

No. 645,055.

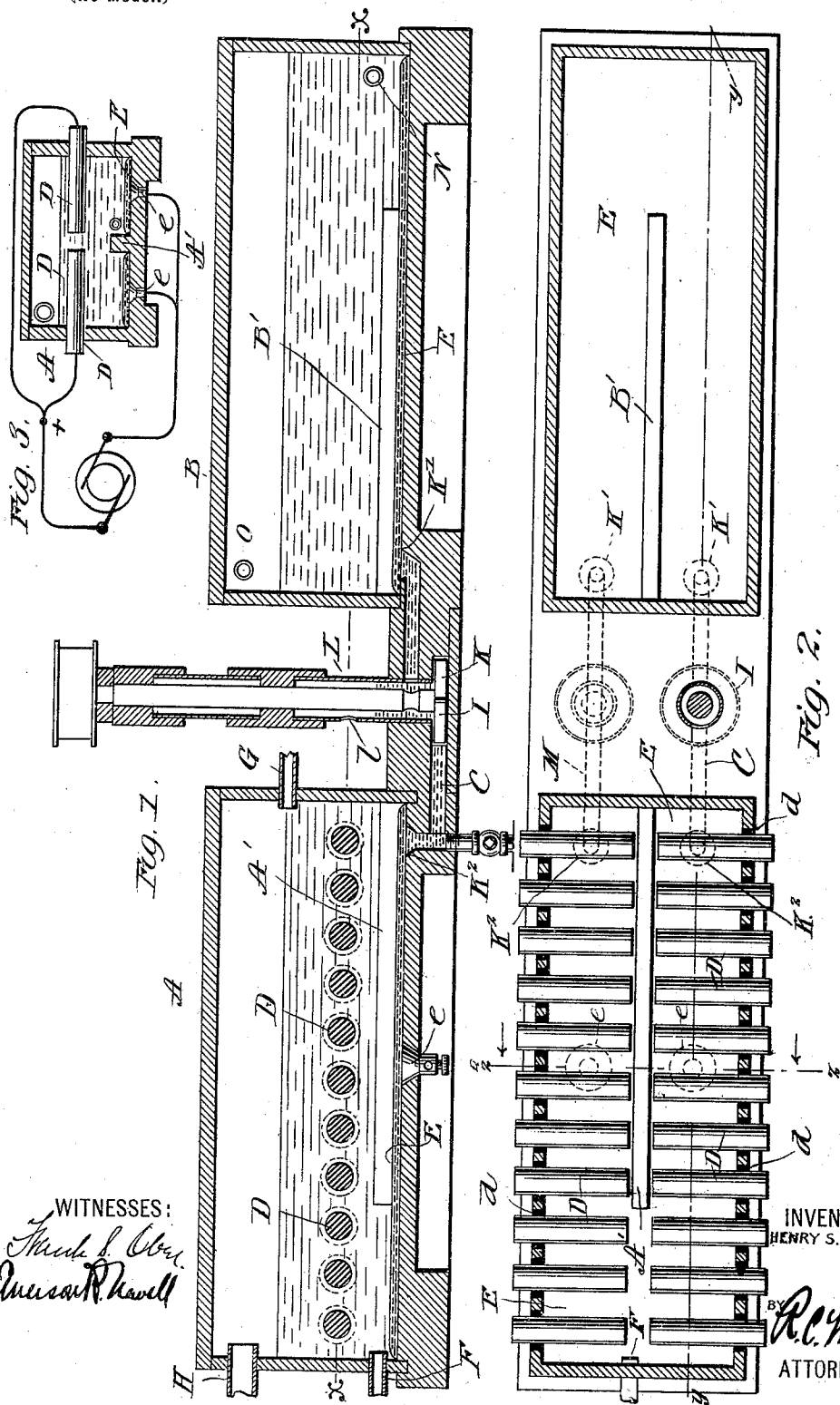
Patented Mar. 13, 1900.

H. S. ANDERSON.

APPARATUS FOR PRODUCING CAUSTIC SODA.

(Application filed Feb. 23, 1899.)

(No Model.)



WITNESSES:

Frank S. Ober
Amos R. Howell

INVENTOR
HENRY S. ANDERSON.

BY *R. C. White*
ATTORNEY

UNITED STATES PATENT OFFICE.

HENRY S. ANDERSON, OF SPRINGFIELD, MASSACHUSETTS:

APPARATUS FOR PRODUCING CAUSTIC SODA.

