April 15, 1924. 1,490,332

I. H. LEVIN

DIAPHRAGM FOR ELECTROLYTIC CELLS

Filed Oct. 4, 1921

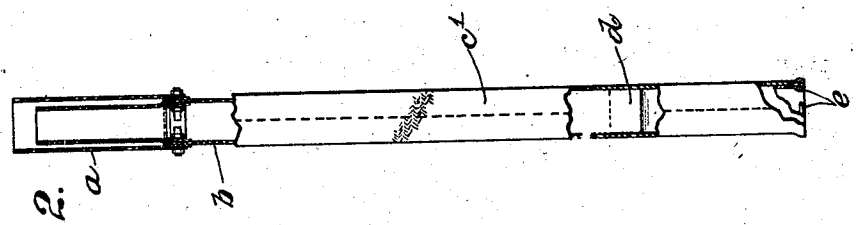


Fig. 2.

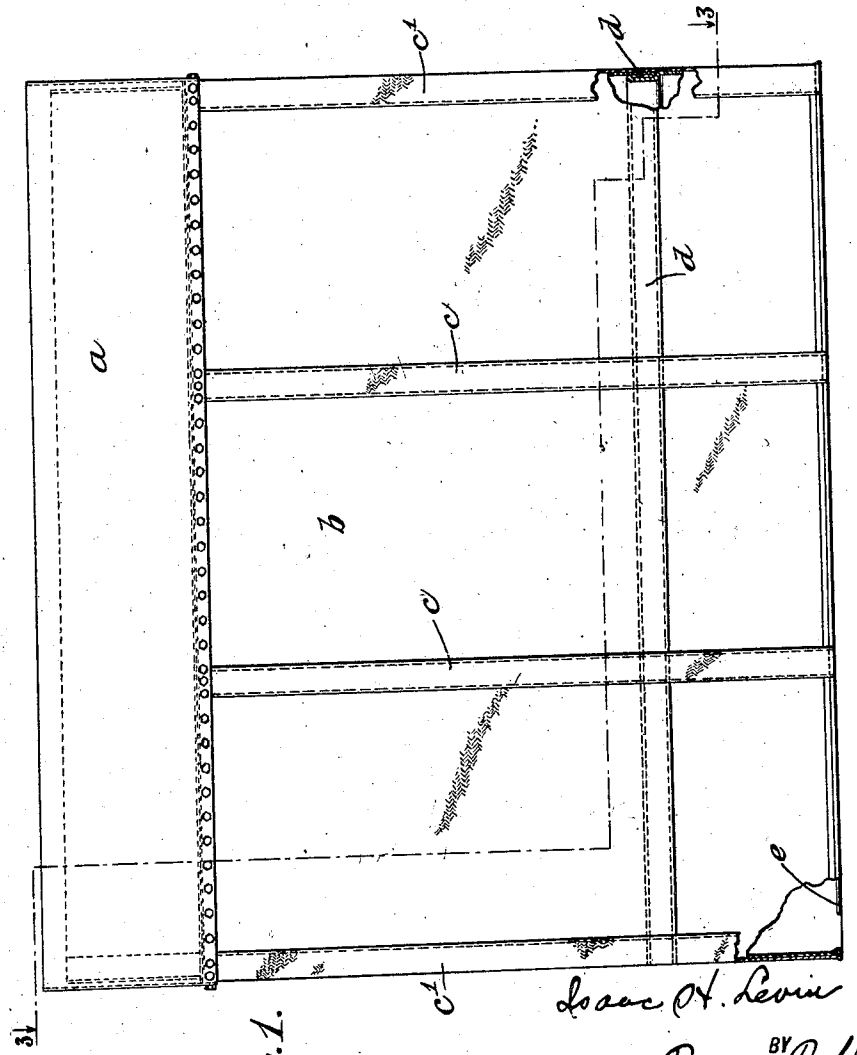


Fig. 1.

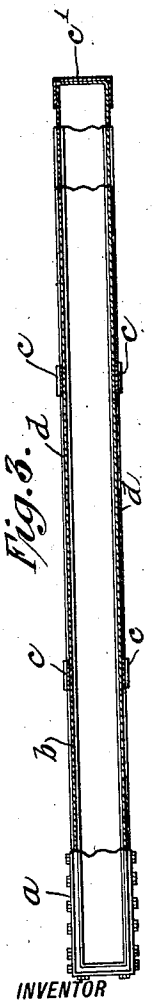


Fig. 3.

Isaac H. Levin
INVENTOR

BY Frank P. Wentworth
ATTORNEY

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UNITED STATES PATENT OFFICE.

