No. 641,276. Patented Jan. 16, 1900.

J. D. DARLING.

POROUS DIAPHRAGM FOR CELLS EMPLOYING FUSED ELECTROLYTES.

(Application filed Dec. 6, 1898.)

(No Model.)

FIG. 2.

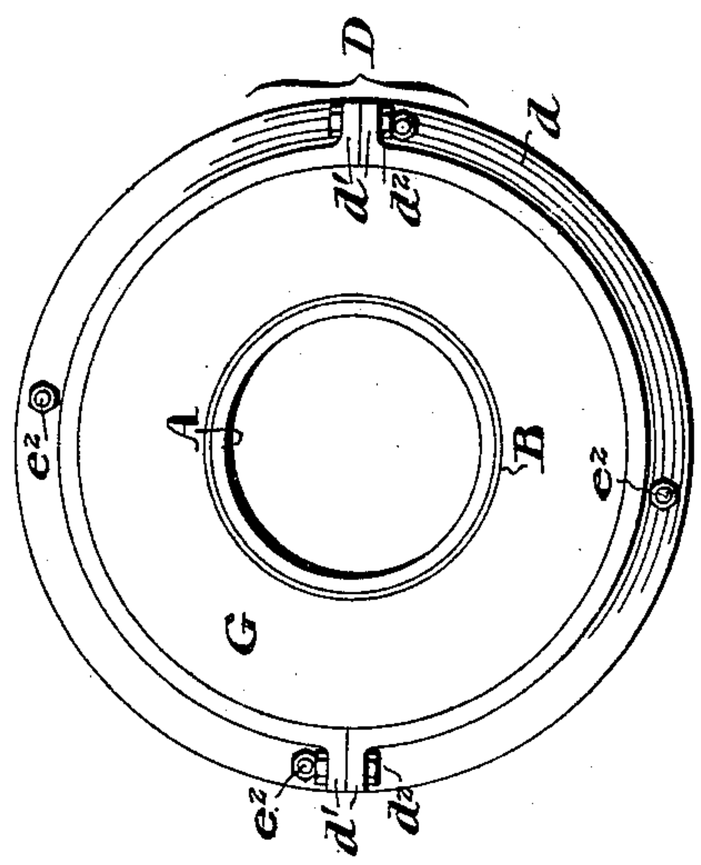


FIG. 3.