SPECIFICATION forming part of Letters Patent No. 645,055, dated March 13, 1900.

Application filed February 23, 1899. Serial No. 706,440. (No model.)

To all whom it may concern:

Be it known that I, HENRY S. ANDERSON, a citizen of the United States, residing at Springfield, county of Hampden, State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Producing Caustic Soda and other Products, of which the following is a full, clear, and exact description.

My invention relates to a new apparatus for producing caustic soda, particularly from brine, by electrolytic action, and has for its object to provide a new and improved apparatus for producing the same and other products in an efficient and convenient manner.

In the electrolysis of common salt for the purpose of producing caustic soda, chlorin, and other products much trouble has been experienced with the cathode and the liquid surrounding it. In the first place, most cathodes are subject to polarization by hydrogen and so give rise to a high counter electromotive force or resistance, thus lowering the efficiency of the operation and increasing the cost. In the second place, the liquid surrounding the cathode, if not quickly removed, is subject to secondary electrolysis, thus again lowering the efficiency, and if quickly removed the ratio of the product desired to the original salt is small, making the cost of separation high. These difficulties are to a large extent overcome by the use of a mercury cathode. As long as the mercury is sufficiently pure the alkaline metal as it is separated by the electrolytic action is at once taken up by the mercury and the two form an amalgam, thus preventing both the formation of secondary compounds leading to secondary electrolysis and also the generation of hydrogen and consequent polarization. If, however, the electrolytic action be allowed to continue undisturbed, the mercury will soon become so impregnated with the alkaline metal that the former disadvantages will arise. It is advisable, therefore, to withdraw the amalgam from the electrolyzing-vat before this period arises, replacing it by fresh mercury. I have found that I can attain the desired results by means of a very simple apparatus and have illustrated one embodiment of the same in the accompanying drawings, forming part of this specification, in which—

Figure 1 represents a vertical section through my apparatus on the line *yy* of Fig. 2. Fig. 2 represents a plan view in cross-section on the line *xx* of the device shown in Fig. 1. Fig. 3 represents a cross-section of Fig. 2 on the line *zz*.

In the preferred form of my invention shown in the drawings I provide a chamber or vat A, in which the electrolytic action takes place, and a second or washing chamber or vat B, connected thereto by pipes C M.

The chamber A has walls of insulating material, through which pass pencils D D, preferably of carbon. These pencils form the anode of the electrolyzing-cell. The cathode consists in this embodiment of a sheet of mercury covering the floor of the chamber A, as shown at E, and electrical connection is made with this sheet of mercury by studs or binding-posts *e*, passing through the floor of the chamber A. The electrolyte, such as a saturated solution of salt and water, is pumped into the chamber A through the pipe F.

G is an overflow-pipe.

T is the dynamo or other source of electric current connected to the anode D D and cathode E.

When an electric current is passed from the anodes D D to the cathode E, its path will be down through the lower part of the electrolyte, and the sodium chlorid therein will break down, resulting in the production of chlorin and sodium. The chlorin tends to work its way to the top of the chamber A and escape through the opening H in the form of a gas. The sodium is taken up by the mercury and combines therewith to form an amalgam. In the pipe C, connecting the vats, is a centrifugal pump I, which acts to withdraw the mercury from the electrolyzing-chamber A and force it up into the washing-chamber B. A centrifugal pump is much preferable to a reciprocating pump for use at this point, for the latter would give an oscillating or intermittent motion to the mercury, whereas the former produces a continuous and steady flow of the same. The mercury is sufficient in amount to form an unbroken layer over the bottom of both chambers. I place the pump I, provided with an overflow-pipe having a vent *l*, in a depression of the pipe C between the vats A and B, as shown in Fig. 1, since in that case

the mercury preserves a seal between the vats under very unfavorable conditions. Suppose, for instance, the vats were joined by a pipe at the same level as their floors and that for any cause the pump worked too fast, so that the supply of mercury was broken. This would result in the electrolyte in A being pumped over into B, and the purity of the product in B would be affected. In my embodiment, however, there is always a column of mercury K K', preventing the passage of any electrolyte to the vat B and acting in such a manner that if the electrolyte got into the pump it would, instead of passing into the washing-chamber B, be forced up the overflow-pipe and escape by the vent l. In order to insure more perfect circulation and even flow of mercury, I may put a second pump in the return-pipe M. (Shown in dotted lines.) Further, in order that there shall be no dead-point in the circulation, but that the whole mass of mercury shall be compelled to take part in it, I preferably nearly divide each chamber into a plurality of sections by dividing-ridges A' B'. This prevents the mercury from passing directly from the mercury-inlet to the outlet therefor and keeps the whole body in circulation. The difference in level of the floors of the vats facilitates the return of mercury to the chamber A after it has been pumped into the washing-chamber B.