ISAAC H. LEVIN, OF NEW YORK, N. Y.

DIAPHRAGM FOR ELECTROLYTIC CELLS.

Application filed October 4, 1921. Serial No. 505,303.

To all whom it may concern:

Be it known that I, ISAAC H. LEVIN, a citizen of the United States, residing at the borough of Manhattan, in the city, county, and State of New York, 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, which form a part thereof.

My invention relates to diaphragms for electrolytic cells, and more particularly to a diaphragm of this type in which, by reason of its use with cells of large capacity in which the diaphragm is suspended from the means forming the gas chamber above the electrode, must have large surface area and possess sufficient tensile strength to resist distortion as a result of the dead load of the diaphragm upon its points of suspension.

Diaphragms of the type to which my invention relates, are ordinarily formed of woven asbestos, the weave being sufficiently close to form a gas impervious barrier possessing sufficient porosity to ensure the absorption thereby of electrolyte in a cell. Such fabrics have little inherent strength, and when a considerable length and breadth thereof is required to form the diaphragm, the constant stresses to which such diaphragms are subjected, as a result of the circulation of the electrolyte from adjacent the anode to adjacent the cathode, coupled with the dead load of the weight of the diaphragm, have a tendency to stretch the diaphragm at some point thereof in a manner to attenuate or separate some of the strands of asbestos cord with which the diaphragm is made to an extent to form channels of sufficient magnitude to permit the flowing electrolyte to carry gas bubbles from adjacent one electrode to adjacent the other while the cell with which the diaphragm is used is in operation. This likelihood of the formation of openings in the diaphragm as a result of the distortion thereof from the causes above referred to, was developed only with the development of high amperage cells.

In order to permit the use of diaphragms of woven asbestos or other similar material which is not subject to disintegration by contact with the diaphragm, I so construct the diaphragm that portions thereof only will be so reinforced as to have imparted thereto sufficient tensile strength to sustain the load of the diaphragm without likelihood of its stretching, these reinforcements being of the same material as, or a material similar to the body of the diaphragm, being so spaced in relation to each other as to cause a sufficient portion of the load of the diaphragm to be sustained thereby, while permitting intervening portions of the diaphragm to possess those characteristics which permit a free circulation of the electrolyte therethrough while preserving therein the necessary gas impervious properties. In this manner stretching of the diaphragm is reduced to a minimum, as determined by the increased strength of these reinforced portions without materially effecting or modifying the total capacity of the diaphragm as to the passage of electrolyte therethrough.

In a measure, the reinforced portions of the diaphragm will also check a tendency of the fabric of the diaphragm to wrinkle or buckle during the assembling of the cell, which tendency is also resisted by providing the lower edge of the diaphragm with a substantially rigid reinforcement extending about same. Since this reinforcement is carried by the diaphragm which is itself of non-conductive material, likelihood of short-circuiting through this stiffening or reinforcing member at the lower edge of the diaphragm is practically precluded, although preferably I enclose the reinforcing member in a bight or hem formed about this lower edge.

As a further safeguard against distortion of the diaphragm, I form a tuck in the material thereof which extends circumferentially about the entire diaphragm intermediate the top and bottom thereof.

In a diaphragm embodying my invention, I preserve therein a sufficient measure of flexibility, while ensuring sufficient stability in the fabric of the diaphragm to avoid likelihood of the formation of openings therethrough with a resultant commingling of gases generated upon opposite sides of the diaphragm.

The invention consists primarily in a diaphragm embodying therein a woven textile sheet immune to deterioration from the action of the electrolyte thereon, said diaphragm having an open top by which it is adapted to be suspended, a face of said sheet having secured thereto vertically extending strips spaced apart with relation to each other, and formed of a textile material also immune to the action of the electrolyte; and

in such other novel features of construction and combination of parts as are hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

Referring to the drawings,

Fig. 1 is a side view of a diaphragm embodying my invention;

Fig. 2 is an end view thereof; and

Fig. 3 is a section on the line 3—3 of Fig. 1.

Like letters refer to like parts throughout the several views.

In the embodiment of my invention shown in the drawings, *a* indicates a member forming a chamber adjacent the top of a cell for the reception of gas generated within the diaphragm.

The diaphragm proper consists of a sheet of textile fabric extending entirely about and secured to the lower part of the member *a* so as to form a continuous barrier about an electrode supported within said diaphragm. In this manner the top and the bottom of the diaphragm are both open so as to permit electrolyte to circulate freely through the open bottom thereof and permit the gas bubbles to escape freely through the open top thereof into the gas chamber above same.

