(No Model.)

2 Sheets—Sheet 1.

H. BLACKMAN.

ELECTROLYTIC PROCESS AND APPARATUS.

No. 541,146. Patented June 18, 1895.

FIG. 1.

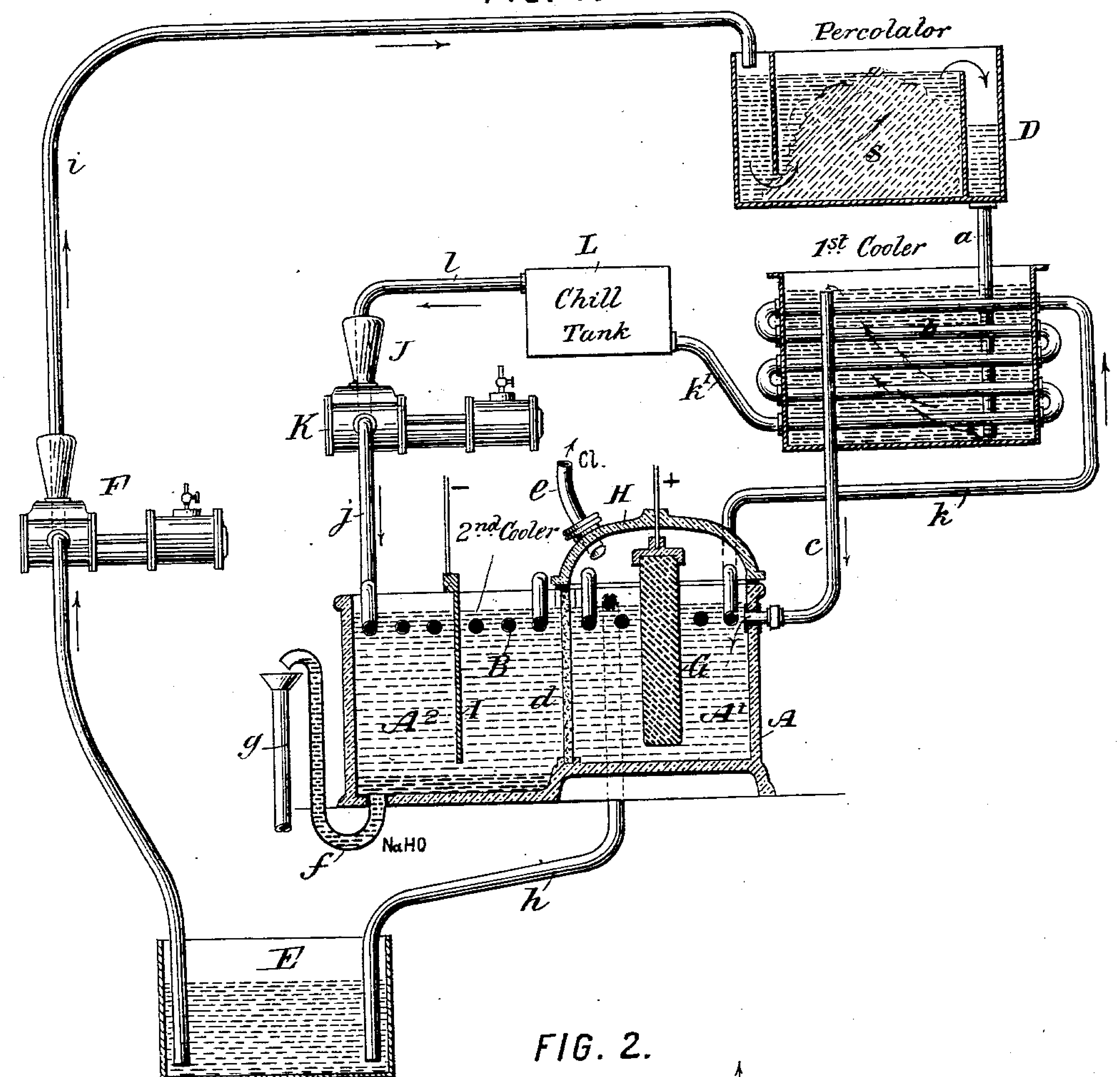
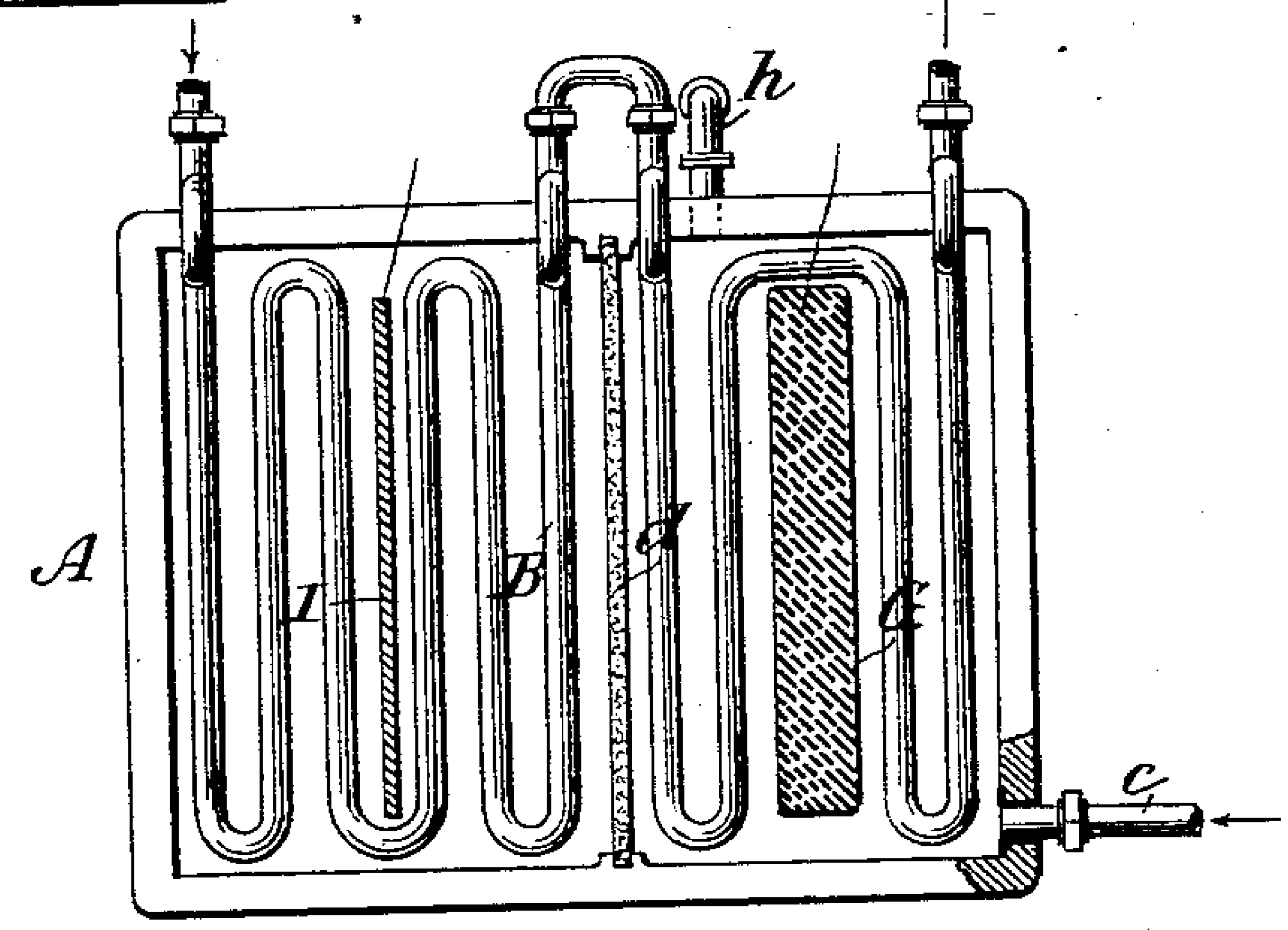


FIG. 2.



