(No Model.)

J. D. DARLING.

POROUS DIAPHRAGM FOR ELECTROLYTIC APPARATUS.

No. 590,826. Patented Sept. 28, 1897.

FIG. 2.

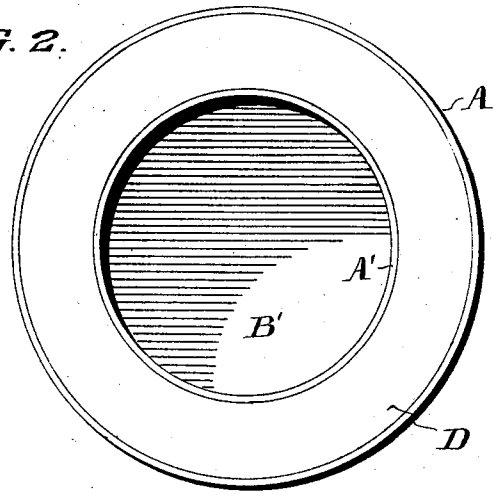
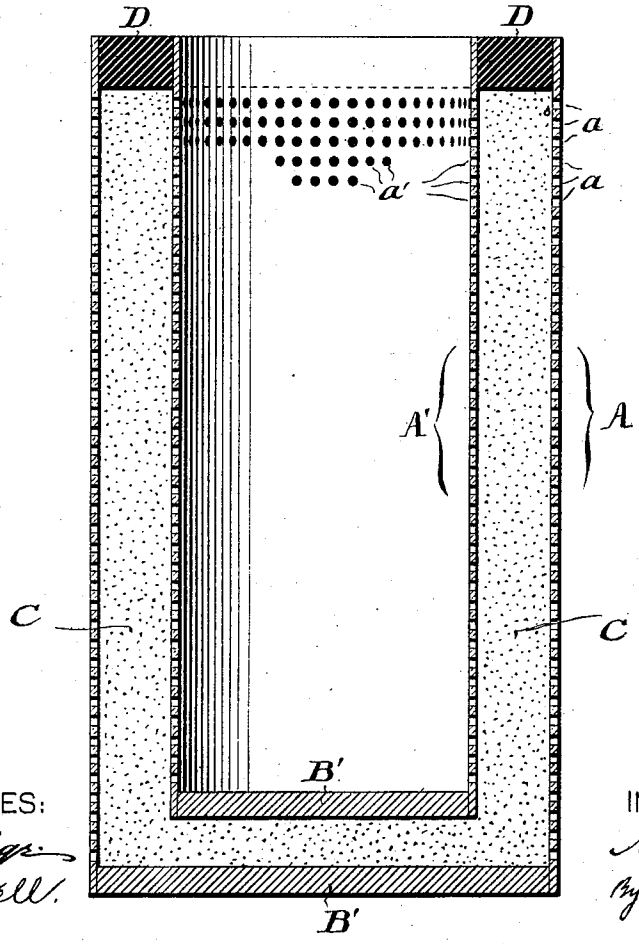


FIG. 1.



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POROUS DIAPHRAGM FOR ELECTROLYTIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 590,826, dated September 28, 1897.

Application filed October 21, 1896. Serial No. 609,525. (No model.)

To all whom it may concern:

Be it known that I, JAMES D. DARLING, a resident of the city of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Porous Diaphragms for Electrolytic Apparatus, of which the following is a specification, reference being had to the accompanying drawings, wherein—

Figure 1 represents a vertical longitudinal section through an apparatus embodying the invention in a preferred form, Fig. 2 being a top or plan view of the same.

In the electrolysis of many dissolved or fused salts there is usually a large loss of efficiency through the tendency of the liberated ions to recombine, either assuming their former relation or forming some new compound. A common expedient to avoid this difficulty is found in the use of porous diaphragms which effect the physical separation of the positive from the negative electrode, and consequently prevent recombination, while at the same time affording no substantial impediment to the electrolytic travel in the desired direction. While in the case of aqueous solutions this method is quite practicable, it is found that where the electrolyte is a fused mass—such as an hydroxid, or haloid salt of an alkali metal, or an alkaline earth metal, or a nitrate or sulfate of such metal—the action thereof is highly destructive of the porous diaphragm, so that the utility of the apparatus is limited to a comparatively short duration.

