(No Model.)

E. A. LE SUEUR.

DIAPHRAGM FOR ELECTROLYTIC CELLS.

No. 518,786. Patented Apr. 24, 1894.

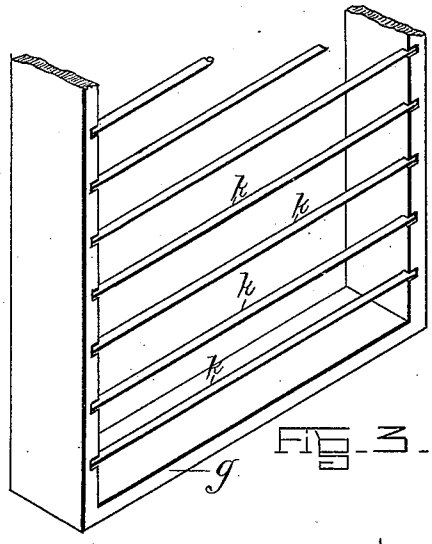

FIG. 3.

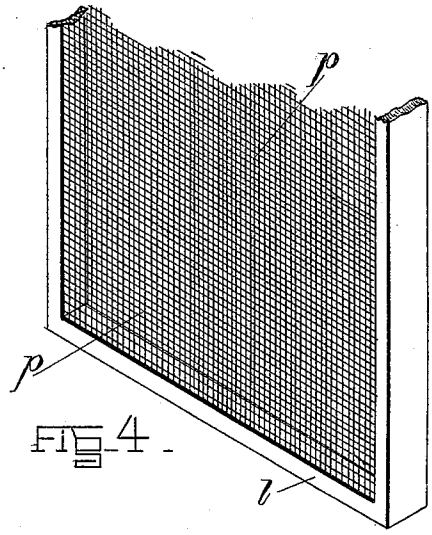

FIG. 4.

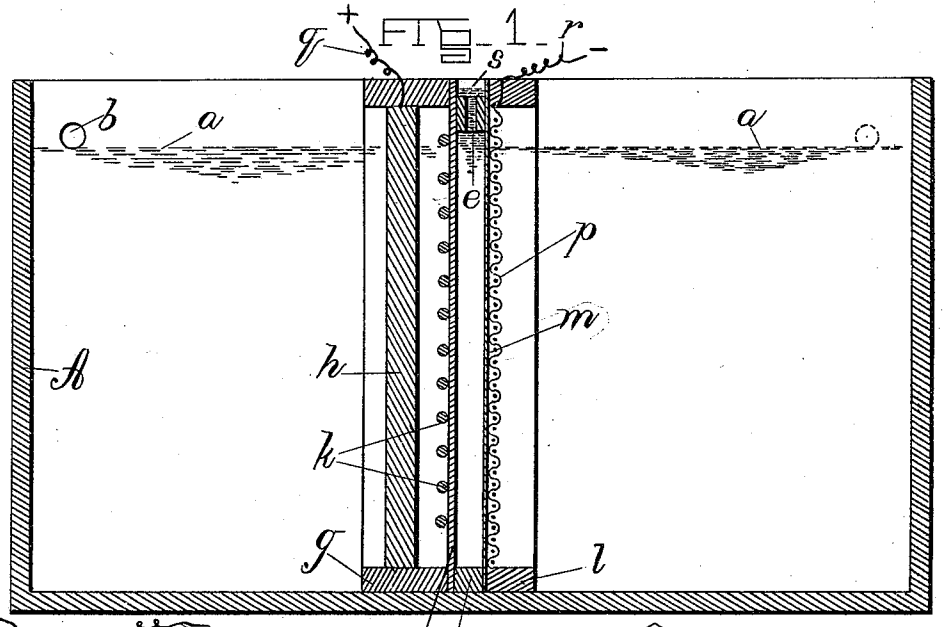

FIG. 1.

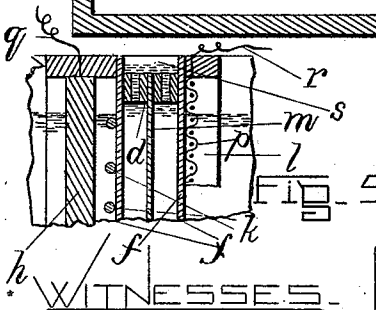

FIG. 5.

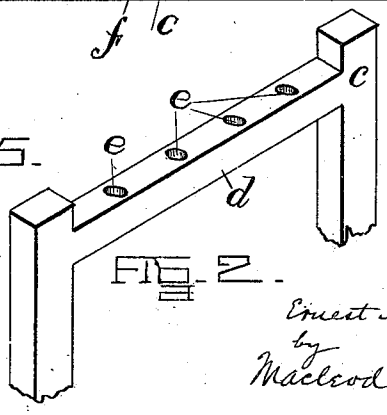

FIG. 2.

WITNESSES.

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DIAPHRAGM FOR ELECTROLYTIC CELLS.

SPECIFICATION forming part of Letters Patent No. 518,786, dated April 24, 1894.

Application filed August 29, 1892. Serial No. 444,488. (No model.)

