

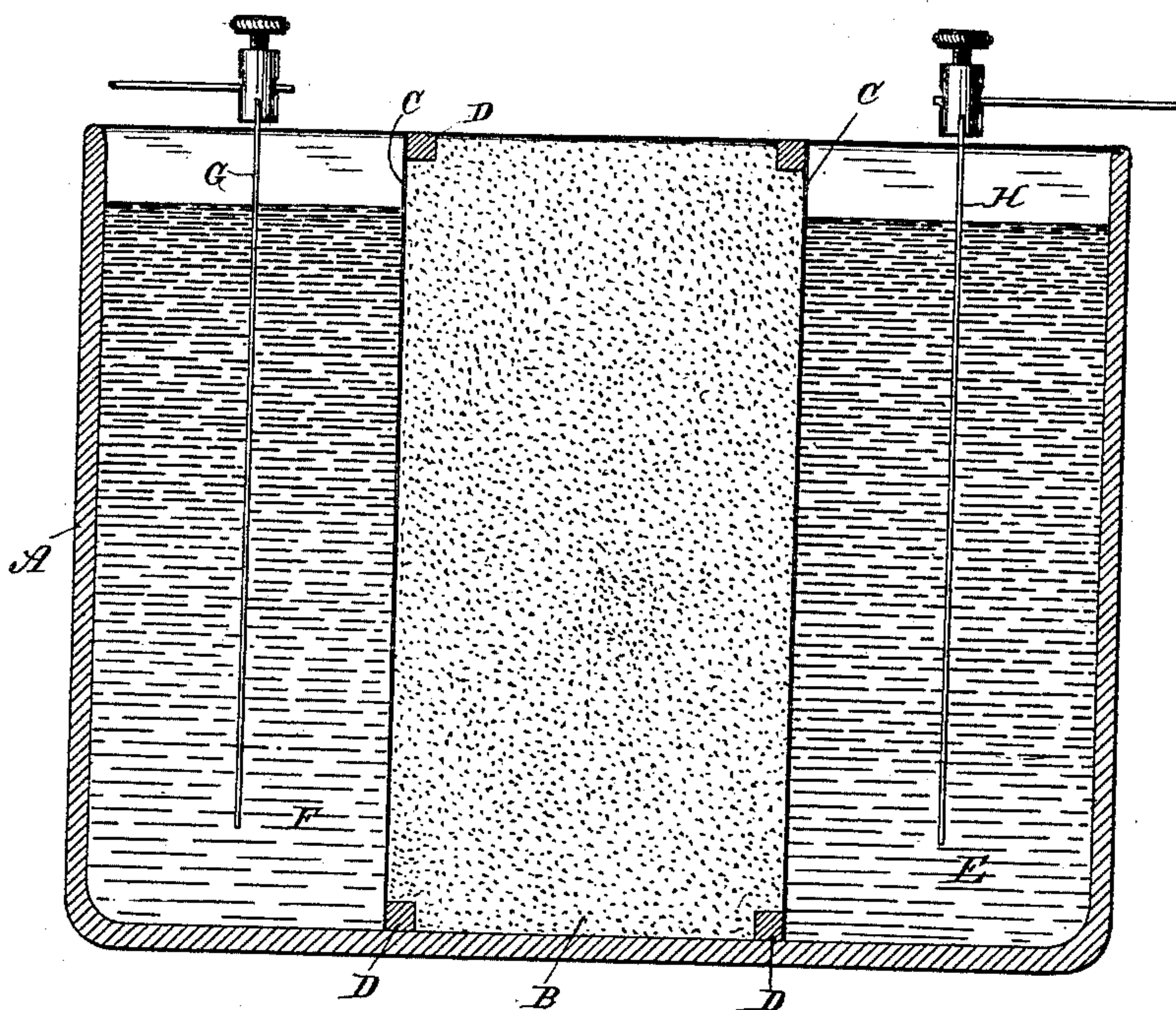
(No Model.)

I. L. ROBERTS.

SEPARATING DIAPHRAGM FOR ELECTROLYTIC CELLS.

No. 442,203.

Patented Dec. 9, 1890.



WITNESSES:

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SEPARATING-DIAPHRAGM FOR ELECTROLYTIC CELLS.

SPECIFICATION forming part of Letters Patent No. 442,203, dated December 9, 1890.

