(No Model.) 2 Sheets—Sheet 1.

T. CRANEY.

ELECTROLYTIC CELL.

No. 520,257. Patented May 22, 1894.

Fig. 1.

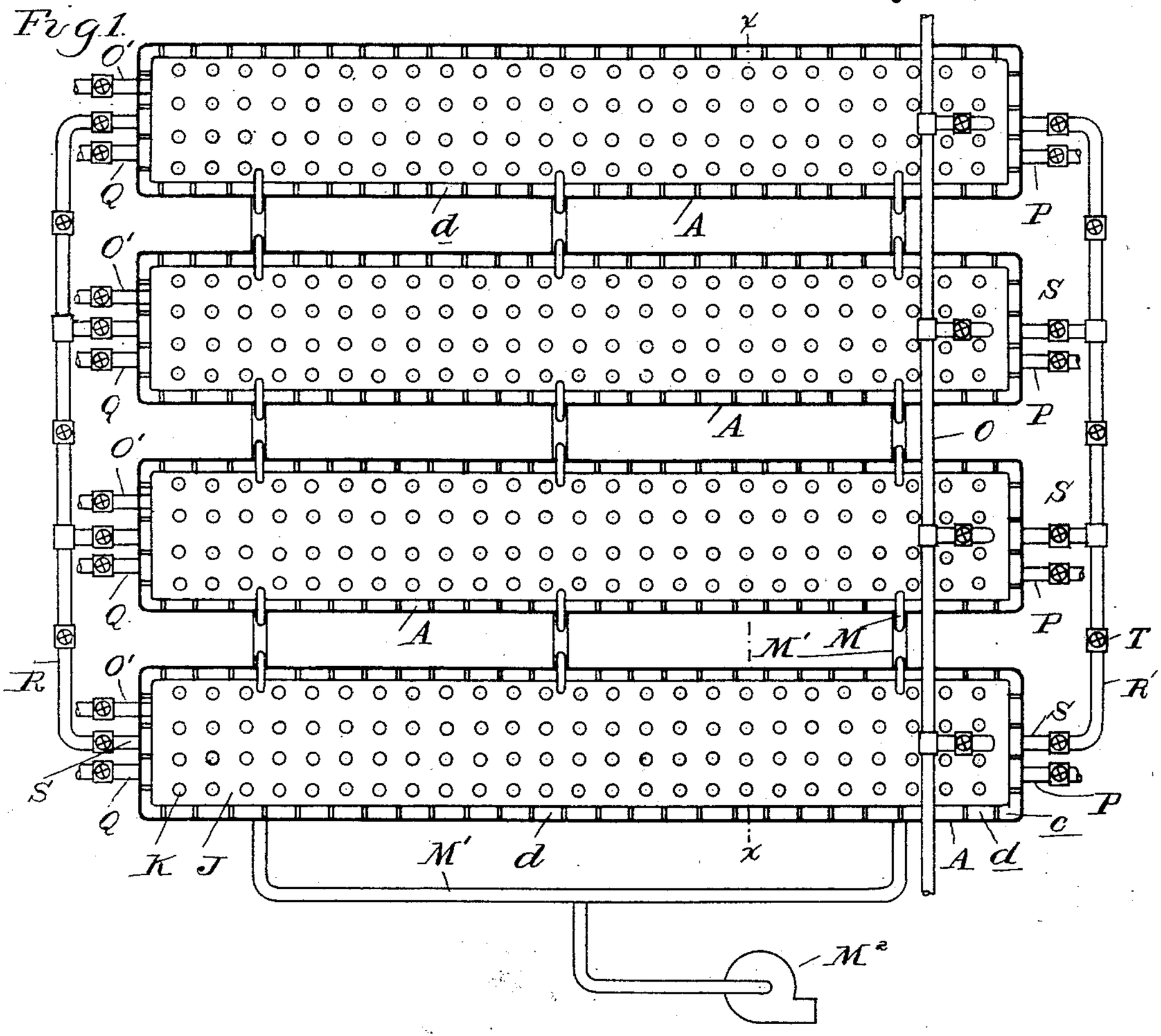
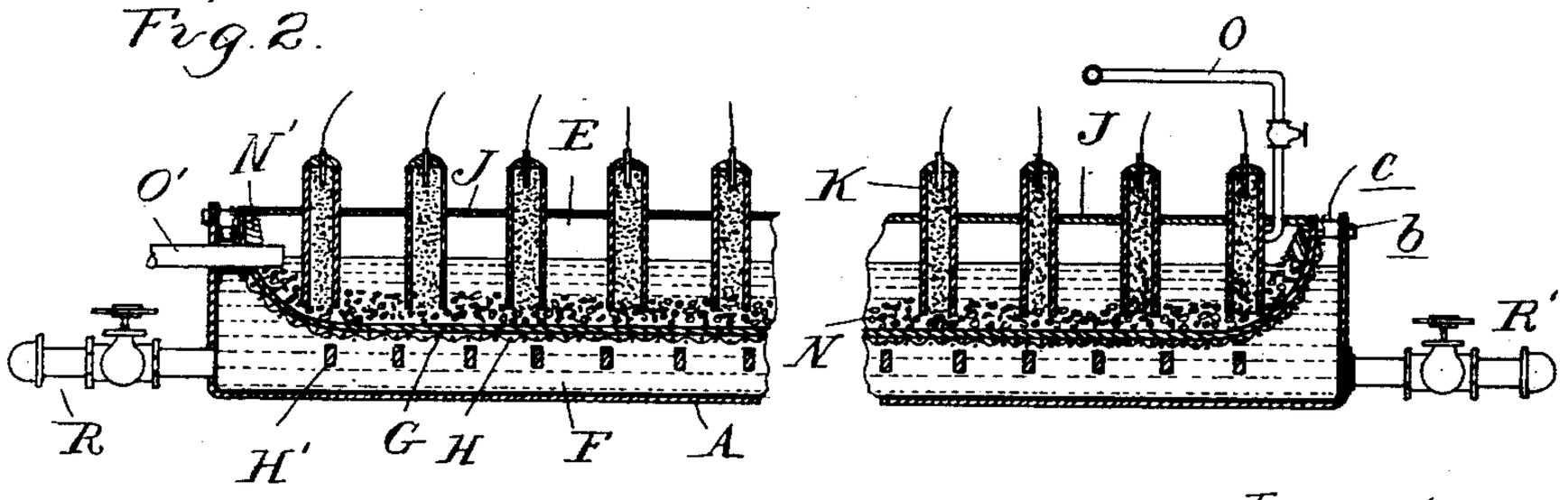


