No. 646,281. Patented Mar. 27, 1900.

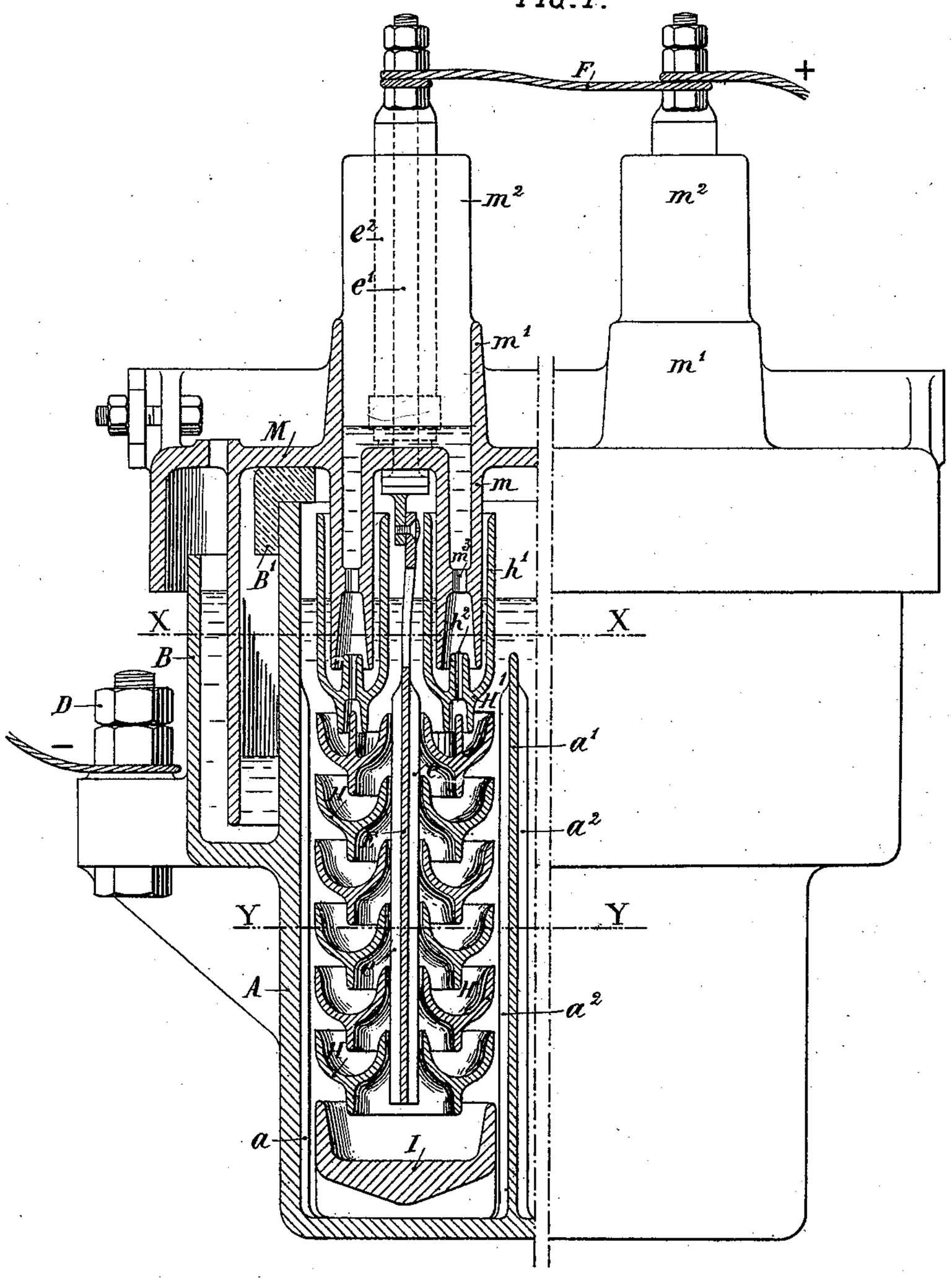
L. H. A. B. M. HAZARD-FLAMAND.

