

J. GERSTLE.
ELECTROLYTIC CELL.
APPLICATION FILED JUNE 9, 1919.

1,342,378.

Patented June 1, 1920.
2 SHEETS—SHEET 1.

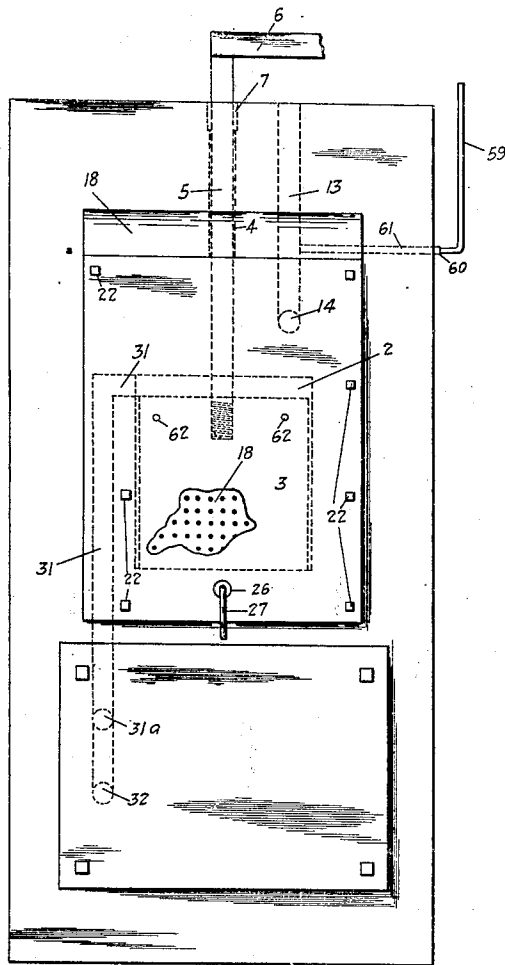


Fig. 1

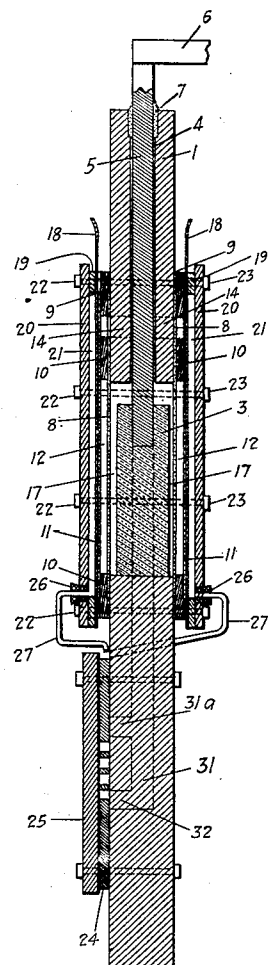


Fig. 2

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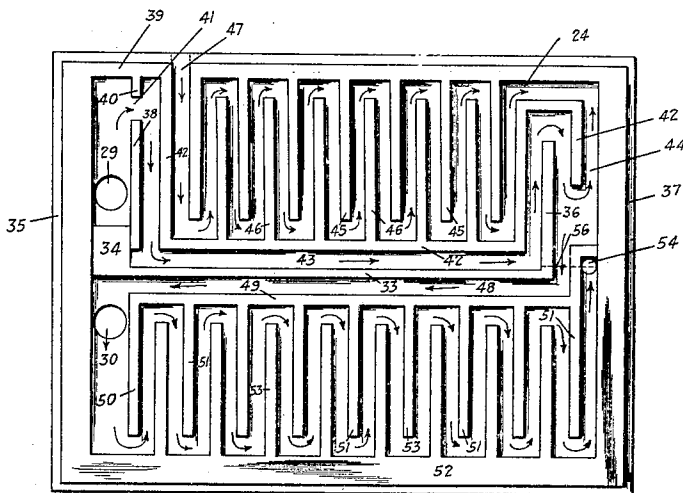


