(No Model.)

T. CRANEY.

PROCESS OF AND APPARATUS FOR MANUFACTURE OF SODIUM BICARBONATE.

No. 552,955. Patented Jan. 14, 1896.

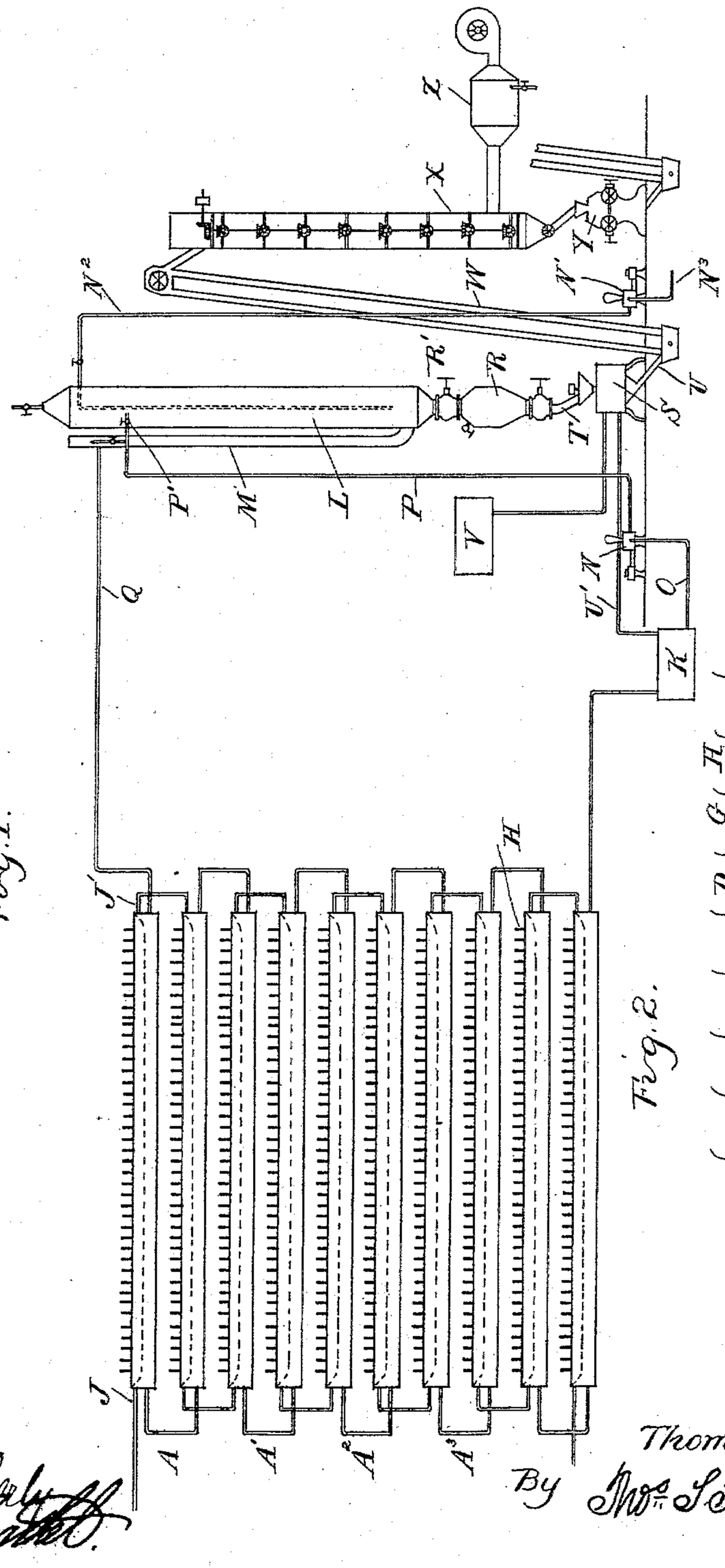

Fig. 1.

Fig. 2.

Witnesses
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UNITED STATES PATENT OFFICE.

THOMAS CRANEY, OF BAY CITY, MICHIGAN.

PROCESS OF AND APPARATUS FOR MANUFACTURE OF SODIUM BICARBONATE.

SPECIFICATION forming part of Letters Patent No. 552,955, dated January 14, 1896.

Application filed May 11, 1894. Serial No. 510,832. (No model.)