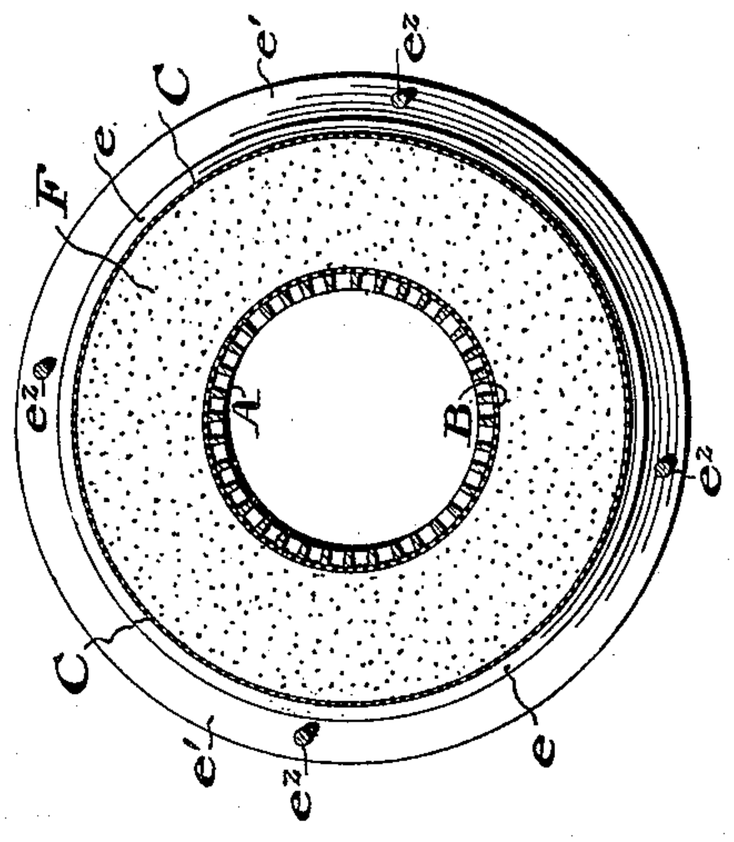
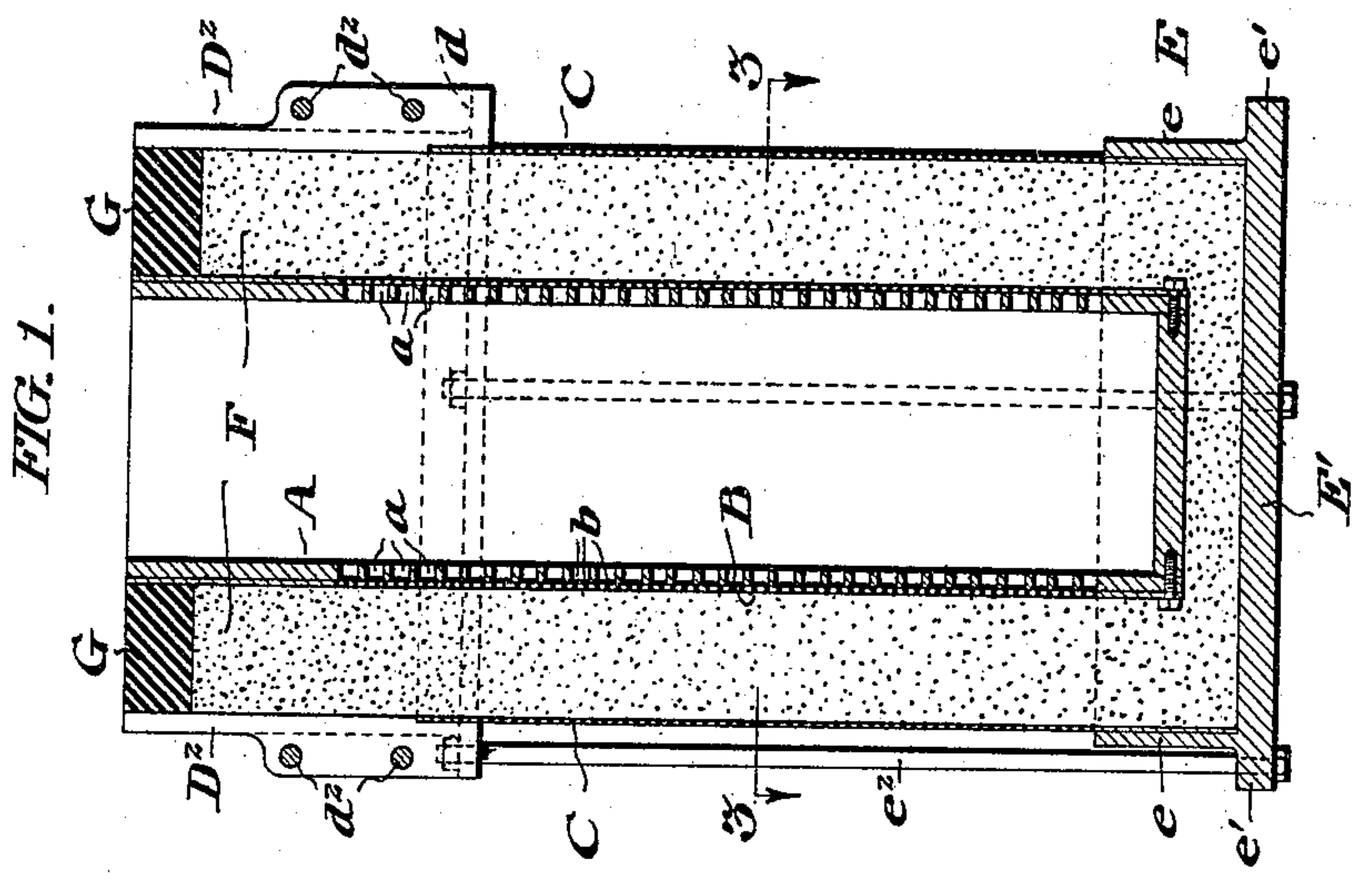


FIG. 1.



WITNESSES:

Arthur E. Paige.

James H. Bell

INVENTOR:

James D. Darling,

By Raby & Paul,

Attorneys.

UNITED STATES PATENT OFFICE.

JAMES D. DARLING, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE HARRISON BROS. & COMPANY, INCORPORATED, OF SAME PLACE.

POROUS DIAPHRAGM FOR CELLS EMPLOYING FUSED ELECTROLYTES.

SPECIFICATION forming part of Letters Patent No. 641,276, dated January 16, 1900.

Application filed December 6, 1898. Serial No. 698,407. (No model.)

To all whom it may concern:

Be it known that I, JAMES D. DARLING, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Porous Diaphragms for Cells Employing Fused Electrolytes, whereof the following is a specification, reference being had to the accompanying drawings.

In said drawings, Figure 1 represents a vertical longitudinal section through a diaphragm embodying the invention. Fig. 2 is a top or plan view thereof; and Fig. 3 is a cross-section on the line 3 3 of Fig. 1.

