No. 862,783. PATENTED AUG. 6, 1907.

E. A. ALLEN.

ELECTROLYTIC CELL.

APPLICATION FILED JULY 17, 1906.

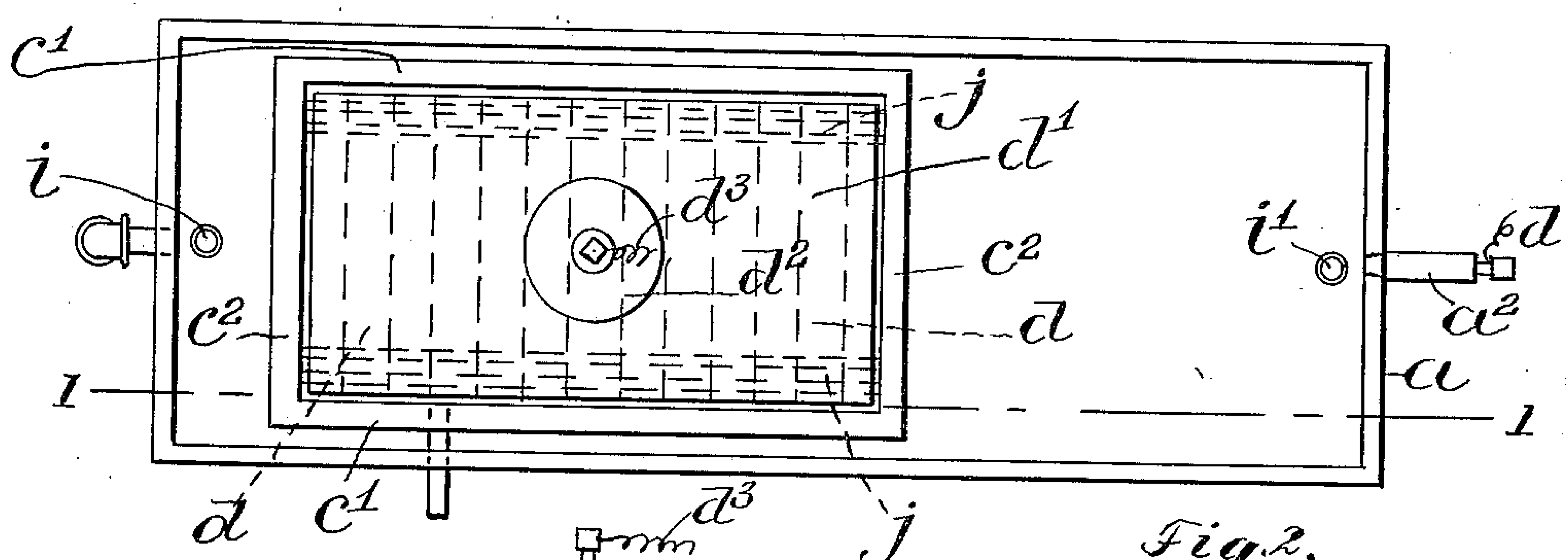

Fig. 2.

