

(No Model.)

I. L. ROBERTS.  
APPARATUS FOR USE IN ELECTROLYSIS.

No. 442,333.

Patented Dec. 9, 1890.

FIG. 1

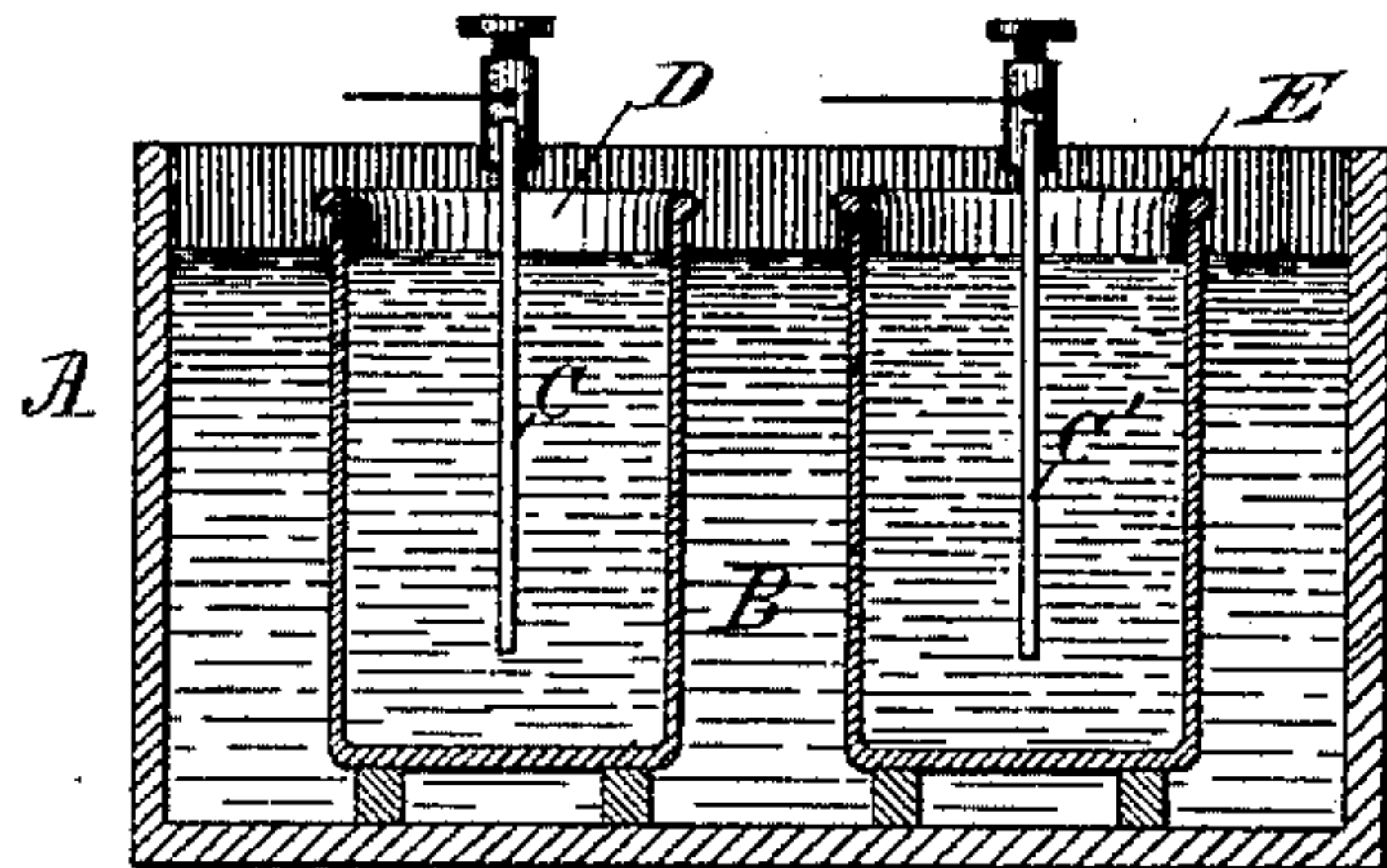


FIG. 2

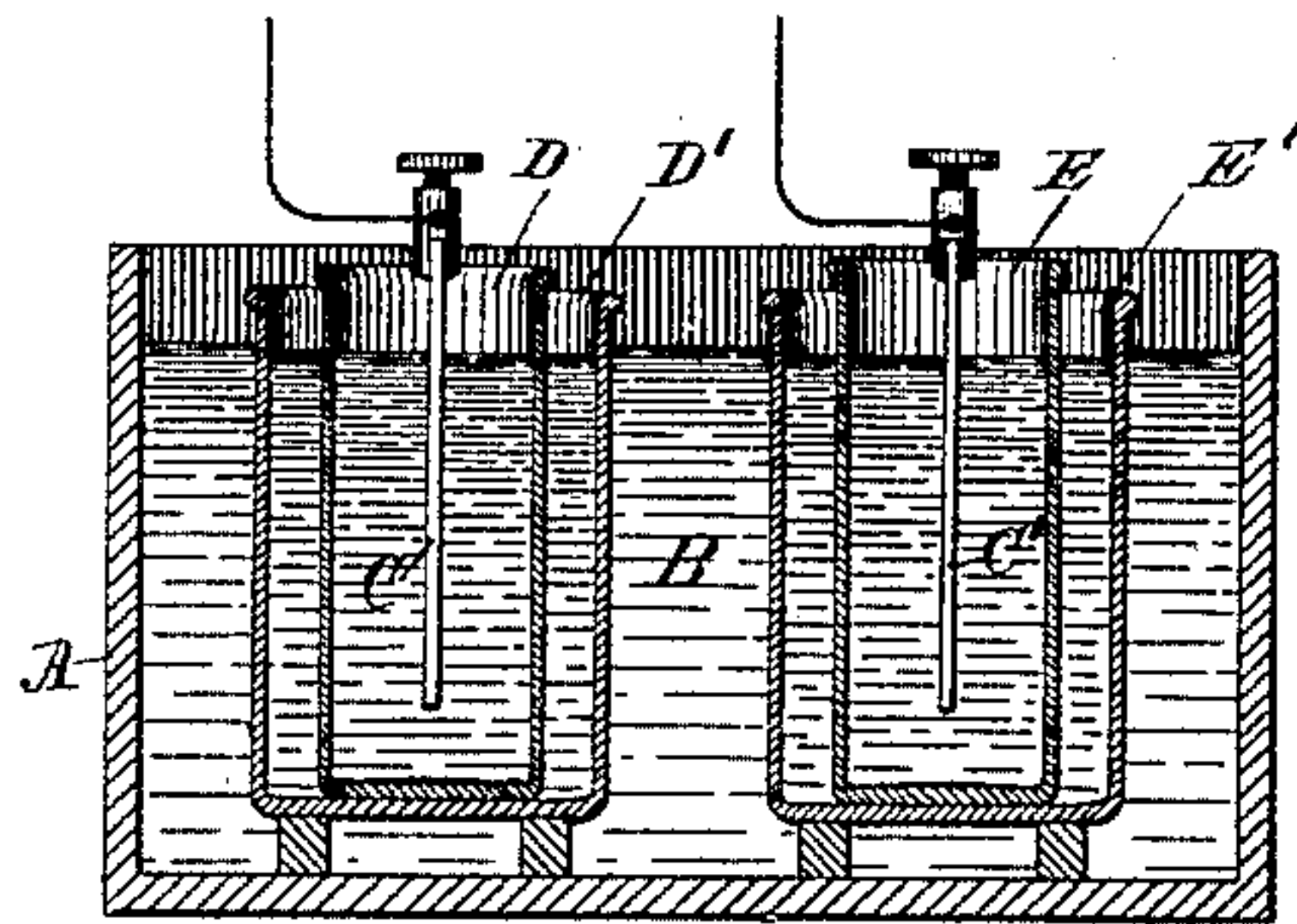
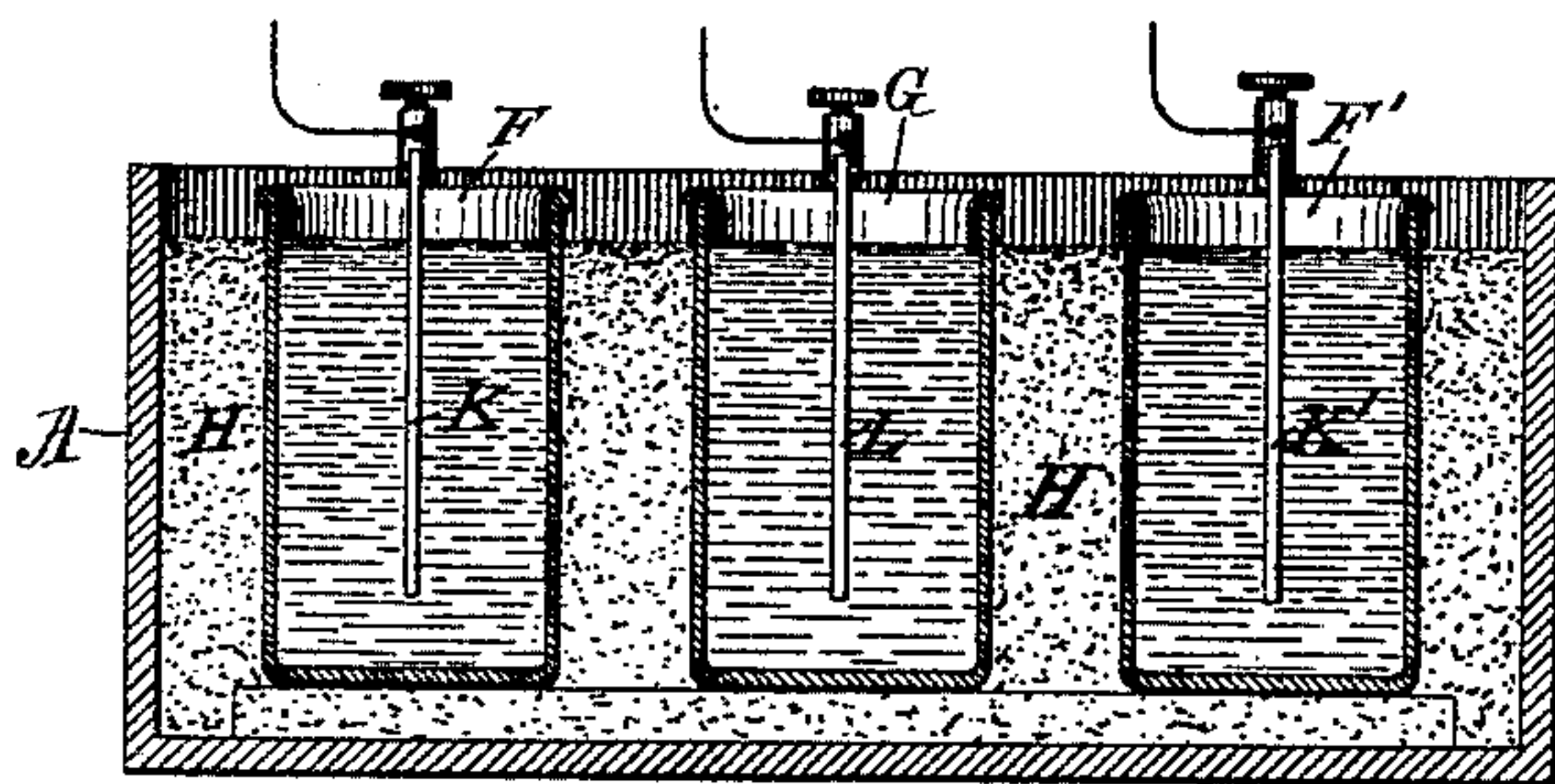


FIG. 3



WITNESSES:

*Raphael Netter*  
*Frank E. Hartley*

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# UNITED STATES PATENT OFFICE.

