

No. 703,289.

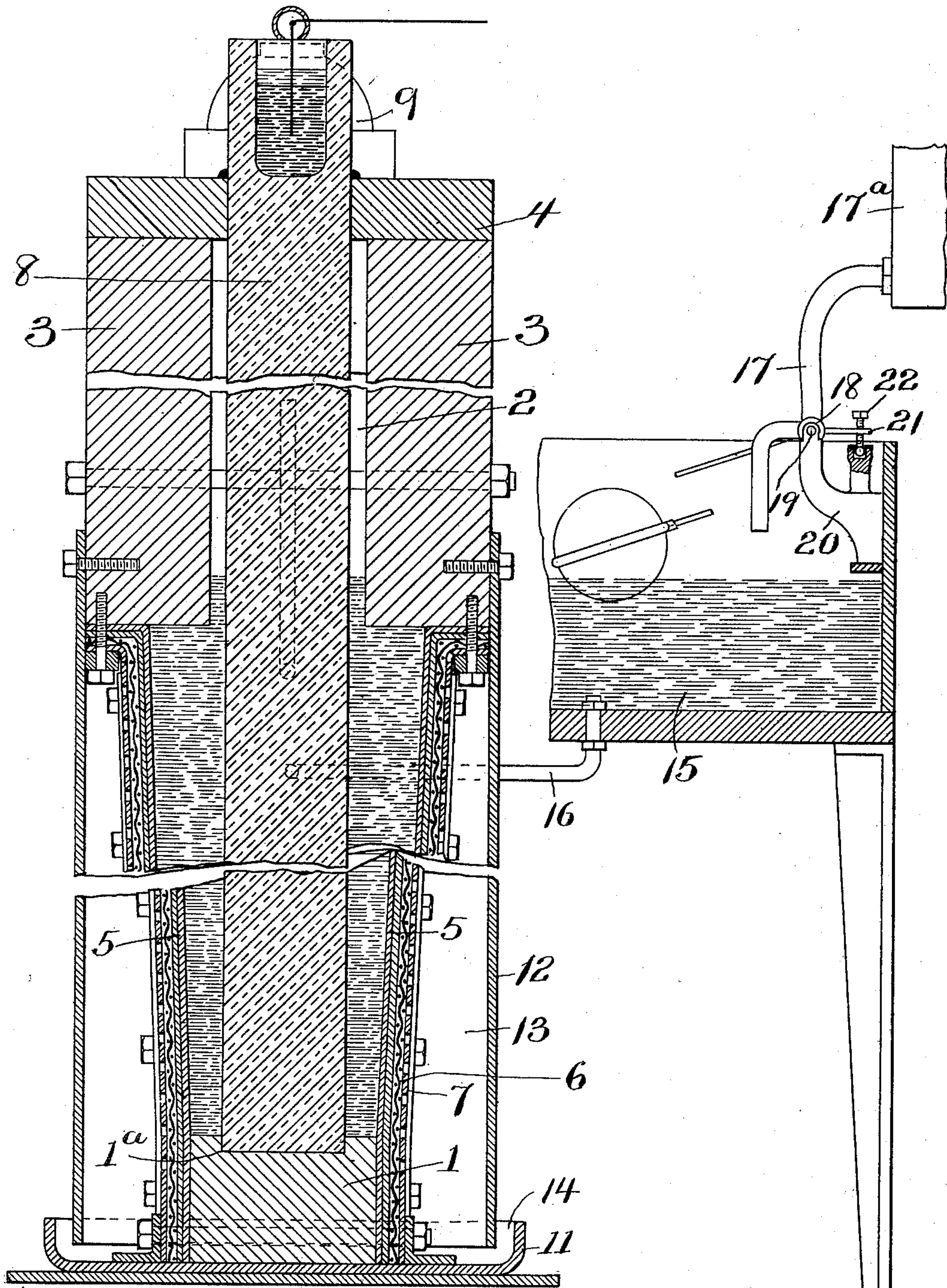
Patented June 24, 1902.

H. K. MOORE.

PROCESS OF PRODUCING CAUSTIC.