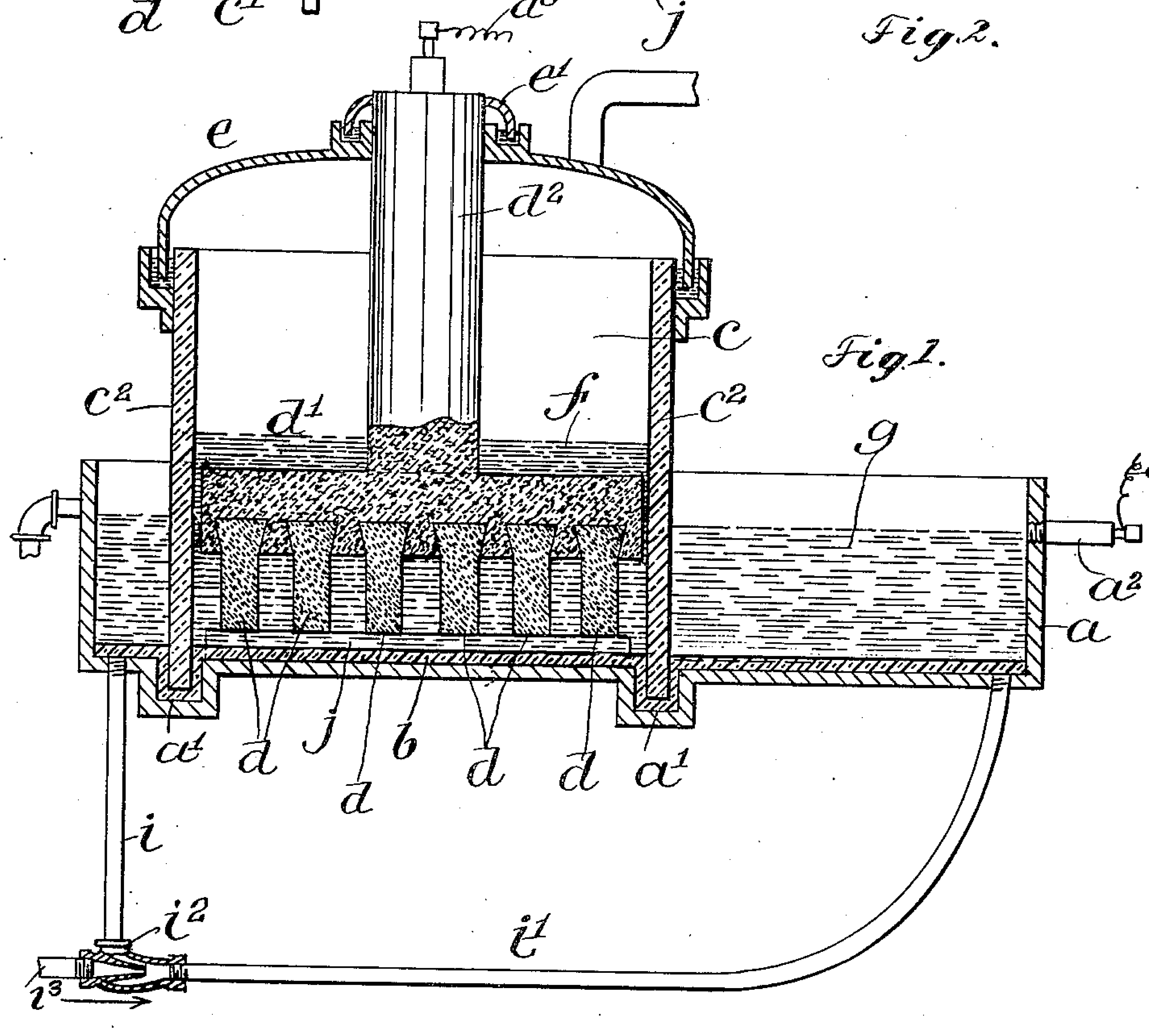

Fig. 1.

Witnesses.
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Inventor:
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by Wright, Brown, Quinby & May
his attys

UNITED STATES PATENT OFFICE.

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ELECTROLYTIC CELL.

No. 862,783. Specification of Letters Patent. Patented Aug. 6, 1907.

Application filed July 17, 1905. Serial No. 269,972.

To all whom it may concern:

Be it known that I, EDWARD A. ALLEN, of Rumford Falls, in the county of Oxford and State of Maine, have invented certain new and useful Improvements in Electrolytic Cells, of which the following is a specification.

This invention has relation to cells for electrolyzing saline and other solutions, and relates more particularly to that type of such cells in which mercury is utilized for the amalgamation of the metal produced by reason of the electrolysis. In such cells it is of the utmost importance that the amalgam should be broken up so as to liberate the metal and permit a reaction in which the said metal is converted into hydrate. I find that this breaking-up of the amalgam may be accomplished with the greatest efficiency by the employment of steam or hot water, or any other gas or liquid which will not interfere with the final reaction which it is desired to secure.

I have illustrated and will describe the operation of the cell when it is utilized for the production of sodium-hydrate from a sodium-chlorid solution, but it will be understood that the cell may be used for various other chlorids or saline solutions.

Referring to the accompanying drawings,—Figure 1 represents in longitudinal section a cell embodying the invention. Fig. 2 represents a plan view of the cell with the cover and the lutes of the electrolytic chamber removed.

I have illustrated the cell conventionally, and it will be understood that it may be equipped with all the necessary appurtenances which are usual in such cells.

