J. McPHAIL.

ELECTROLYTIC CELL.

APPLICATION FILED FEB. 5, 1909.

929,469. Patented July 27, 1909.

Fig. 1.

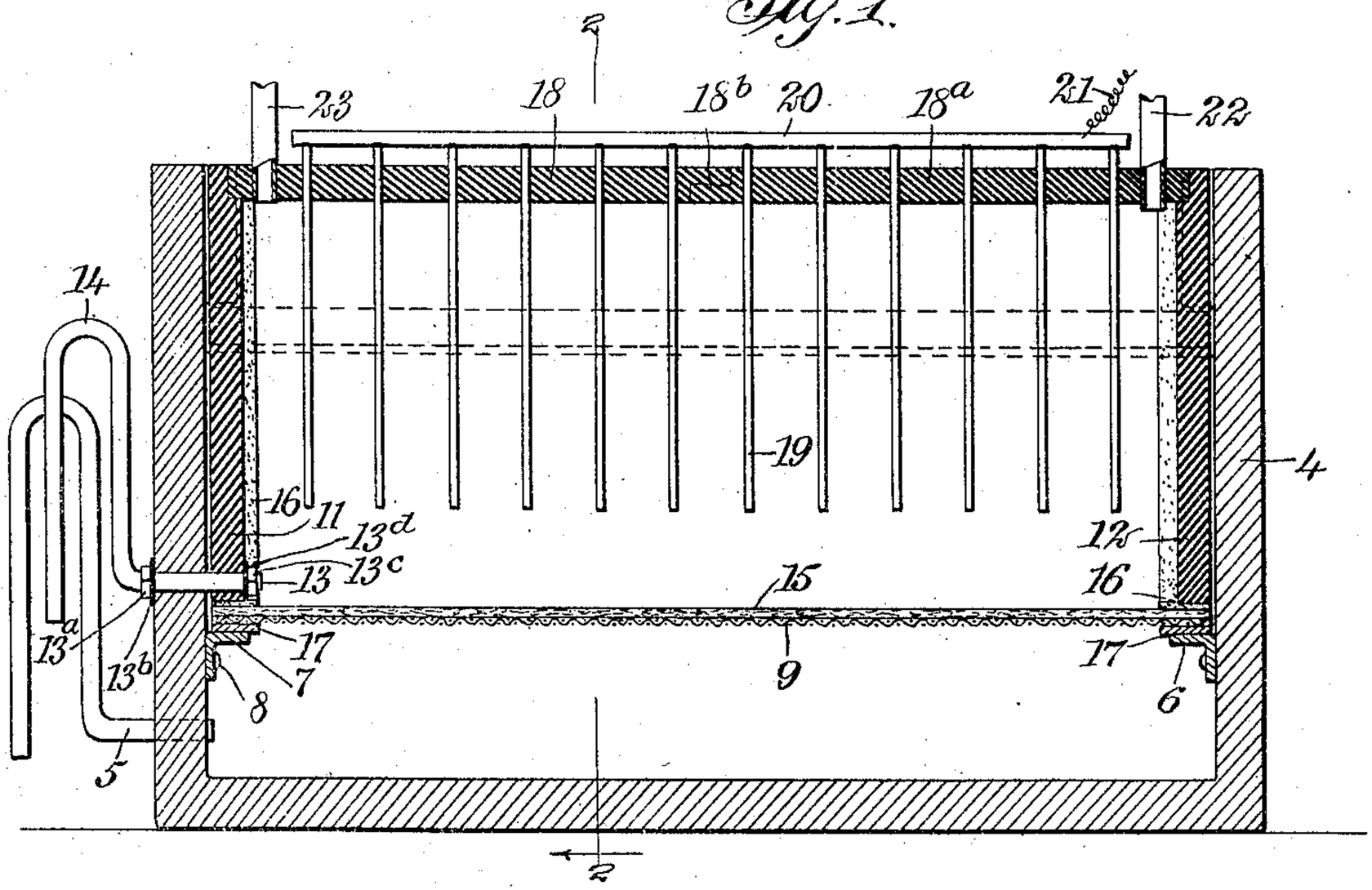


Fig. 2.