WITNESSES:

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Thos. F. Wallace

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Henry Blackman,

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(No Model.) 2 Sheets—Sheet 2.

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FIG. 3.

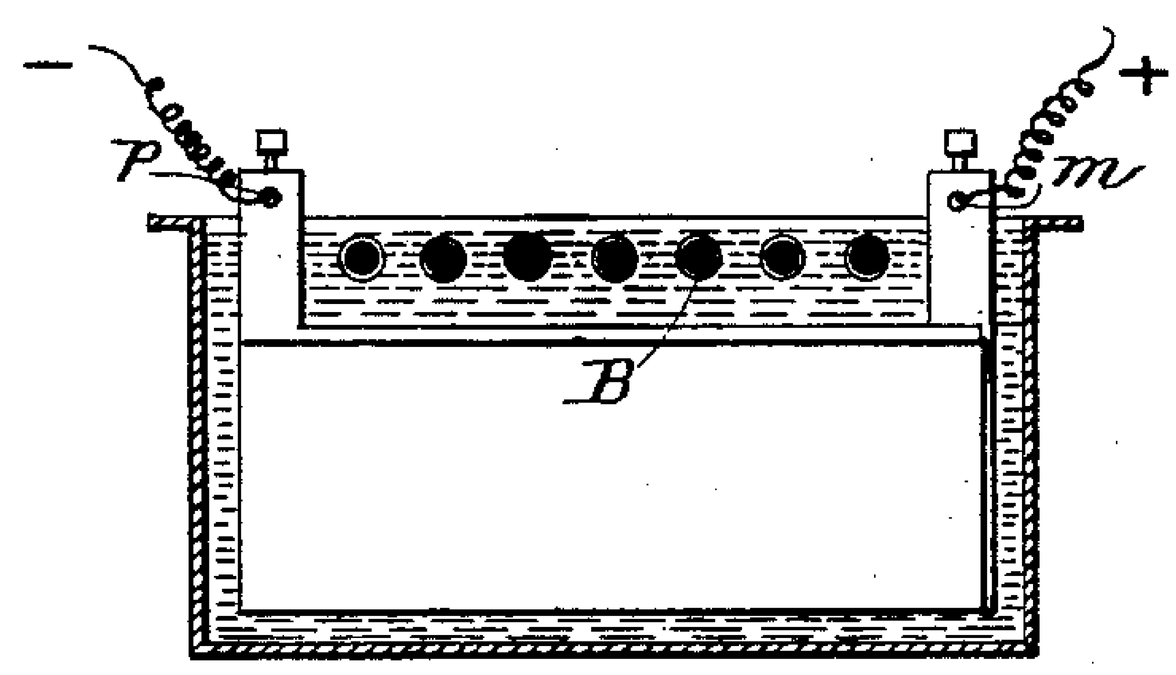


FIG. 4.

