

No. 666,387.

Patented Jan. 22, 1901.

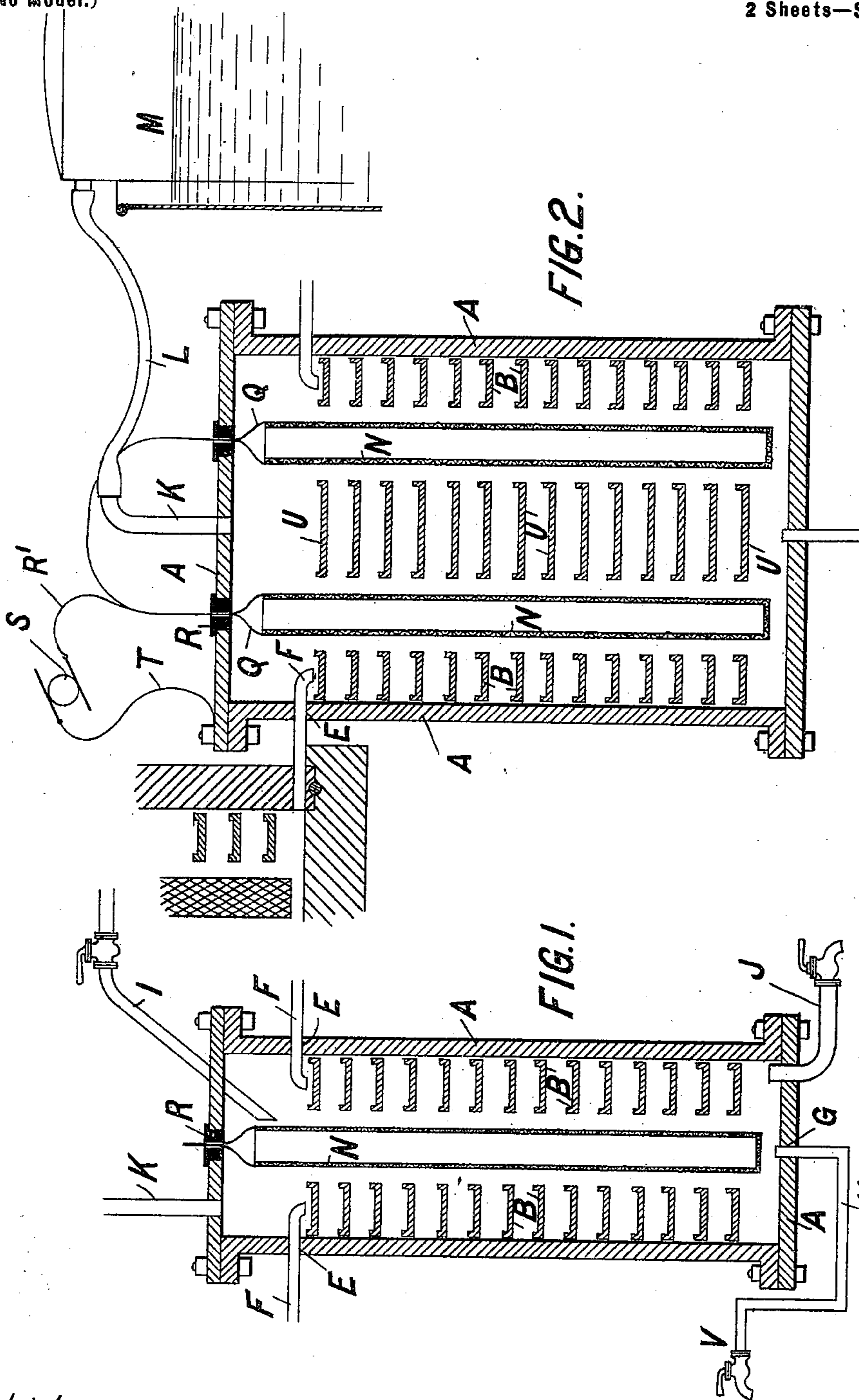
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APPARATUS FOR PRODUCING ALKALI, ELECTRICITY, AND HYDROGEN FROM
ALKALI METAL AMALGAM.

(Application filed Dec. 5, 1899.)

2 Sheets—Sheet 1.

(No Model.)



Witnesses
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FIG. 4.

