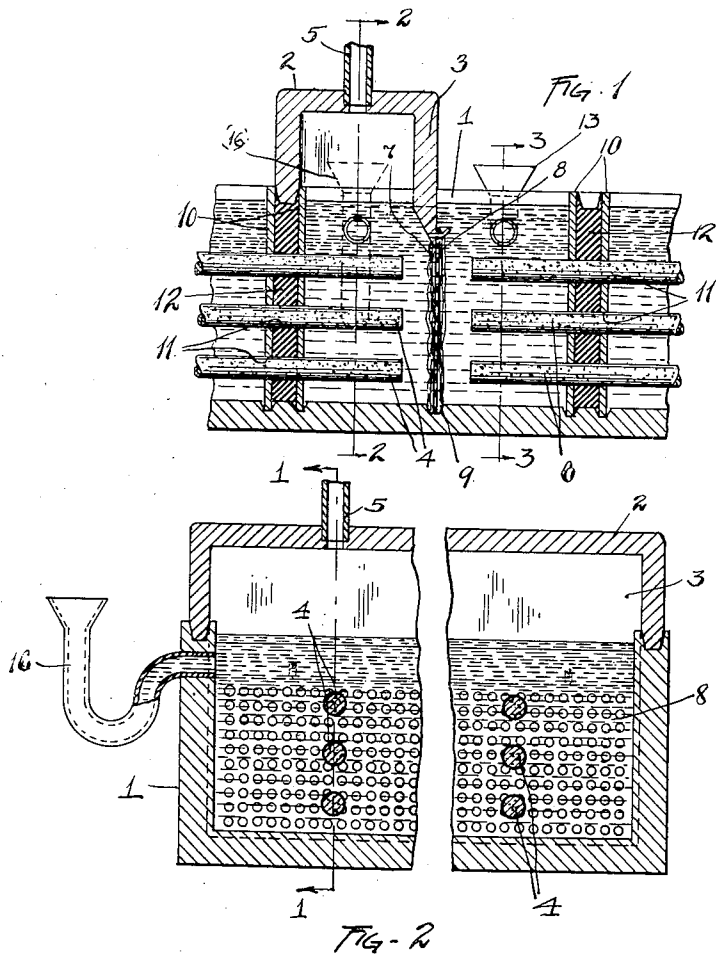
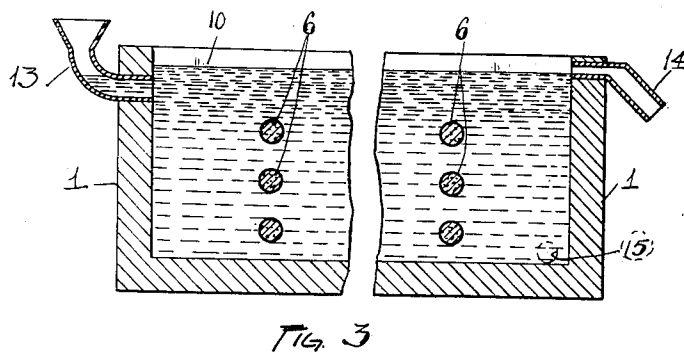


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ELECTROLYTIC APPARATUS.
APPLICATION FILED SEPT. 3, 1918.

1,386,094.

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ELECTROLYTIC APPARATUS.

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To all whom it may concern:

Be it known that I, HERBERT H. Dow, a citizen of the United States, and a resident of Midland, county of Midland, and State of Michigan, have invented a new and useful Improvement in Electrolytic Apparatus, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

The present invention relating as indicated to electrolytic apparatus has more especial regard to the provision of apparatus for electrically treating natural brine in the production of chlorine and alkali. The invention may be regarded as an improvement on the apparatus disclosed and claimed in my Patent No. 1,100,290, dated June 16, 1914, along with the method of electrolyzing exemplified in the operation of such apparatus; in other words, a diaphragm is formed between the anode and the cathode by precipitating from the solution that is being electrolyzed the hydrates of certain bases, specifically alkaline earth and iron chlorides, found in such solution.

The object of the present invention is to provide in an electrolytic apparatus of this sort, means whereby the diaphragm thus formed may be readily removed when desired as well as to render the interior of the apparatus as a whole more accessible. A further object is to provide an improved construction of the end and partition walls, wherein the electrodes are held, so as to prevent the leakage of electric current there-through.

To the accomplishment of the foregoing and related ends the invention then consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawing and the following description setting forth in detail an approved embodiment of the invention, which, however, constitutes but one of the various ways in which the principle of the invention may be used.

In said annexed drawing.

Figure 1 is a more or less diagrammatic representation in cross section of an electrolytic cell constructed in accordance with my present invention; Fig. 2 is a longitudinal section of such cell taken on the plane in-

dicated by the line 2—2 Fig. 1; and Fig. 3 is a section of a detail on the line 3—3, Fig. 1.

