(No Model.)

# I. L. ROBERTS.

## APPARATUS FOR ELECTROLYSIS OF SALTS.

No. 522,618. Patented July 10, 1894.

Fig. 2

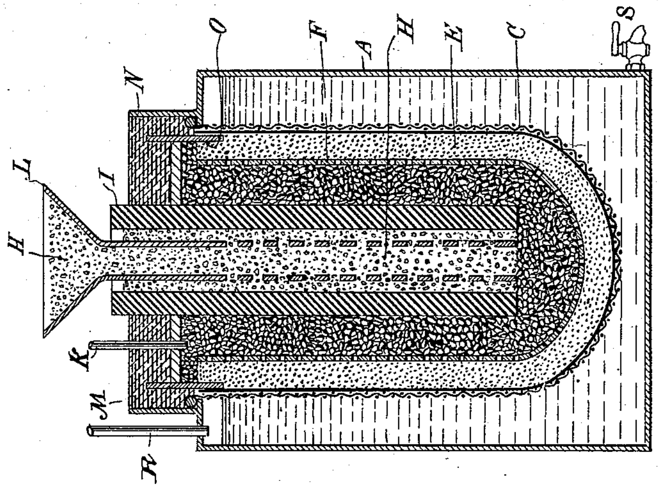
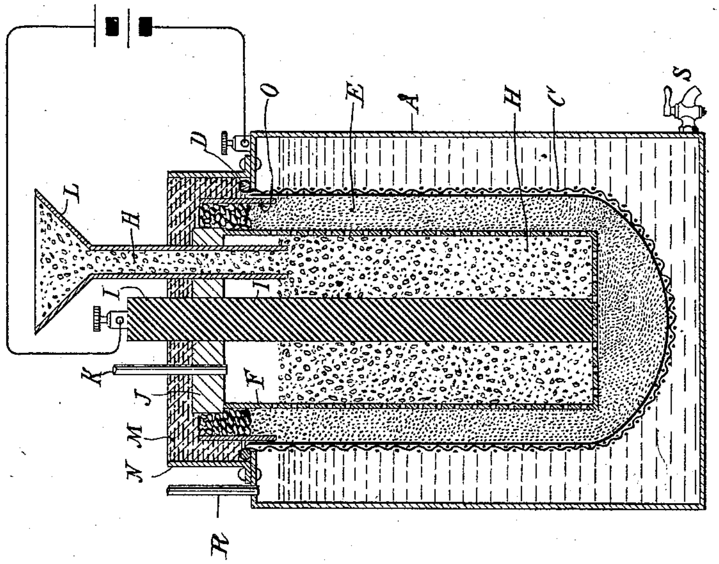


Fig. 1



Witnesses
Raphaël Netter
James N. Catlow

Inventor
Isaiah L. Roberts
By his Attorneys
Duncan & Page.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

## ISAIAH L. ROBERTS, OF BROOKLYN, NEW YORK.

## APPARATUS FOR ELECTROLYSIS OF SALTS.

**SPECIFICATION** forming part of Letters Patent No. 522,618, dated July 10, 1894.

Application filed October 4, 1892. Renewed February 1, 1894. Serial No. 498,802. (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 the Electrolysis of Salts, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

In a number of patents granted to me I have shown and described apparatus for the electrolytic decomposition of metallic salts in which the cathode and anode chambers or compartments are separated by a diaphragm composed of an amorphous substance, or a material in such a fine state of subdivision as to constitute a practically amorphous partition between the electrodes, impervious to the transition of the liquids or solutions under all ordinary circumstances, but of such nature as to permit of what is now known as electrolytic transfusion, which is the passage of a portion of the liquid through the diaphragm in the direction and during the flow of the electric current, and the electrolytic transfer of the radicals or bases.

My present invention consists of improvements in the construction of apparatus of this character, the said improvements being in details of the construction of the same which adapt the apparatus for use under conditions different from those heretofore followed by me, chiefly in providing a means for feeding crystals of the salt to be decomposed into contact with the anode, and for maintaining a continuous supply of such salts, whereby the mass of undissolved crystals may be maintained up to or above the level of the fluid in the anode compartment or chamber.

Figures 1 and 2 of the accompanying drawings illustrate in central vertical section modified forms of decomposition cell embodying my improvements and by means of which I carry out my improved process of electro-decomposition.

Referring to Fig. 1,—A is a tank or vessel, preferably of a metal such as iron, in order that it may serve as the cathode.

C is a bag composed generally of wire netting and cloth or asbestus fabric which is secured to a metal ring D that rests on the edges of an opening in the cover of the tank and supports the bag C and its contents in the tank.

E is the diaphragm or partition of silica, powdered anthracite coal or similar material contained between the two supporting walls formed by the bag C and a perforated or porous jar F, which may be ordinary unglazed porcelain.

H is a mass of the crystals of the salt to be decomposed, and I is an anode of conducting charcoal.

J is a block of wood or preferably an unglazed terra-cotta tile soaked in hot paraffin to fill the pores. This tile contains three holes, one for the passage of the anode I, another for a gas vent, as K, and a third for a long tube L through which a supply of salt crystals is introduced into the anode compartment.