To all whom it may concern:

Be it known that I, THOMAS CRANEY, a citizen of the United States, residing at Bay City, in the county of Bay and State of Michigan, have invented certain new and useful Improvements in Processes of and Apparatus for the Manufacture of Sodium Bicarbonate, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to the commercial manufacture of bicarbonate of soda from salt brine, and the invention consists in the improved process of manufacturing it by the electrolysis of salt brine; further, in the apparatus or plant used for the process whereby the article is produced in commercial form, all as more fully hereinafter described.

In the drawings, Figure 1 is a diagram elevation of the plant. Fig. 2 is a vertical section of one of the electrolytic vats.

A A′ A^2 A^3, &c., represent a suitable number of electrolytic vats, such as have been used by me heretofore for the continuous production of caustic soda in solution by the electrolysis of salt brine, and described in my United States Letters Patent No. 520,257, dated May 22, 1894. In the section shown in Fig. 2 the details of construction of one of such vats is shown, in which B represents a metallic tank; C, a diaphragm dividing the tank into two compartments D and E; F, a metallic frame supporting the diaphragm and forming the cathode.

G represents a layer of carbon forming the anode, and H a series of carbon pencils inclosed in suitable supports and forming the electric connection with the anode.

I and I′ are the feed and discharge connections of the chamber E, and J J′ the feed and discharge connections of the chamber D, all substantially arranged and constructed as described in the above-named application. A number of these tanks being arranged in vertical series, connections are made between the like chambers D and E, whereby the said chambers are connected in series to overflow from one tank into the next one below, and so on through the entire series, as shown by the arrows in Fig. 1.

K is a receiver into which the product from the compartment E of the last electrolytic vat discharges.

L is a vertical stand-pipe constituting a carbonator.

M is a vertical branch communicating with the lower end of the stand-pipe.

N is a pump.

O is a supply-pipe connecting the pump with the receiver K.

P is a discharge-pipe from the pump communicating into the upper end of the stand-pipe and controlled by a valve P′.

Q is an overflow-pipe from the branch M into the soda-chamber of the upper electrolytic vat.

R is a receiver communicating with the lower end of the stand-pipe through a valve-controlled connection R′.

S is a centrifugal separator.

T is a valve-controlled discharge connection from the receiver into the centrifugal separator.

U is the discharge-trunk from the centrifugal separator for the solid products.

U′ is a liquid-discharge pipe from the centrifugal separator into the receiver K.

V is a tank provided with a valve-controlled discharge-pipe into the centrifugal separator.

W is a conveyer.

X is a drier.

Y is a grinding-mill, and Z is a hot-air-blast apparatus.

N′ is a gas-pump.

N^2 is the discharge-pipe from the pump entering the top of the stand-pipe and extending down inside, near the bottom of the same.

N^3 is the supply-pipe of the pump connecting it with a suitable source of carbonic-acid gas.

In practice, the parts being arranged as shown and described, they are intended to operate as follows: Salt brine from a suitable source is fed into the anode-chamber of the upper electrolytic vat in quantity to produce a constant overflow and circulation into the corresponding chamber of the next lower vat and so on through the whole series, escaping from the last vat to be further treated as a by-product in any desired manner, not forming a part of this invention. The cathode or

