(No Model.) 2 Sheets—Sheet 1.

A. L. NOLF.

PROCESS OF AND APPARATUS FOR OBTAINING CHLORINE AND SODIUM.

No. 271,906. Patented Feb. 6, 1883.

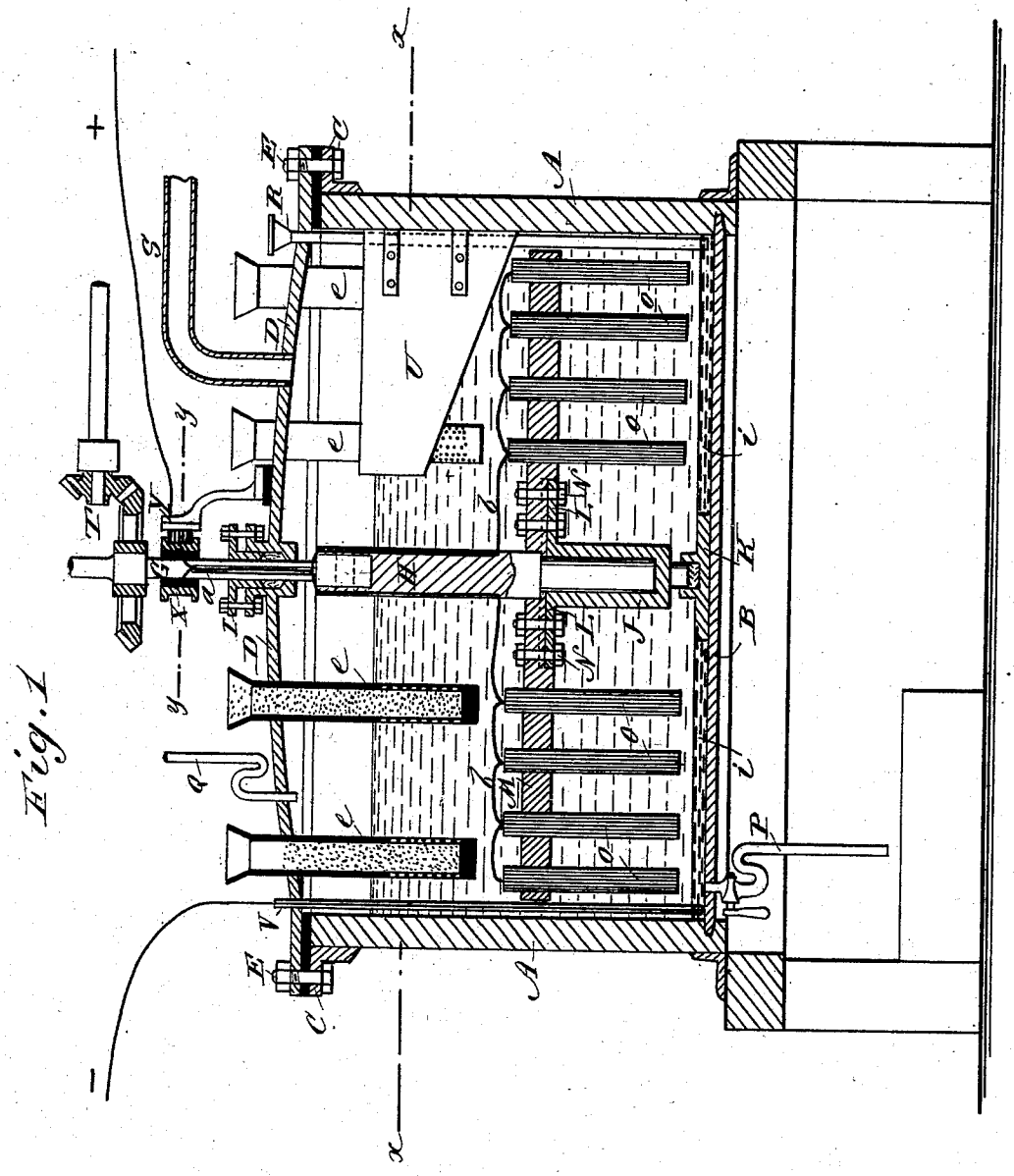


Fig. 1.