Fig. 2.



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(No Model.)

T. CRANEY.

2 Sheets—Sheet 2.

ELECTROLYTIC CELL.

No. 520,257. Patented May 22, 1894.

Fig. 3.

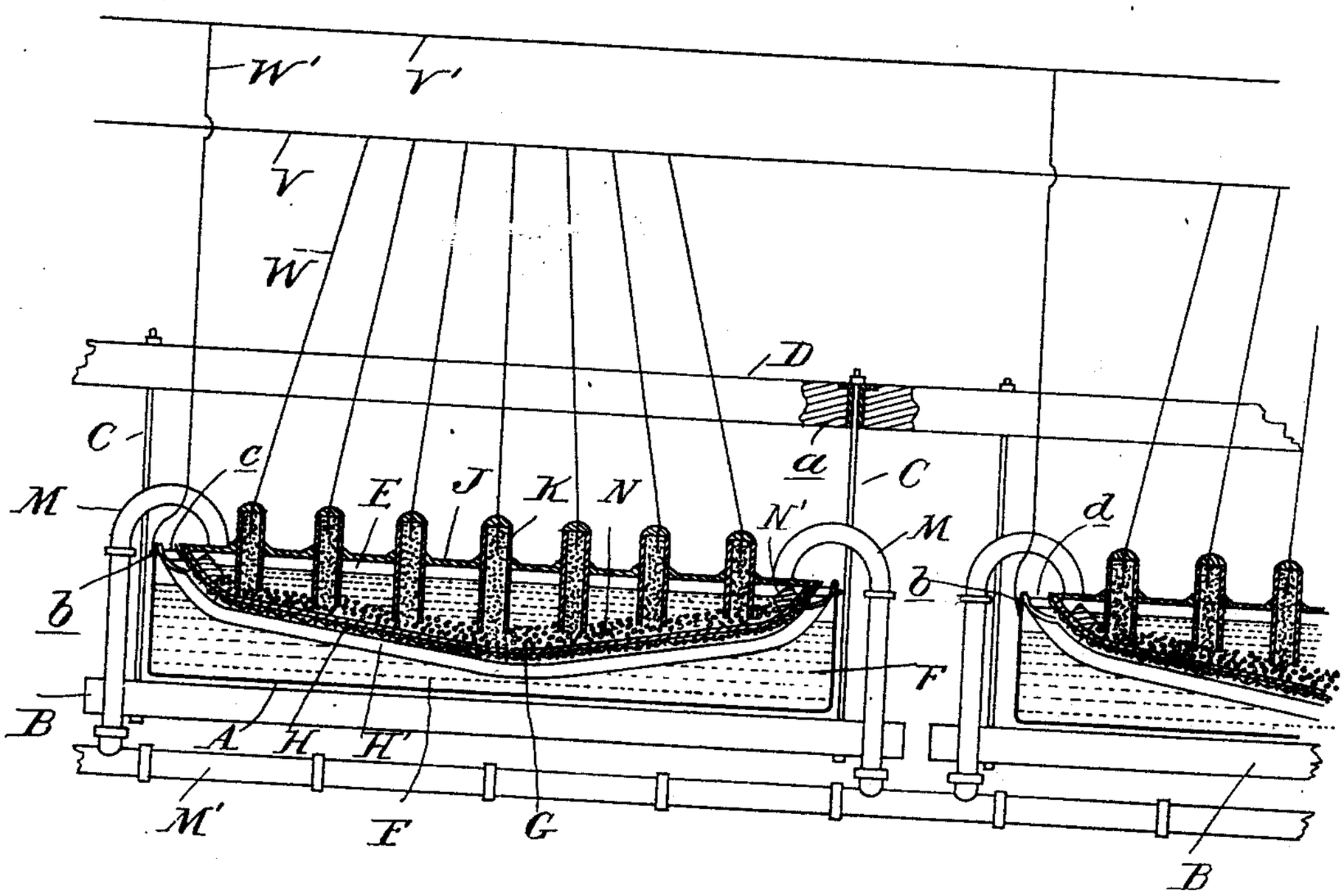


Fig. 4.

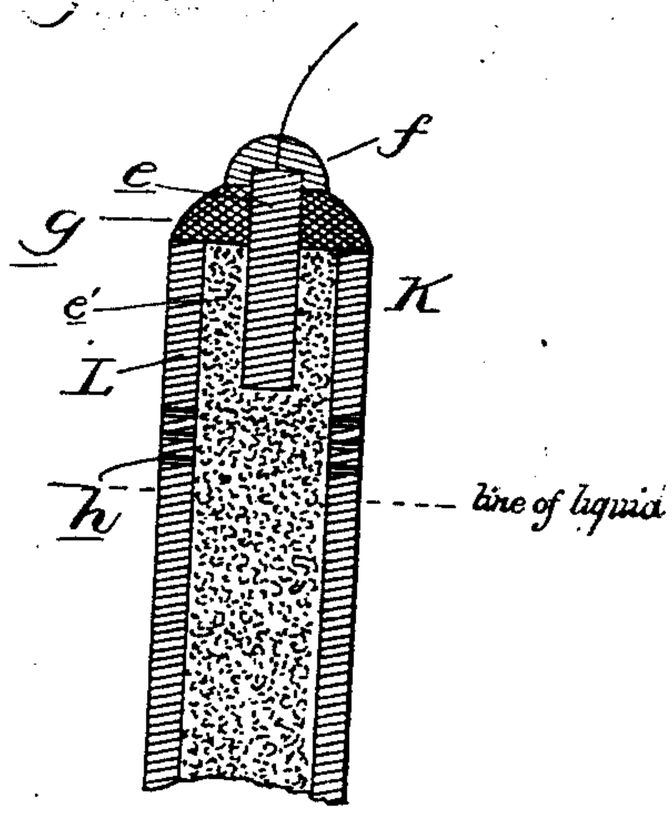
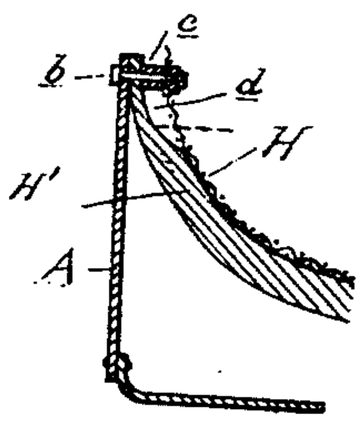


Fig. 5.



