

WATER ELECTROLYZING APPARATUS.

1,220,262.

4 SHEETS—SHEET 1.



Witnesses
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இதற்கு

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WATER ELECTROLYZING APPARATUS.

APPLICATION FILED JAN. 2, 1914. RENEWED JAN. 17, 1917.

1,220,262.

Patented Mar. 27, 1917

4 SHEETS—SHEET 2.

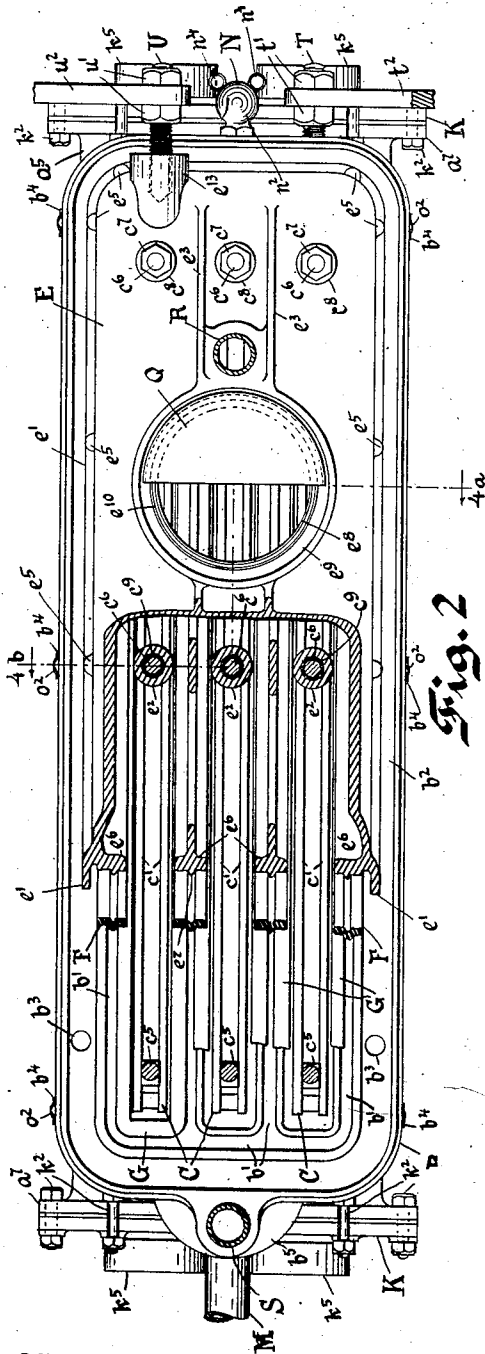


Fig. 2

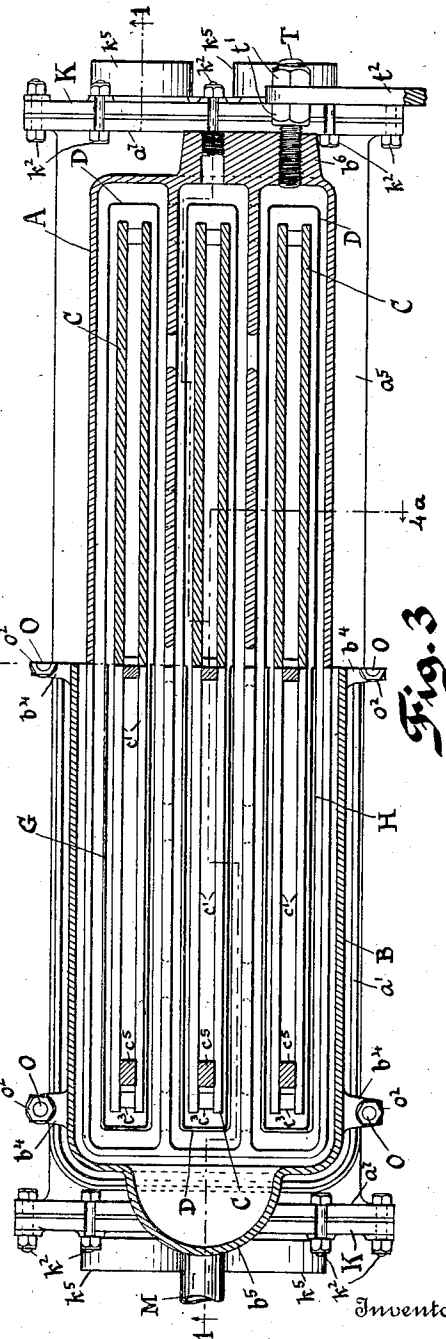


Fig. 3