The vat B is supplied with pure water. When the mercury-and-sodium amalgam is pumped into the chamber B, the sodium is oxidized and absorbed by the water, forming caustic soda, the purified mercury returning to the decomposing-vat A through the pipe M. A pipe N communicates with the lower part of the chamber B for the purpose of drawing off the caustic-soda solution, while an inlet O is used for replenishing the vat with water. The sides of the vat B are of any material which is not attacked by caustic soda. They are preferably of a material—carbon, for instance—which is a conductor of electricity and in electrical contact with the amalgam, which results in an electrical action which aids the oxidation of the sodium and the formation of the caustic soda. As the oxidation of the sodium in the amalgam may take place at a relatively-different rate in the vat B from that at which it forms in the vat A, I make the vat B of such size relatively to the vat A that the mercury amalgam may remain therein until it is entirely freed from sodium, from which it results that there is no overaccumulation of sodium, resulting in thickening of the amalgam, so as to be no longer sufficiently fluid, and in the formation of undesirable by-products.

In the electrolyzing-chamber A the outlet G is near the top and the inlet F is near the bottom. The reverse arrangement occurs in the washing-chamber B, where the inlet O is toward the top and the outlet N near the bottom thereof. The reason for this reversed ar-

range is that in the electrolyzing-chamber electrolysis takes place between the anode and the cathode—that is, in this apparatus near the bottom of the chamber—so that the chlorine produced tends to work its way toward the top, while fresh liquid is supplied through the inlet F where the waste takes place—that is, at the lower part of the vat, substantially at the point of electrolysis. An additional advantage arises from the introduction of the brine at the bottom of the chamber instead of at the top, as the fresh brine entering at this point displaces the decomposed electrolyte, which overflows through the outlet G, and thus puts a check on the formation of by-products. In the chamber B the chemical action takes place and the caustic soda forms at the point of contact of the water with the mercury sheet—that is, at the bottom of the chamber—and the resulting solution will therefore be strongest at the bottom. The outlet N is therefore placed at this point.

The operation of the whole system is continuous. Fresh brine is continually supplied to the vat A, as described, and fresh water to the vat B. The mercury is kept in continuous motion by the pump and takes up sodium in the vat A, the chlorine passing off in such a manner that it may be collected and saved. When the mercury reaches the vat B, it is relieved of its sodium, the same uniting with the water and forming the soluble product—caustic soda—which is drawn off and utilized as may be desired. The pure mercury then automatically returns to the vat A, and the operation continues, it being necessary only to supply brine, water, and electric current and keep the pump running. The pump requires but little power.

It will be obvious that many changes may be made in my apparatus herein disclosed without departing from the spirit of my invention.

What I claim is—

1. In an electrolyzing apparatus in combination an electrolyzing-vat having an anode of an electric circuit and a fluid metal cathode, a second vat the floor of which is at a higher level than that of said first vat, connections to convey said metal between said vats, and means to convey said metal from said vat through one of said connections to said second vat.

2. In an electrolyzing apparatus in combination an electrolyzing-vat having an anode of an electric circuit and a fluid metal cathode, a second vat, a connection to convey said metal between said vats, a pump therein, an overflow-pipe connected to said pump between it and said second vat.

3. In an electrolyzing apparatus in combination an electrolyzing-vat having an anode of an electric circuit and a fluid metal cathode, a second vat, a connection to convey said metal between said vats having a de-

pression therein, a pump in said depression, and an overflow-pipe in communication with said connection beyond said pump.

5 4. In an electrolyzing apparatus in combination an electrolyzing-vat having an anode of an electric circuit and a fluid cathode, a washing-chamber, a connection to convey said fluid between said vat and washing-chamber, a pump to force said fluid through said con-

nection into said washing-chamber and an overflow-pipe joined to said connection between said pump and washing-chamber.

Signed at Springfield, Massachusetts, this 6th day of February, 1899.

HENRY S. ANDERSON.

Witnesses:

DEXTER E. TILLEY,
S. SWEENEY.