(Application filed Apr. 30, 1900.)

(No Model.)



WITNESSES:

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UNITED STATES PATENT OFFICE.

HUGH KELSEA MOORE, OF LYNN, MASSACHUSETTS, ASSIGNOR TO MOORE ELECTROLYTIC COMPANY, OF PORTLAND, MAINE, AND BOSTON, MASSACHUSETTS, A CORPORATION OF MAINE.

PROCESS OF PRODUCING CAUSTIC.

SPECIFICATION forming part of Letters Patent No. 703,289, dated June 24, 1902.

Application filed April 30, 1900. Serial No. 14,787. (No specimens.)

To all whom it may concern:

Be it known that I, HUGH KELSEA MOORE, of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and
5 useful Improvements in Processes of Producing Caustic, of which the following is a specification.

This invention has relation to processes for the production of hydrates of alkali metals
10 in which is employed a cell having the parts arranged to permit the free percolation of the electrolyte through a porous diaphragm and the gravitation of the cathion solution from the cathode without being brought into con-
15 tact with an aqueous solution exterior to the cathode. In such cells more or less inconvenience has been experienced by reason of the various impurities which are found in the commercial salts, such impurities consisting
20 principally of the chlorids, chlorates, and sulfates of magnesium and calcium, and to a lesser degree of ferrous oxid, silica, and vegetable matter. The foreign chlorids found in salts to be treated are electrolyzed and
25 are converted into hydrates upon reaching the cathode, being precipitated on the outer surface of the diaphragm and in the cathode. The presence of the precipitated calcium or magnesium hydrates or the chlorates, sul-
30 fates of magnesium, and calcium clogs the diaphragm and cathode and prevents the free percolation of the electrolyte, also increasing the electrical resistance of the cell. The precipitation of these foreign substances
35 upon the surface of the cathode greatly reduces the active face thereof, and the polarization which results is highly injurious to the successful operation of the cell. Again, the heat generated by the electrolytic action
40 in the cell causes the drying of the hydrate upon the exterior of the cathode, this being increased by the upward escape of the liberated hydrogen, which induces a flow of air in close proximity to the cathode and a con-
45 sequent evaporation of the liquid therein, whereby the hydrate is carbonated and a comparatively thick crust thereof is formed on the cathode. This layer of carbonate gradually thickens in the direction of the

diaphragm, being aided by the heat of the
cell, which causes the drying of the aqueous
hydrate until the operation of the cell is so
retarded that the diaphragm has to be re-
moved and the cathode freed from encrusted
material.

I have discovered that the precipitation of
the hydrate of the foreign substances, such
as calcium or magnesium, can be prevented
by excluding air from the cathode, and con-
sequently preventing the evaporation of the
60 liquid contained in the hydrate. I accom-
plish this by enveloping the cathode in a bath
of the hydrogen which is given off thereat, so
that it is impossible for the air to reach the
cathode and cause the evaporation of the liq-
65 uids or the carbonating of the hydrates.

On the drawing is illustrated a cell with
which my process may be carried out, there
being shown in section a cell and an auto-
matic doser or feeding-tank. Said cell com-
70 prises a receptacle having a bottom 1, end
walls 2, and longitudinal sills or bars 3 3, con-
necting the end walls at their upper ends. The top of the cell is closed by a cover 4. The parts thus far described are preferably
75 constructed of slate or other material capable
of resisting the attacks of the chlorin or the
chlorinated liquid, and they are connected
together in any suitable way, the top being
cemented in place. The provision of the lon-
80 gitudinal bars 3 3 leaves open the lower por-
tion of the sides of the cell, and to close the
same I employ a diaphragm 5, preferably con-
sisting of a layer or layers of asbestos paper,
through which the electrolyte may percolate in
85 considerable quantities. Outside of the dia-
phragms and in contact therewith are placed
the cathodes, each cathode consisting of a
layer 6 of wire-cloth and a perforated plate 7
90 of iron or other suitable metallic substance.
The diaphragms and cathodes are secured in
place in any suitable way, and they confine
the body of the electrolyte within the recep-
tacle, the latter constituting the anode-com-
partment. The wire-cloth and perforated
95 metallic plate constitute a spongy cathode
capable of retaining by capillary attraction
a considerable body of the solution of hydrate

and the undecomposed electrolyte which percolates through the diaphragm. It will be observed that the end walls taper from top to bottom, whereby the diaphragms are farthest apart at their upper ends and nearest together at their lower ends.