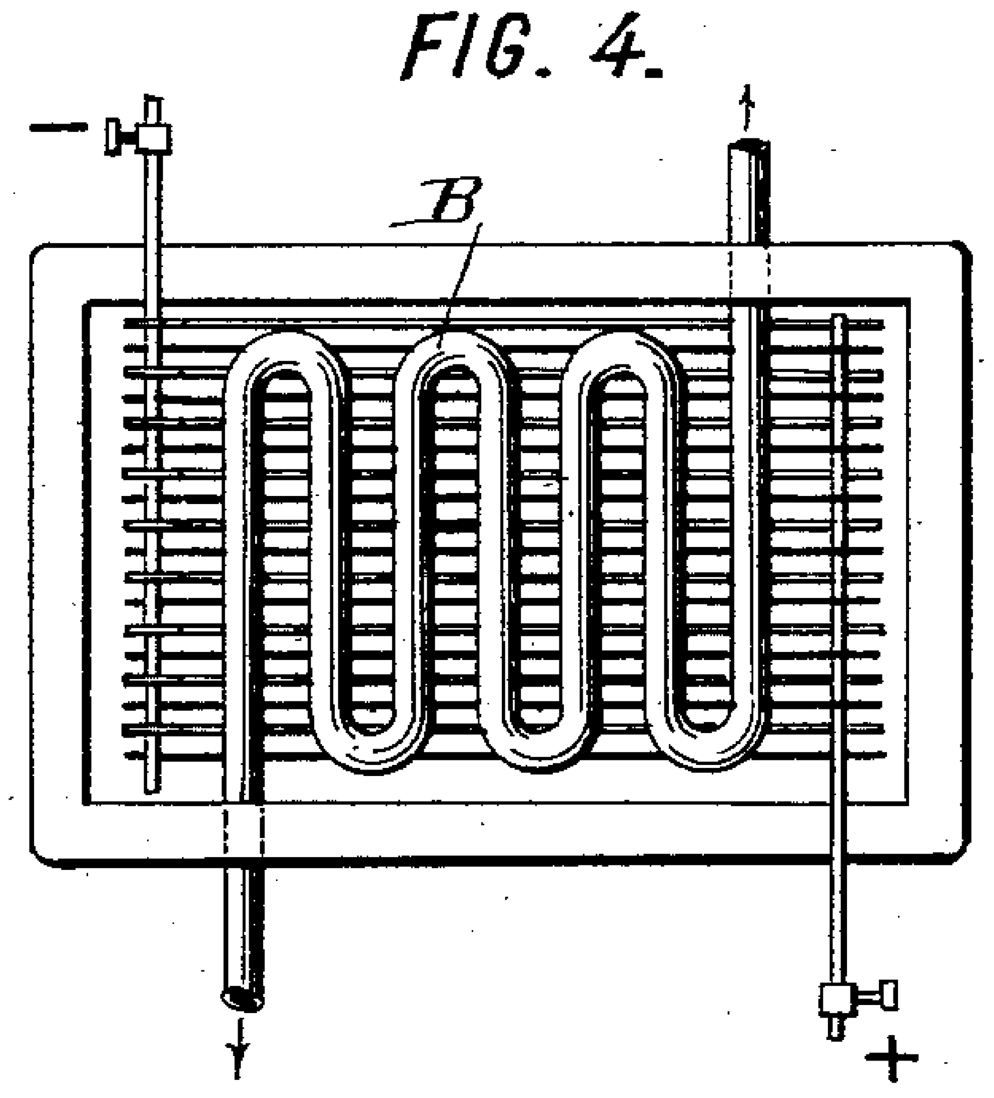
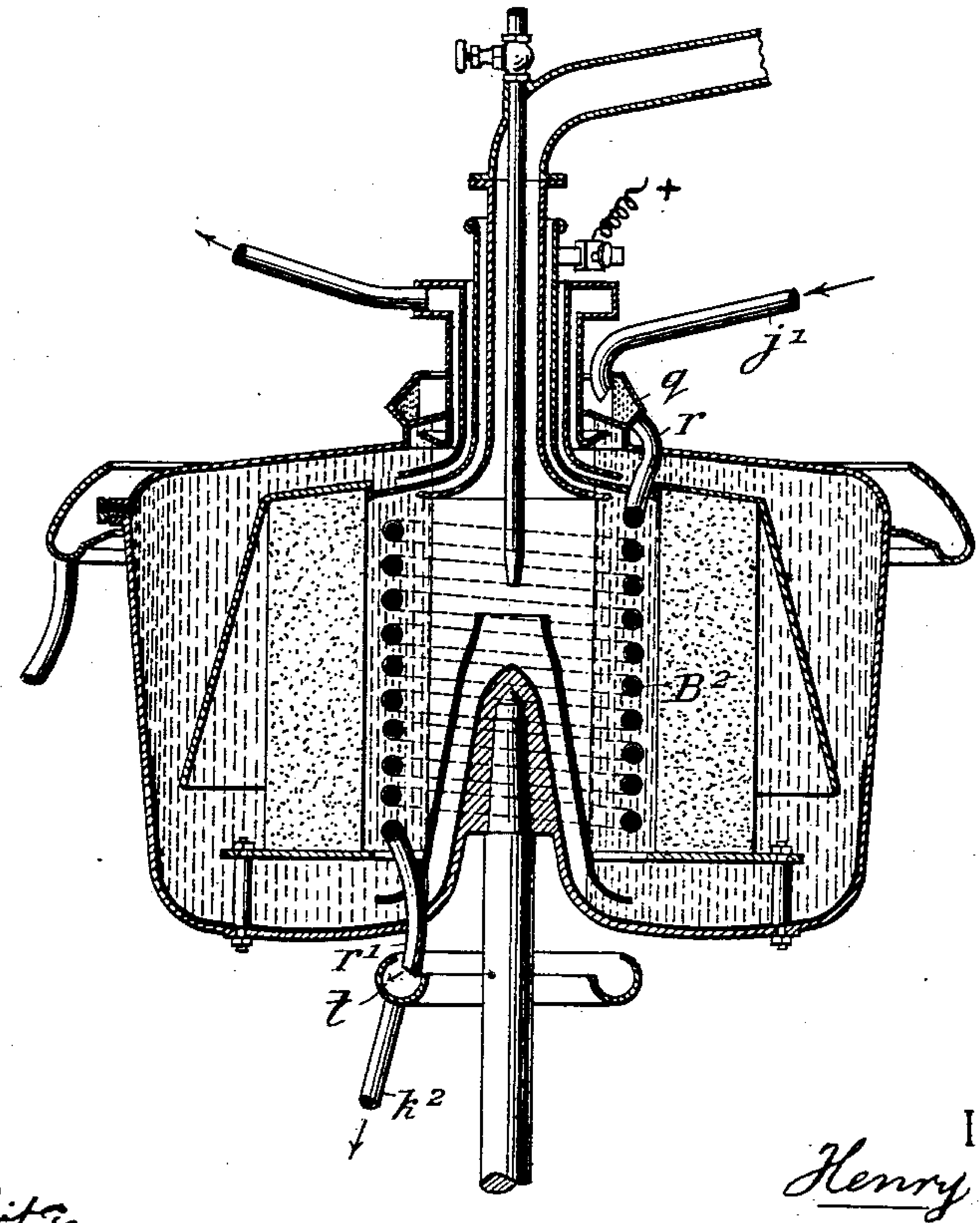


