G. KOLSKY.

PROCESS OF MAKING CHLORATES AND APPARATUS THEREFOR.

APPLICATION FILED APR. 4, 1913.

**1,092,369.**

Patented Apr. 7, 1914.

2 SHEETS—SHEET 1.

*Fig. 1.*

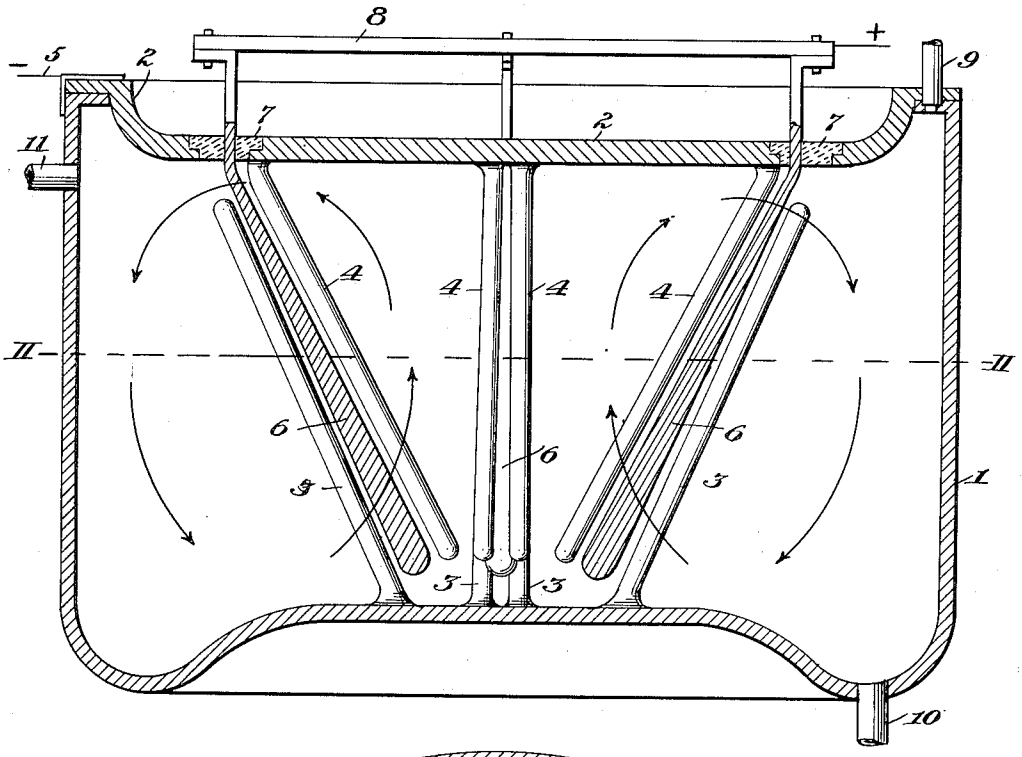
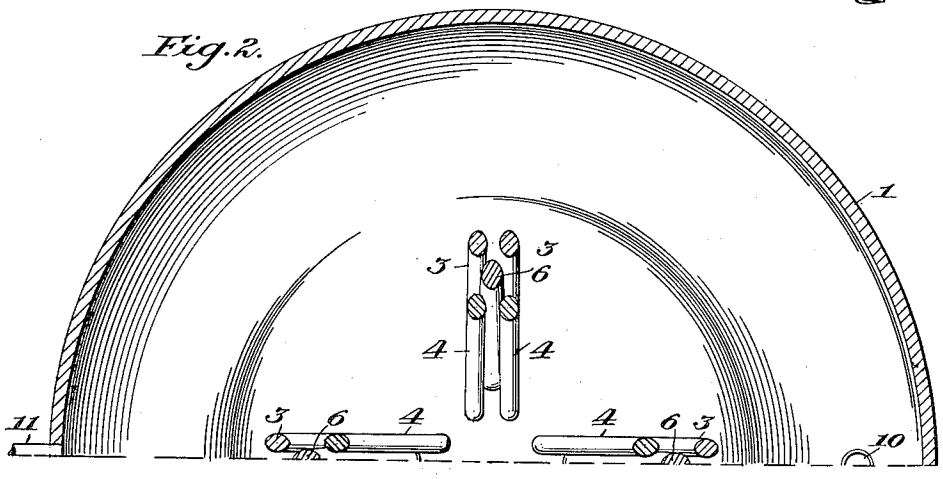



*Fig. 2.*




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2 SHEETS—SHEET 2.

