged in any suitable manner without changing operation and results.

The electrolyte which is a saturated solution of sodium chloride, enters cell 7 through pipe 10 in a continuous or discontinuous manner and leaves said cell through pipe 11 in a discontinuous manner, as for instance through syphon device 12. When the feeding of the electrolyte is continuous, the discharging device 12 has to have a capacity greater than feeding pipe 10.

When the electrolytic process is started, if the liquid level in the compartment 8 is maintained constant and electrolyte is continuously fed to cell 7, the liquid level in said cell increases till the level of syphon 12 and the pressure on the amalgam increases too, so that an amount of said amalgam is pushed from cell 7 into compartment 8. In said compartment 8 said amalgam is decomposed as in the described case of Fig. 1.

When the liquid level in cell 7 reaches the level of the syphon 12, some liquid is quickly discharged and the pressure in cell 7 decreases. Then, the mercury regenerated in the electrolytic compartment 8 may pass again into the cell 7 in order to take up a new amount of sodium. Such a process is performed in a continuous and efficient manner and the resulting advantages are obvious.

In Fig. 3 there are an electrolytic cell or compartment 14 and two compartments 15 and 16 for the amalgam decomposition. Both said compartments 15 and 16 are connected with cell 14 at their lower section containing mercury, through troughs 17 and 17′ both having mercury sealing.

In the compartments 15 and 16 the sodium amalgam is decomposed by means of solutions of sodium hydroxide in the presence of a conducting material as iron or graphite which must be in contact with both amalgam and hydroxide.

Owing to the amalgam decomposition, a concentration of the alkali solution results and hydrogen is developed.

In said compartments 15 and 16 the sodium hydroxide solution is fed in a discontinuous manner through feeding pipes 18 and 18′ and it is discharged in a discontinuous manner through syphons 19, 20 and 19′, 20′.

During the operation of the cell, if the system is arranged in such a way as to have an increase of the liquid level in compartment 15, equal to the lowering of the liquid level in compartment 16, while the liquid level in cell 14 remains constant, a flow of regenerated mercury from compartment 15 into cell 14 and a flow of the same amount of amalgam from cell 14 into compartment 16, are obtained. In such a way, the distance between the mercury cathode and the anode 21 of cell 14 remains invariated during the operation, so that the inner electric resistance of the cell remains the same and the terminal voltage is constant. In the system illustrated in Figs. 1 and 2 said distance between cathode and anode was variable and the inner electric resistance of the cell was in said cases not constant. The synchronisation of the movements of the liquids in compartments 15 and 16 which cause the mercury displacements, may be obtained, for instance, by means of pumps 22, 22′ one of which pushes the alcali solution discharged from compartment 15, into compartment 16 and the other pushes the solution discharged from compartment 16, into compartment 15.

The water necessary to the reaction is introduced into compartments 16 and 15 in a continuous or discontinuous manner, through the feeding pipes 23, 23′ and the alcali obtained by chemical reaction in said compartments, is discharged in a continuous or discontinuous manner through discharge pipes and valves 24 and 24′.

PIETRO ACHILLE.