Fig. 4

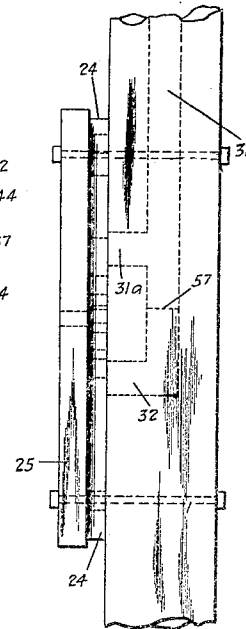


Fig. 5

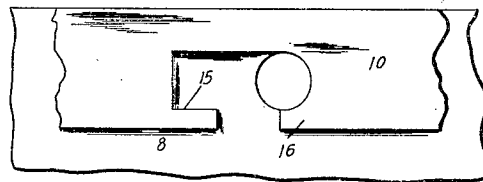


Fig. 3

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UNITED STATES PATENT OFFICE.

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ELECTROLYTIC CELL.

1,342,378.

Specification of Letters Patent.

Patented June 1, 1920.

Application filed June 9, 1919. Serial No. 302,672.

To all whom it may concern:

Be it known that I, JOHN GERSTLE, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Electrolytic Cells, of which the following is a specification.

This invention relates to new and useful improvements in electrolytic cells.

One of the important objects of my invention is to provide a simple and highly efficient diaphragm hypochlorite cell by forming the chlorin and caustic soda in separate chambers, and thereafter mixing them to form the hypochlorite in baffled chambers that, while they are an integral part of the cell, are separate and distinct from the first named chambers. The hypochlorite is therefore prevented from coming in contact with the electrodes.

It is highly undesirable that the hypochlorite should come in contact with either the anode or cathode, for this leads to secondary reactions which destroy the hypochlorite, changing it back to the original salt (sodium chlorid). During the electrolysis, the hypochlorite at the cathode is reduced by nascent hydrogen generated at that electrode, while at the anode the OCl ions in the hypochlorite are oxidized to ClO₂ ions; that is, chlorate is produced. So long as any hypochlorite comes in contact with either electrode, these reactions will take place, resulting in a wastage of a portion of the current by converting the hypochlorite back to ordinary salt and thus lowering the efficiency of the cell.

My invention obviates the above current losses by the provision of means for preventing the hypochlorite from coming in contact with either electrode, and at the same time for forming it at the rate at which the chlorin and caustic soda are produced, by mixing the chlorin and caustic thoroughly and economically in a baffled chamber or chambers that are separate and distinct from the chambers in which said chlorin and caustic are formed. The baffled chamber or chambers make it possible for the chlorin to be absorbed by the caustic soda in a thorough manner and in a relatively small space.

Other important and incidental objects will be brought out in the following specification and particularly set forth in the

subjoined claims.

One form of embodiment of my invention is illustrated in the accompanying drawings, of which Figure 1 is a front elevational view of my improved electrolytic cell. Fig. 2 is a side view thereof, partly in section. Fig. 3 is a plan view of the recessed portion of the rubber gasket between the asbestos diaphragms. Fig. 4 is a front view of the baffled mixing chamber, with the outside cover board removed. And Fig. 5 is a side view of said mixing chamber and cover, in place on the supporting member.

Throughout the specification and drawings, similar reference characters denote corresponding parts.

Referring to the accompanying drawings, the numeral 1 designates a relatively flat member that may be constructed of concrete, soapstone or any other material that resists chlorin, caustic and hypochlorite. Preferably provided in the middle portion of the member 1 is a rectangular opening or hole 2 adapted to receive an anode 3 preferably constructed of graphite. Each face of the anode 3, when the latter is in place within the opening 2, is slightly below the outer surfaces of the member 1, while a space is left between the top of the anode and the top of the hole 2 to permit the free exit of chlorin and chlorinated brine.

Leading to the anode 3, through a longitudinal hole or channel 4 in the member 1, is a bar 5 that is secured at its outer end to a bus bar connection 6. In the upper end of said channel 4 around the bar 5, putty 7 is placed to prevent gas leakage.