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To all whom it may concern:

Be it known that I, ISAIAH L. ROBERTS, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have discovered certain new and useful Improvements in Electrolytic Cells, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

The state of the art as it concerns or relates to the invention which forms the subject of the present application is, so far as my present information extends, substantially as follows: Porous partitions or diaphragms of various kinds have been used in electrolytic cells, having been interposed between the electrodes. With these diaphragms it has been proposed to use a decomposable anode—that is to say, an anode composed of a substance capable of chemically combining with and absorbing the acid radicals set free by the electrolytic action, and also an anode which will not so unite with the nascent acid radical. I have, moreover, used with a decomposable anode a partition or diaphragm of practically non-porous character and sometimes two or more of such partitions interposed between the electrodes. In all cases, however, the thickness of the diaphragms or partitions has been determined, chiefly, by considerations of the purely electrical resistance which they offer. In other words, these diaphragms have been made as thin as possible with a view in the case of porous partitions to intercepting only the passage of solid particles and of not adding materially to the internal resistance of the cell, and in the case of non-porous diaphragms merely to oppose the diffusion of the electrolytic and the recombination of the liberated radicals and bases by an impermeable barrier, which permits, however, the transference of the acid radicals.

If by means of any form of electrolytic cell heretofore made and using non-decomposable anode the attempt be made to decompose an electrolyte, the tendency of the liberated acid radicals and bases to recombine will be prevented by the ordinary porous diaphragms to such a small extent as to render the process

of little practical value. Even the use of a thin partition of a non-porous character obviates this in a measure only, as the recombination takes place in the body of the partition itself, destroying after a time its conductivity and rendering it useless.

I have discovered what appears to be a property of these partitions or diaphragms hitherto disregarded, or which, at least, has not been taken advantage of in processes of this character, in which it is desirable to obtain products by electrolysis approximately chemically pure. In other words, I have discovered that these diaphragms offer a resistance to electrolytic action, as well as to the passage of the electric current, which “electrolytic resistance,” if it may be so termed, increases with the thickness or mass of any given partition. As an example, if a cell containing electrodes of hard carbon or platinum be divided by an ordinary thin porous partition and filled with a solution of common salt, a current passed through it operates to transfer the chlorine radical to the anode-chamber to liberate hydrogen at the cathode; but in practice it will be found under such conditions that but little gas actually escapes at the cathode, and that the chlorine radical merely recombines with its base, for which it has apparently a stronger affinity than for the hydrogen.

I have found that by increasing the electrolytic resistance of the diaphragm, which, as I have before stated, may be done by increasing its thickness independently of or without regard to its true electrical resistance, this tendency to recombination is proportionately overcome and practicable and useful results obtained. I have found, for instance, that commercial caustic soda may be obtained in this manner by the use of a slightly porous or non-porous partition of about five centimeters in thickness, which it is desirable to construct in such manner as to secure as low an electrical resistance as practicable.

To define in general terms, therefore, the invention, and assuming that heretofore these partitions or diaphragms when used have had a relatively low or practically no electrolytic

resistance, I would state it as consisting, broadly, in the employment, with the electrodes of an electrolytic cell, of a partition or diaphragm of a relatively high electrolytic resistance.

In the case of an electrolytic tank or cell containing two chambers or compartments filled with solutions I have found, as above stated, that the thickness of the diaphragm should be about five centimeters or more; but the actual thickness in all cases that is necessary to the attainment of the best results will obviously vary.

It is obvious that in increasing the electrolytic resistance of the partition it is undesirable to increase the electrical resistance; but with the ordinary forms of diaphragm or partition this would be scarcely possible. In seeking, therefore, to obviate this I have devised a form of partition which answers the practicable requirements of the case. This partition I designate a "composite" partition or diaphragm—that is to say, it consists of a support or frame containing or sustaining a suitable substance that will permit the proper electrolytic action to take place through it without adding injuriously to the electrical resistance of the cell. This may be accomplished in many ways. For example, I form two supporting-walls of cloth, canvas, thin earthenware, or the like, and fill in the intermediate space with a solution of silicate of soda and water of about 18° Baumé and gelatinize it. This I do, preferably, by filling the anode and cathode chambers with an acid or a salt which will gelatinize the silicate when mixed with it. Combination through the walls will gradually take place by diffusion in more or less time, according to the mass of silicate, thus gradually producing a dividing-wall of gelatinous silica between the electrode-compartments. If a current of electricity be passed through the cell, it will somewhat hasten the gelatinization.