The object of my invention is to provide a diaphragm which shall resist destruction as far as possible under the conditions of use and which can be so arranged as to afford any degree of resistance within the desired limits. To these ends I combine with a suitable support a filling or mass of granular material whose chemical constitution is such that it is substantially not decomposible or fluxible by the fused electrolyte and whose physical properties enable it to maintain with substantial permanence a definite granular form without tendency to break down into an impalpable powder and drift away. I have found that material having the necessary chemical constitution may by exposure to a very high heat attain a substantially vitrified condition and that after such treatment it may be reduced to small granules, which can be used for the purpose indicated without fluxing or mechanical disintegration to such an extent as prevents commercial economy.

I will now proceed to describe a typical and preferred embodiment of my invention.

In the accompanying drawings, A represents a cylindrical shell of sheet-iron or steel, perforated with numerous small holes, as indicated at *a*, and firmly secured to a solid base B. Within this shell is a smaller shell A′, similarly perforated, as partially indicated at *a*′, and secured to a corresponding base B′. The annular inner space between the shells may be of such radial diameter as may be desired to facilitate the insertion and removal of the filling which is about to be described, or to provide for any desired thickness of such filling. So also a space may be left between the bases B B′, as indicated.

Convenient dimensions are as follows: The outer shell may be seventeen inches in diameter, the inner one fifteen and one-half inches, the total diameter of the outer shell nine and one-half inches, and the inner shell six inches, though I of course do not limit myself to such dimensions nor to the specific form above described.

The interspace between the shells contains the filling, which constitutes the primary feature of my invention, and which is prepared as follows: I take, preferably, magnesia, as nearly as possible chemically pure, and fuse it in an electric furnace to a vitrified condition, approximating in appearance a nearly clear glass. This is then crushed or granulated to a proper degree of fineness, the particles being preferably of such size as to pass through a twenty-mesh sieve, but not through one of thirty mesh. The interspace between the cylinders A and A′ is then packed uniformly with this granular vitrified material, as indicated at C, to a point near the top, above which a layer of cement D may be applied to hold the particles firmly in position. The perforations in the shells A and A′ are indicated conventionally in the drawings,

but it must be understood, of course, that they are not so large as to allow the material to readily fall out under the conditions of use. The porosity and resistance of the diaphragm thus formed may be varied to suit any desired conditions by increasing or diminishing the total thickness of the mass of granular material or by using finer or coarser granules. A porous diaphragm can be thus obtained which resists in the highest degree the destructive action of the fused salts, and which is at the same time properly permeable for electrolytic travel.

I have indicated magnesia as the preferred material for the diaphragm, but I do not limit myself thereto, since other earthy oxids—such, for instance, as those of calcium or barium or mixtures of earthy oxids—may be employed, provided the material be such as resists in a high degree combination with or fluxing by alkaline hydroxids, or the haloid salts of alkali metals, or the alkaline earth metals, or the nitrates or sulfates of such metals. The more nearly that the material employed for the filling is chemically pure the more highly resistant it will usually be found under given conditons, but in commercial practice it is of course very difficult to obtain such chemically pure material, and for commercial purposes absolute indestructibility of the material is of course not essential, since the electrolytic process can be carried on with economy and success even though the filling should deteriorate after a time under the intensely severe exposure to which it is subjected. Hence I do not limit my invention to the use of chemically pure materials, nor to such as are absolutely indestructible, but in my claims I employ the words "substantially resistant to combination or fluxing" as indicating the general characteristics of the material without rigid limitation to the possession of qualities beyond practical needs.

I have described the invention as embodied in a "cup," properly so called, but obviously its use is not limited to this specific arrangement, since a diaphragm for electrolytic purposes may be of any desired form, and I prefer to use the word "diaphragm" as generally comprehending the structure without reference to its shape. So also I have specified perforated sheet metal as the preferred material for the support used to retain the granulated filling; but I do not limit my claim thereto, and use the term "perforated" support as comprehending, broadly, any retaining device which is provided with openings and which is otherwise suitable for the indicated purpose. I do not, however, claim, broadly, the use of such perforated supports, as I am aware that they have heretofore been employed in electrolytic apparatus.

Having thus described my invention, I claim—

1. As an improvement in porous diaphragms for electrolytic apparatus, the combination, with a support, of a granular filling consisting principally of a vitrified oxid or oxids, substantially resistant to combination or fluxing by a fused hydroxid or other above-specified compound under the conditions of electrolysis, substantially as set forth.

2. As an improvement in porous diaphragms for electrolytic apparatus, the combination, with a support, of a granular filling consisting principally of vitrified magnesia, substantially as set forth.

3. As an improvement in porous diaphragms for electrolytic apparatus, the combination, of a pair of cylindrical, perforated supports, arranged with an interspace between them; bases for said supports; an intermediate granular filling consisting principally of vitrified magnesia arranged in the interspace between said supports; and an annular top of cement above said filling, substantially as set forth.

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