ISAIAH L. ROBERTS, OF BROOKLYN, ASSIGNOR OF ONE-HALF TO THOMAS H. MCGRAW, OF POUGHKEEPSIE, NEW YORK.

## APPARATUS FOR USE IN ELECTROLYSIS.

SPECIFICATION forming part of Letters Patent No. 442,333, dated December 9, 1890.

Application filed July 27, 1888. Serial No. 281,225. (No model.)

*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 invented certain new and useful Improvements in Apparatus for Use in Electrolysis, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

10 In an application filed by me July 13, 1888, Serial No. 279,852, I have described an apparatus for use in the production by electrolysis of certain salts and hydrates in which a non-porous electrolytic diaphragm is employed to effect and maintain the separation of the salts and hydrates. I have found that by this process the separation of the elements produced by the electro-decomposition may be maintained to a very great extent; but when

20 a single diaphragm is used the operation after a time is retarded or checked. This I attribute to a change which I have found the diaphragm undergoes. As an instance, in the operation of the process in which the salt of an alkali, as chloride of sodium, is used on one side of a single diaphragm or partition and a decomposable electrode on the other, the chlorine radical is transferred to the decomposable electrode—say of iron—forming

30 chloride of iron, which is held in solution; but this solution of iron penetrates, to some extent, at least, the diaphragm, and there meets the alkaline hydrate produced at the same time with the chloride of iron and held in solution on the opposite side of the diaphragm. The meeting of these two salts results in the precipitation of the iron as a hydrate, which gradually decomposes more or less into an oxide, which is a non-conductor,

40 and not an electrolyte. Thus, although no serious consequences result from the actual transfusion of the elements from the liquid on one side of the diaphragm into that on the other, yet the usefulness of the diaphragm or partition is gradually destroyed by increasing its resistance to the passage of the electrolytic current. The plan which I have now devised for obviating this difficulty and rendering more practicable and economical my

50 apparatus is to interpose two or more such

diaphragms and one or more bodies of liquid between the electrodes of the cell.

Considering, by way of illustration, the application of this discovery to the treatment of the materials above named, its purpose and effect are that any soluble salt of iron which may find its way from the anode through one diaphragm will enter the intermediate body of liquid, and there meeting any of the caustic alkaline solution from the cathode chamber will be precipitated without injuring either of the partitions or diaphragms.

I will explain my invention now in detail by reference to the drawings, which exhibit some of the forms of apparatus which I have devised for carrying out the same.

The three figures are in central vertical section and represent modified forms of cell.

In Figure 1, A is the trough or box; D, one of the partitions, in this case in the form of a cup or jar, containing one of the electrodes—say the cathode C. E is a second partition, also shown as a cup or jar, and containing the anode C'. The space between or surrounding the two jars is filled with an electrolyte or conducting-fluid B, and the proper solutions are put in the two jars.

The jars, partitions, or diaphragms I make of a substantially non-porous substance which is capable of serving as an electrolyte. Such partitions are described in patents granted to me and to Henry L. Brevoort and myself, jointly, and are made partially or wholly of jelly-like or gelatinous substances of various kinds, that which I prefer being made in the following manner: I take a cup, plate, or sheet of very porous or fibrous character—such as baked earthenware or thick felt—and saturate it by soaking it for several hours, the longer the better, in an aqueous solution of alum. I then immerse it in a solution of an alkali—such as caustic soda—until by the action of the same upon the alum the pores of the porous cup or plate are filled with a gelatinous mass; or I may soak the cup in an aqueous solution of silicate of soda or potash, which should be just thin enough to enable it to penetrate the pores of the cup or plate. Then when the cup is thoroughly saturated I dip it, say, for an hour in muriatic acid



or the salts of a metal, such as chloride of iron. These substances cause the silicate to deposit silica in the form of a gelatinous mass in the pores of the cup or plate.

