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J. D. GILMOUR.

APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS.

(Application filed Apr. 29, 1901.)

(No Model.)

FIG. 1.

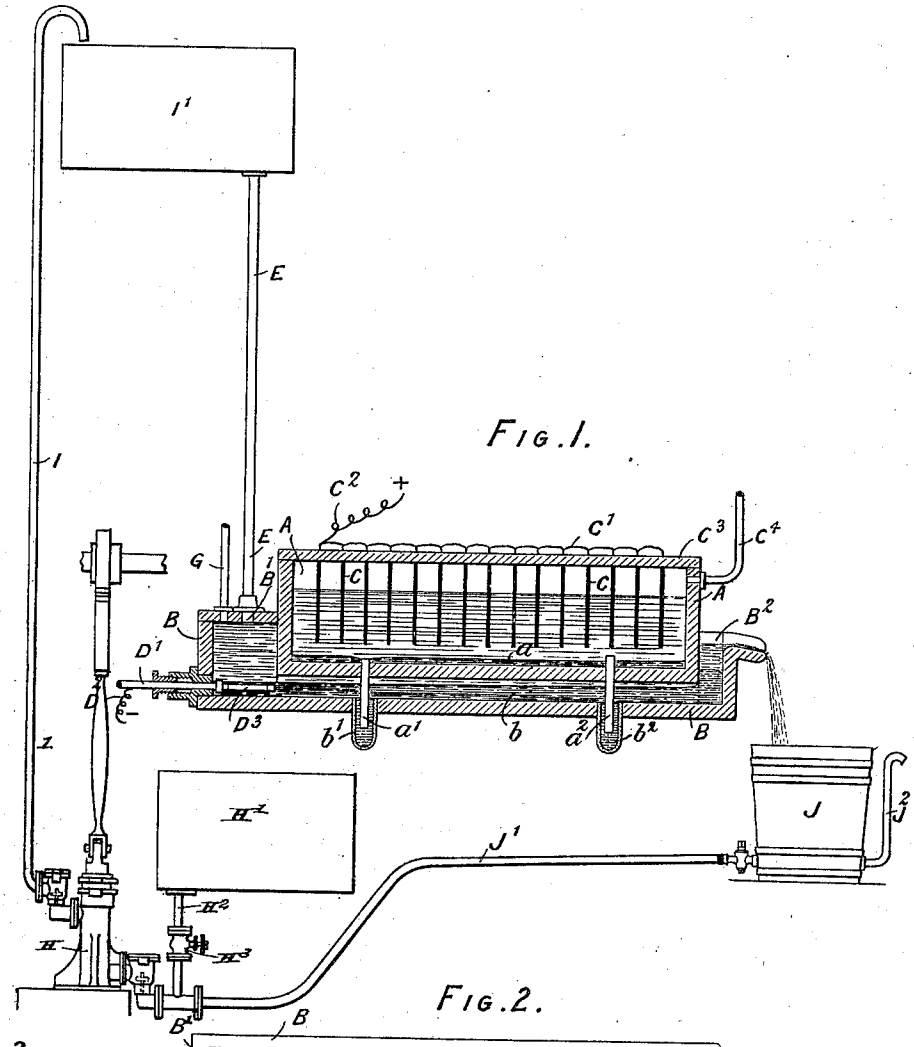


FIG. 2.

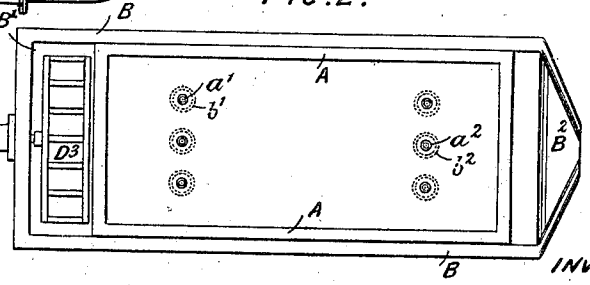
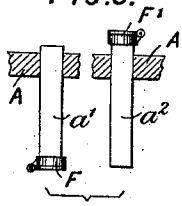


FIG. 3.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS.

SPECIFICATION forming part of Letters Patent No. 695,302, dated March 11, 1902.

Application filed April 29, 1901. Serial No. 58,023. (No model.)

To all whom it may concern:

Be it known that I, JAMES DICK GILMOUR, chemist, a subject of the King of Great Britain and Ireland, and a resident of the city of Glasgow, Scotland, have invented a new and useful Improved Apparatus for the Electrolytic Decomposition of Alkaline Salts, of which the following is a specification.