FIG. 5.



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UNITED STATES PATENT OFFICE.

HENRY BLACKMAN, OF NEW YORK, N. Y.

ELECTROLYTIC PROCESS AND APPARATUS.

SPECIFICATION forming part of Letters Patent No. 541,146, dated June 18, 1895.

Application filed July 2, 1894. Serial No. 516,256. (No model.)

To all whom it may concern:

Be it known that I, HENRY BLACKMAN, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Electrolytic Processes and Apparatus, of which the following is a specification.

This invention relates to improvements in the electrolytic decomposition of aqueous or other solutions of salts or other soluble bodies. A type of such electrolytic processes is that in which an aqueous solution of sodium chloride is decomposed by an electric current to form on the one hand chlorine, and on the other caustic soda. In such electrolytic processes it is found that the electrolytic cell shows a considerable tendency to heat, and that as soon as a considerable degree of heat is manifested the electrolytic action becomes less effective, the electric energy being wasted apparently in the production of heat, instead of being to the same degree as at the outset utilized in the chemical decomposition.

The object of my invention is to prevent such heating of the cell, in order to prevent waste of electric energy to preserve the electrodes from injury and to facilitate or secure such electrical decomposition as a heated cell might impede or prevent.

To this end my invention provides for the artificial cooling of the electrolyte, in the cell by maintaining a constant circulation of the electrolyte, continually drawing it off from the cell, passing it through a cooler and returning it to the cell, while at the same time maintaining it cool while in the cell by the application of cooling pipes within the cell.