ELECTROLYTIC APPARATUS.

(Application filed Sept. 22, 1898.)

(No Model.) 3 Sheets—Sheet 1.

FIG. 1.



Witnesses

Edwin. D. Bartlett.

Arthur J. Stephens.

Inventor

Louis Henry Antoine Barthelemy Maurice Hazard-Flamand

per Herbert Sefton-Jones

Attorney

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FIG. 2.

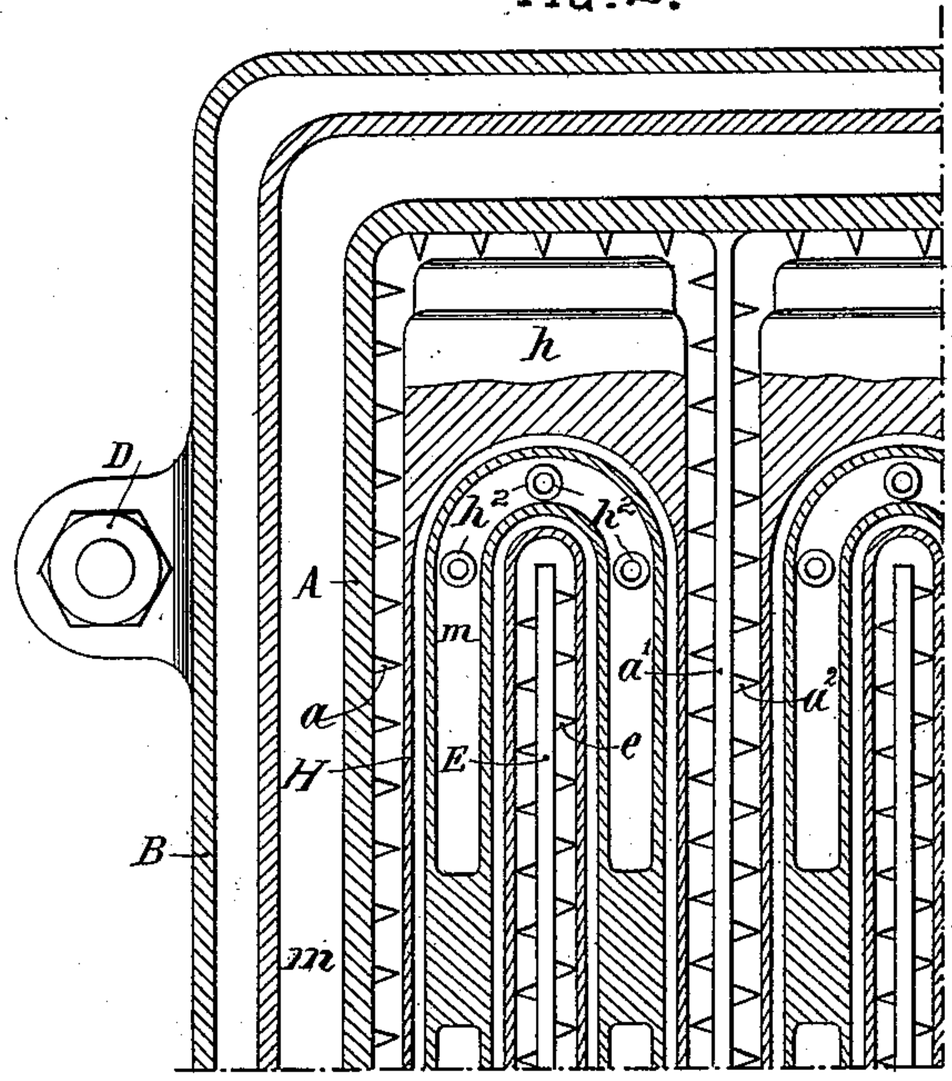

FIG. 3.