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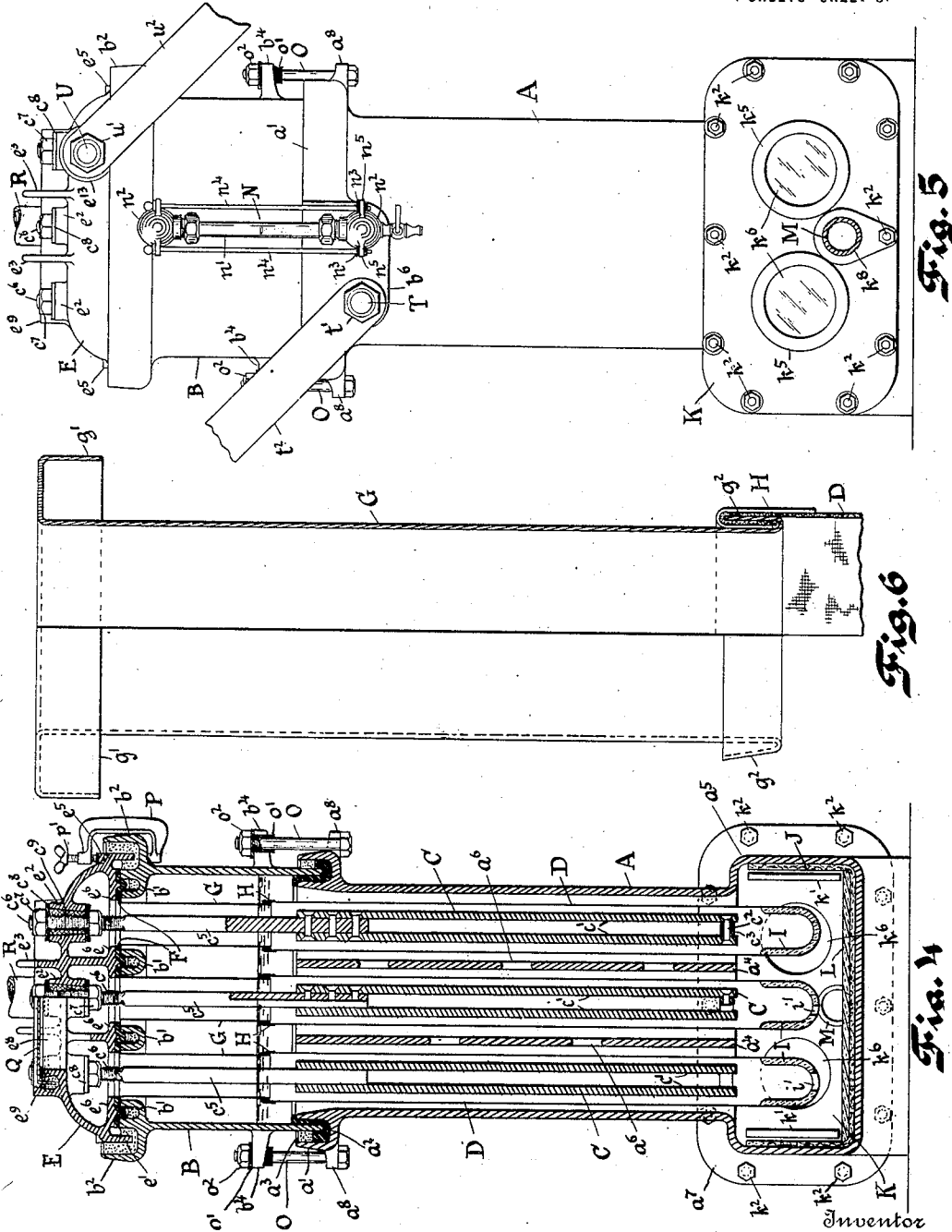
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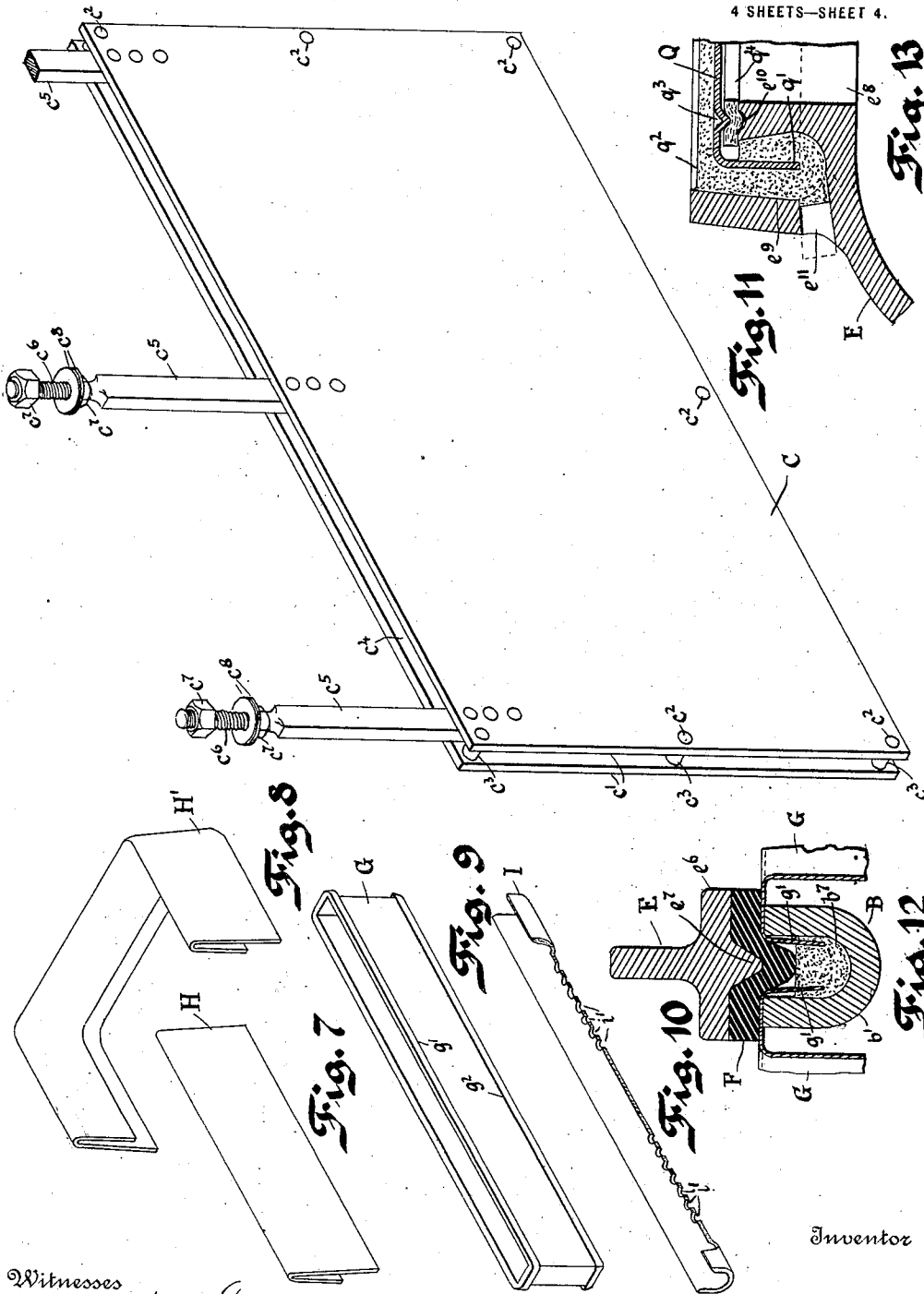
WATER-ELECTROLYZING APPARATUS.