In the accompanying drawings, Figure 1 is a sectional elevation illustrating one embodiment of my invention. Fig. 2 is a plan view of the electrolytic cell shown in Fig. 1. Fig. 3 is a transverse section, and Fig. 4 is a plan, of a modified construction of electrolytic cell. Fig. 5 is a transverse mid-section showing the application of my invention to a centrifugal electrolytic cell.

I will first describe my invention with reference to Figs. 1 and 2.

Let A designate the electrolytic cell as a whole; B, a cooler applied thereto; C, another cooler exterior to the cell; D, a percolating tank; E, a receiving tank, and F a pump.

Assuming that brine is to be electrolyzed, a mass of salt will be placed as shown at *s* in the percolator D, and the water or weak brine will be introduced into this percolator and caused to circulate, and the strong brine thus formed descends through a pipe *a* into the cooler C. This cooler consists of a tank or vessel traversed by pipes *b b* through which flows the cold liquid. The brine entering by the pipe *a* flows around these pipes and is cooled thereby, overflowing through a pipe *c* which conducts it into the electrolytic cell A.

The cell A consists of a vessel, preferably non-conducting as earthenware for example, and divided by a porous partition *d* into two chambers A′ and A^2 respectively. The chamber A′ contains the anode G, which may consist of a slab or carbon as shown. This slab is inclosed by a cover H in order to confine the chlorine, which is generated in this chamber, and which is taken out by a pipe *e*. In the other chamber A^2 is placed a cathode I, which may consist of an iron plate. The anode and cathode may be supported in any usual or suitable way. The sodium hydrate generated in this chamber A^2 falls to the bottom by reason of its greater specific gravity, and is conducted out by the pipe *f*, from which it overflows into a pipe *g*. For maintaining a constant circulation of the electrolyte, an overflow pipe *h* is applied to the cell, so that as fast as fresh electrolyte enters through the pipe *c*, an overflow is produced through the pipe *h*, the quantity overflowing equaling that which enters less the amount of decrease by decomposition.

For cooling the electrolyte in the cell A, a cooler B is applied thereto consisting of a pipe or equivalent vessel through which the cold liquid is circulated. I prefer to employ a coil of pipe, as shown in Fig. 2. This coil is preferably placed near the surface of the electrolyte in order to come in contact with the warmest portions thereof, and by cooling such portions and thereby increasing their specific gravity, causing them to descend to the bottom of the cell, and thus instituting a circulation by which all of the electrolyte is kept cooled. The pipe *h* conducts the overflow from the cell into the receiving tank E. From this tank a suitably controlled pump F elevates it through a pipe *i* and returns it to the percolator D, as shown in Fig. 1. The pump

F can be controlled by the level of the liquid in the tank E, fresh liquid being supplied from time to time either to the tank E or percolator D. By this means the circulation of the electrolyte is made continuous.

The coolers B and C may be cooled by circulating any cold fluid or medium through them. They are preferably made part of a cold brine circuit J, as shown in Fig. 1, this circuit consisting of a circulating pump K, a a pipe j leading thence to the coil B, the latter coil, a pipe k leading thence to the coil b in the cooler C, a pipe k' leading from this coil to a chill-tank L, and finally a pipe l leading back to the pump K. The chill-tank L is cooled by the vaporization or expansion of ammonia gas or other refrigerating medium in the manner commonly understood in ice or refrigerating machinery. The brine or other non-congealable liquid in the circuit J being thus cooled in the chill-tank L, is pumped through the circuit continuously by the pump K, circulating first through the coil of the cooler B so that it takes up heat from the electrolyte in the cell A, and being thus slightly increased in temperature, passes thence through the coil of the cooler C, where it takes up a further quantity of heat from the electrolyte in this cooler, the warmed brine then returning to the chill tank, where it is again cooled. By this means the electrolyte descending from the percolator or elevated tank D, is first cooled in the cooler C, and is then discharged into the cell A, where it is again cooled to a lower temperature by the cooler B. The cooler C should preferably be constructed so that the cooling medium will flow in one direction and the electrolyte to be cooled will flow past it in the opposite direction, numerous coolers or condensers or attemperators being well known in the art for this purpose, and the construction shown being merely suggestive of the principle involved.