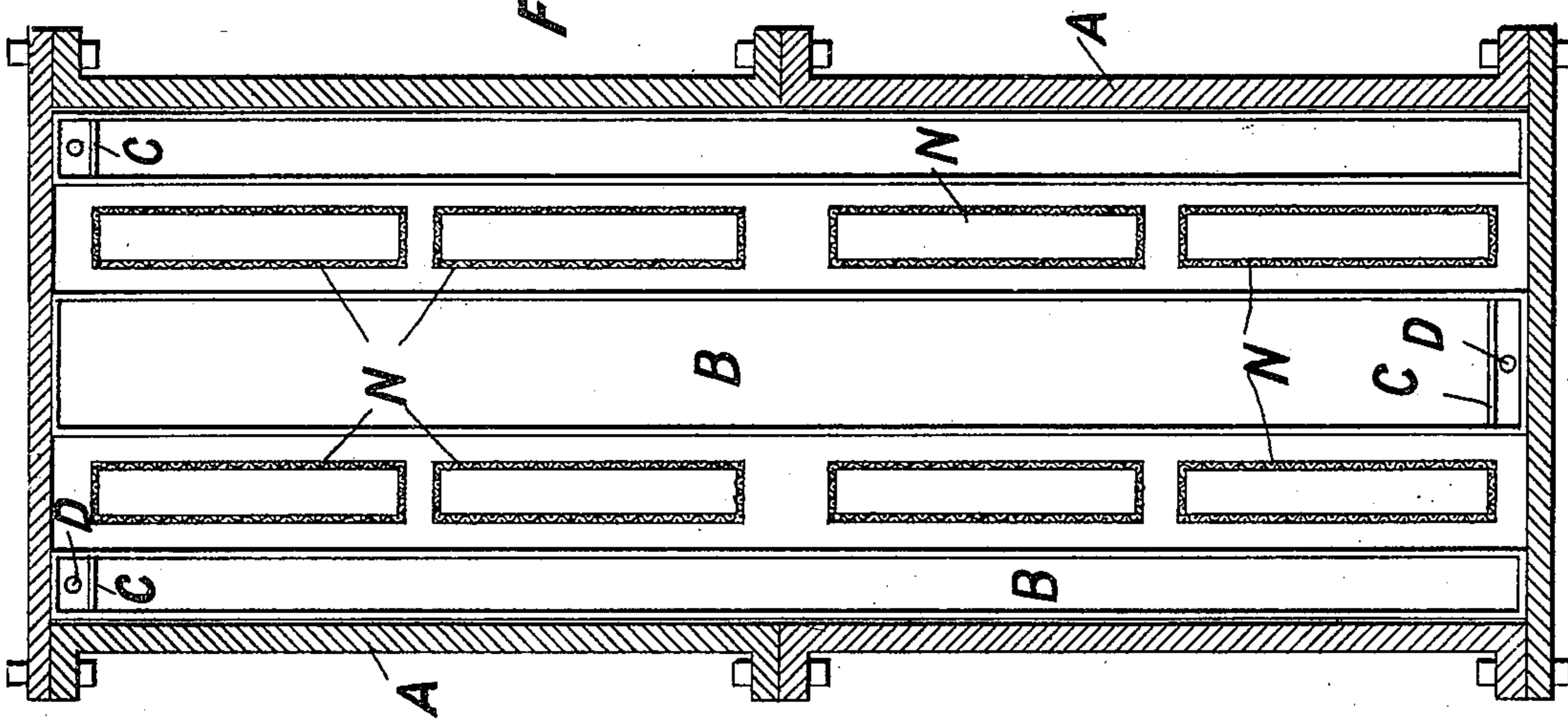
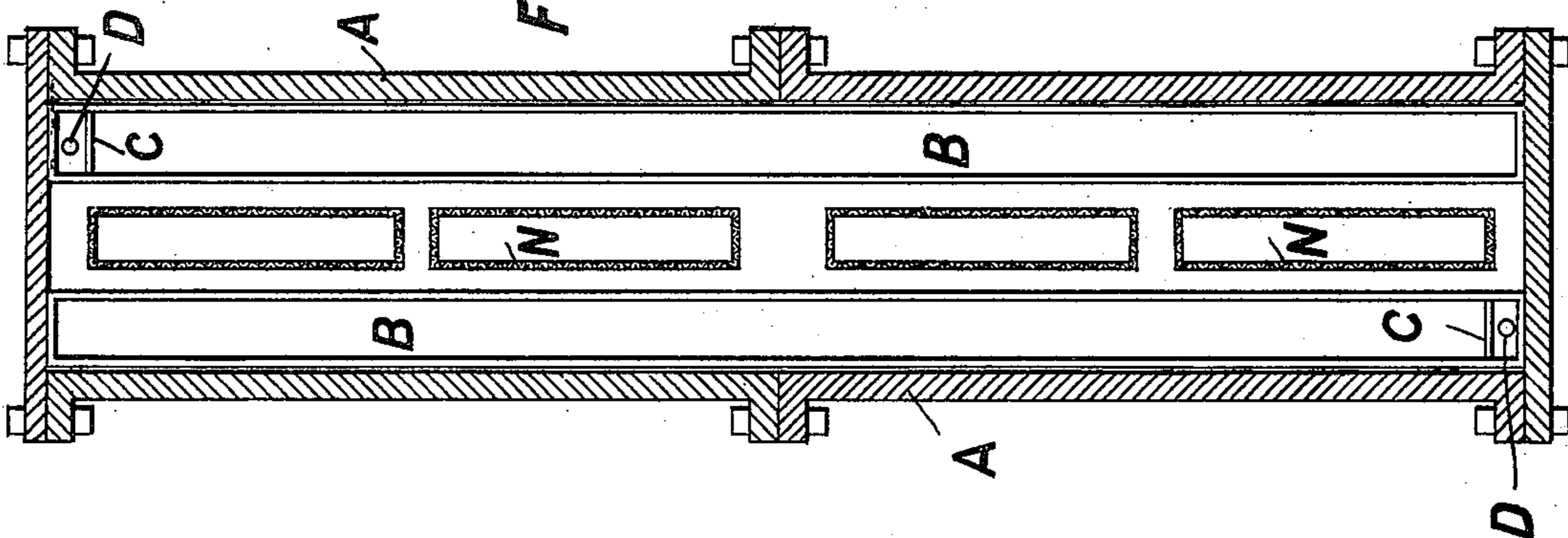