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ELECTROLYTIC CELL.

SPECIFICATION forming part of Letters Patent No. 520,257, dated May 22, 1894.

Application filed September 2, 1893. Serial No. 484,618. (No model.)

To all whom it may concern:

Be it known that I, THOMAS CRANEY, a citizen of the United States, residing at Bay City, in the county of Bay and State of Michigan, have invented certain new and useful Improvements in Electrolytic Apparatus, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to electrolytic apparatus adapted for the commercial exploitation of the process of electrolysis of salts, especially the chlorides, such as chloride of sodium; and the object of my invention is particularly to make a durable, economical and effective apparatus in which the operation can be carried on continuously.

To this end my invention consists in the improved construction and arrangement of an electrolytic cell, and in the combination of several cells to form a large plant adapted to meet various contingencies when in operation, all as more fully hereinafter described and pointed out specifically in the claims.

In the drawings, Figure 1 is a diagram plan view of an electrolytic plant composed of four cells and embodying my improvements. Fig. 2 is a longitudinal, central, cross-section of one of the cells shown in Fig. 1. Fig. 3 is a cross-section on line *x x* in Fig. 1. Fig. 4 is an enlarged, vertical, section through one of the anodes, and Fig. 5 is a section showing some details of construction.

In the drawings, I have shown an apparatus comprising four cells, each of which is constructed as follows: A is a large iron tank preferably of boiler iron and supported upon cross bars B by hangers C from suitable overhead beams D. The tank is electrically insulated in any suitable manner, such as by passing the hangers C through insulating bushings *a* in the beams. The tank is divided by a diaphragm into an anode compartment E occupying the upper portion of the tank and a cathode compartment F occupying the space in the tank below the diaphragm. The diaphragm forms a complete vessel and consists of porous material G which constitutes the diaphragm proper, and of a vessel-shaped frame or screen, through which the liquid can pass, but which is adapted to hold the material of which the diaphragm is made. The frame can be made of open work in any manner to form a screen, but I preferably use iron wire screen H and support it at intervals by iron cross bars H′, which are secured to and electrically connected with the edges of the tank by bolts or rivets *b*. As shown more particularly in section in Fig. 5 the bars H′ are flattened at the ends and washers *c* are placed upon the bolts to hold the edges of the screen away from the edges of the tank and thus form an opening *d* for the escape of the gas from the cathode compartment. The diaphragm proper I make of asbestus, which I preferably use in the form of so-called asbestus sheet placed on the inside of the supporting frame in several thicknesses and with the joints broken so as to form an even and unbroken lining. The frame and lining thus form an inner porous anode vessel in the tank, and a particular feature is that the frame has outwardly inclined sides and a sloping bottom, the object of which will be explained hereinafter. The opening *d* may be left open for the escape of the gas or it may be covered and pipes placed in the cover if it is desired to collect the gas for use. The anode compartment is closed on top by a cover J, which is provided with openings in which the anodes K are secured and project into the compartment below. These anodes I preferably form of gas carbon inclosed in tubular supports L of earthen ware open at the bottom and with a wire connection leading into the top.

As shown in the detail in Fig. 4 I preferably take a solid piece of gas carbon *e* to which is cast a metallic head *f* of lead or other suitable material. The gas carbon *e* projects into the support L and powdered carbon *e′* is packed around it, while the upper end is hermetically sealed into the top of the support by plaster of paris *g* or other cement placed around it, and the wire terminal is soldered into the lead *f*. The gaseous products of decomposition from the anode compartment escape through specially provided exit pipes M which lead from the cover over the sides of the tank into mains M′, which pass underneath the cells and receive the individual pipes from the anode compartments of every cell and carry the gas to an exhaust fan M^2. In this manner air is drawn