To all whom it may concern:

Be it known that I, ERNEST ARTHUR LE SUEUR, a subject of the Queen of Great Britain, residing at Ottawa, in the Province of Ontario, Dominion of Canada, have invented certain new and useful Improvements in Diaphragms for Electrolytic Cells, of which the following is a specification, reference being had therein to the accompanying drawings.

In an electrical apparatus designed for the decomposition of common salt and similar chemical substances it is necessary to interpose a diaphragm between the positive and negative electrodes. The office of the diaphragm is to keep the products of decomposition in their respective portions of the cell. If some such device were not employed the two would mix and besides depreciating the purity of the products of decomposition, the working of the apparatus would be seriously affected, from the fact that the current would expend itself in decomposing the secondary products formed by the combination of soda and chlorine instead of expending its energy in decomposing the brine proper. Great difficulty has been experienced in obtaining suitable material and arrangements of the same for the diaphragms in such cells. The difficulty is due to the fact that a diaphragm which is impervious to the passage of the liquids and will therefore keep them wholly separate is apt to interpose a high resistance to the passage of the current. The thing to be desired is a durable diaphragm which will perfectly separate the contents of the cell and will at the same time be of very low resistance. Vegetable parchment has been employed and affords an excellent diaphragm both as to non-porosity and low resistance but it lacks durability in a cell in which a corrosive substance like chlorine is evolved and will go to pieces in a short time. Asbestus on the other hand will resist the action of the chlorine, but if used in a sheet thin enough to be of low resistance the liquid will pass through it too freely, while if it is made thick enough to prevent the passing of the liquid, its resistance is too high.

My present invention has for its object to produce a diaphragm which shall obviate these objections and by the use of which the diffusion of the liquid contents of the cell may be prevented while the resistance is maintained at a minimum, and it consists in a diaphragm composed of two layers or sheets of material separated by a mass of liquid, the level of which is somewhat higher than that of the level of the liquid in the cell, all as more particularly hereinafter set forth and as is pointed out in the claims which are appended hereto and made a part hereof.

In the drawings I have shown my invention in the best form now known to me, and in the following description of my improvement I will specifically refer thereto.

In said drawings, Figure 1 is a vertical section of a cell or containing vessel showing my improved diaphragm. Fig. 2 shows the upper portion of the central frame hereinafter referred to. Fig. 3 is a perspective of a portion of the side frame in which the carbon electrode is supported. Fig. 4 is a similar view of the other side frame in which the negative electrode is supported. Fig. 5 is a detail on a smaller scale, which is hereinafter referred to.

My invention is simple and will be readily understood from the following description in which the construction is set forth. The outer containing vessel or cell is shown at A, and may be of any well-known shape or construction. The brine or solution which is to be decomposed is contained within this cell, the level of the liquid therein being indicated at *a*. An overflow is shown at *b* which serves to prevent the liquid in the positive electrode compartment of the cell from rising above the level indicated. If required a similar overflow may be provided in the negative electrode compartment, as indicated by dotted lines in Fig. 1. A frame, which I have termed the central frame is shown at *c* and is constructed of suitable material as lead, for example, and made to fit the interior of the cell A closely. The cross piece *d* at the top of the frame *c* is joined to the upright portions of the frame somewhat below the top thereof as shown Fig. 2 so as to leave the uprights projecting above the cross piece. A series of holes *e* which pass vertically through the cross piece *d* are made therein. The sides of the frame *c* are made true so that a diaphragm or layer of material may be securely clamped thereon said layer or diaphragm being secured