FIG. 3.



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JOSIAH W. KYNASTON, OF LIVERPOOL, ENGLAND.

APPARATUS FOR PRODUCING ALKALI, ELECTRICITY, AND HYDROGEN FROM ALKALI-METAL AMALGAM.

SPECIFICATION forming part of Letters Patent No. 666,387, dated January 22, 1901.

Application filed December 5, 1899. Serial No. 739,244. (No model.)

To all whom it may concern:

Be it known that I, JOSIAH WYCKLIFFE KYNASTON, a subject of the Queen of Great Britain, residing at Liverpool, in the county of Lancaster, England, (whose post-office address is Oak Terrace, Beech street, Liverpool,) have invented certain new and useful Improvements in Apparatus for the Production of Alkali, Electricity, and Hydrogen from Alkali-Metal Amalgam, of which the following is a specification.

The manufacture of caustic alkalies by the medium of alkaline metal amalgam obtained by the electrolytic decomposition of solutions of alkaline chlorids with a mercury cathode is carried out on an extensive scale, and many and varied forms of apparatus have been designed for this purpose. In most of these arrangements the alkali-metal amalgam is caused to pass from the compartment in which it has been produced to a second or more compartments of the same piece of apparatus. These second compartments are supplied with water, and in them the amalgam is partially denuded of alkali metal and then returned to the first compartment to receive a fresh charge of alkali metal. The construction of plants of this kind, in which two distinct and essentially varying operations are to be performed, is very difficult, and the second operation—the denuding of the amalgam of alkali metal—is never completely effected, and only very minute quantities of alkali are obtained at each circulation of the amalgam through the denuding-compartment, and by reason of the complications involved in the construction of this combined apparatus it has not been found possible to build it of sufficiently large size to obtain from one instalment of apparatus more than a very small quantity of caustic alkali in proportion to the size of the apparatus. My improved form of denuding apparatus is designed to overcome these difficulties and impediments and to permit of the perfect denudation of large quantities of amalgam in a comparatively limited space and to use an amalgam much richer in alkali metal than has been heretofore treated and to obtain hydrogen and electricity at the same time.

I use as the outer inclosure of the apparatus a tank or cistern built up of wrought or

cast iron plates firmly riveted or bolted together to form a water-tight vessel. In the simplest form of the apparatus which I have designed the approximate internal dimensions of the inclosure will be as follows: the height about half the length and the breadth about one-sixth of the length. For instance, in an inclosure of which the length is ten feet I make the height five to six feet and the breadth one foot nine inches to two feet. I do not, of course, bind myself to these dimensions.

Referring to the drawings, Figure 1 is a transverse vertical section of a simple form of my denuder with one cathode or range of cathodes; Fig. 2, a similar view of a denuding apparatus, showing two ranges of cathodes, also a dynamo and parts of gasometer and amalgam-producer in diagram form; Figs. 3 and 4, horizontal sections of the denuders shown in Figs. 1 and 2, respectively.