This invention has reference to and comprises an improved apparatus for the electrolytic decomposition of alkaline salts, principally of the halogen series, in the manufacture of caustic soda and caustic potash. The apparatus operates by circulating the mercury between upper and lower vessels by the intermittent pulsating action of a caustic-liquor pump, electric-current supply being provided, with means for permitting circulation of mercury between the vessels and preventing the chlorin compounds in the inner vessel from mixing with the caustic alkali formed by reaction between the water and the sodium amalgam in the outer vessel. By these improvements no mechanical movement of any part of the apparatus or separate pumping of mercury is required, there is no necessity for special cooling arrangements, sodium is always present and prevents mercury being attacked by the chlorin, and the space occupied by the apparatus is reduced by about one-half over the appliances heretofore in use; and in order that others skilled in the art to which my invention relates may understand how same may be carried into practice I have hereunto appended a sheet of explanatory drawings, in which—

Figure 1 is an elevation showing in section the apparatus. Fig. 2 is a plan view of the vessels of the apparatus, the covers being removed, and Fig. 3 is a detached view showing the arrangement of tubes and check-valves by which the mercury may flow between the vessels.

In carrying out my invention I make an upper inner vessel A and a lower outer vessel B of such materials as will not be destroyed by the action of caustic alkali, chlorin, or other halogen, the outer vessel B being preferably formed of wood or iron and the inner vessel of wood or porcelain.

The inner vessel A is preferably somewhat shorter than the outer vessel B, and fits closely at the sides into the outer vessel B to within one-eighth to a quarter of an inch from the bottom of the same, so that water or other liquid may be forced in at the one end at B′ and passed under the inner vessel A and flow out at the other end B^2. Into each vessel a layer of mercury *a b* is placed about an eighth of an inch deep. These two layers *a b* communicate with one another by means of two sets of tubes a' a^2, one set placed toward the back and the other toward the front. The tubes a^2 preferably project about one-eighth of an inch at the one end above bottom of vessel A, while the tubes a' similarly project about one-sixteenth of an inch at the other end up into the inner vessel A. The two tubes pass down into hollow tubular projections b' b^2, closed at their lower ends but open at their upper ends, so as to be in communication with the other vessel A, and thus form a seal.

The inner vessel A is fitted with carbon or suitable electrodes C, coupled up by the wire C′ to the anode-terminal C^2, which is connected up to the positive pole of a dynamo or equivalent source of electricity. A solution of an alkali-metal chlorid is introduced into the vessel A, and this vessel is closed by a cover C^3 and is fitted with a pipe C^4 for the escape of the chlorin or gas generated to any suitable collecting apparatus.

The outer vessel B is coupled up by the terminal D^2 to the negative pole of the dynamo or other source of electricity, and preferably has a conductor consisting of an overhung spindle D′ and a series of connecting-bars comprising an iron or like grating D^3 in communication with the mercury *b* at bottom of the outer vessel B. The electric current being turned on, chlorin is given off at the electrodes C of the inner vessel A and carried off by the pipe C^4 and sodium amalgam is formed with the layer of mercury *a* at the bottom of the same. Water is now pumped into the outer vessel by means of an ordinary plunger-pump H through a pipe I leading to an overhead distributing trough or cistern I′. From this cistern the water would flow by pipes E to

the vessels B at intermittent intervals. The trough I′ is necessary only when there are several vessels to be fed and is employed to secure a uniform distribution of the water to the several vessels, the trough emptying itself between each pulsation. By the action of the water-pressure the mercury is made to flow into and recede from the inner vessel A through the tubes b^2 a^2 and b' a', the flow of mercury returning by gravity to the vessel B between the pulsations of the pump, and a continuous circulation of the mercury is thus kept up between the two vessels B A. The mercury flows into the vessel A from the vessel B through both tubes a' and a^2, but returns to the vessel B principally, if not wholly, through the shorter tubes a', it being preferable to have the weak caustic liquor meet the strong amalgam toward that end of the vessel. The seals prevent the chlorin compounds in the inner vessel A mixing with the caustic alkali formed between the water and the sodium amalgam in the outer vessel B. In place of seals I may, as shown in Fig. 3, use check-valves F F′, the one, F, being placed at the lower part of tube a' and the other, F′, at top of tube a^2, so that the mercury shall flow up the tube a^2 by the pulsating action of pump and down the tube a' by the action of gravity. The water is pumped in through the pipe E to the outer vessel B and passes under the inner vessel A, thoroughly scrubbing the mercury, and passing out at the spout end B^2 it is circulated from the tank J by the pipes J′ and I by the pump H until it reaches a convenient strength of caustic alkali. The overflow of liquor takes place by the pipe J^2 to the ordinary evaporators for further concentration, and fresh water is admitted by the pipe H^2 and regulating-valve H^3 from the cistern H′.