As in the case of the cell construction illustrated in my prior Patent No. 1,100,290, above referred to, the cell 1 in the present improved construction is of general rectangular form in cross section, and is provided with a closure or cover 2 that extends over approximately one-half the width of the cell and thence downwardly in the form of a partition 3, that depends some distance below the normal level of the liquor in the cell. The anode 4, which is preferably in the form of a series of carbon rods supported in the fashion presently to be described, extends within the inclosed space bounded by the cover and depending partition, as shown, so that the gas, specifically chlorine in the case under consideration, which is set free by the electrolytic action of the cell will be prevented from escaping by such inclosure, it being conducted through the passage 5 into a suitable receiving chamber, not shown.

In the other, or open, portion of the cell will be disposed the cathode 6 which will preferably likewise consist of a plurality of rods, either carbon or iron, supported in the fashion presently to be described. The rods thus constituting the cathode extend transversely of the cell chamber as shown in cross section in Fig. 1, toward the rods which constitute the anode 4 but terminate short of the latter so as to leave a clear vertical space between the two sets of rods. It will be understood that the particular form and disposition of anode and cathode just described, save for the feature last mentioned viz: that of the clear space left between the two, may be varied. Thus the rods may extend longitudinally, *i. e.* at right angles to that shown in the present drawing; in other words, they may be disposed as is illustrated and described in my aforesaid patent and the cathode may take the form of a wire mesh instead of rods.

As already indicated, a diaphragm 7 is maintained between the anode and cathode, said diaphragm taking the form of a substantially vertical partition that extends downwardly from the partition 3 to the bottom of the cell. This diaphragm is made up of deposits of calcium, magnesium and iron hydrates which are precipitated as a result

of the electrolytic action immediately upon starting the operation of the cell as described in detail in my earlier Patent No. 621,908, dated March 28, 1899. As suggested in this last mentioned patent I propose to use in the present connection as a nucleus for the diaphragm a sheet of pervious material 8, preferably a thin sheet of wood such as veneering, perforated at close intervals or else a sheet of fabric loosely woven out of wicker or the like. Where the diaphragm-nucleus or base is thus constructed of fabric, a light frame to initially support the same may be provided. The sheet or frame in any case rests in a shallow groove 9 in the bottom and side walls of the cell chamber and is detachably secured or rested against the front face of the partition 3, that is the face directed toward the cathode side of the cell. Thus hooks 8^a may be used for this purpose. However, such upper edge of the sheet or frame and thus of the diaphragm is designed to lie below the level of the electrolyte so that the precipitated hydrates which form the diaphragm proper will seal off such upper edge and prevent the escape of chlorin gas into the atmosphere from the anode side of the cell. The anode side of the partition 3 is preferably beveled off as shown in Fig. 1 to assist in directing the bubbles of chlorin that rise from the cathode into the space inclosed by cover 2.

Such cover with its side walls including the separately designated partition 3, consists in effect of an inverted trough that removably seats upon the wall in which the anode is supported as well as on the adjacent portions of the side walls of the cell, the walls in question being grooved and the engaging portions of the cover being beveled to effect a tight joint.

The end walls of the cell are preferably constructed of two boards 10 spaced a suitable distance apart, and provided with aligned openings 11 in which the rods composing the anode or cathode as the case may be, are more or less tightly fitted. After the rods have been inserted in position in such boards and the latter secured by this or other means in properly spaced relation, the space therebetween is filled with a suitable insulating pitch 12, such pitch being thus filled in while in plastic condition and subsequently allowed to cool and harden. By the construction just described the seeping of the electrolyte through the cell wall around the electrodes is effectually prevented and the serious wastage of current that might otherwise occur is avoided. Whenever it is desired to secure access to the anode side of the cell the cover may be readily lifted off as already indicated. In such event it will of course be desirable to first detach the upper edge of the diaphragm from the depending partition wall 3 of such

cover and such detachability of the diaphragm will also more frequently be made use of in order to remove the diaphragm itself. In other words, whenever the diaphragm requires attention either for the purpose of removing an excessive accumulation of the hydrates which cling to the diaphragm base and constitute the diaphragm proper, by simply detaching the upper edge of the base or nucleus sheet from the wall 3 in question, the entire diaphragm may be readily lifted out of the cell and then subsequently replaced or a fresh diaphragm nucleus inserted in its stead as found desirable.

The general operation of the cell will not require extended description. It will be understood that liquids can pass from the one cell portion to the other only by diffusion through the aforesaid diaphragm. Accordingly I either initially supply, or subsequently maintain, in the cathode portion of the cell, a solution other than the brine which forms the body of the electrolyte being treated in the anode portion. The solution surrounding the cathode is preferably relatively pure sodium chlorid solution, although it may be a solution of any alkali chlorid which is substantially free from the alkali earth and iron chlorids that are found in the natural brine. Upon the current now being passed through the cell the diaphragm will immediately begin to form and the pure brine just described will be separated from that containing the natural impurities. If desired, by adding a little caustic to the pure solution the deposit of the hydrates which constitute the diaphragm proper may be started even before electrolysis is actually begun. When the alkalinity of the brine surrounding the cathode has reached the desired degree, it may be drawn off in whole or in part, or the desired degree of alkalinity may be maintained and a continuous flow of alkaline effluent obtained by adding fresh sodium chlorid brine to the cathode liquor and permitting the portion of causticized catholyte thus displaced to flow out of the cell. The inlet 13 for the pure brine or sodium chlorid solution is shown in Fig. 3 as well as the outlet 14 therefor at the opposite end of the cell. For the purpose of discharging the spent solution an opening 15, normally closed by a plug, is provided near the bottom of the cell. The natural or impure brine is at the same time supplied to the anode side of the cell so as to maintain the level of liquid in the cell substantially constant, such brine being thus supplied through a pipe 16 formed with a trap in order to prevent the escape of the chlorin produced by the electrolysis.