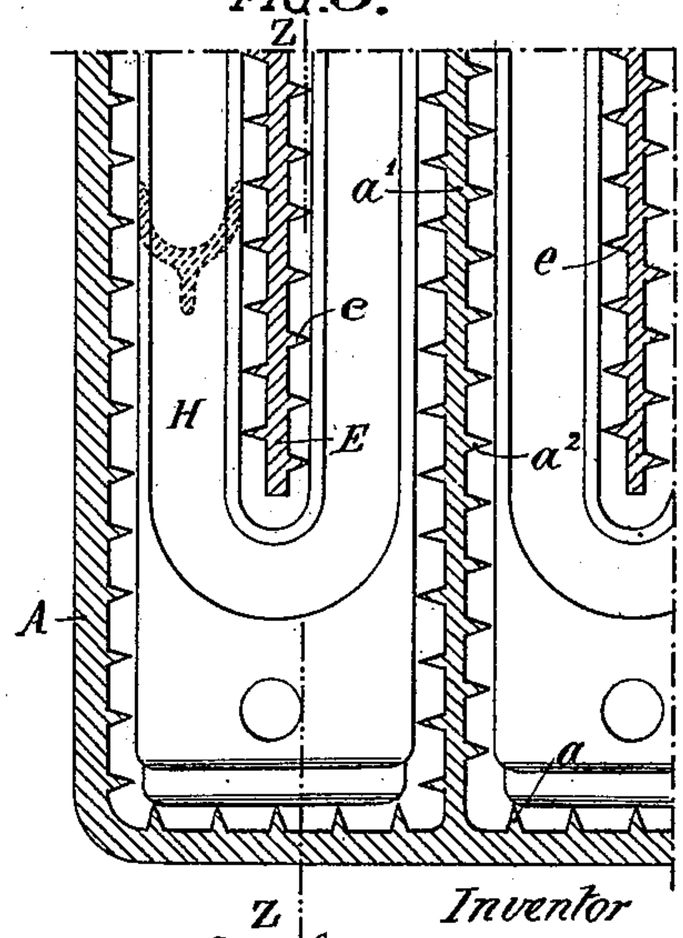

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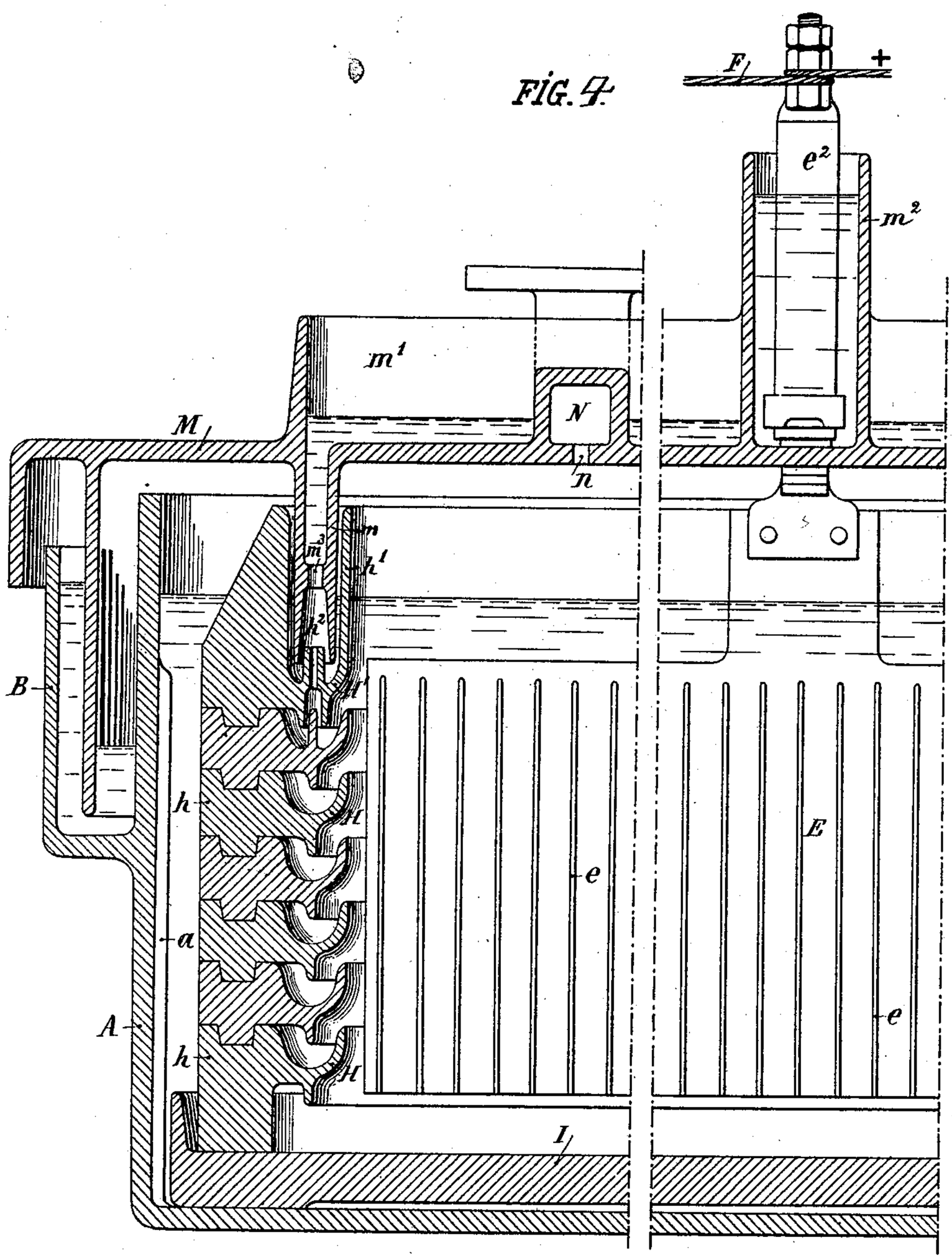
FIG. 4.