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E. Sedgwick

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Fig. 2

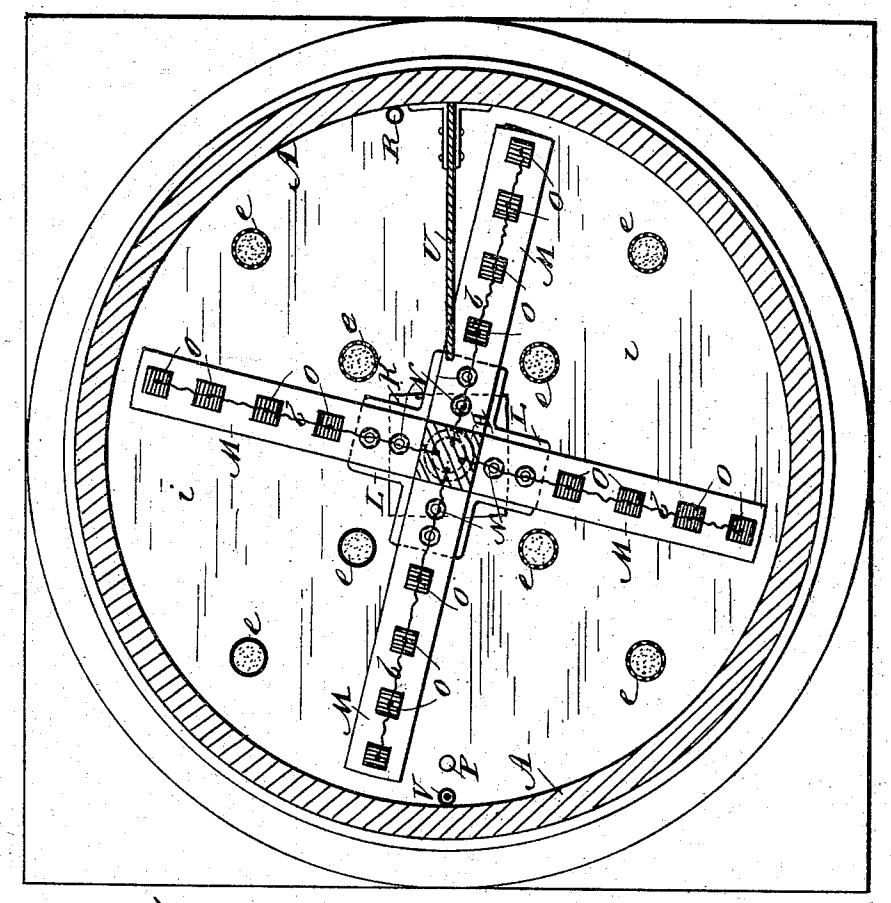
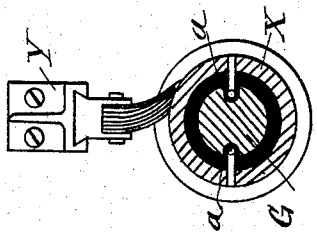


Fig. 5



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UNITED STATES PATENT OFFICE.

ANDRÉ LEOPOLD NOLF, OF BRUSSELS, BELGIUM.

PROCESS OF AND APPARATUS FOR OBTAINING CHLORINE AND SODIUM.

SPECIFICATION forming part of Letters Patent No. 271,906, dated February 6, 1883.

Application filed October 5, 1882. (No model.) Patented in Belgium September 1, 1882.

To all whom it may concern:

Be it known that I, ANDRÉ LEOPOLD NOLF, a subject of His Majesty the King of the Belgians, and residing at Brussels, Belgium, have invented a new and useful process of and apparatus for the production of chlorine gas and of metallic sodium by the decomposition of chloride of sodium through the agency of dynamic electricity, (for which I have obtained a patent in Belgium, bearing date the 1st of September, 1882,) of which the following is a specification.

My invention relates to certain means and apparatus for decomposing chloride of sodium by dynamic electricity into two constituent elements—viz., sodium and chlorine—the decomposition being effected by means of a special form of vat or trough, which I call the "Nolf Apparatus," and into which is placed the solution of chloride of sodium to be acted upon. The various effects produced simultaneously by the Nolf apparatus are as follows: The sodium is reduced to a metallic state and prevented while in that state from decomposing the water of the solution in which it is placed. The chlorine is allowed to disengage itself in a gaseous state, so that it may be easily collected. All polarization of the electrodes in the bath which is subjected to decomposition is prevented. The solution of chloride of sodium is always maintained at the same degree of concentration without the necessity of stopping the decomposition for a single moment.