The pulsating action of one pump H will be sufficient for a number of cells, pipe connections being taken from the cistern I′ to these. The hydrogen gas generated in the chamber B′ of vessel B escapes by the pipe G.

It will be seen that there is no mechanical movement of any part of the apparatus, nor is there any separate pumping of the mercury, the mercury being circulated entirely by the pulsation of the caustic-liquor pump. The large quantity of liquor that can be circulated prevents the necessity of special cooling arrangements, and the tubes projecting into the inner vessel insure that sodium shall always be present and prevent the mercury being attacked by the chlorin, and the anode being nearly directly above the cathode the space occupied is reduced by about one-half.

I claim as my invention—

1. Apparatus for the electrolytic decomposition of alkali-metal salts, comprising upper and lower vessels, mercury in the vessels, means whereby the mercury may flow between the vessels and means adapted to cause the mercury to circulate from vessel to vessel by the variation in pressure of the caustic liquor, substantially as described.

2. Apparatus for the electrolytic decomposition of alkali-metal salts, comprising an interior and exterior vessel, anodes in the interior vessel and mercury in the bottom of such vessel acting as cathode, mercury in the exterior vessel and tubes connecting said two vessels, and a pump adapted to force caustic liquor intermittently through the exterior vessel, whereby the mercury is caused to circulate from vessel to vessel, substantially as and for the purpose described.

3. Apparatus for the electrolytic decomposition of alkali-metal salts, comprising an interior vessel, an exterior vessel in which it is fitted, so as to leave a passage beneath the interior vessel, mercury in each vessel and tubes connecting the mercury, and inlet for caustic liquor to the exterior vessel and an outlet therefor and a pulsating pump to pump the caustic liquor, whereby the mercury is caused to circulate by the different pressure of caustic liquor in the exterior vessel, substantially as and for the purpose described.

4. For the electrolytic decomposition of alkali-metal salts, a caustic-liquor pump, in combination with an interior vessel containing an anode and a mercury cathode and an exterior vessel having mercury in electric contact with said mercury cathode, conduits for the circulation of the mercury between the vessels, said conduits having means to prevent the chlorid compounds in the interior vessel from mixing with the liquid in the exterior vessel and means for circulating the mercury by the flow from the caustic-liquor pump, substantially as set forth.

5. Apparatus for the electrolytic decomposition of alkali-metal salts, comprising a pulsating and circulating pump, interior and exterior vessels containing mercury, piping from the pump to the exterior vessel, conduits connecting the vessels which are fitted together to permit the circulating liquor to flow from one end of the exterior vessel down under the bottom of the interior vessel, to scrub the mercury in the exterior vessel and pass out above the mercury at the opposite side of the exterior vessel, an anode in the interior vessel, said mercury acting as cathode, and means to pass continuously electric current between the anode and cathode, substantially as set forth.

6. Apparatus for the electrolytic decomposition of alkali-metal salts, comprising a pulsating and circulating pump, interior and exterior vessels, piping from the pump to the exterior vessel, an anode in the interior vessel connected to the positive pole and mercury in both vessels, in contact with the negative pole of a source of electric-current supply, said mercury acting as the cathode, and conduits adapted to permit the circulation of the mercury between the interior and exterior vessels upon the varying of pressure in the exterior vessel, substantially as set forth.

7. Apparatus for the electrolytic decomposition of alkali-metal salts, comprising an exterior vessel, a terminal therein surrounded with mercury, an interior vessel, an anode therein, said interior vessel fitting the exterior one to leave a conduit beneath the interior vessel, mercury in the bottom of both vessels, tubes connecting the bodies of mercury and means for supplying caustic liquor with pulsation to the exterior vessel at one side, and a delivery end of higher level than the mercury, whereby on the pulsation of the supply means the mercury is caused to circulate between the two vessels, as and for the purpose described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

J. D. GILMOUR.

Witnesses:
JOHN SIME,
WM. MCKENZIE.