Placed on each side of the member 1, to cover completely the opening 2, is a rectangular diaphragm 8 preferably constructed of asbestos or other suitable porous material. Surrounding each diaphragm 8 is a rubber border 9 of the same thickness as the diaphragm. Placed against the outer edge of each diaphragm 8 and its respective rubber border 9, is a spacing gasket 10 preferably constructed of rubber and of greater width at the top than at the bottom. Resting against each rubber gasket 10 is a second asbestos diaphragm 11, there being formed between each diaphragm 8 and each diaphragm 11, a brine chamber

12 to which salt brine is conducted as follows:

Referring to Figs. 1 and 2, there extends downwardly through the top portion of the member 1, at one side of the longitudinal hole 4 a brine inlet 13 which terminates at its lower end in two right-angled branches 14, each one of which communicates, through a hole in its respective diaphragm 8 and a cut-away portion of the rubber gasket 10, with its respective chamber 12, to deliver salt brine thereto. The rubber gaskets 10 are recessed as shown in Fig. 3 not only to admit salt brine to the chambers 12, but to provide fins 15 and 16 that press the diaphragms 8 tightly against the member 1 around the inlet openings 14, for the purpose of preventing the brine seeping into the chambers 17 between the anode and said diaphragms 8.

Seated against each diaphragm 11, is a perforated cathode plate 18 preferably constructed of iron. Resting against the outer marginal portion of each cathode 18, is a spacing gasket 19 preferably constructed of rubber. Seated against each gasket 19 is a rectangular board 20 constructed of fiber or other suitable caustic resisting material. There is thus formed on each side of the member 1, between the cathode 18 and fiber board 20, a caustic chamber 21. Studs 22, preferably four in number, project through the fiber boards 20 and intervening parts, to clamp them firmly together by means of nuts 23 applied to the outer ends of said studs.

Secured to one side of the member 1, below the chambers just described, is a baffled hypochlorite mixing chamber 24 provided with an outside cover 25 constructed of any suitable material for resisting chlorine, caustic and hypochlorite. (See Figs. 2 and 4.)

Preferably communicating with the lower portion of each caustic forming chamber 21, through a cork insert 26 extending into an opening in each fiber board 20, is the upper end of a caustic drain tube 27, said tubes communicating at their lower ends with the top portion of the baffled mixing chamber 24 through a port 47, to deliver caustic soda thereto. To ports 29 and 30 provided in said chamber, chlorine and chlorinated brine are respectively delivered by a channel 31 which extends downwardly from the anode chambers 17 through the member 1, said channel having a right-angled branch 31^a which communicates with the port 29 to deliver chlorine thereto and a right-angled terminal portion 32 that communicates with the port 30 to deliver to it chlorinated brine.

Referring to Fig. 4, the baffled chamber 24 is divided into an upper and a lower section by a partition 33, one end 34 of which,

being enlarged, is secured to an end wall 35 of the chamber, while the other end of said partition terminates in an upturned baffle portion 36 between which and the other end wall 37 of the chamber a wide space is provided. Secured to the enlarged portion 34 of the partition 33, is an upright baffle 38 that forms between it and the end wall 35 a channel which the chlorine enters from the port 29. From the top 39 of the chamber 24, a short baffle 40 extends downwardly toward the baffle 38, a small space 41 being left between them to admit the chlorine to a channel provided between the baffle 38 and a baffle 42 which projects downwardly from the top 39 of the chamber, and then horizontally toward the upturned projection 36 of the partition 33, and then upwardly, horizontally and downwardly over said projection 33 to a point just above its middle portion, as shown in Fig. 4. There is thus provided between the baffle 42 and partition 33, a channel 43 which conducts the chlorine to a point where it enters the space between the baffle 42 and the end wall 37 and top 39 of the chamber. Projecting downwardly from the top 39 of the chamber are baffles 45, between the upright portions of the baffle 42 and terminating a short distance above the horizontal bottom portion of the latter. Projecting upwardly from the horizontal bottom portion of said baffle 42, between the baffles 45, are baffles 46 which terminate at points a short distance below the top of the chamber. Since the caustic soda enters the chamber 24 at the point 47, its head will cause it to flow between the baffles 45 and 46 toward and through the space 44, becoming thoroughly mixed with the chlorine which passes through it from the opposite direction.