The following is a description of the apparatus, reference being had to the three figures of the annexed drawings.

Figure 1 is a vertical transverse section of the apparatus. Fig. 2 is a horizontal section on line *x x* of Fig. 1, and Fig. 3 is a sectional detail view on the line *y y* of Fig. 1.

A is a trough, made of hard wood, its interior being coated with a varnish which will resist the action of the chlorine.

B is the bottom of trough, formed of sheet-iron, perfectly flat.

C is a rim or flange of sheet-iron, which encircles the whole of the vat or trough, forming a rim or ledge on its outside of about eight or ten centimeters, onto which the cover of the apparatus is bolted.

D is the cover, also formed of sheet-iron, slightly domed, and perfectly adjusted to the rim or flange.

E are bolts placed at equal distances around the whole circumference of the cover, and which, when once tightened up, should insure a hermetic closing. An india-rubber ring is placed between the cover and the rim or flange to secure this perfect closing.

G is a vertical iron shaft or axle passing through the center of the apparatus cover.

H is an axle or shaft, formed of hard wood, perfectly true, and fixed solidly to the iron axle, of which it forms the continuation.

I is a stuffing-box, in which the axle G revolves freely, while at the same time maintaining a hermetic closing.

J is a cast-iron sleeve inclosing the lower end of the wooden axle H. The upper part, L L, of the sleeve is arranged in the form of a cross to support four wooden arms, hereinafter described.

R is a bearing fixed to the bottom of the vat or trough.

M M are arms, formed of hard wood, strongly fixed by means of bolts N N to the cross of the iron sleeve.

O O are pieces of gas-retort carbon, thirty centimeters long, ten centimeters wide, and three or four centimeters thick. Passing through the wooden arms M, they project a short distance above the upper part, and are fastened to the arms in such a manner as not to move in any way. These carbons form the positive electrode of the decomposing-bath.

i i represent a layer of mercury one centimeter in thickness resting on and covering the bottom of the apparatus, and forms the negative electrode of the bath.

P is an iron tube of five millimeters interior diameter, bent like a siphon, and provided with a cock, also made of iron, for emptying the mercury when required.

Q is a mercury-pressure gage for indicating the pressure which may be formed inside the apparatus.

R is an iron tube one centimeter in diameter, rigidly fixed to the cover, which it traverses, and passes down to within two millimeters of the bottom of the apparatus. This tube is for the purpose of charging the apparatus

with mercury when necessary, and its upper part is widened out in the form of a funnel.

S is a leaden tube three centimeters interior diameter, fixed on the cover, and serving for the escape of the chlorine gas.

T is the gearing for communicating a slow and regular rotary motion to the vertical axle.

U is a partition of thin wood, fixed rigidly to the inside of the wooden trough, and serving to produce a continuous stirring of the solution when the agitator is in motion. This partition is called a "depolarizer," because the stirring it produces prevents any adherence of bubbles of gas to the surface of the electrodes.

V is a glass tube of small diameter passing through the apparatus cover and resting on the layer of mercury on the bottom. In this tube is a copper wire which puts the layer of mercury in the apparatus into communication with the negative pole of a dynamo-electric machine.

X is a copper ring fixed to the axle G, but at the same time completely insulated therefrom by an intermediate sleeve of india-rubber or gutta-percha.

Y is an iron piece fixed at its base to the cover, but completely insulated therefrom, its upper part carrying a flat brush of silvered copper wire, which impinges against the circumference of the ring X. This brush is put into communication with the positive pole of the dynamo-electric machine by means of a copper conducting-wire.

a is a small vertical groove on the iron axle, commencing at the place where the ring X is fixed and terminating at the lower end of the iron axle.

b is a platinum wire fitting into the groove *a*, from which it is insulated, and serving to conduct the electric current from the ring X to the upper part of all the carbons O O, to which it is strongly fastened by means of pinchers or fasteners of any kind. When the contacts are perfectly established the platinum wire, the pinchers or fasteners and all the other points of contact are carefully covered or coated with a mastic varnish not affected by the chlorine. It is also essentially necessary to insure the perfect insulation of the platinum wire from the cross L L of the pivot-sleeve.

e e are tubes of vulcanized india-rubber, eight centimeters interior diameter, fixed to and passing through the cover. The bottoms of these tubes are made very thick, and they are pierced with a number of small holes up to about ten centimeters from their bottom. The upper part of these tubes is slightly widened or funnel-shaped. They are kept constantly filled with chloride of sodium, and are called "alimentary tubes," their object being to always maintain the solution under decomposition at the same degree of concentration.