It is not essential to my invention that the preliminary cooler C be employed, as the cooling may be accomplished entirely in the electrolyzer A.

A modified construction of electrolyzer is shown in Figs. 3 and 4. In this case the anode and cathode are subdivided into a great number of alternated plates, which may be of zinc and platinum respectively, and the cooling coil B is placed above the plates, as shown in Fig. 3. The anode plates are connected or coupled to a conducting bar m, while the cathode plates are connected or coupled to a conducting bar p. This particular construction of electrolyzer is well adapted for treating brine electrolytically to convert it into a bleaching solution of sodium hypochlorite. The electrolyte should be continuously circulated through the cell, flowing through the parallel spaces between the plates or electrodes.

Fig. 5 shows the application of my present invention to the construction of centrifugal electrolytic cell shown in my Patent No. 484,990, dated October 25, 1892. For a description of the special construction and operation of this cell reference is made to that patent. So far as my present invention is concerned, it is only necessary to say that the centrifugal cell is provided with a coil of pipe B^2, so arranged as to be just outside of the cylindrical surface assumed by the liquid under centrifugal force, in order consequently to be immersed in the liquid of least specific gravity. This coil is connected at one end by a pipe r to a trough or channel q, while at its other end it terminates in a discharge pipe r', the liquid discharged from this pipe being caught by a stationary channel or gutter t. This coil B^2 may be made part of the cold brine circuit J shown in Fig. 1, the brine or other cold liquid being introduced by a pipe j' to the trough q, wherein it is held by centrifugal force, and by the same force is caused to flow through the coil B^2, being finally discharged by the pipe r' and caught by the gutter t, from which it flows off by the pipe k^2. Thus a circulation of cold liquid is maintained through the coil or cooler B^2, by which the electrolyte in the centrifugal electrolytic cell is constantly cooled.

The extent to which the electrolyte should be cooled according to my invention cannot be stated with exactness, as a considerable range of temperatures is admissible. It should be sufficiently cooled to overcome and counteract the heating action or tendency of the cell, the amount of cooling consequently varying with the volume of current passed through the cell, or in other words, with the energy of the electrolytic decomposition. The electrolyte may thus be maintained at any temperature at or below the normal, the lower the temperature as a general rule the more effective the result, until a temperature so low as to approach too closely to the freezing point of the electrolyte is attained.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. The improvement in electrolytic processes, which consists in first cooling the electrolyte, then introducing it to the cell, and then subjecting it to electrolysis and again cooling it during the electrolysis.

2. The improvement in electrolytic processes which consists in artificially cooling the electrolyte by circulating a cold liquid first through passages in the electrolytic cell and then through a preliminary cooler, the electrolyte being first partially cooled in the latter and then introduced into the cell.

3. The combination with an electrolytic cell of cooling pipes or passages in said cell, a preliminary cooler, a source of cold liquid with pipes for circulating it first through said passages in the cell and then through said preliminary cooler, and a source of electrolyte

with pipes for first circulating it through said preliminary cooler, and then introducing it into said cell.

4. The combination with an electrolytic cell of cooling pipes or passages therein, a preliminary cooler, a chill tank, a circulating pump, and a circuit of pipes for circulating cold liquid by said pump from the chill tank through the cooling passages in the cell, through the preliminary cooler and back to the chill tank, a source of electrolyte, and pipes for circulating it first through said preliminary cooler and then through the electrolytic cell.

5. The combination with an electrolytic cell of cooling pipes or passages therein, a preliminary cooler, a percolator, a circuit of pipes for circulating the electrolyte first through said percolator, then through said preliminary cooler, then through the electrolytic cell and back to the percolator, a circulating pump in said circuit, and a source of cold liquid with pipes for circulating it first through said cooling passages in the cell, and then through said preliminary cooler.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

HENRY BLACKMAN.

Witnesses:

ARTHUR C. FRASER,
GEORGE H. FRASER.