The hypochlorite thus formed passes into and through a channel 48 provided between the partition 33 and a baffle 49 having at one end a downwardly projecting portion 50 between which and the end wall 35 of the chamber 24 is a space which receives the chlorinated brine from the port 30. Projecting downwardly from the baffle 49 are a series of baffle projections 50 which terminate a short distance above the bottom 52 of said chamber. Projecting upwardly from said chamber bottom 52, between the baffle projections 51, are a series of baffle projections 53 which terminate a short distance below the horizontal portion of the baffle 49. There is thus provided between the baffle projections 51 and 53, a circuitous course for the hypochlorite, which enables the latter to absorb from the chlorinated brine, any chlorine that it may contain. The hypochlorite then passes into the space between the last baffle projection 51 and the end wall 37 of the chamber, at the upper end of which space there is an exit port 54

from which the hypochlorite may be withdrawn in any suitable manner. (See the arrows in Fig. 4.)

In operation, the salt brine enters the channel 13 and flows, part through one branch 14 to the chamber between the diaphragms 8 and 11 on one side of the member 1, and the other part through the other branch 14 to the chamber between the diaphragms 8 and 11 on the opposite side of the member 1. To each middle chamber 17 between a diaphragm 8 and the anode 3, part of the brine will flow from the middle chambers just mentioned. In the anode or inner chambers 17, chlorine will be generated when a current of electricity flows through the cell, the chlorine and chlorinated brine passing into the channel 31 which conducts the chlorine to the port 29, and the chlorinated brine to the port 30, in the mixing chamber 24.

The remaining part of the brine in the middle chambers between the diaphragms 8 and 11, flows through the diaphragms 11 and perforated cathode plates 18, into the chambers 21 formed between said cathode plates and the fiber boards 20. In the latter chambers on the cathodes caustic soda is formed when an electric current flows through the cell, said caustic passing from said chambers 21 into the drain tubes 27, which conduct it to the receiving port 47 in the mixing chamber 24.

The hypochlorite mixing chamber 24 is so divided by the partition 33 that the upper section, through its series of baffles, will be for the absorption of the chlorine gas by the caustic, while the lower baffled section is designed for the absorption by the hypochlorite, of any gas dissolved in the brine. The chlorine gas, which is admitted to the chamber 24 through the port 29, passes through the opening 41 into the channel 42, which in turn conducts it to the space 44, where it starts on its zig zag path between the baffles 45 and 46, flowing through the caustic soda which moves between said baffles from the opposite direction after entering said chamber through the port 47. The caustic solution as it flows toward the chamber wall 37, absorbs the chlorine gas. It then passes through the channel 48, and over the port 30 where the chlorinated brine enters, into the space between the baffles 51 and 53, where it absorbs the chlorine gas which the brine contains, finally leaving the chamber through the port 54 as sodium hypochlorite. The port 54 is so placed that the channel 48 is filled with liquor to form a liquid seal at the point 56, for the purpose of preventing the chlorine gas from entering the lower chamber section. A similar level is carried in the channel 31 at the point 57, to prevent the chlorine gas from flowing first into the lower system of baffles.

For the purpose of readily ascertaining the height of the salt brine in the cell, a gage 59 is provided. The latter is secured, by means of a cork insert 60, in the outer end of a horizontal channel 61 that leads through the member 1 to the brine inlet channel 13 within the latter. (See Fig. 1).

Provided in each fiber board 20, at points within the active electrode space, are two holes 62, for the escape of hydrogen when caustic soda and hydrogen are formed on the cathodes by the action of the electric current.

By providing the baffled mixing chamber 24 in the cell, separate and distinct from the chlorine and caustic forming chambers, there is no danger of the hypochlorite coming in contact with the electrodes to effect the current losses heretofore mentioned. Thus in keeping said chambers apart in the same cell, the hypochlorite not only is formed at the rate at which the caustic and chlorine is produced, but is kept away from the electrodes, with the result that the efficiency of the cell is greatly increased.