*Fig. 3.*

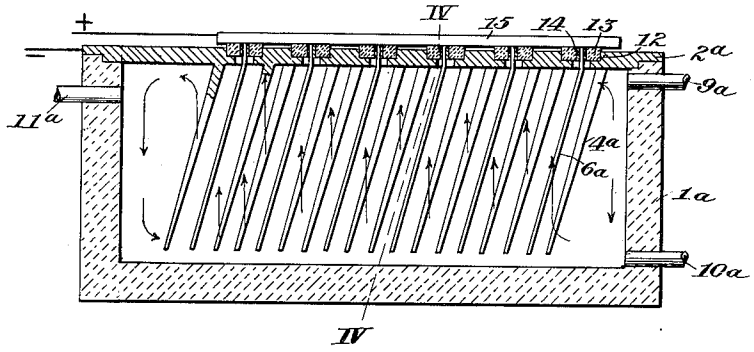



*Fig. 4.*

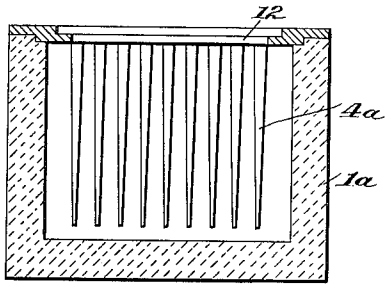



*Fig. 5.*

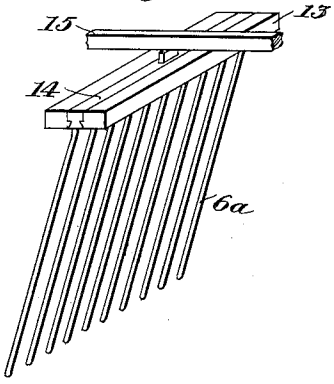
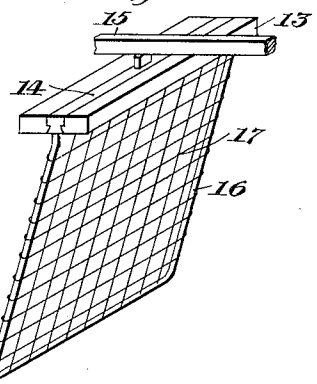



*Fig. 6.*




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# UNITED STATES PATENT OFFICE.

GEORGE KOLSKY, OF NIAGARA FALLS, NEW YORK.

## PROCESS OF MAKING CHLORATES AND APPARATUS THEREFOR.

1,092,369. Specification of Letters Patent. Patented Apr. 7, 1914.

Application filed April 4, 1913. Serial No. 756,920.

*To all whom it may concern:*

Be it known that I, GEORGE KOLSKY, a citizen of the Republic of Switzerland, residing at Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Processes of Making Chlorates and Apparatus Therefor, of which the following is a specification.

This invention relates to processes and apparatus for the electrolysis of saline solutions, more particularly for the preparation of chlorates of the alkali metals, and other compounds resulting from the interaction of anodic and cathodic products of electrolysis.

For a full understanding of the invention, reference is made to the accompanying drawings, wherein:—

Figure 1 is a central vertical section of one form of apparatus embodying the invention; Fig. 2 is a partial horizontal section thereof on line II—II of Fig. 1; Fig. 3 is a vertical longitudinal section of a modified form of apparatus likewise embodying the invention; Fig. 4 is a transverse section on line IV—IV of Fig. 3, the anodes being removed; Fig. 5 is a perspective view of one form of anode; and Fig. 6 is a similar view of a modified form of anode.

Referring to Figs. 1 and 2, 1 represents a tank or vessel which may be of cast iron, and is preferably of large capacity, usually several hundred gallons. 2 is a cover of similar material in electrical contact with the body of the vessel. 3, 3 are bars, rods or projecting members of suitable conductive material, preferably of cast iron; these bars may be integral with the bottom of the vessel. 4, 4 are similar bars or rods, indicated as cast integral with the cover 2. The bars 3, 4, together with the interior of the vessel or so much thereof as is in contact with the electrolyte, constitute the cathode elements of the electrolytic cell, electrical connection thereto being indicated at 5. 6, 6 represent the anodes, which may be of copper plated or otherwise covered with platinum. These anodes are rods arranged adjacent and between the cathodes 3, 4 and extending through insulating plates 7 in the cover of the cell, to the anode bus-bar 8. 9 represents the gas-eduction pipe, 10 the liquid draw-off, and 11 the supply-pipe for electrolyte. It will be noted that the anode and cathode elements are, in this construction, arranged at an inclination to the vertical, and are so disposed as to permit the free circulation of the liquid through an open or grid-like structure formed by electrodes of opposite polarity. In the operation of the cell for the preparation of chlorates, for example, hydrogen is liberated at the cathodes 3, 4, and owing to their inclined position escapes therefrom with comparative freedom, rising directly to the surface of the electrolyte. This upward motion of the gas induces a strong circulation of the electrolyte along the general lines of flow indicated by the arrows in Fig. 1; and this circulation, in turn, aids in the detachment of the bubbles, with the result that not only is all polarization of the electrodes avoided, but fresh electrolyte is constantly brought to the field of most intense electrolytic action. Moreover, under this arrangement the electrolyte flows in quick succession in contact with surfaces of opposite polarity, thereby affording the most favorable conditions for the union of the anode and cathode products of electrolysis. Under these conditions, a very high current-efficiency is assured and it becomes practicable to employ very high current densities, for as will readily be understood, the velocity of flow of the liquid increases as the current-density is increased, by reason of the increased evolution of hydrogen.