The anode consists of a plurality of oblong carbon plates 8, which are passed through apertures in the cover 4 and have their faces confronting the diaphragms. The carbons rest in a longitudinal groove 1^a, formed in the base-plate 1, and the minute spaces between the anodes and the walls of the aperture in the cover 4 are filled with any suitable putty or cement. The sides or faces of the anode are parallel, whereby the space between each anode-face and the adjacent diaphragm is substantially V-shaped.

Provision is made for the escape of chlorine by means of a suitable duct. (Illustrated conventionally in dotted lines at 9.) The receptacle rests upon an inclined plate 11, with which the cathode is in electrical contact, said plate and said anode being the terminals of an electrical circuit, as usual.

Outside of the cathode is placed a casing 12, which is secured tightly to the longitudinal bars 3 3 and the end walls 2 2, so as to form a compartment 13, surrounding the cathodes. The lower end of the casing is separated from the plate 11 by a passage-way 14, for a purpose to be described. 15 represents more or less conventionally a tank from which the brine flows to the cell through a pipe 16, whereby the same level of liquid is maintained in the cell and in the tank. The brine flows from an initial receiving-tank 17^a through a pipe 17 and float-cock 18 to the tank 15. Said float-cock is secured upon a shaft 19, journaled in brackets 20 on the wall of the tank, said shaft being provided with an arm 21, through which an adjusting-screw 22 passes, said screw being rotatively connected to the bracket. By turning the said screw said cock may be swung upon the axis of the shaft to permit a variation of the height of the liquid in the tank, as will be understood without further explanation. By this mechanism it will be seen that the height or column of liquid in the cell may be varied by degrees by merely turning the screw 22.

The tank and the cell are filled with the brine to be electrolyzed and the electrical current is passed through the cell.

Assuming for illustration that the electrolyte consists of a practically-saturated solution of sodium chlorid and water, the following result will occur: The current of electricity flowing from the anode to the cathode electrolyzes the solution, said solution percolating through the diaphragm and coming into contact with the cathode. The ions are given off at their respective electrodes, chlorine being given off at the anode and the sodium liberated at the cathode being changed into hydrate by the water of the undecomposed solution, which has percolated through the

diaphragm. The hydrogen gas which is given off at the cathode outside of the diaphragm fills the compartment 13, formed by the casing 12, and escapes into the atmosphere through the passage-way 14. As the solution of hydrate and undecomposed electrolyte fills the pores of the spongy cathode to saturation it begins to gravitate therethrough, the electrolytic action continuing and the undecomposed solution in the cathode being electrolyzed until the resultant hydrate which flows from the cathode to the plate 12 contains a maximum percentage of caustic and a minimum percentage of sodium chlorid. As the compartment 13 becomes filled with hydrogen it, being lighter than air, fills the top of the compartment, and gradually, as it increases in volume, drives out all the air through the passage-way 14 until the cathode is nearly enveloped in a steamy cloud of the hydrogen. This prevents the access of air to the cathode, and thereby prevents the evaporation of the liquid contained in the cathode and incidentally prevents the oxidation of the copper or iron forming the cathode. The magnesium or calcium chlorid which is contained in the electrolyte is decomposed and is converted into hydrate in the cathode; but inasmuch as the cathode is enveloped in the steamy cloud of hydrogen and the evaporation of the liquid in the cathode is prevented the magnesium and calcium is not precipitated, but flows in solution with the sodium hydrate onto the plate 11. The presence of the casing 12 and the confining of the hydrogen therein prevents the hydrogen from carrying with it a quantity of caustic vapor, which is usually disseminated through the room by the escaping hydrogen, such particles of caustic vapor being condensed upon the interior of the casing and flowing therefrom to the plate 11. As it is well known that the resistance of the electrolyte decreases with the rise in temperature thereof, the employment of the casing prevents the cooling of the cell and a consequent increase in the voltage necessary for the production of a hydrate.