Referring to the drawings,—*a* indicates a tank which is preferably formed of iron, so that the tank together with the mercury therein shall constitute the cathode of the cell. This tank may be formed in any desired manner, and its dimensions may be varied in accordance with the requirements. As illustrated it is rectangular in shape. Between its ends the bottom of the tank is provided with two transverse troughs or grooves *a′ a′* which are filled with mercury, the level of the mercury being above the bottom of the tank, as indicated at *b*. In actual practice I find that if the depth of mercury in the tank above the bottom thereof is substantially one-fourth of an inch, it is sufficient for all practical purposes.

Placed in the tank is a receptacle *c* for the electrolyte. This receptacle has side walls *c′ c′* which rest upon the bottom of the tank and with end walls c^2 which extend down into the troughs or grooves *a′*, as shown in Fig. 1. The electrolyte is introduced by any suitable means into the chamber at *c*, and is automatically maintained at proper level by any suitable mechanism such as is well known in connection with this art.

The tank *a* and the mercury *b*, as already stated, constitute the cathode of the cell. The anode consists of carbon blocks or bars *d* which are dovetailed into a carbon support *d′* and which rest upon longitudinal glass bars *j*. These bars may be of any shape in cross section. The carbon-support *d′* is connected to or formed with the upstanding carbon connection or rod d^2, to which one terminal of the circuit d^3 is connected. The other terminal of the circuit d^4 is connected by a binding-screw a^2 with the walls of the conducting tank *a*.

The receptacle *c* which constitutes the anode compartment is provided with a luted cover *e*, and the carbon-rod or connection d^2 is luted at the top thereof as at *e′*.

The electrolyte in the anode compartment is indicated at *f* and in the tank *a* is placed water which is indicated at *g*. When a current of electricity of the proper voltage and amperage is passed through the cell, the solution of sodium chlorid is electrolyzed and chlorin is given off at the anode, the metallic sodium forming with the mercury *b* an amalgam. In order to continue the process and break up the amalgam, so as to liberate the metallic sodium and bring it into and cause the sodium to unite with the oxygen and hydrogen of the water, for the production of caustic soda by the reaction $H_2O+Na=NaOH+H$, I provide means for causing a circulation of the mercury, so as to remove it from the anode compartment and from the troughs or grooves *a* and bring it into contact with the water in the tank. The means which I employ may vary, though I preferably use two pipes *i i* which depend from upstanding ends of the tank *a* and which are connected by a T-coupling i^2. The T-coupling contains an injector, so that steam introduced through the pipe i^3, forces the mercury in the direction of the arrow in Fig. 1, through the pipe *i′*, and causes the mercury to be drawn downward through the pipe *i*.

The introduction of steam or hot water not only serves to effect a circulation of the mercury and amalgam, but also serves to break up the amalgam, and permits the described reaction to take place. This breaking up of the amalgam takes place largely in the pipe *i′*, although the reaction continues when the amalgam reaches the water *g* in the tank. The effects of the application of heat to the amalgam are to reduce the electromotive force required for the decomposition of the saline solution by raising its temperature; to increase the efficiency of the electrolysis by reducing the chlorin content of the electrolyte; and to permit the use of higher current densities and the production of richer amalgams than would otherwise be the case, owing to the increased fluidity of the amalgam at the higher temperatures.

While I have illustrated but one set of conduits for effecting a unidirectional flow of the mercury from one end of the tank to the other, yet I desire to state that I may employ any number of conduits which may be necessary. Furthermore, in some cases I may employ a pump in the conduits for effecting the circulation of the mercury and the amalgam.

It will be apparent to those skilled in the art to which this invention relates that there may be various refinements of the invention, and that it may be embodied in a variety of ways, and further that the details which I have illustrated may be changed without departing from the spirit of the invention.

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. An electrolytic cell for aqueous solutions comprising a tank having decomposing and oxidizing compartments, a mercury cathode therein, an anode in the decomposing compartment, a return-flow conduit for amalgam extending between opposite portions of said tank, and means for imparting heat to the amalgam in said return-flow conduit.

2. An electrolytic cell for aqueous solutions comprising a tank having decomposing and oxidizing compartments, a mercury cathode therein, an anode in the decomposing compartment, a return-flow conduit for amalgam extending between opposite portions of said tank, and means for imparting heat to the amalgam in said return-flow conduit, said means comprising an injector for a heated fluid oxidizing agent.

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

EDWARD A. ALLEN.

Witnesses:
C. C. STECHER,
M. B. MAY.