Ordinarily this diaphragm is made of woven asbestos fabric which is immune to substantial deterioration from the electrolyte within the cell.

With high amperage cells using electrodes of large surface area, it is essential to use diaphragms also having a large area and the dead weight of such diaphragms is sufficiently great to cause the stretching thereof while the cell is in operation, with a resultant opening of interstices therethrough of sufficient magnitude to permit small gas bubbles to flow therethrough with the circulation of the electrolyte from one side of the diaphragm to the other, as a result of pressure conditions developed during the decomposition of the electrolyte. Such stresses on the diaphragm are in a direction from adjacent the anode to adjacent the cathode and are very much accentuated in cells of high output capacity.

Since large diaphragms possess considerable inherent weight which is very much increased when saturated with the electrolyte, it is apparent that in mounting the diaphragms in or removing them from the structure of the cell, the likelihood of distortion is very great under such conditions, even though the diaphragm is secured to the member *a* at closely adjacent points.

To avoid local disintegration of the diaphragm either while in use or while being assembled in or removed from the cell, I provide reinforcements extending vertically of the diaphragm, which will cause no material reduction in the absorptive properties of the diaphragm and will afford points of support spaced apart with relation to each other sufficiently to leave large areas of the desired normal thickness of the diaphragm, while sustaining the main load of the diaphragm at points having relatively lower elasticity or stretch than the main portion of the diaphragm.

In the accompanying drawings, the sheet of asbestos fabric forming the diaphragm is shown at *b*, while the vertically extending reinforcing strips which are preferably formed of the same material, are shown at *c*, the end reinforcing strips *c'* extending across the ends of the diaphragm and being lapped over the adjacent side portions thereof, since the additional thickness of the diaphragm at this point will have no appreciable effect upon the generation of the gases by reason of the thinness of the edges of the electrodes presented towards this portion.

The strips *c*—*c'* may be secured to the body sheet *a* in any desired manner as by stitching, although any other desired fastening means may be employed, since even though of metal, such means being supported by a body which is itself of non-conducting material, will have no tendency to short-circuit the cell.

To avoid possible skewing of the sheet, or a sagging thereof intermediate the reinforcements *c*—*c'*, I preferably loop the diaphragm upon itself to form a tuck therein, which extends horizontally about the diaphragm at a point intermediate the top and bottom thereof and forms a horizontally extending reinforcement *d*, this tuck being formed before the application of the reinforcing strips thereto.

At the bottom of the diaphragm, I preferably mount a rigid stiffening member or reinforcement *e*, which member is enveloped in the material of the diaphragm sheet so that it may, if desired, be of heavy metal wire, since the materials of the diaphragm sheet will serve as an insulation for this bottom reinforcement.

The number and arrangement of strips *c*—*c'* may be varied according to the surface area of the diaphragm, as may also their width, it being desired to limit the number to as few as possible, in order that the major portion of the diaphragm will have a standard thickness which will facilitate the circulation of electrolyte therethrough, although the absorbent properties and porosity of the reinforcing strips, both vertical and longitudinal, will permit the circulation of electrolyte therethrough with but slight retardation.

While the diaphragm is in use, the reinforcements employed will prevent any substantial vertical stress in the fabric of the

sheet *b*, since the reinforcements *c*—*c'* will give sufficient support to the diaphragm at points adjacent thereto to ensure against stretch at such points, and the dead weight of the diaphragm intermediate such reinforcements will be insufficient to cause material stretch at such intermediate point.

The horizontal reinforcement *d* will check any tendency of the diaphragm to stretch by reason of the bulging of the portions thereof between the strips *c*—*c'*, or check any tendency of these portions to stretch by reason of a skewing action of the diaphragm.

The rigid reinforcement *e* at the bottom of the diaphragm while supplementing the action of the reinforcement *d*, is provided mainly for the purpose of ensuring against the wrinkling or bunching in the diaphragm when assembling it in the cell.

It is not my intention to limit the invention to the precise details of construction shown in the accompanying drawings, it being apparent that such may be varied without departing from the spirit and scope of the invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent, is:—

1. A diaphragm embodying therein a woven textile sheet of material immune to deterioration from the action of electrolyte thereon and so formed as to completely enclose an electrode, and vertically extending strips secured upon a face thereof and spaced apart with relation to each other, said strips being formed of a textile material immune to the action of electrolyte thereon, whereby said sheet may be suspended from adjacent the upper edge thereof about the diaphragm without likelihood of the weight of the diaphragm distorting same so as to form openings of sufficient magnitude to permit gas bubbles to flow therethrough.