between said central frame *c* and the side frame which is likewise made true so that the diaphragm may be evenly and tightly clamped. The chlorine is evolved at the positive electrode and I therefore place a layer or sheet of material preferably of asbestus, against the positive side of the central frame *c*. This layer is shown at *f* Fig. 1, and should be thin enough to offer a low resistance to the passage of the current. The layer *f* is secured in place by clamping it between the frame *c* and a side frame *g* which supports the positive or carbon electrode *h*. A series of rods *k* are placed in the frame *g* crosswise thereof and adjacent the layer or sheet *f*. The rods *k* are preferably secured in place by being laid in a slot or recess provided at each end of each rod in the upright portion of the side frame *g* as shown Fig. 3. The rods *k* serve to prevent the asbestus layer *f* from bulging toward the carbon electrode. On the other side of the frame *c* I place another side frame *l* shown Fig. 4 between which and the frame *c* is clamped a layer or sheet of parchment *m* or a material having the qualities of parchment and of which parchment is the type. In the frame *l* the negative electrode which may be a sheet of iron netting is preferably secured adjacent the parchment sheet and serves to prevent said sheet from bulging toward the negative side of the cell. The positive wire is indicated at *q* and the negative wire at *r*. These wires are shown as connected with the positive and negative electrode respectively. It is unnecessary to do more than indicate the connections as the details thereof are merely matters of electrical engineering and well known to those skilled in the art. The diaphragm proper, that is the parchment layer *m* is separated from the layer or sheet of asbestus *f* by the thickness of the frame *c* and this may be varied as desired without departing from my invention. The space between the layers or sheets *m* and *f* is provided with brine which is supplied as desired to the space shown at *s* Fig. 1 directly above the cross piece *d* of the central frame *c*. This brine passes down through the holes *e* into the space below the said cross piece *d* and between the layers *m* and *f*. The level of the liquid in the intermediate space between said layers is maintained at a higher level than the level *a* of the liquid outside said space. This causes a flow of the liquid outwardly through the pervious asbestus layer from the space between the layers *m f* toward the positive electrode side of the cell and thus serves to prevent the chlorine or any of the liquid containing chlorine from reaching the parchment diaphragm *m*. As the parchment is quite durable unless attacked by the chlorine its life is in this way prolonged and its effectiveness secured. As the layer of asbestus *f* is not attacked by chlorine its full efficiency is also obtained and a diaphragm of great durability and efficiency is the result. As previously stated the inter-diaphragm space between the layers *m f* is supplied with fresh solution and as this solution constantly flows through the pervious asbestus layer into the positive compartment of the cell, the electrolyte supply for the positive compartment is wholly or largely furnished in this way. The effect of the excess of pressure due to the higher level of the liquid in the inter-diaphragm space is to minimize and render of no importance the diffusion of chlorinated solution toward the parchment sheet which electrically considered is the diaphragm proper. It will be clear that the value of my device does not depend upon the use of either parchment or asbestus for the sheets *m f* and I do not therefore desire to confine myself to such sheets. Many substances may be used in place of these materials. As an equivalent for the parchment I may mention a bichromatized gelatine which has been rendered insoluble by exposure to the sun-light and very thick woven cloth fabric. In place of the asbestus thin porous earthenware may be used.

In case the products of decomposition at the negative electrode is sufficient to destroy or render it desirable to protect, the diaphragm or non-porous sheet *m* from their action the negative electrode may be removed somewhat from the said diaphragm and a pervious sheet similar to the sheet *f* may be placed on the negative side of the sheet *m*, in a manner similar to that in which it is shown as arranged on the positive side in the drawings and the supply of the solution for the negative compartment may be caused to take place through this pervious sheet. In other words the arrangement shown in Fig. 1 is for use in cases where the products of decomposition which are liberated at the negative electrode are not such as will attack the parchment sheet. In case, however these products are injurious to the parchment sheet and the parchment sheet requires to be protected therefrom it is only necessary to duplicate the pervious sheet shown in Fig. 1 on the negative side of the diaphragm proper thus providing for a flow of liquid from the intermediate space into the negative compartment thus securing the diaphragm from attack on that side. Such a construction is shown in Fig. 5. The central frame *c* may be made by cutting it from heavy sheets of lead. The holes *e* in the cross bar *d* of said frame not only serve for the admission of the solution but also for the escape of any bubbles of gas which may be liberated in the inter-diaphragm space. The negative electrode frame *l* is preferably of slate but it may be of high quality stone ware or of glass. The rods *k* are also preferably of glass.

The device employed for clamping the frames together is not shown but any well known clamp may be employed.

The frames employed for supporting the diaphragm as also the pervious sheet or sheets

may be varied as will be obvious in form and construction without departing from my invention, the important feature of which is the separation of the diaphragm proper from the corrosive product by the interposition of a pervious sheet and fresh liquid, the latter flowing away from the diaphragm.

What I claim is—

1. An electrolytic cell having in combination with the diaphragm thereof a pervious sheet or layer interposed between said diaphragm and the electrode of the cell, and separated from said diaphragm by a space forming a chamber containing liquid under greater relative pressure than the liquid in the adjacent compartment of the cell, whereby the movement of the liquid in the cell due to the said greater pressure will be from said diaphragm and through the pervious sheet or layer, substantially as set forth.

2. In an electrolytic cell, the combination with the diaphragm of a sheet or layer separated from said diaphragm and interposed between the same and the electrode of the cell, and suitable frames for preventing said diaphragm and said pervious sheet from bulging under the pressure of the liquid, all substantially as described, and whereby the level of the liquid in the space between the diaphragm and the pervious sheet may be maintained at a higher level than the level of the liquid in the compartment of the cell, substantially as set forth.

3. The combination with the cell A provided with a suitable overflow *b*, of the frame *c* provided with holes *e*, the diaphragm *m* and pervious sheet *f* at opposite sides of the frame *c* and the side frames *g l*, for the electrodes, placed respectively beside the said pervious sheet and the diaphragm substantially as shown and described.

4. The combination with the frame *c* of the pervious layer *f* at one side thereof and the frame *g* and rods *k*, at the side of the pervious layer substantially as shown and described.

5. The method of protecting the diaphragm of an electrolytic cell, which consists in first producing a diaphragm wall or layer of fluid between the said diaphragm and the contents of the cell adjacent to the said diaphragm, then occasioning pressure upon the fluid, and keeping the latter under pressure and thereby maintaining in the said fluid lateral pressure with tendency to lateral flow away from the diaphragm, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

ERNEST ARTHUR LE SUEUR.

Witnesses:
WM. A. MACLEOD,
ROBT. WALLACE.