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4 SHEETS—SHEET 4.



Witnesses

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UNITED STATES PATENT OFFICE.

RUDOLPH JACOB JOHANNES MUELLER AND ERROLL GODDARD ROWLANDS, OF SHEBOYGAN, WISCONSIN, ASSIGNORS TO UNIVERSAL OXYGEN COMPANY, A CORPORATION OF WISCONSIN.

WATER-ELECTROLYZING APPARATUS.

1,220,262.

Specification of Letters Patent.

Patented Mar. 27, 1917.

Application filed January 2, 1914; Serial No. 809,816. Renewed January 17, 1917. Serial No. 142,961.

To all whom it may concern:

Be it known that we, RUDOLPH JACOB JOHANNES MUELLER and ERROLL GODDARD ROWLANDS, of Sheboygan, Wisconsin, have invented a Water-Electrolyzing Apparatus, of which the following is a specification.

This invention relates to devices for producing hydrogen and oxygen gas from water by electrolysis; and our object is to produce an improved practical form of cell for the purpose.

In our copending United States application No. 755,886, we have disclosed and claimed a water-electrolyzing apparatus some of whose features are also included in the present apparatus; and it is the object of the present invention to introduce certain improvements into the construction of that previously disclosed. In particular, we aim, first, to provide an improved construction of the tank and diaphragm-frame, the wooden frame previously shown being here replaced by a special member which is also part of the tank itself and is insulated from both positive and negative poles; secondly, to provide an improved means of suspending the diaphragms; thirdly, to provide a closed bottom for each diaphragm and a trough-shaped member in the bottom of the diaphragm which serves as a receiver and retainer of scale and oxid-dust dropping from the anode; fourthly, to provide an improved construction of anodes; fifthly, to provide an improved construction of the bottom of the tank, which is enlarged and provided with a trough-shaped lining to cut off all electric action or flow of current from the bottom of the tank to the anodes; sixthly, to provide improved means for flushing or cleaning out the tank; seventhly, to provide means for ocular inspection of the interior of the tank during operation; eighthly, to provide improved hermetic sealing-devices to prevent escape of gas to the open air and also of hydrogen to the oxygen chamber, or vice versa; and generally to improve the construction and operation of apparatus of this class.

The invention consists in the construction, arrangement and combination of parts as hereinafter particularly described and pointed out in the claims.

In the accompanying drawing like characters designate the same parts in the several figures.

Figure 1 is a longitudinal vertical section taken approximately on the line 1—1, Fig. 3, parts of one of the anodes and one of the diaphragms being successively broken away from left to right; Fig. 2 is a plan view of the apparatus, the cover and sealing gasket being partially cut away on the line 2—2, Fig. 1; Fig. 3 is a horizontal section on the line 3—3, Fig. 1; Fig. 4 is a vertical transverse section, the left hand half being taken on the line 4^a and the right hand half on the line 4^b, Figs. 2 and 3; Fig. 5 is an end elevation of the apparatus viewed from the right relative to Figs. 1, 2 and 3; Fig. 6 is an enlarged view, partly in end elevation and partly in vertical cross section, of one of the diaphragm hangers, a part of a diaphragm and an attachment clip being shown; Figs. 7 and 8 are perspective views of two of the diaphragm attachment clips, a side clip and an end clip; Fig. 9 is a small scale perspective view of one of the diaphragm hangers; Fig. 10 is a similar view of one of the diaphragm troughs; Fig. 11 is a perspective view of one of the anodes, the right hand hanger rod being broken away; Fig. 12 is a large scale transverse section of one of the joints between the neutral section, cover and diaphragm hangers; and Fig. 13 is a similar section through one side of one of the safety covers and its seat.

The tank or container is in the present instance made in two sections, a lower section A and an upper section B, electrically separated from each other by an insulating joint which comprises a trough *a'* extending around the top of section A and containing the U-shaped insulating gasket *a*² (omitted from Fig. 3) preferably of soft rubber which forms a cushion and also a hermetic seal. A liquefiable insulator such as paraffin, *a*³, filling the upper portion of the trough *a'*, further insures a tight joint between said sections. The lower edge of section B rests in the groove of the gasket *a*². As only the lower section A is electrically active and forms a part of the electric circuit, to-wit: the negative electrode of the cell, and the upper section is electrically in-

insulated from both electrodes, the former will be designated the tank section or member, and the latter the neutral section or member.