In order to obtain the best results, I use for the walls or supports porous earthenware plates which have been soaked in the solution of silicate above described and then treated with an acid or a salt to gelatinize the silicate in its pores, or I may use for the same purpose a substance commercially known as "gelatinized fiber."

Another way to make a partition is to fill in the space between the supporting-walls with a paste made of slaked lime and of the consistency of mortar. This should be filled in so as not to leave any air holes or spaces in the mass, as these tend to increase the electrical resistance of the partition or permit the commingling of the liquids on its opposite sides. It is to be observed that with a partition thus made with lime only alkaline electrolytes should be used, as acids would dissolve it, unless it were some such acid as sulphuric acid, which would convert it into an insoluble sulphate, which would very materially increase the electrical resistance unless the

paste contains a large proportion of water. Precipitated or pulverized sulphate of calcium, however, would answer the purpose, if used as a mortar. Very fine sand or preferably silica may also be used, but to less advantage than lime. Other materials which may be used for the same purpose are fibrous asbestos packed in between the supporting-walls, and this should be wet with an acid or salt, or a paste made of cooked starch in water or of various other gelatinous, glutinous, and albuminous substances. Gelatinous silica should be used on the anode side of the partition in all these cases, as the acid liberated there would tend to injure most, if not all, the organic pastes and gelatinous substances. Partitions thus made and used under the conditions set forth should have a thickness of about five centimeters, and may be thicker.

Any conductor may be used as a cathode; but the anode should be some conductor which will not unite with the nascent acid radical when liberated, at least to an injurious extent. Platinum or hard-baked carbon will answer for the anode in any case. In certain cases, as when chlorine radicals are liberated, I use an anode of lead; but this is slowly decomposed.

For such materials as I have described the thickness of the diaphragms should be about as I have stated. If other materials be used, and I have discovered certain others, the diaphragms may be more or less thick; but this will be determined solely by the electrolytic resistance, or, in other words, by the tendency which they possess of resisting chemical recombination.

Through the partitions which I have described no appreciable endosmose or exosmose will take place; but a slight commingling of the liquid may take place in course of time by the law of diffusion; but this is so slow in comparison to the effect of endosmose and exosmose as not to seriously interfere with the attainment of excellent results.

Generally, it may be stated that the thicker the partition within reasonable limits and the more thoroughly gelatinous or finely divided the compound or the fibrous or granular the substance the more nearly perfect the electrolysis and the more nearly pure the products.

I have shown in the accompanying drawings a vertical central cross-section of a cell constructed in accordance with my invention. The partition or diaphragm, it will be understood, may be of any shape or form, provided it divides the cell into at least two compartments containing, respectively, the electrodes and a suitable electrolyte.

In the present case A is a jar, vat, or tank; G H, the electrodes; F E, the electrode chambers or compartments containing the desired fluids. C C indicate the supporting or containing walls of the composite partition; D D, any light frame-work supporting the same, in case they may be incapable of self-support, as

when made of flexible materials, like canvas. B is the intermediate filling substance, gelatinous, fibrous, or granular, as the case may be.

Having now described my invention, what I claim is—

1. In an electrolytic cell, the combination, with the electrodes, of an intermediate partition or diaphragm having a relatively high electrolytic resistance, as set forth.

2. In an electrolytic cell, the combination, with a cathode and an anode not decomposable by the electrolyte, of a dividing wall or partition of relatively high electrolytic resistance interposed between the electrodes, as set forth.

3. In an electrolytic cell, the combination, with a cathode and an anode not decomposable by the electrolyte, of a non-porous partition or wall interposed between the electrodes, as set forth.

4. A composite diaphragm or partition for electrolytic cells, composed of supporting or containing walls or holders, with an intermediate filling, as set forth.

5. A composite diaphragm or partition for electrolytic cells, composed of supporting or containing walls of porous earthenware saturated with a gelatinous substance, with an intermediate filling of gelatinous substance, as set forth. 25

6. A composite diaphragm or partition for electrolytic cells, composed of a gelatinous or equivalent substance held by rigid or equivalent supports in the form of a dividing wall or partition between the electrodes, as set forth. 30 35

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Witnesses:

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