soda compartments of the electrolytic vats we will suppose for the present to be filled with pure water, also the receiver K, stand-pipe L, and its branch M. In establishing now the electrolytic action it will be seen that the fresh water in the cathode-compartments of the electrolytic vats will become impregnated with the caustic soda, and if we now set the pump N to work the contents of one chamber will gradually overflow into the one next below and so on through the entire series into the receiver K. The pump N being now in continuous operation, the solution of caustic soda will be gradually delivered through the pipe P into the top of the stand-pipe and from there by displacement into the leg M and through the pipe Q back into the cathode-chamber of the uppermost vat, thus forming a complete circulation of the liquid through the cathode-chambers, stand-pipe, and branch M. The pump N′ being set in operation and connected with a suitable source of supply of carbonic-acid gas (which may be produced in the usual manner by combustion of carbon) the gas is injected through the pipe N^2 into the stand-pipe, from which it escapes near the bottom of the stand-pipe and passes up through the liquid, its quantity being sufficient to convert all the caustic soda contained therein into bicarbonate. Should the concentration of the solution be sufficient to form a precipitate bicarbonate of soda it would fall to the bottom of the stand-pipe, while the bicarbonate in solution would find its way up through the branch M and discharge-pipe Q back into the electrolytic vats. Here coming in contact and mingling with the caustic soda produced therein it would be transformed into monocarbonate of soda and pass as such into the receiver K, from which it would be again delivered into the stand-pipe and subjected to the repeated process of carbonation. In the continuous operation of the apparatus we would have thus a constant supply of monocarbonate of soda into the stand-pipe and converted therein by the constant supply of fresh carbonic-acid gas into bicarbonate of soda, and all the bicarbonate which remains in solution is constantly returned into the cathode-chambers of the electrolytic vats and reconverted into monocarbonate by the additional supply of caustic soda. The precipitate of bicarbonate of soda will collect in the bottom of the stand-pipe, or if the valve R′ is dispensed with or left open it will collect into the receiver R and from there it may be discharged at suitable intervals into the centrifugal separator S. This separator is intended to operate in the usual manner to remove the liquid from the solid matter, the liquid being returned through the pipe U′ into the receiver K. The precipitate of bicarbonate is discharged and transferred by the conveyer W into the drying apparatus, which may be of any suitable description, (such as shown and described in detail in my application Serial No. 484,618,) the drying being preferably effected therein by passing through it a mixture of hot air and carbonic-acid gas from the apparatus X. The material being received in a suitable dried condition is discharged into a suitable grinding-mill, which it leaves as a commercial product.

My invention requires the use of an electrolytic vat in which an effective separation is obtained by a diaphragm between an anode and cathode chamber. Should, however, any trace of salt find its way into the product of the cathode-chambers and from there into the bicarbonate of soda it may be removed by treating in a centrifugal separator by the use of a suitable washing-fluid—such as a solution of bicarbonate of soda—introduced from the tank V.

It will further be seen that in my construction of apparatus the bicarbonate of soda is precipitated in a medium or body of a solution of bicarbonate of soda, owing to making the stand-pipe of great height and capacity relatively to the amount of bicarbonate produced and by introducing the carbonic-acid gas near the bottom and the monocarbonate near the top, whereby the latter is entirely converted into bicarbonate before it reaches the bottom.

By using a suitable number of electrolytic vats and supplying the same with a continued and ample supply of salt brine and by a proportionate supply of fresh water into the cathode-compartment to replace the loss by decomposition and evaporation my apparatus will work on the continuous plan.

It will be understood that by charging the apparatus on the start with a solution of monocarbonate or bicarbonate of soda the time for obtaining its normal operation is correspondingly shortened.

My invention reduces the electrical horse-power required to electrolize the salt to a minimum on account of the chemical affinity of the bicarbonate and the caustic soda.

What I claim as my invention is—

1. The process of producing bi-carbonate of soda, which consists in supplying the cathode compartment of an electrolytic apparatus with an aqueous solution of bi-carbonate of soda, in supplying the anode compartment with salt in solution and electrolytically decomposing the same, conveying the product from the cathode compartment after its conversion into mono-carbonate into a separate vessel, in treating it therein with carbonic acid gas in quantity to convert the sodium carbonate solution into bi-carbonate of soda, in returning the solution back into the cathode compartment and in forming a precipitate of bi-carbonate of soda in the separate vessel by maintaining a constant circulation of the liquid through the cathode compartment and the separate vessel with continuous electrolysis of salt and treatment with

carbonic acid gas, and in removing the precipitate from the liquid, substantially as described.

2. Obtaining mono-carbonate of soda in solution as a product from the electrolysis of salt brine, by supplying the anode chamber or chambers of an electrolytic apparatus with salt brine, and the cathode chamber or chambers with a solution of bicarbonate of soda, and in producing caustic soda in the cathode chamber by electrolysis of the salt brine substantially as described.

3. In an apparatus for the manufacture of bi-carbonate of soda, the combination of an electrolytic apparatus organized for the continuous production of caustic soda in solution, the stand pipe or carbonator L, connected in circuit with the cathode compartment of the electrolytic apparatus and provided with means for supplying it with carbonic acid gas, means for circulating the liquid through the carbonator and cathode compartment, the receiver R having the valve controlled connection R′ connecting it to the bottom of the receiver, the valve controlled discharge spout T from the bottom of the receiver, substantially as described.

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

THOMAS CRANEY.

Witnesses:
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