Witnesses

Edwin D. Bartlett

Arthur J. Stephens.

Inventor

Louis Henry Antoine Barthelemy Maurice Hazard-Flamand.

per Herbert Septimus Jones

Attorney

UNITED STATES PATENT OFFICE.

LOUIS HENRY ANTOINE BARTHELEMY MAURICE HAZARD-FLAMAND, OF BOULOGNE-SUR-SEINE, FRANCE.

ELECTROLYTIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 646,281, dated March 27, 1900.

Application filed September 22, 1898. Serial No. 691,654. (No model.)

To all whom it may concern:

Be it known that I, LOUIS HENRY ANTOINE BARTHELEMY MAURICE HAZARD-FLAMAND, a citizen of the French Republic, residing at Boulogne-sur-Seine, France, have invented a new and useful Improvement in Electrolytic Apparatus, (for which I have applied for Letters Patent in Great Britain on the 7th day of June, 1898, No. 12,765; in Belgium on the 11th day of August, 1898, No. 107,418; in Germany on the 11th day of June, 1898, No. H. 20,506; in France on the 6th day of August, 1898, No. 268,193; in Italy on the 22d day of August, 1898; in Spain on the 22d day of August, 1898, and in Switzerland on the 24th day of August, 1898,) of which the following is a specification.

This invention relates to a device for obtaining gases by electrolysis free from admixture, the said gases being so separated from the moment of their production onward that no gas disengaged from the one electrode can possibly become mixed with that from the other, even if differences of level and of pressure occur in the apparatus.

The invention will be described in view of the production of oxygen and of hydrogen by the decomposition of water by electricity; but it is equally applicable to the production of other gases which can be obtained by the action of an electric current.

Referring to the accompanying drawings, Figure 1 is a view of the apparatus partly in longitudinal section, partly in elevation. Fig. 2 is a horizontal partial section of the apparatus on the line X X of Fig. 1. Fig. 3 is a horizontal section of the apparatus on the line Y Y of Fig. 1. Fig. 4 is a vertical transverse section of the apparatus on the line Z Z of Fig. 3.