into the anode compartments through the cracks or leaks around the cover and other places which may not be closed quite air tight and this inward suction prevents the escape of any gas from the anode compartments and thus the decomposition of chlorides of sodium may be carried on without there being even a trace of the noxious chlorine gas in the surrounding air. The tubular supports of the anode project to near the bottom of the anode compartment which is covered with a layer of broken pieces of gas carbon N distributed over the whole surface of the diaphragm. At the extreme edges, however, I preferably use a row of brick or large chunks of gas carbon N' laid upon the diaphragm for the purpose of preventing the edges of the diaphragm from being accidentally disturbed. The carbon on the bottom of the anode compartment forms the anode by being in contact with the carbon in the tubes L, it holds the lower ends of the tubes in place against accidental displacement and tends to exclude the gaseous products of decomposition from entering into the tubes. This preserves the mechanical continuity of the anode which might in time become destroyed by the corrosive action of chlorine, and as a further safeguard I place perforations *h* in the tubular supports L above the line of the liquid whereby any gas formed in the tubes can escape into the anode compartment without danger of forcing its way to the top and corroding the metallic conductor.

The anode compartment of each tank is provided with a valve controlled supply pipe O and an overflow pipe O' placed at opposite ends of the compartment.

In using my apparatus for the electrolysis of common salt a constant supply of fresh brine is preferably allowed to flow into the anode compartment and thus a saturated solution is constantly maintained therein, while the overflow pipe maintains the liquid at a fixed height in the compartment and produces a flow of the liquid through the tank. The advantage of having a constant feed is that most of the chlorine gas is thereby carried off in solution and the quantity of the product in the cathode compartment is naturally increased by maintaining the liquid in the anode compartment at its full strength. The overflow from the anode compartment may be freed from the chlorine gas, and if required, saturated with fresh salt, and then used again.

The cathode compartment of the cell is provided with a valve controlled feed pipe P through which pure water or a solution of the liquid flows into the compartment in sufficient quantity to discharge the product by displacement, through a discharge pipe Q. In case of several cells being connected, the cathode compartment of the first cell need only be provided with a feed pipe P, and that of the last cell only with a discharge pipe Q, and the product is carried from one cathode compartment into the next by means of suitable communicating pipes, which I preferably arrange in the manner shown and wherein R R' are main communicating pipes arranged at both ends of the tanks and communicating with each cathode compartment through valved branches S, and valves T are placed in the main pipes between each two tanks. To prevent short circuiting the pipes R R' are partly made of sections of tubing of rubber or other insulating material. With this construction it will be seen that by a proper manipulation of the different valves, the cathode compartments may be connected for the flow of the liquid in series through the compartment while at the same time in case of needed repairs or for any other reason, one or more of the tanks may be cut out without interfering with the working of the others, in combination. The main leads V V' through which the current is furnished are preferably arranged overhead with feeders W W' leading from them to the anodes and to the cathodes, the latter of which are represented by the metallic support of the diaphragm and by the metallic tank to which the feeders may be connected.

An important feature of my invention is the frame which supports the diaphragm proper. It has the form of a vessel without any vertical walls. The object is to hold the lining of asbestus in position by making the walls at a suitable inclination, and my apparatus comprises a porous vessel or diaphragm entirely of incompact material. What I mean by incompact, is material of granular pulpous or fibrous condition, such as sand, cotton, pulpous or fibrous asbestus, or material which is transformed into this condition when used in a liquid, such as asbestus sheet which becomes pulpous when used as a diaphragm. Heretofore the porous vessel was usually either entirely formed of a solid material, such as the porous earthenware vessels or of incompact material filled in between solid supports or forming only a portion of the walls of the vessel. Considering that the incompact materials spoken of are generally preferable as diaphragms to the use of compact or solid diaphragms on account of their having less electrical resistance the advantage of my construction is obvious. I not only get the benefit of having the incompact material from the entire walls of the vessel, but as the material itself forms the inner walls of the vessel or diaphragm, the anode can be placed directly in contact therewith, and by making the supporting frame the cathode, I contrive to have a cell in which the anode and cathode are co-extensive with the diaphragm and are only separated from each other by the incompact material, and thus the electrical resistance is decreased to a minimum.