The electrodes have been illustrated, for the sake of clearness and simplicity, as comparatively few in number and disposed in several groups: but it is to be understood that they may be, and preferably are, disposed in the form of a practically uninterrupted grid or open cone-shaped structure within the vessel 1, so as most effectively to subject all of the electrolyte to their action. Obviously, the direction and degree of inclination of the electrodes may be varied as desired, without sacrificing the essential purposes of the invention.

As illustrated in Fig. 1, the anodes 6 gradually increase in cross-section toward their lower ends, the cathodes being cylindrical and substantially parallel to the anode surfaces. This construction is not essential, but is desirable as insuring a greater proportionate liberation of gas at points well below the surface of the electrolyte, where its efficiency in promoting the circulation of the electrolyte is of course higher.

Obviously, the electrodes may be arranged otherwise than in the form of a cone. For

example, as shown in Figs. 3, 4, the electrolytic cell may comprise a rectangular tank $1^a$ of concrete or the like, having a cast-iron or other metal cover $2^a$, from which the cathode bars $4^a$ depend, each transverse series of bars forming a comb-like structure as indicated in Fig. 4. $9^a$ indicates the gas outlet, $10^a$ the liquid outlet and $11^a$ the liquid supply-pipe. The cover $2^a$ is slotted as at 12 to receive insulating slabs 13 of concrete or the like, which carry the anodes $6^a$, usually consisting of platinum or platinized copper.

Various constructions of anode may be employed, the essential feature being the provision of an open or grid-like structure, through which the electrolyte may circulate freely. For example, each anode may comprise a series of platinized copper bars $6^a$ (Fig. 5), set in a lead cap 14, which is connected to the anode bus-bar 15. Or as shown in Fig. 6, the anode may comprise similarly mounted frames 16 of platinized copper, carrying screens 17 of platinum wire.

It is preferred in all cases to incline the electrodes, since a better circulation of electrolyte is thereby obtained, but I do not regard such inclination as essential in every case to the practice of my invention, since commercially practicable results may be obtained with electrodes which are either vertically or horizontally disposed, provided the combined electrode structure be such as to permit the free passage of a circulating body of electrolyte.

In the construction illustrated in Figs. 1 and 2, the inner electrode 4 may, if desired, be replaced by a continuous conical conductive structure, perforated or not, without seriously interfering with the circulation; and, in general, the apparatus may be variously modified without departing from the spirit of my invention.

The apparatus may be used not only for the preparation of chlorates, but as well for the manufacture of hypochlorites and, in general, of such compounds as result from the interaction of anodic and cathodic products of electrolysis.

In the use of the apparatus for the manufacture of potassium chlorate, it is preferred to subject the considerable body of liquid contained in the vessel to electrolytic action for several hours, or until the percentage of chlorate has risen to the desired degree, whereupon the liquid is withdrawn and replaced by fresh electrolyte. Under this mode of operation, there is no continuous flow of electrolyte into and from the apparatus, and the circulation of the liquid therein is due solely to the evolution of hydrogen at the cathodes, and its upward movement therefrom. For the operation of the device at high efficiencies, it is accordingly necessary to employ relatively high current-densities, in order that the gas-evolution may be sufficiently rapid to maintain an active circulation of the electrolyte and to effect the continuous depolarization of the electrodes. A current-density of 60 to 100 amperes per square dcm. of cathode surface has been found satisfactory for the purposes of the invention, the current-density at the anode surfaces being, say, 160 to 200 amperes per square dcm.

I claim:

1. An electrolytic process of producing chlorates or the like, which consists in passing an electric current through a suitable electrolyte between electrode surfaces separated only by said electrolyte, and maintaining such evolution of gas at the cathodes as will suffice to induce an active circulation of the electrolyte past the electrodes and effect the depolarization thereof, the lines of flow of the electrolyte passing electrodes of opposite polarity in rapid succession.

2. An electrolytic process of producing chlorates or the like, which consists in passing an electric current through a suitable electrolyte between inclined electrode surfaces separated only by said electrolyte, and maintaining such evolution of gas at the cathodes as will suffice to induce an active circulation of the electrolyte past electrodes of opposite polarity and effect the depolarization thereof.

3. In electrolytic apparatus for the preparation of chlorates or the like, the combination of a vessel and a plurality of electrodes of opposite polarity therein, said electrodes separated only by the electrolyte and disposed to provide an open or grid-like structure through which the electrolyte may freely circulate, said electrodes being so arranged that the hydrogen liberated at the cathode will induce a repeated circulation of the electrolyte through said grid-like structure, the lines of flow of the electrolyte passing electrodes of opposite polarity in rapid succession.

4. In electrolytic apparatus for the preparation of chlorates or the like, the combination of a vessel and a plurality of electrodes of opposite polarity therein, said electrodes separated only by the electrolyte, arranged at an inclination and disposed to provide an open or grid-like structure through which the electrolyte may freely circulate under the influence of the liberated hydrogen.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE KOLSKY.

Witnesses:

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WILL H. BLAIN.