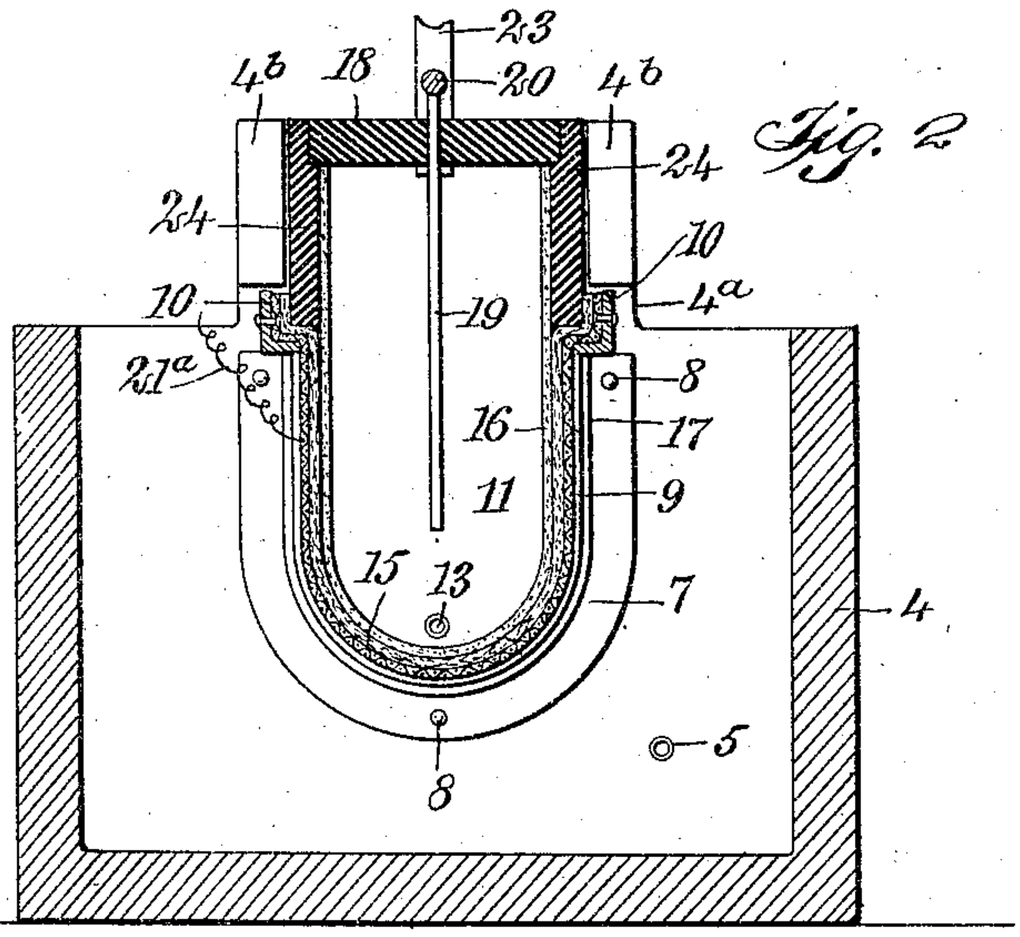
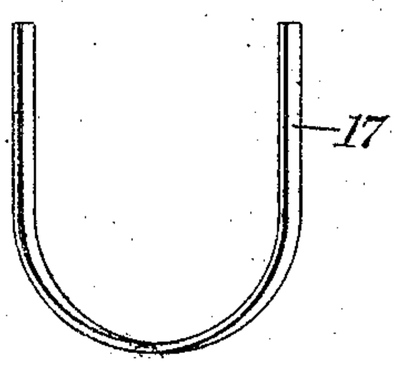


Fig. 3.