The negative electrode is formed by a vessel A, of cast-iron or other suitable conducting material, the vertical internal walls whereof are covered with ribs a for the purpose of increasing the surfaces and of correspondingly diminishing the polarization. The interior of the vessel A is divided into equal compartments by means of divisions a', cast in metal in one piece with the vessel. The said partitions are likewise provided with ribs a^2. The vessel A can be constructed of insulating material; but in this case negative electrodes formed of suitable plates must be provided and connected together by a suitable conductor.

Around the whole of its exterior surface the vessel A is provided with a deep channel or gutter B, in which lodges the rim of the cover M, and this gutter is filled with an insulating liquid, such as paraffin or petroleum oil or any other hydrocarbon oil, to form a hydraulic joint. The cover M rests upon the edges of the vessel by means of interposed pieces of ebonite B'. The vessel, moreover, has a screw terminal D, upon which is attached the conductor for the current in the usual manner.

The positive electrode is formed of plates E, of cast-iron or other suitable conducting material, having ribs e placed within the compartments of the vessel A and supported by the conducting-bars e', which pass through the lid of the vessel, being electrically insulated from this latter by rings of ebonite to prevent any escape of gas. The conducting-bar e' is inclosed in a bell e^2 with a paraffin-joint, and this bell e^2 is itself inclosed in a cylindrical vessel m^2, cast in one piece with the lid M. This cylindrical piece m^2 is filled with paraffin, constituting a hydraulic joint, which will prevent any escape of gas.

All the conducting-bars are connected with a conductor F, which leads to the screw terminals of the following vessel.

The positive plates E are surrounded with elongated gas-proof insulating-rings H, (ebonite, porcelain, glass, enameled iron, &c.,) superposed so as to form internally a vertical tube around the positive electrodes E. Each ring forms a hydraulic joint with the following and the preceding ring and has the section shown in Fig. 1, so that while the electric current can pass freely through the liquid in the cups escape of the gases through the rings is absolutely prevented. The form shown in Fig. 1 is preferred to any other, because it gives the largest sectional area to the liquid conductor.

The aforesaid rings H are maintained the one above the other by means of the external supporting-pieces h, Fig. 4, secured to the ends of the said rings. Below they are supported by the pieces h upon a porcelain dish or other suitable insulating material which

is impermeable to the gases. This dish *l*, Fig. 4, only rests upon its feet, and the center has underneath a hollow devised to allow free passage to the hydrogen gas which may be generated below the bottom of the dish.

In order to close the upper part of the cell containing the positive electrode, the last ring H′ is preferably of the shape shown and ends in a deep channel *h*′, in which the cover M forms a hydraulic joint by the aid of the prolonged rings *m*, cast in one piece with it. One or more holes h^2, suitably placed, pierced in the last insulating-ring, puts the liquid of the vessel into hydraulic communication with the liquid contained in the reservoir formed in the upper part of the cover by means of the lips or walls *m*′. The reason for this arrangement will be explained hereinafter.

The electrolyte—that is to say, the solution which is decomposed by the current into hydrogen and oxygen—is preferably a conducting solution of an alkali such as soda or potash. The carbonating of the liquid is prevented by a layer of mineral oil which is contained in the reservoirs formed at the upper part of the cover by the ribs *m*′. The holes h^2, pierced in the last ring *h*′, being upon an equipotential line, there could theoretically only be produced parasitic currents in the lid. In practice the place for these holes cannot be fixed mathematically, and currents of very small intensity are produced; but they are absolutely unimportant, because of the electromotive force being proportional to the distance between the holes, and their theoretical position is insignificant, because from one plate to the other this electromotive force cannot exceed three volts. Further, the resistance is enormous, because the holes h^2 are of small diameter and of very limited number.