Having thus explained the nature of the invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. The herein-described process of electrolyzing the chlorids chlorates or sulfates of alkali metals consisting in bringing an aqueous solution thereof into contact with one face of a diaphragm of sufficient porosity to permit free flow of the solution; passing an electric current through said solution and diaphragm to an unsubmerged foraminous cathode in contact with the other face of the diaphragm; thereby converting the metal into hydrate by the water of the undecomposed percolated solution and confining the liberated hydrogen gas in contact with the outer face of the

cathode and thereby excluding atmospheric air, whereby the cathion solution flows by gravitation from said cathode without evaporation and without the carbonating of the hydrate.

2. The herein-described process of electrolyzing the chlorids chlorates or sulfates of alkali metals consisting in bringing an aqueous solution thereof into contact with one face of a diaphragm of sufficient porosity to permit free flow of the solution; passing an electric current through said solution and diaphragm to an unsubmerged foraminous cathode in contact with the other face of said diaphragm, thereby converting the metal ion into hydrate by the water of the undecomposed percolated solution, and continuing the electrolysis of said undecomposed solution in the pores of said cathode; and excluding atmospheric air from the cathode and the solution therein contained, to prevent the precipitation of foreign metals present in the form of chlorids, chlorates hydrates or sulfates in the said solution.

3. The herein-described process of electrolyzing the chlorids chlorates or sulfates of alkali metals consisting in bringing an aqueous solution thereof into contact with one face of a porous diaphragm of sufficient porosity to permit free flow of the solution; passing an electric current through said solution and diaphragm to an unsubmerged foraminous cathode in contact with the other face of said diaphragm, thereby converting the metal ion into hydrate by the water of the undecomposed percolated solution, and continuing the electrolysis of said undecomposed solution in the pores of said cathode, and confining the liberated hydrogen in a steamy bath in contact with the cathode to the exclusion of atmospheric air, substantially as described.

4. The herein-described process of preventing the precipitation of the hydrates of foreign sulfates or chlorids chlorates, in the electrolysis of commercial salts, which consists in bringing a saline solution containing said sulfates or chlorids into contact with a diaphragm of sufficient porosity to permit free percolation of said solution, passing an electric current from an anode in said solution to an unsubmerged cathode outside said

diaphragm and enveloping the cathode in a confined bath of gas and thereby preventing the evaporation of liquid contained on the cathode.

5. The herein-described process of preventing the carbonating of the hydrate resulting from the electrolysis of the chlorids chlorates or sulfates of alkali metals, which consists in bringing a saline solution containing said sulfates or chlorids into contact with a diaphragm of sufficient porosity to permit free percolation of said solution, passing an electric current from an anode in said solution to an unsubmerged cathode outside said diaphragm and entirely excluding atmospheric air from contact with the said hydrate.

6. The herein-described process of preventing the carbonating of the hydrate resulting from the electrolysis of the chlorids chlorates or sulfates of alkali metals, which consists in bringing a saline solution containing said sulfates or chlorids into contact with a diaphragm of sufficient porosity to permit free percolation of said solution, passing an electric current from an anode in said solution to an unsubmerged cathode outside said diaphragm and enveloping the cathode containing said hydrate in a bath of hydrogen gas, and thereby preventing the contact of atmospheric air therewith.

7. The herein-described process of preventing the precipitation of the hydrates of foreign sulfates chlorates and chlorids, in the electrolysis of commercial salts, which consists in bringing a saline solution containing said sulfates or chlorids into contact with a diaphragm of sufficient porosity to permit free percolation of said solution, passing an electric current from an anode in said solution to an unsubmerged cathode outside said diaphragm and enveloping the cathode in a bath of the hydrogen gas liberated at the cathode and thereby preventing the evaporation of liquid contained on or in the cathode.

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

HUGH KELSEA MOORE.

Witnesses:

C. E. MONROE,
C. E. YOUNG.