WITNESSES

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ELECTROLYTIC CELL.

No. 929,469. Specification of Letters Patent. Patented July 27, 1909.

Application filed February 5, 1909. Serial No. 476,235.

To all whom it may concern:

Be it known that I, JOHN MCPHAIL, a subject of the King of Great Britain, and a resident of Carteret, in the county of Middlesex and State of New Jersey, have invented a new and Improved Electrolytic Cell, of which the following is a full, clear, and exact description.

My invention relates to electrolytic cells, my more particular purpose being to produce a cheap and efficient cell suitable for the electrolysis of metallic salts, and so arranged as to dispose of the gases formed during electrolysis.

More particularly stated, I seek to construct an electrolytic cell in which there may be brought about a complete separation of the products, with a minimum of undesirable by-products, the cell occupying a comparatively small space and being simple and easily handled, and also being economical in operation.

My invention further relates to the provision in a cell of the character mentioned of a removable diaphragm which may be easily renewed or changed.

While my invention admits of general use and may be used in connection with metallic salts of almost any kind, I have in mind more particularly the electrolysis of a solution of common salt (sodium chlorid) so as to form chlorin gas and sodium, the latter immediately forming, because of its contact with water, sodium hydrate, according to the following reactions: $NaCl = Na + Cl$; then, $Na + H_2O = HNaO + H$. As may be seen from these equations, free hydrogen is liberated, and it is one of the purposes of my invention to make adequate provision for the escape of this hydrogen.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a substantially central vertical section through one of my improved cells complete; Fig. 2 is a vertical cross section upon the line 2—2 of Fig. 1; and Fig. 3 is a perspective showing a detail of one of the clamps used in the cell.

A containing vessel 4 made of iron, slate or other suitable material, is provided, the space within this vessel being the cathode compartment. An overflow pipe 5 is tapped into the vessel 4 and is bent upwardly and then downwardly as indicated in Fig. 1, being employed for the purpose of removing portions of the liquid contents of the vessel 4 from time to time. Disposed within the vessel 4 and at opposite ends of the same are supporting brackets 6, 7, each of substantially U-shape and secured in position by aid of rivets 8.

A netting 9 of steel or other suitable metal, is bent into such form that its cross section is of substantially U-shape, as will be understood from Fig. 2. Within this netting I place a diaphragm. At the top of the netting 9 and adjacent to opposite edges thereof I rivet directly to the cathode two angle irons 10, each having substantially an L-shape in cross section. These angle irons 10 constitute supporting members for the netting 9 and rest at their ends directly upon the U-shaped brackets 7. I provide two plates 11, 12 of slate, glass or porcelain, and having their lower ends rounded as indicated in Fig. 2.

A tube 13 extends through the plate 11 and also through the wall of the vessel 4. Connected with this tube is a substantially U-shaped pipe 14, as will be understood from Fig. 1. The outer end of the tube 13 is fitted with a brass lock nut 13^a and with a rubber gasket 13^b. The inner end of the tube 13 is provided with a hard rubber lock nut 13^c and with a rubber gasket 13^d. A diaphragm 15, made of a septum, such as asbestos paper or asbestos cloth, is placed within the netting 9 and at the ends of this diaphragm are strips 16 of soft rubber. One of these strips is disposed intermediate each plate 11, 12 and the adjoining end of the diaphragm 15, so as to form a watertight joint.

The plates 11, 12, rubber strips 16, diaphragm 15 and netting 9, together constitute a receptacle which, as a whole, rests within the vessel 4 and has no communication therewith except through the diaphragm 15 and netting 9. At 17 are two clamps of substantially U-shape, these clamps being made of spring steel and being adapted to partially encircle the plates 11, 12, so as to grip tightly thereupon the adjacent ends of the netting 9 and diaphragm 15.