Having described my invention, I claim:

1. In an electrolytic cell, means for forming chlorine and caustic soda separately therein, and separate means that are a part of said cell for mixing the chlorine and caustic soda as they are formed.

2. In an electrolytic cell, means for forming chlorine and caustic soda separately therein, and a separate chamber attached to said cell for mixing the chlorine and caustic soda at the rate at which they are formed.

3. In an electrolytic cell, separate chambers therein for forming chlorine and caustic soda, and a chamber that is a part of said cell separate and distinct from the first named chambers for mixing the chlorine and caustic soda at the rate at which they are formed and out of contact with the electrodes.

4. In an electrolytic cell, means for forming chlorine and caustic soda separately therein, and separate baffled means that are a part of said cell for mixing chlorine and caustic soda as they are formed.

5. In an electrolytic cell, means for forming chlorine and caustic soda separately therein, and a baffled chamber attached to said cell, separate from the forming means, for thoroughly and economically mixing said chlorine and caustic soda as they are formed.

6. In an electrolytic cell, a relatively flat member containing a central opening, an anode in said opening, a middle and an outer chamber formed on each side of said opening, a cathode between each middle and outer chamber, means for conducting salt brine to each middle chamber, a mixing chamber secured to said flat member out of contact with said anode and cathode, and

means for conducting chlorin from said anode, and caustic soda from the outer chambers, to said mixing chamber.

7. In an electrolytic cell, a relatively flat member containing a central opening, an anode in said opening, a pair of diaphragms on each side of said opening, to form a porous brine receiving chamber, a washer between the diaphragms of each pair, a perforated cathode against the outer diaphragm of each pair, a washer seated against said cathode, a fiber board in tight engagement with the last named washer, a mixing chamber secured to said flat member below and out of contact with said anode and cathode, and means for conducting chlorin from said anode, and caustic soda from the chamber between the cathode and fiber board, to said mixing chamber.

8. In an electrolytic cell, a relatively flat member containing a central opening, an anode in said opening, a pair of porous diaphragms on each side of said opening, to form a brine receiving chamber, a gasket between the diaphragms of each pair, a perforated cathode seated against the diaphragm of each pair, a gasket seated against said cathode, a fiber board secured against the last named gasket, a baffled mixing chamber secured to said flat member below and out of contact with said anode and cathode, and means for conducting the chlorin from said anode, and the caustic soda from said cathode, to different inlets in said mixing chamber.

9. In an electrolytic cell, a relatively flat member containing a central opening, an anode in said opening, a pair of porous diaphragms on each side of said opening, a marginal washer surrounding each inner diaphragm, a gasket between the diaphragms of each pair, said flat member having a brine conducting channel which communicates through a hole in each inner diaphragm, and a recessed portion of the gas-

ket, with the chamber formed between each pair of diaphragms, a perforated cathode seated against the outer diaphragm of each pair, a second gasket seated against each cathode, a fiber board secured against the last named gasket, a baffled mixing chamber secured to said flat member below and out of contact with said anode and cathode, and means for conducting the chlorin from said anode, and the caustic soda formed on said cathode, to different inlets in said mixing chamber.

10. In an electrolytic cell, separate chambers for forming chlorin and caustic soda therein, a mixing chamber attached to the cell, below the forming chambers, means for conducting said chlorin and caustic soda to separate inlets in said mixing chamber, baffles in said mixing chamber, and means in said chamber for directing the chlorin and caustic soda around said baffles from opposite directions, whereby the caustic soda will absorb the chlorin.

11. In an electrolytic cell, separate chambers for forming chlorin and caustic soda therein, a mixing chamber attached to the cell, below the forming chambers, a partition dividing said mixing chamber into an upper and lower section, baffles in each section of said mixing chamber, means for conducting the caustic soda to one end of said mixing chamber, the upper section of said mixing chamber communicating at the other end with the lower section, and a conduit having an upper branch which conducts chlorin to the upper section of said mixing chamber, and a branch that delivers chlorinated brine to the lower section of said mixing chamber.

In testimony whereof, I have hereunto set my hand this 7th day of June, 1919.

JOHN GERSTLE.

Witness:

HOWARD S. SMITH.