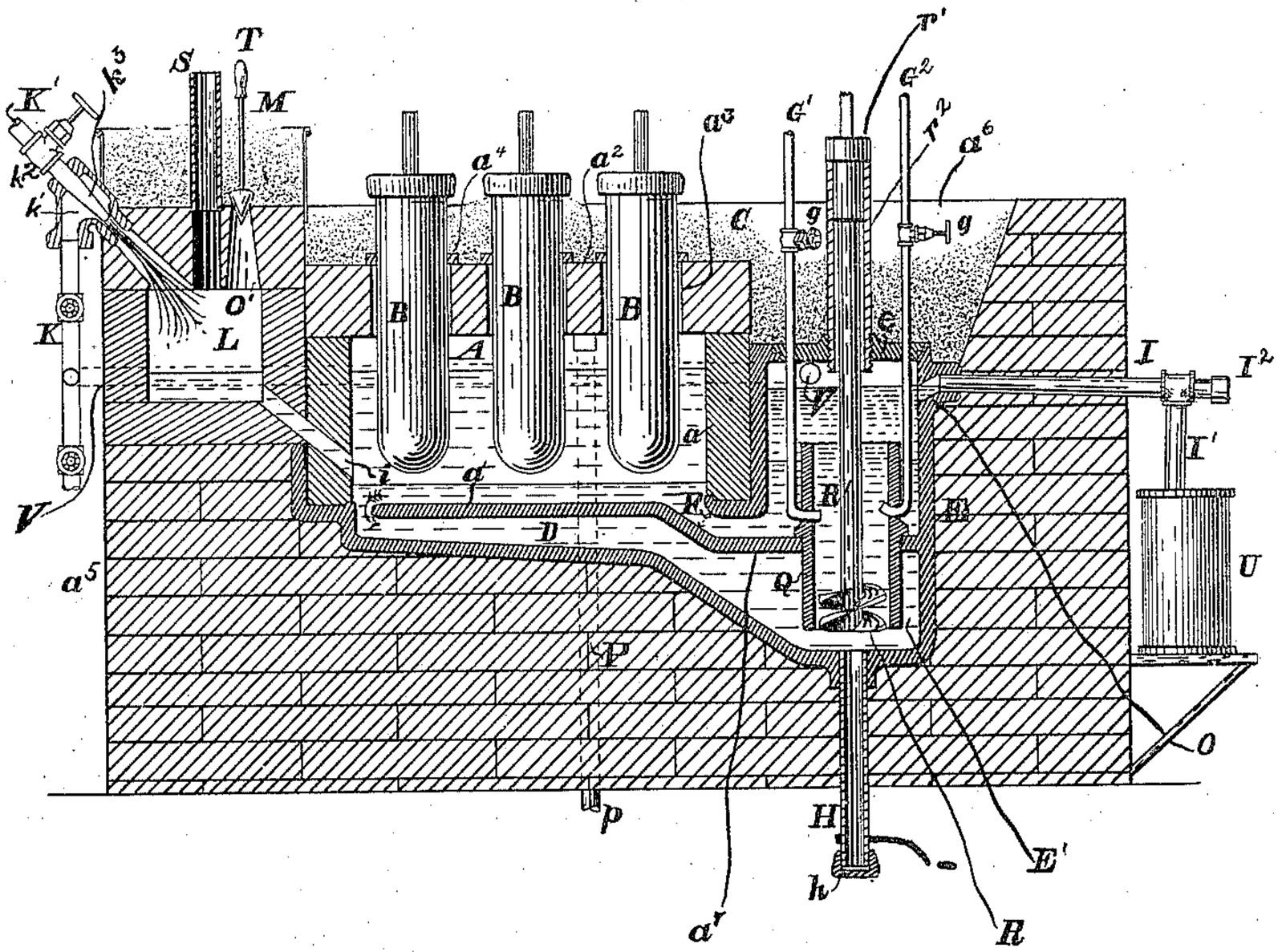
No. 687,709. Patented Dec. 3, 1901.

C. E. ACKER.

PRODUCTION OF CAUSTIC ALKALI AND HALOGEN GAS.

(Application filed July 18, 1899.)

(No Model.)



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CHARLES ERNEST ACKER, OF NIAGARA FALLS, NEW YORK, ASSIGNOR TO THE ACKER PROCESS COMPANY, OF NIAGARA FALLS, NEW YORK, A CORPORATION OF NEW JERSEY.

PRODUCTION OF CAUSTIC ALKALI AND HALOGEN GAS.

SPECIFICATION forming part of Letters Patent No. 687,709, dated December 3, 1901.

Application filed July 18, 1899. Serial No. 724,226. (No specimens.)

To all whom it may concern:

Be it known that I, CHARLES ERNEST ACKER, of Niagara Falls, in the county of Niagara and State of New York, have invented a new and useful Improvement in the Production of Caustic Alkali and Halogen Gas, of which the following is a specification.

The object of my invention is to economize in the production of practically anhydrous caustic alkali and halogen gas.

My invention consists in a novel process and also in an improved apparatus for the purpose.

The accompanying drawing is a longitudinal vertical section of an apparatus for the manufacture of caustic alkali in accordance with my improvement.

A designates an electrolytic furnace, which may be of any suitable form. As here shown, it has walls a, which may be made of basic material—as, for example, magnesia. These walls rest upon a hearth a', which may be of iron or steel. The furnace is closed by a cover a^2, which may be made of fire-clay. This cover rests upon the walls a. In the cover are openings a^3, through which pass anodes B, preferably made of carbon, the openings a^3 being, as here shown, considerably larger in diameter than the anodes. Preferably these openings will be closed around the anodes by auxiliary covers a^4, preferably made of two parts in the form of half-rings. Above the cover a^2 and in the masonry a^5 of the furnace a recess a^6 is formed, and in this is a body of salt C.