It may also be found necessary or desirable, as liquor in the anode compartment becomes weaker, due to the electrolytic ac-

tion, to remove part of the same and supply fresh liquor in a correspondingly increased amount.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In apparatus of the class described, the combination of a cell having a partition depending below the normal level of the solution therein, an anode and a cathode on the respective sides of such partition, a closure for the anode side of the cell, the other side being open, and a diaphragm depending substantially vertically from such partition between said anode and cathode in spaced relation thereto.

2. In apparatus of the class described, the combination of a cell having a partition depending below the normal level of the solution therein, an anode and a cathode on the respective sides of such partition, a closure for the anode side of the cell, the other side being open, and a diaphragm formed of hydrates precipitated from the solution and depending substantially vertically from such partition between said anode and cathode in spaced relation thereto.

3. In apparatus of the class described, the combination of a cell having a partition depending below the normal level of the solution therein, an anode and a cathode on the respective sides of such partition, a closure for the anode side of the cell, the other side being open, and a diaphragm detachably secured at its upper edge to such partition so as to depend substantially vertically from the latter between said anode and cathode in spaced relation thereto.

4. In apparatus of the class described, the combination of a cell having a partition depending below the normal level of the solution therein, an anode and a cathode on the respective sides of such partition, a closure for the anode side of the cell, the other side being open, and a diaphragm formed of hydrates precipitated from the solution and detachably secured at its upper edge to such partition so as to depend substantially vertically from the latter between said anode and cathode in spaced relation thereto.

5. In apparatus of the class described, the combination of a cell having a partition depending below the normal level of the solution therein, an anode and a cathode on the respective sides of such partition, a closure for the anode side of the cell, the other side being open, and a diaphragm depending substantially vertically from such partition between said anode and cathode in

spaced relation thereto, said diaphragm comprising a pervious sheet and a coating of hydrates precipitated thereon from the solution.

6. In apparatus of the class described, the combination of a cell having a partition depending below the normal level of the solution therein, an anode and a cathode on the respective sides of such partition, a closure for the anode side of the cell, the other side being open, and a diaphragm comprising a pervious sheet detachably secured at its upper edge to such partition so as to depend substantially vertically from the latter between said anode and cathode in spaced relation thereto and a coating of hydrates precipitated on said sheet from the solution.

7. In apparatus of the class described, the combination of a cell, a diaphragm therein, an anode and cathode on the respective sides of such diaphragm and spaced therefrom, and a removable cover for the anode side of said cell, the other side of said cell being open and the one wall of said cover forming a partition depending below the normal level of the solution in said cell.

8. In apparatus of the class described, the combination of a cell, a diaphragm therein, an anode and cathode on the respective sides of such diaphragm and spaced therefrom, and a removable cover for the anode side of said cell, the other side of said cell being open and the one wall of said cover forming a partition depending below the normal level of the solution in said cell and said diaphragm being secured at its upper edge to such partition.

9. In apparatus of the class described, the combination of a cell, a diaphragm therein, an anode and cathode on the respective sides of such diaphragm and spaced therefrom, and a removable cover for the anode side of said cell, the other side of said cell being open and the one wall of said cover forming a partition depending below the normal level of the solution in said cell and said diaphragm comprising a pervious sheet detachably secured at its upper edge to such partition and a coating of hydrates precipitated on said sheet from the solution.

10. In apparatus of the class described, the combination of a cell, a diaphragm therein, an anode and cathode on the respective sides of such diaphragm and spaced therefrom, and a removable cover for the anode side of said cell, the other side of said cell being open and the one wall of said cover forming a partition depending below the normal level of the solution in said cell and said diaphragm comprising a pervious sheet detachably secured at its upper edge to such partition likewise below such normal level of the solution and a coating of hydrates precipitated on said sheet from the solution.

11. In apparatus of the class described, the combination with a cell, of rods forming electrodes, said rods extending transversely through a wall of said cell and such wall comprising spaced boards and a plastic insulating material filling the space therebetween and surrounding the included portions of said electrodes. 10 15
12. In apparatus of the class described, the combination with a cell, of rods forming electrodes, said rods extending transversely through a wall of said cell and such wall comprising spaced boards and a plastic insulating material filling the space therebetween and surrounding the included portions of said electrodes. 10 15

Signed by me, this 24 day of August, 1918.

HERBERT H. DOW.