My invention is intended for use in electrolytic apparatus adapted for the treatment of such electrolytes as a hydroxid, the haloid salt of an alkali metal, or an alkali-earth metal, or a nitrate or sulfate of such metal in a fused state, the action of such electrolyte being, as is well known, highly destructive of the material which is ordinarily used for the diaphragm. In Letters Patent No. 590,826, dated September 28, 1897, I have set forth and claimed a diaphragm for this purpose, consisting principally of a vitrified oxid or oxids. Such diaphragms are permanent and efficient to the highest extent, but somewhat costly under present conditions of manufacture, and I have therefore addressed myself to the construction of a diaphragm which should possess the necessary qualities in a high degree, but at the same time be comparatively moderate in cost. It has generally been supposed that any material containing silica would be of little value for such purpose, owing to the fact that in theory the fused electrolyte would naturally attack the silica with great eagerness, and thus destroy the integrity of the structure. I have, however, ascertained that, contrary to natural expectation, a diaphragm composed of Portland cement in combination with a refractory oxid not in itself liable to combine with or be fluxed by the fused electrolyte is highly permanent and efficient and has little or no tendency to crack under the conditions of use. I have utilized this discovery in the invention now sought to be patented and which I will describe as embodied in a convenient form.

Referring to the drawings, it will be seen that in this instance the diaphragm is in the form of a hollow cylinder closed at the bottom, and consists of a supporting-casing and a filling of the efficient material of the diaphragm. The supporting-casing comprises an interior shell A, preferably of wrought-iron pipe, throughout the greater portion of whose length a number of radial holes *a* are drilled. Immediately outside of this and in close contact therewith is a covering of wire-gauze B, having interstices *b* of very much less diameter than the holes *a*. A larger concentric shell C, of perforated metal or wire-gauze, forms the exterior wall of the casing.

To minimize local and secondary action upon the metal walls of the casing, the latter may be electrically connected with the line-wire at a point between the anode and the positive pole of the source of electricity. I do not, however, in this application claim the use of such shunt-circuit, as the same is set forth in my pending application, Serial No. 710,571, filed March 27, 1899.

For convenience of renewal of the parts I prefer to construct the top and bottom of separable imperforate pieces, as indicated, D representing the annular top, composed of two semicircular pieces D′ D², joined together by means of bolts d^2, passing through adjacent vertical flanges d' d', said pieces being also provided with outwardly-projecting horizontal flanges *d* around the lower periphery. The cup-shaped bottom piece E, which may be constructed integrally, comprises a base E′ with a vertical cylindrical wall *e*, outside of which is a horizontal flange *e*′. Through the flanges *d* and *e*′ vertical bolts e^2 extend at proper intervals, thus uniting the top and bottom portions, the outer shell C being tightly inclosed thereby, as indicated. The space between the outer shell C and the covering B of the inner shell is filled with the material F of the diaphragm proper. This is composed of Portland cement, combined with a refractory oxid of the character before mentioned.

I have found that a material well adapted for the purpose consists in burned or calcined magnesite. When calcined at a red heat, the magnesite, which is a natural carbonate of magnesia, is reduced to magnesium oxid in the form of hard dense lumps, which are then

ground to a proper degree of fineness—for instance, of such size as to pass through a twenty-mesh sieve, but not through a thirty mesh. A mixture of equal parts, by measure, of Portland cement and such ground burned magnesite, mixed with water and allowed to set in position between the shells, gives a filling which is highly permanent both as against the attack of the electrolyte and as against what otherwise would be the destructive effect of the heat. The filling may be topped with a layer G of cement alone, if desired. In my broad claim for the use of Portland cement with such an admixture I do not, of course, limit myself to the particular material described as preferable, as any oxid which does not combine with and is not fluxed by the fused electrolyte and which does not in itself increase the tendency of the cement to crack under the effect of heat may be substituted without departing from the principle of my invention.

Having thus described my invention, I claim—

1. The combination of a vessel adapted to withstand the action of a molten electrolyte; means for maintaining the electrolyte in a molten condition; electrodes; and a diaphragm, consisting of Portland cement and a powdered oxid, substantially resistant to combination or fluxing by the fused electrolyte, interposed between the electrodes, substantially as described.

2. The combination of a vessel adapted to withstand the action of a molten electrolyte; means for maintaining the electrolyte in a molten condition; electrodes; and a diaphragm, consisting of Portland cement and ground burned magnesite, interposed between the electrodes, substantially as described.

3. The combination of an inclosed shell, consisting of an inner perforated tube; a cylindrical covering of wire-gauze having smaller perforations; an exterior perforated shell; a porous filling arranged between said shells; and removable top and bottom pieces provided with projecting flanges and with bolts engaging said flanges, substantially as set forth.

JAMES D. DARLING.

Witnesses:
JAMES H. BELL,
RANDOLPH SALTER.