

UNITED STATES PATENT OFFICE

1,942,183

DIAPHRAGM FOR ELECTROLYTIC CELLS

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No Drawing. Application June 7, 1928, Serial No. 283,737, and in Austria February 15, 1928

4 Claims. (Cl. 204—28)

This invention relates to diaphragms for use in electrolytic cells and particularly those used in chlorine-alkaline electrolysis.

In previous chlorine-alkaline cells diaphragms have been employed consisting of sulphate of barium, with or without the addition of loosening means, applied to a support or carrier. With such diaphragms, relatively thick layers of the material must be employed in order that the separating effect and control of the current flow should be sufficient. Owing to the granularity of the materials usually employed, it is generally necessary to place the diaphragms at a considerable distance from the electrodes in order to avoid agitation thereof by the gas developed at the anode during the process.

The object of the invention is to provide a simple and efficient diaphragm which can be made thinner than usual, disposed closer to the electrodes to reduce the voltage loss, and will not materially be effected by the agitation of gas developed at the anode during the process.

The invention concerns an important improvement widely departing from former practice and comprises a porous diaphragm formed of finely divided non-porous material, held firmly together by means of a binder of glutinous material. The material used is either substantially insoluble in the electrolyte or becomes insoluble as soon as used in the electrolyte. If an ordinarily soluble substance is used, it has to be chemically treated to become insoluble after being molded to form with the binder. With such structures, the necessary separation effect and control of the current flow can be obtained with a much thinner layer and with much less material. The cohesion between the particles of material produced by the use of binder material allows the distance between the diaphragm and the electrode to be reduced without detrimental effect on the diaphragm, and with a corresponding decrease in voltage drop. Such diaphragms are readily manufactured in any required size or shape and in case of damage can be easily repaired.

For large diaphragms, forms of paper, fabric cloth or the like can be used, and then stripped from the diaphragm when set, or chemically dissolved out. Metal fabrics, perforated or slotted frames, glass cloths, asbestos cloths or the like, can be employed as carriers for the diaphragm material, one or both sides being impregnated with the material or a mixture of material. Electrodes can also be coated and used.

As diaphragm materials, substances preferably

in finely divided form which are non-porous and insoluble, or only slightly soluble, are suitable, such as barium sulphate, quartz, glass powder, cleansed slag, asbestos powder, corundum, and mixtures of these materials.

Suitable glutinous binding materials are solutions of rubber, gutta-percha, balata, cellulose products, natural and artificial resins and the like, or mixtures of these materials.

To increase the porosity of these diaphragms, soluble materials such as sodium chloride can be added to the mixture and then dissolved out of the diaphragm either before being used, or when first used.

Following are examples of diaphragms constructed in accordance with my invention:

Example 1.—The diaphragm substance according to the present invention may consist of 100 parts of a benzine rubber solution mixed with 160 parts of barium sulphate and 10 parts of asbestos, which gives a pulpy coherent rubber-mass which can be spread in a thin coherent and uniform layer on the metal fabric and allowed to dry. Instead of benzine, other solvents such as trichlorethylene, carbon tetrachloride, chloroform and the like can be employed. There are on the square metre then 1500 g. of benzine rubber solution, 2400 g. barium sulphate, 160 g. asbestos.

A layer about 0.5 mm. thick of the diaphragm forms an efficient separation between the cathode and anode chamber and reduces the potential fall by one volt as compared with the usual diaphragm at a current load of 1000 amps. per square metre of diaphragm surface. Such a diaphragm is very flexible, and is capable of being rolled up into a cylindrical form, like a carpet.

Example 2.—Instead of barium sulphate and asbestos, glass powder may be employed with equally good results, 80 parts of glass powder are thoroughly mixed with 100 parts of a benzine rubber solution to a uniform mass which can be easily spread as a coherent uniform layer on the diaphragm carrier.

Example 3.—150 parts of a gutta-percha-chloroform solution are thoroughly mixed with 100 parts of barium sulphate and 1 part of asbestos and uniformly applied. The action is the same as in Examples 1 and 2.

Example 4.—An electrode consisting of a conducting metal fabric is spread over with one of the diaphragm materials mentioned in Examples 1-3 and is inserted horizontally in a chlorine-alkali electrolytic cell. In spite of the reduction in the electrolytic voltage, the efficiency and separating

effect are in no way lessened as compared with the other diaphragms.

Example 5.—An iron wire cloth is coated according to Example 4 with one of the previously mentioned diaphragm substances and is inserted vertically as a cathode-diaphragm-electrode for electrolyzing aqueous alkali.

Example 6.—A diaphragm substance according to Example 5 is applied to a nickel wire cloth and is used as the anode in electrolyzing water. The resulting gases have the highest purity.

Example 7.—To the compounds described in Examples 1-6 are added, more particularly when metal carriers are used, one-half part of short fibred asbestos, glass wool, mineral wool or the like. To increase porosity, one half part of sodium chloride or another suitable soluble salt or mixture of soluble salts may be added.

Example 8.—Instead of the rubber or gutta-percha solutions of the preceding examples, solutions of cellulose esters can be employed having the following composition:

10 parts of cellulose acetate are dissolved in 100 parts of a solvent for acetylcellulose. 5 parts of powdered corundum and 18 parts of the cellulose acetate solution are well stirred into a homogeneous mass, if necessary with the addition of further quantities of the solvent, and are applied to the diaphragm supports in a thin coherent layer and allowed to dry. In applying this diaphragm in the manner described in Examples 1-7 equally satisfactory results as to quality and yield of products are obtained.

Example 9.—10 parts of nitrocellulose are dissolved in 100 parts of a suitable solvent and mixed with 7 parts of purified powdered slag, eventually with the addition of further quantities of the solu-

tion until the mass is homogeneous and can be easily spread and applied in a thin coherent layer to a suitable carrier. After evaporation of the solvent, the diaphragm obtained in this way can be employed as described in the preceding examples.

The quantity relations given in the examples can obviously be varied, and the cellulose products can be replaced by other cellulose derivatives, for example cellulose ether, or ester-ether mixtures can be used with equally good results.

It is understood that in the following claims any reference to specific materials employed are intended to be interpreted to include the equivalents thereof which are set forth in the specification.

I claim:

1. A diaphragm for an electrolytic cell comprising finely divided barium sulphate, and a binder of organic glutinous character.

2. A diaphragm for an electrolytic cell comprising finely divided barium sulphate, insoluble fibrous material, and a binder of organic glutinous character.

3. A flexible diaphragm for an electrolytic cell comprising finely divided substantially insoluble non-porous material, an organic binder insoluble in water and soluble in organic solvents, and a conducting carrier.

4. A flexible diaphragm for an electrolytic cell comprising finely divided substantially insoluble non-porous material, insoluble fibrous material, an organic binder insoluble in water and soluble in organic solvents, and a metallic conducting carrier.

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