The specific way in which I have presented my invention has several advantages, thus it will be seen that by using vessels of small height with large area the diaphragm and the

electrodes are of large area in proportion to the contents of the vessels and thus a large output is obtained. The walls of the frame may be arranged at any suitable incline,—either straight or curved; by curving them however, interior corners are avoided. The bottom may be flat, but I prefer to make it slope toward the middle so as to make the inclines less abrupt and prevent the gas from collecting on the under side. The layer of broken pieces of gas carbon firmly hold the material which forms the diaphragm in position against the screen, it also forms an inner compartment for the liquid which is in contact with it throughout. The screen may be suitably fine mesh to hold the material of the diaphragm from passing through it, but I prefer using coarser screen and cover it with some fabric such as one or more sheets of cotton.

What I claim as my invention is—

1. In an electrolytic cell, a containing vessel and a porous vessel therein consisting of an outer supporting frame or screen, the walls of which are inclined and of a lining of incompact material forming the inner walls of the vessel and constituting a diaphragm, and the electrodes substantially as described.

2. In an electrolytic cell, a containing vessel and a porous vessel therein consisting of a vessel shaped supporting frame or screen provided with outwardly inclined sides, and of an inner lining of incompact material coextensive with the supporting frame and constituting a diaphragm, and the electrodes substantially as described.

3. In an electrolytic cell, a containing vessel and a porous vessel therein consisting of the wire screen G having the form of a vessel with outwardly inclined sides and a bottom sloping toward the center, an asbestus sheet applied as an inner lining to the screen, and the electrodes substantially as described.

4. In an electrolytic cell, the combination with an outer containing vessel forming the cathode compartment of an inner porous vessel forming the anode compartment and consisting of a vessel-shaped frame or screen secured in the outer vessel and having inclined walls, and a lining of incompact material coextensive with the frame, and the electrodes substantially as described.

5. In an electrolytic cell, the combination with an outer vessel forming the cathode compartment of a porous inner vessel forming the anode compartment and consisting of a vessel-shaped screen, cross bars upon which said screen is suspended in the outer vessel and forming a marginal opening between the walls of the outer vessel and the screen, and an inner lining of incompact material, substantially as and for the purpose described.

6. In an electrolytic cell, the combination with an outer vessel or cathode compartment, of a vessel-shaped metallic screen supported in the outer vessel above the base thereof, a diaphragm of incompact material supported by said screen and forming an inner porous vessel, a layer of broken carbon supported upon said diaphragm and constituting the anode, and electrodes projecting into the anode compartment substantially as described.

7. In an electrolytic cell, the combination with an outer vessel, of a vessel shaped metallic screen cross bars supporting the same in the outer vessel and provided with flattened ends, bolts securing the edges of the screen and the ends of the cross bars to the edges of the outer vessel, washers interposed between the cross bars and screen and through which said bolts pass, and an inner lining of incompact material supported by the screen and dividing the outer vessel into anode and cathode compartments, substantially as described.

8. In an electrolytic cell, the combination with a containing vessel forming a cathode compartment, of a suspended diaphragm in the vessel having a lining of disintegrated material, a coating of carbon on the lining, and electrodes entering the vessel above the diaphragm, substantially as described.

9. In an electrolytic cell, the combination of an outer vessel forming the cathode compartment, a vessel shaped metallic screen supported in said vessel, a lining of incompact material supported by the screen and forming a porous inner vessel, a layer of broken carbon upon the incompact material forming a vessel shaped compartment for the liquid to be electrolyzed and constituting the anode and carbon contained in tubular supports electrically connecting said anode with the source of electricity, substantially as described.

10. In an electrolytic cell, the combination of the outer vessel A, the cross-bars H′ secured in said vessel and forming a vessel shaped support with inclined curved sides and a bottom sloping toward the longitudinal center of the tank, the metallic screen H supported upon said cross bars, and the diaphragm G supported by the screen and dividing the outer vessel into an anode and cathode compartment, substantially as described.

11. In an electrolytic apparatus, the combination with a plurality of cells divided into anode and cathode compartments by an electrolytic diaphragm, of the communicating pipes R R′, having valve controlled connections with the opposite ends of the cathode compartments respectively, the valves T in said communicating pipes between the connections and valve controlled feed and overflow connecting into and from said cathode compartments, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS CRANEY.

Witnesses:
M. B. O'DOGHERTY,
JAMES WHITTEMORE.