Having thus completely established the apparatus, the cover is well bolted on, and a concentrated solution of chloride of sodium in a cold state is allowed to flow into the apparatus by means of an india-rubber tube arranged in any suitable manner. When it has reached a height of forty-five centimeters the inlet-cock is closed and a dynamo-electric machine (which should be placed as close as possible to the apparatus) is put in motion. A slow and regular motion is imparted to the axle G, when the decomposition of the chloride of sodium instantly commences. The liberated sodium is attracted to the negative electrode—*ie.*, the mercury—with which it forms an amalgam, which preserves it from any decomposing action on the water, while the chlorine in a gaseous state, finding no body at the positive electrode with which it can combine, disengages itself abundantly, flowing through the escape-tube S in the cover. The sodium or the amalgam of sodium is collected by simply opening the cock on the small emptying-tube P at the bottom of the apparatus. This amalgam is very fluid when care is taken not to allow it to become charged with too much sodium, and it flows of itself toward this tube by slightly tilting the whole apparatus. When the mercury charged with sodium has been extracted and the apparatus placed upright the inlet-tube R is opened, allowing a fresh charge of pure mercury to flow to the bottom of the apparatus. The general arrangement of the apparatus is such that the two operations effected by one attendant are completed without the necessity of stopping the dynamo-electric machine. The sodium contained in the amalgam is then utilized as required.

By distilling a part only of the mercury a concentrated amalgam of sodium may be formed, the use of which is so important in the treatment of gold or silver ores by amalgamation. By distilling the whole of the mercury, pure sodium is obtained for the treatment of certain metallic ores. Finally, caustic soda, chemically pure, may be manufactured and a large quantity of hydrogen obtained by simply placing the sodium amalgam in warm water, which is rapidly decomposed.

As regards the gaseous chlorine, it is conducted by the escape-tube S to the place where it is required to be used—either to the lime-chambers for forming hypochlorite of lime, or into a solution of soda for forming hypochlorite of soda, or into a series of "Woulff" apparatus to mix with water and form chlorated water to the maximum of chlorination, or directly into paper-pulp or tissue bleaching troughs, or into special receivers containing auriferous arsenical pyrites previously well roasted and slightly moistened with water for the purpose of effecting the complete chlorination of the gold contained in the pyrites. Finally, the chlorine gas may be utilized by means of special apparatus to rapidly chlorate the silver contained in a large number of oxidized metallic ores.

By the above-described apparatus and process I practically utilize for industrial purposes the strong affinity of sodium when in a

nascent state for mercury, and thereby insure the stability of the amalgamated sodium so long as it remains under electric influence. Further, I utilize the absolute want of affinity of chlorine in a nascent state for gas-retort carbon, forming the positive electrode, thereby facilitating the manufacture of a number of chemical products derived either from chlorine or from sodium.

I am aware that it is not new to subject an aqueous solution of sodium, salt, sea-water, hydrochloric acid, or chlorides to a current of voltaic electricity to obtain the chlorine at the anode and the other element at the cathode of a decomposing-cell; but

What I claim as new and of my invention is—

1. A process of decomposing chloride of sodium by passing an electric current through a concentrated solution of chloride of sodium in the presence of mercury and in a close vessel, as described.

2. The apparatus for decomposing chloride of sodium for the production of chlorine gas and metallic sodium, consisting of a closed receptacle fitted with suitable supply-pipes and provided with conductors of an electric circuit connected to a negative electrode of mercury and a positive electrode of carbon contained in the vessel, substantially as shown and described.

3. In apparatus for decomposing chloride of sodium, the combination and arrangement, substantially as described, of the shaft H and arms M, carrying the carbon electrodes, with the closed receptacle, for the purpose of agitating the solution.

4. In apparatus for decomposing chloride of sodium, the fixed partition or depolarizer U, in combination with the vessel A and revolving agitator.

5. In apparatus for decomposing chloride of sodium, the perforated tubes *e*, combined with the vessel A, substantially as shown and described, for containing chloride of sodium for obtaining an automatic and continuous saturation of the solution in the vessel.

ANDRÉ LEOPOLD NOLF.

Witnesses:
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FRANÇOIS DEBRUYN.