Integral with the vessel 4 and extending upwardly therefrom are portions 4^a (see Fig. 2), and mounted upon these portions are lugs 4^b which are used for the purpose of preventing displacement of the various re-

movable parts contained within the vessel 4. Two plates 18, 18[a] (see Fig. 1) constitute the top of the inner vessel, these two plates being connected together by an overlapping joint 18[b]. At 19 are a number of metallic or carbon anodes which are connected in parallel to a bus bar 20 and extend directly through the plates 18, 18[a]. A wire 21 is connected to the bus bar 20 and serves to supply current to the same. Pipes 22, 23 extend through the plates 18[a], 18. One of these pipes, say the one numbered 22, is used for supplying into the inner vessel the fluid to be operated upon by the current. The other pipe, say 23, is used for allowing the discharge of gaseous by-products. Of course, if it be desired to utilize these gaseous by-products the pipe for drawing them off is led to some point suitable for carrying out this purpose. A wire 21[a] is connected directly with the netting 9. At 24 are shown two slats, resting on edge, and supported partially by the lugs 4[b], these slats supporting the boards 18, 18[a]. This completes the electrolytic cell. As will be readily understood from the foregoing description, the cell, when complete, has an anode compartment representing the space inside of the diaphragm 15, and a cathode compartment representing the space intermediate the netting 9 and the vessel 4.

The operation of my device is as follows: The cell being filled or partially filled, for instance with a solution of sodium chlorid, a portion of this liquid being inside of the diaphragm 15 and a portion being outside of said diaphragm, both portions of the liquid acquiring, because of the porosity of the diaphragm 15, a common level, current is now applied in the manner well known with reference to the operation of electrolytic cells. During the operation of the cell, hydrogen is liberated freely from the netting 9 and from the inner surface of the vessel 4. The liquids contained partly in the anode compartment and partly in the cathode compartment undergo mechanical changes, the sodium hydrate being set free and gradually collecting so that it may be continuously removed. The pipe 5 may, of course, be used as a brine overflow; that is to say, it can be employed for removing the solution of sodium chlorid from the entire cell whether or not any electrolytic action has taken place. The rotund shape of the netting 9 at its bottom (see Figs. 1 and 2) facilitates the free escape of the hydrogen liberated and prevents polarization. The result is that the cell attains a high degree of efficiency.

From the above description, it will be understood that when the cell is in action, brine is contained within the diaphragm, and that outside of the diaphragm is water. Practically all of the diaphragm, including its sides and bottom, are exposed directly to the cathode compartment. The slates and netting form together a portable diaphragm which may be easily removed, cleaned and replaced and used repeatedly.

In the construction of the cell more electric current can be carried in proportion to its size than is the case with most other cells used nowadays. In my apparatus hydrogen is more easily diffused, and chlorates and hypochlorids and the like are less liable to form than in a cell having a horizontal or vertical diaphragm.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. In an electrolytic cell, the combination of a containing vessel, having substantially a rectangular form and provided at its ends with projecting portions, and an inner vessel mounted within said containing vessel and extending from one end to the other thereof, said inner vessel being provided with portions abutting against said projecting portions of said containing vessel.

2. An electrolytic cell, comprising a containing vessel, brackets mounted therein and disposed oppositely to each other, supporting members for resting upon said brackets, a netting connected with said supporting members, a diaphragm disposed adjacent to said netting, and means for sending a current through said diaphragm and said netting.

3. In an electrolytic apparatus, the combination of a containing vessel, a metallic foraminous member disposed therein, slates disposed at the ends of said metallic foraminous member, means for clamping the ends of said slates, and a lining for said metallic member, said lining being made of fibrous material to form a diaphragm.

4. In an electrolytic cell, the combination of a containing vessel, a pair of supporting brackets mounted therein and supported by oppositely disposed portions thereof, each of said brackets being of substantially U-shape, and a diaphragm having a substantially U-shape in cross section, said diaphragm engaging said supporting brackets.

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

JOHN McPHAIL.

Witnesses:
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W. J. BURKE.