Referring first to Figs. 1 and 2, upon each of the sides of the wrought or cast iron inclosure A and running the entire length I arrange a series of narrow horizontal shelves B, of iron, at a distance of a few inches from each other, the uppermost shelf being about one foot from the top of the inclosure and the lowest three or four inches from the bottom. In place of iron other conducting material could be employed for these shelves, provided it be not soluble in mercury or caustic liquor, or a non-conductor, such as glass, could be used if the various layers of amalgam be electrically connected with the tank or conducting-wire. The shelves are hollowed out on the upper surface to the depth of about one-half inch, the depression reaching to about one-quarter inch of the outer edges of the shelves. At the alternate ends of each of adjacent shelves and about three inches from the ends a narrow ridge C, one-eighth of an inch lower than the outer upper edge of the shelf, runs across it, and in the depression beyond the ridge a hole D about one inch in diameter is bored through the shelf. Holes E are also provided through each of the sides or ends of the inclosure at a short distance above the level of the uppermost of the shelves, and pipes F, for the conveyance of amalgam to the shelves, are firmly fixed in the apertures. A hole G is also provided in

the bottom plate of the inclosure, and to this a pipe H is firmly and tightly fitted. This pipe serves for the withdrawal of the denuded mercury from the inclosure. Pipes or tubes I are also provided for passing water into the inclosure, and others, J, for drawing off the solution of caustic alkali when sufficiently concentrated, the feed-pipe being fixed in the cover or in the side near to the cover of the inclosure and the run-off pipe in the bottom of the inclosure (when it must protrude one or two inches over the surface of the bottom plate) or in the side near to the bottom. An orifice K in the cover of the inclosure permits of the escape of the hydrogen gas produced during the oxidation of the alkali metal in the amalgam through pipe L to the gasometer M.

I suspend through apertures in the cover of the inclosure in the central space between the shelves a series of plates or sheets of iron N, which may be perforated or in the form of grids cast or bent so as to form hollow rectangular plates or boxes, or I use for this purpose sheets of stout iron gauze bent to shape, as above described. These hollow boxes, sheets, or plates are of such depth that they extend from about the level of the uppermost of the shelves B to within a short distance from the bottom of the tank A, and the suspenders Q must be carefully insulated by insulators R where they pass through the metal cover of the tank. These iron sheet or gauze boxes form the cathode element, in relation to which the amalgam upon the shelves is the anode, and the arrangement constitutes a powerful voltaic battery. The suspenders Q are connected with conductor R' with a dynamo S or other device for utilization of the electricity generated, a conducting-wire T also connecting with the tank, and thus with the anode-trays B.

I extend the denuding capacity of the apparatus, if desired, exactly upon the same principles as above described. The width of the inclosure is increased to the requisite extent, and in addition to the two series of side shelves I fix in the center of the space between the side shelves a third series of shelves U, Fig. 2, the breadth of each of which is the sum of the width of two of the side shelves. In this duplicate arrangement two sets of cathode-plates are employed and are suspended in the spaces between each of the series of side shelves and the central series of shelves. It is evident that in the same way the power of the apparatus may be still further augmented.

In starting the manufacture of solution of caustic alkali by means of this apparatus the tank A is first filled with water to a little over the level of the uppermost of the shelves B.

The liquid amalgam is then passed in and falling upon the uppermost shelf of each series it fills the depression and then falls through the opening D at the farther end to the next shelf, and so on until all the shelves are charged, when the stream being continued it falls to and covers the bottom of the vessel, and the mercury is completely, or almost completely, denuded of alkali metal and allowed to flow out of the vessel. When the solution of caustic alkali has attained a sufficiently high degree of concentration, a tap V, attached to the outlet-pipe, is opened and the liquor drawn off in a continuous stream, the supply of water being continued through the inlet-pipe I, so as to maintain a constant depth of liquor in the vessel. The hydrogen gas liberated passes away by the aperture K, provided for the purpose, and is utilized either as fuel for driving gas-engines or otherwise. The electric current is led away by wires R and T, attached to the outer casing of the tank A and to the suspended cathodes N, to perform any useful work.

I declare that what I claim is—

1. An apparatus for denuding alkali-metal amalgam of its alkali, and at the same time producing electricity, which consists of an iron cathode a series of superposed trays surrounding the same, a thin quiescent horizontal layer of alkali-metal amalgam on each of these trays, and electric conductors connected respectively with the amalgam and the iron cathode, forming when combined an electric circuit.

2. An apparatus for denuding alkali-metal amalgam of its alkali and at the same time forming a primary battery, having a cathode of iron an anode of alkali-metal amalgam, shelves carrying the latter arranged around the anode, an iron tank carrying the shelves and an electrolyte of dilute caustic alkali, substantially as described.

3. The combination in an apparatus for denuding alkali-metal amalgam of its alkali, of the iron tank A, superposed shelves B in said iron tank carrying thin layers of alkali-metal amalgam, iron cathodes N in close proximity to the said shelves, the device for utilizing the electricity, and electrical connections connecting the alkali-metal amalgam on the shelves and cathode with said device, substantially as described.

In witness whereof I have hereunto signed my name, this 20th day of November, 1899, in the presence of two subscribing witnesses.

J. W. KYNASTON.

Witnesses:

WM. P. THOMPSON,
W. H. BEESTON.