N is an annular collar riveted to or cast on the top of tank C, and M is a luting or seal of wax or a proper material that closes the tank.

O is a ring of glass, hard rubber, glazed tile or the like, that is used to more effectively insulate the material of the diaphragm E from the tank A.

To construct and operate the above described apparatus and to carry out the process to be described, I construct a tank as above and suspend a net of insulated wire or twine on the ring D. I then put a canvas bag in such net which may be lined with asbestus paper. I also knead to a stiff dough an amorphous powder made from anthracite coal, silica, or any substance which will be unacted upon by either the radical liberated or its base. Using a solution of the base intended to be transferred for making the dough. For instance, if caustic soda is intended to be produced a solution of it in water is used. When the dough is made I pack in the bottom of the bag the amount necessary for the thickness of the partition. I prefer at least two or three inches of wall although more or less may be used, but the thicker the wall or diaphragm the purer and richer can the solution of the base be made. When the thickness desired is attained in the bottom I set in the center the porous cup or tile F. Then I pack around it the aforesaid dough until the space between it and the outer wall is filled. I prefer to carry it above the ring D a little way so as to allow for any shrinkage that might take place. When this is done the tubes and anode are sealed in, as described above. When the wax is cool I fill the space around the anode in the cup or tile through the long tube L, with the salt crystals and water desired for decomposition, say chloride of sodium or potash and pour in enough water to come above the lower end of the wide tube and seal it; then I fill the outer compartment with water through an inlet R. I prefer to use a weak solution of the base on starting to lower the resistance of the water. I now connect the positive pole of the source of electricity to the anode and the negative pole to the tank or cathode. The action of the current is to send the base of any salt, as sodium, potassium, iron or copper toward the cathode and liberate the acid radical on the anode. If such radical is a gas it will escape through the tube K. If it is a liquid it can be drawn off by a siphon or pumped out when desired. The liquid bases, such as caustic alkalies may be drawn off at the cock S. The process can thus be made continuous by adding crystals on the anode side of the diaphragm and drawing off the base on the cathode side.

The specific form of anode and arrangement of the anode chamber may be much varied. In Fig. 2, for instance, I have shown a cylindrical anode I, of conducting charcoal. The feed tube L extends down through the anode and is perforated as shown. The space around the anode is filled in with coarse particles of a conducting charcoal or what I have found to be the equivalent thereof, to wit, carbonized anthracite coal. In this case the mass of broken charcoal really constitutes the anode while the cylinder or rod I serves merely as a connector. I have found that where the anode rod is made a mere connector in this manner and is surrounded by a porous mass of conducting particles that it is not liable to disintegration or the destructive action of the nascent gases, and that it may be composed of other material than conducting charcoal. For example, I have used for this purpose ordinary electric light carbons and other conductors.

The construction above described furnishes an electrolytic apparatus in which the anode and cathode are separated by a partition of substantially non-porous or amorphous, but electrolytic character, while a space or chamber is formed in or around the anode throughout its entire length into which crystals of the salt to be decomposed may be continuously fed, so as to maintain at all times during the operation of the device a supply of crystals in said chamber up to or above the water level. I have found that by doing this in the specific ways illustrated, and otherwise, that I prevent the tendency of the anode to disintegrate, and I attribute this to the fact that I, by such means, prevent any impoverishment of the solution and the consequent production of oxygen, which I have found to be highly destructive to an anode as ordinarily made.

In the form of device shown in Fig. 2, when in addition to the provisions for maintaining a constant supply of salt crystals, I employ a mass of broken conducting carbon or charcoal around the anode proper, I secure additional protection to the anode because even when oxygen tends to form on the anode side it develops in the porous mass of carbon and does not have the same opportunity to mechanically disintegrate the loose particles as it would exert upon the anode if it were developed entirely on the surface and in the pores near the surface of the same.

What I claim as my invention is—

1. In an apparatus for the electrolysis of metallic salts the combination of a cathode an anode a substantially non-porous or amorphous electrolytic diaphragm between the same, a cover or seal by which the electrode compartments are closed, and a feed-tube extending through the cover into an open space in which the anode is exposed, and opening into said space below the water level, the feed-tube being of such character as to admit a continuous supply of crystals of the salt to be decomposed into the open space in the anode compartment, as set forth.

2. In an apparatus for the electrolysis of metallic salts, the combination of a cathode, an anode made hollow or with an opening extending through it, an amorphous electrolytic diaphragm interposed between the cathode and anode, a cover or seal closing the electrode compartments, and a feed-tube extending through the cover into the space within the anode, and opening into the same below the water-line, the feed-tube being of such diameter as to admit a continuous supply of crystals of the salt to be decomposed into the hollow anode, as set forth.

3. In an apparatus for the decomposition of metallic salts, the combination of a cathode and an anode, an amorphous electrolytic diaphragm interposed between the same, a mass of broken charcoal between the diaphragm and the anode and in contact therewith, and a feed-tube extending into an open space within the anode, and adapted to admit to the surface of the anode a continuous supply of the crystals of the salt to be decomposed.

ISAIAH L. ROBERTS.

Witnesses:
ROBT. F. GAYLORD,
M. G. TRACY.