In practice there can be obtained the theoretical quantity of gas corresponding to the quantity of the current which traverses the voltmeter. Moreover, the electromotive force of these parasitic currents being only a small fraction of a volt cannot decompose the electrolyte and give admixture of gas. The gases disengaged at the electrodes and being so placed that they cannot mix, as already explained, are collected in the following manner: The lid M of the vessel has two channels of cast-iron, one of which, N, is shown at the left of the axis of the vessel, Fig. 4, and the other (not shown on the drawings) is placed symmetrically therewith—*i. e.*, to the right of the axis of the vessel. The longitudinal axes of these channels are normal to the surface of the electrodes. The left channel N, for instance, devised to collect the gases disengaged in the positive cells, communicates by the holes *n* with the said positive cells, while the right channel communicates through similar holes with the positive cells. These channels communicate with collecting vessels, (not shown in the drawings,) whereof one collects the oxygen and the other the hydrogen. It has been already said that the reservoirs formed by the ribs *m*′ are upon the lid and contain liquid in communication with the liquid in the interior of the vessel. This arrangement has for its object to form a hydraulic joint which prevents the gases from escaping to the open air through the holes h^2 and m^3 when the apparatus is working normally. If, however, the liquid is allowed to run short through negligence and the level of the liquid in the vessel is reduced down to the lower lip of the cast-iron ring *m*, Fig. 1, which forms the hydraulic joint, the gas escapes around this ring and passes through the hole m^3, escaping to the outside through the liquid-joint. The bubbling which results in the upper cells formed upon the lid, gives notice of this accident, and without allowing the gases, which have found a way of escape toward the outside, to become mixed—that is to say, to pass from an internal cell to the other. If the disengagement of the gases of one or more cells is prevented by an obstruction of any kind to the holes *n* or *n*′, the pressure which results causes the level of the liquid to sink in the corresponding cells; but when the level of the liquid reaches the lower part of the lip of cast-iron of the rim *m* of the cover the liquid escapes to the outside, as before, producing a bubbling, which gives notice of the accident without danger of any mixture, as already explained in the preceding case.

My system of separation is especially designed for apparatus producing oxygen and hydrogen by the decomposition of water by the passage of an electric current; but I may apply the same system for the production by electrolysis of other gases.

What I claim is—

1. In electrolytic apparatus for the production of gases, positive and negative electrodes, an annular gas-tight diaphragm separating the said electrodes, a deep channel around the upper part of the said diaphragm, said channel being partially immersed in the electrolyte, holes pierced through the base of said channel and connecting the electrolyte with a sealing liquid in the interior of the said channel, a cover having a prolongation projecting downward into said channel, and concentric therewith, communicating with a second channel on the top of the said cover, substantially as described.

2. In electrolytic apparatus for the production of gases, a gas-tight diaphragm penetrable by the current, and also by the electrolyte, said diaphragm surrounded by a deep channel partially immersed in the electrolyte, holes in the base of the said channel leading to a hollow prolongation of the cover, so that the said channel is in liquid communication with a channel on the top of the said cover, substantially as described.

3. In electrolytic apparatus for the production of gases, containing electrodes surrounded by an annular gas-tight diaphragm, the combination with the upper part of the dia-

phragm of an annular channel H′, having at its lower part holes h^2, the edge h' of said channel rising above the surface of the electrolyte, and combining with a prolongation m of the cover connected by means of holes m^3 with an annular receptacle m' upon the said cover.

4. In electrolytic apparatus for the production of gases, electrodes, a diaphragm separating the electrodes the combination of a cover provided with channels, hollow prolongations from said channels communicating with a deep annular channel around the upper part of the diaphragm separating the electrodes, said annular channel partially immersed in the electrolyte, and provided with orifices h^2, substantially as described.

5. In electrolytic apparatus for the production of gases, an electrode E, a diaphragm having a deep annular channel h' around the said electrode, and partially immersed in the electrolyte; the said channel h' providing liquid communication on the one hand with the electrolyte through orifices in its lower part, and on the other hand with the lid of the cover by means of a hollow prolongation of the said cover, in combination with the elongated rings H superposed so as to form a series of hydraulic joints.

In witness whereof I have hereunto set my hand in presence of two witnesses.

LOUIS HENRY ANTOINE BARTHELEMY
MAURICE HAZARD-FLAMAND.

Witnesses:
JACQUES CONDOMY,
AUGUSTE FOURNOL.