Below the hearth a' and communicating with the interior of the furnace A near one of the end walls of the latter is a conduit D. Preferably this will be cast integral with the hearth a'. It extends to the lower portion of a chamber E, and the latter may be a portion of a single casting comprising the conduit and the hearth. A removable cover e closes the top of the chamber E, and the recess a^6 extends down to such cover. A pipe H leads from the bottom of the chamber E and is provided with any suitable device for controlling the flow of its contents from it. As here shown, a removable cap h is employed for this purpose. This pipe may form the negative terminal of the furnace.

From the hearth a' is an extension a^7, forming the bottom of the chamber E. It will be seen that the chamber E extends down lower than the furnace A. A conduit F establishes communication between the lower ends of these parts.

Below the chamber E is a well E′, with which communicates that end of the conduit D which is not in communication with the furnace A. It will be observed that this well E′ is lower than the conduit D.

From the upper portion of the chamber E a pipe I extends. As shown, it is approximately horizontal, but preferably will have a slight decline toward its outer end. The pipe I may advantageously be connected with an orifice O, formed in the upright wall of the chamber E in such a manner as to be lower at the inner surface of the wall than at the outer surface. Caustic alkali collected in the chamber E is intended to escape through the pipe I, and by the construction of the orifice O the latter forms a seal to prevent the escape of hydrogen, which will rise to the top of said chamber.

A removable cap I^2 may close the outer extremity of the pipe I to facilitate removal of obstructions. A branch pipe I′ extends from the pipe I into a drum U.

Q designates a conduit of tubular form open at both ends and arranged vertically within the chamber E and well E′ at such a height as to be out of contact with the bottom of the well E′ and also out of contact with the top or cover of the chamber E. As here shown, this conduit is provided with a circumferential rib that rests upon the bottom of the chamber E.

R designates a circulator, here shown as made in the form of a screw or worm and arranged in the lower portion of the conduit Q. It is fixed to a shaft R′, and the latter is provided with a step-bearing r' upon the top of a tube r^2, which is shown as screwed into the cover e of the chamber E. Any suitable means may be employed for rotating the shaft R′ for the purpose of actuating the cir-

culator. The direction of the rotation of the shaft R′ is to be such as to cause the circulator to produce an upward circulation in the conduit Q.

G′ G² designate steam-pipes provided with controlling-cocks *g* and extending downwardly through the cover of the chamber E and thence transversely into the conduit Q intermediate of the extremities of said conduit. The steam-pipe G′ is shown as extending in an approximately horizontal direction into the conduit Q, so that steam issuing therefrom will not have an important, if any, effect in promoting circulation through the conduit Q. The steam-pipe G² is, however, caused to enter the conduit Q at an upward incline, so that the steam emitted from it will contribute to cause an upward circulation through the conduit Q.

Lead in a molten state may be introduced through one of the openings a^3 in the cover of the main furnace A, through which the anodes B pass, and in quantities sufficient to fill the conduit D and cover the hearth *a′*. One of the anodes will of course have to be temporarily removed for this purpose. Immediately afterward the salt employed—for example, sodium chlorid—may be introduced in a molten state. Then the removed anode will be replaced and the full current turned on.

Through the conduit Q flow to the chamber E caustic soda, impoverished alloy, and hydrogen. In the chamber E a separation will occur. Impoverished alloy or lead will return by the conduit F to the main furnace, where it will again act as a cathode and take up sodium.

Hydrogen passes from the upper portion of the chamber E through a pipe V into a pipe K, whence it ascends to a chamber *k′*, into which also leads an air-pipe K′, the latter being controlled by a valve k^2, terminating within the chamber *k′* in a nozzle k^3. The mixture of gases burns in the auxiliary furnace L, into which the salt which is to be decomposed in the main furnace A is fed through an opening *o′* under control of a removable cover T. As here shown, there is a body of salt maintained in a hopper M above the auxiliary furnace. If desirable, any automatic or positive feed may be used instead of or in addition to the opening *o′* with its removable cover T. Products of combustion may escape from the furnace through a conduit S. After the operation shall have been fully started in the main furnace A salt may be supplied in a molten state from the auxiliary furnace through a conduit *i* into the lower portion of the main furnace A.

The contents of the well E′ may be at any time removed through the pipe H. Chlorin gas will escape through the conduit P and pipe *p*.

The contents of the furnace A are to be maintained molten and fluid. The temperature necessary to secure this condition will preferably be maintained by a suitable electric-current density on the anode or anodes and cathode with a higher electromotive force than would ordinarily be required to decompose the molten salt.

It will be seen that there will be a circulation continuously in the same direction through an endless circuit comprising two branches, one of said branches being the hearth of the main furnace A, containing that part of the molten metal in contact with the electrolyte, and the other the conduit D and its connections; also, that steam is introduced into the circulation, so that alkali metal will be oxidized during transit and also that such circuit or circulation is past one or more anodes.

What I claim as new, and desire to secure by Letters Patent, is—

In the manufacture of fused caustic alkali the process which consists in electrolytically decomposing a molten salt of alkali metal while resting on a body of molten lead constituting a cathode, and thereby forming an alloy of lead and the alkali metal, circulating the molten body of cathode metal and alloy past an anode or anodes toward another molten body of lead or of lead and alloy, introducing steam into the last-named molten body below its surface, and regulating the circulation by means independent of the steam.

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

CHARLES ERNEST ACKER.

Witnesses:

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