5 The manner of using this cell will be understood from the following example: In the jar or compartment containing the cathode, which is of carbon or iron, or other conductor not attacked by the products of the decomposition going on, I place a solution of salt, (chloride of sodium,) and in the compartment or jar containing the anode, which should be of iron or a metal that is attacked by and united with the acid radical set free in the cathode-chamber, I place water and sufficient chloride of iron to render it a good conductor. In the intermediate cell I pour a conducting-fluid, preferably a solution of a salt of an alkali, and generally the same salt or a similar salt to that in the cathode-compartment. The effect of a current upon these materials will be to dissociate the chlorine radical from the sodium and transfer it to the anode, with which it combines, forming chloride of iron, while the metallic sodium forms an alkaline hydrate. The intermingling during this process of the chloride of iron and the alkaline hydrate in a way to impair the partitions or the purity of the products of decomposition is thus prevented, for should they find their way through the partitions they meet in the liquid in the intervening compartment and are then precipitated. This cell or apparatus may be used for various other electrolytic processes, but in all cases its action is the same.

35 The principle herein involved may be carried out in various other ways. For example, referring to Fig. 2, the cell there shown contains four partitions or jars. The cathode C is contained in a jar D, similar to those described in connection with Fig. 1. Outside of this is a second jar D' of the same or similar character. The anode C' is likewise contained in a jar E and an outer jar E'. These jars accomplish the same result, while they subserve the further purpose of collecting practically all the escaping salts or hydrates, which at intervals may be poured back into their respective inner jars. The compartments between the inner and outer partitions may be filled with the same solutions as their respective inner compartments. Any solution of a salt of an alkali, or a conducting solution, however, which will not form with the solutions contained in either compartment a precipitate, may be used in the intermediate

cells. It is preferable to employ the same solution as that being decomposed, or in lieu of a solution I may use a paste saturated with a solution of the salt being decomposed, in which case I may dispense with the outer cells D' E'. As an example of this I make, and in many instances I prefer, an apparatus made up as shown in Fig. 3. In said figure F and F' are two jars or cups, preferably made as above described. Between them is a third cup G of similar character. The two cups F and F' contain cathodes K and K', and the cup G an anode L. The composition of the electrodes and the character of the solutions surrounding them may be the same as above described. I then make up a paste H or gelatinous mass, which acts as an electrolyte, and fill in the spaces around the jars with the same. I make this paste in the following manner: I make a saturated solution of chloride of sodium in water and add to it a small proportion of bichloride of mercury, the proportion being from one to two per cent., by weight, of the crystals of bichloride of mercury to the amount of chloride of sodium used. To this solution when cold I then add starch in the proportions of three ounces of starch to one quart of the solution. This I then stir and heat to the boiling-point, the paste being sufficiently thin and hot to pour. I then pour it around the jars or cups in the trough and allow it to stand until cool, when it will be gelatinous and ready for use. It takes the place in an apparatus of this kind of a body of electrolytic or conducting fluid.

What I claim as my invention is—

1. In an electrolytic cell or apparatus, the combination, with the electrodes, of two or more electrolytic partitions of non-porous substance, forming compartments for the electrodes, and one or more electrolytic bodies interposed between the partitions, as herein set forth.

2. In an electrolytic cell or apparatus, the combination, with the electrodes, of two or more electrolytic partitions of non-porous substance, forming compartments for the electrodes, and one or more bodies of electrolytic or conducting paste interposed between the partitions, as herein set forth.

ISAIAH L. ROBERTS.

Witnesses:

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FRANK E. HARTLEY.