2. A diaphragm embodying therein a woven textile sheet of material immune to deterioration from the action of electrolyte thereon and so formed as to completely enclose an electrode, and vertically extending strips secured upon a face thereof and spaced apart with relation to each other, said strips being formed of a textile material immune to the action of electrolyte thereon, whereby said sheet may be suspended from adjacent the upper edge thereof about the diaphragm without likelihood of the weight of the diaphragm distorting same so as to form openings of sufficient magnitude to permit gas bubbles to flow therethrough, said sheet being so formed as to present a continuous barrier about an electrode and to have an open top and an open bottom.

3. A diaphragm embodying therein a woven textile sheet of material immune to deterioration from the action of electrolyte thereon and so formed as to completely enclose an electrode, and vertically extending strips secured at and extending across the opposite ends thereof, and lapping upon the sides adjacent each end, and upon opposite sides thereof at spaced intervals, said strips being formed of a textile material immune to the action of electrolyte thereon, whereby said sheet may be suspended from adjacent the upper edge thereof about the diaphragm without likelihood of the weight of the diaphragm distorting same so as to form openings of sufficient magnitude to permit gas bubbles to flow therethrough.

4. A diaphragm embodying therein a woven textile sheet of material immune to deterioration from the action of electrolyte thereon and so formed as to completely enclose an electrode, and vertically extending strips secured at and extending across the opposite ends thereof, and lapping upon the sides adjacent each end, and upon opposite sides thereof at spaced intervals, said strips being formed of a textile material immune to the action of electrolyte thereon, whereby said sheet may be suspended from adjacent the upper edge thereof about the diaphragm without likelihood of the weight of the diaphragm distorting same so as to form openings of sufficient magnitude to permit gas bubbles to flow therethrough, said sheet being so formed as to prevent a continuous barrier about an electrode and to have an open top and an open bottom.

5. A diaphragm embodying therein a woven textile sheet of material immune to deterioration from the action of electrolyte thereon and so formed as to completely enclose an electrode, vertically extending strips secured upon a face thereof and spaced apart with relation to each other, said strips being formed of a textile material immune to the action of electrolyte thereon, whereby said sheet may be suspended from adjacent the upper edge thereof about the diaphragm without likelihood of the weight of the diaphragm distorting same so as to form openings of sufficient magnitude to permit gas bubbles to flow therethrough, and a horizontal fold extending about the material of the diaphragm.

6. A diaphragm embodying therein a woven textile sheet of material immune to deterioration from the action of electrolyte thereon and so formed as to completely enclose an electrode, vertically extending strips secured upon a face thereof and spaced apart with relation to each other, said strips being formed of a textile material immune to the action of electrolyte thereon, whereby said sheet may be suspended from adjacent the upper edge thereof about the diaphragm without likelihood of the weight of the diaphragm distorting same so as to form openings of sufficient magnitude to permit gas bubbles to flow therethrough, said sheet be-

ing so formed as to present a continuous barrier about an electrode and to have an open top and an open bottom, and a rigid reinforcement extending about the lower edge of the diaphragm.

7. A diaphragm embodying therein a woven textile sheet of material immune to deterioration from the action of electrolyte thereon and so formed as to completely enclose an electrode, vertically extending strips secured upon a face thereof and spaced apart with relation to each other, said strips being formed of a textile material immune to the action of electrolyte thereon, whereby said sheet may be suspended from adjacent the upper edge thereof about the diaphragm without likelihood of the weight of the diaphragm distorting same so as to form openings of sufficient magnitude to permit gas bubbles to flow therethrough, said sheet being so formed as to present a continuous barrier about an electrode and to have an open top and an open bottom, a hem being formed about the open bottom of said diaphragm, and a metallic reinforcement enclosed by said hem, whereby said reinforcement will have a non-conductive covering.

8. A diaphragm embodying therein a flexible absorbent body adapted to be interposed between electrodes of opposite polarity and adapted to be suspended from adjacent the upper edge thereof, and vertically extending strips of absorbent material secured upon a face thereof and spaced apart with relation to each other, whereby said sheet is relieved from likelihood of distortion from the weight of the diaphragm, and the resultant formation of openings of sufficient magnitude to permit gas bubbles to flow therethrough.

In witness whereof I have hereunto affixed my signature, in the presence of two subscribing witnesses, this 30th day of September 1921.

ISAAC H. LEVIN.

Witnesses:
LENA FRIEDMAN,
C. A. KAUFOLD.