5 The interior of the tank section A is divided by a plurality of longitudinal webs a^4 parallel with the side walls into equal sized cellular spaces which are open at top and bottom, these webs a^4 extending, as shown, only from the upper edge of said section to the top of the enlarged base a^5 thereof. The webs a^4 are preferably perforated at intervals with holes a^6 , as shown. The anodes C (three in number) are disposed medially in the cellular spaces between the webs a^4 and side walls of the section A, thus exposing a double surface to the electric current for each anode, and hang in tubular diaphragms D, of woven asbestos or other suitable material, as explained in our aforesaid copending application. The construction of the anodes and the diaphragms and the method of suspension thereof, are however, different in the present application.

25 The anodes C are suspended from the cover E, which in turn rests upon the neutral section B, but is insulated therefrom by means of a grid-shaped rubber gasket F; and to insure gas tight joints for separating the hydrogen from the oxygen chamber, and for separating both chambers from the outer air, the neutral section B is provided with a series of parallel inner troughs b^1 for the former, and for the latter is provided with an encompassing outer trough b^2 , in which the depending marginal flange e^1 of the cover E is sealed by a liquefiable insulator such as paraffin, wax, pitch or the like. To facilitate removal of the sealing material when the cover is to be raised, there are formed in the bottom of the trough b^2 , as shown in Fig. 2, one or more holes b^3 which are stopped with plugs when the trough is filled with the sealing material and removed when it is to be melted and withdrawn as by applying a flame to the under side of the trough.

30 The anodes C are of special design, and one of them is shown separately in Fig. 11. Each anode comprises a pair of parallel plates c^1 , preferably corrugated or grooved on their outer faces, as indicated in Fig. 1, but this is not essential to the invention and is not shown in the other figures. Said plates are joined together in parallel relation by rivets c^2 and interposed spacing sleeves c^3 , which provide a narrow vertical space c^4 for the circulation of the liquid between them, as described in our copending application. Each anode has a number of hanger rods c^5 riveted thereto and screw-threaded at their upper ends c^6 to receive nuts c^7 and washers c^8 . The screwthreaded ends of said rods are inserted in sockets

or orifices e^2 in the cover, in which they are secured by means of said nuts and washers, as shown. Before the upper nut and washer are placed on a hanger rod inserted in a socket e^2 in the cover, the socket is filled around the threaded end of the rod with fused metal c^9 , such as lead, Babbitt metal or the like, which forms a good electrical connection and a strong gas tight joint between the cover and anode. Thus the cover and anodes when assembled form substantially a single piece which is handled as a unit. This unit member, consisting of the cover and anodes, has to be removed when the cell is opened for cleaning or repairs, and to this end the cover is formed with a pair of upright parallel longitudinal ribs e^3 , having holes e^4 for the insertion of rods whereby it can be lifted.

70 The diaphragms each comprise two parts, to-wit: the diaphragm proper D, and a hanger G, one of which is shown on an enlarged scale in Fig. 6. The hanger G is made of thin sheet metal, and obviates the necessity and difficulty of rendering gas-impermeable that portion of the diaphragm which extends above the liquid level. It is tubular in form, of the same cross section as the diaphragm D, and of sufficient length to extend below the liquid level, as shown. It is formed at its upper end with an outwardly and downwardly projecting flange g^1 of proper form to fit into the sealing trough b^1 , which extends continuously around each hanger, as will be evident from Figs. 2 and 4. The lower edge of the hanger is formed with a continuous recurved flange g^2 , which is sufficiently narrow to enable it to pass into the space between adjacent troughs b^1 , and forms a secure joint with the upper folded edge of the diaphragm D, as shown at the right of Fig. 6, the flange of the hanger being pressed lightly against the infolded edge of the diaphragm. It is preferable, although not essential, to insert clips H H' with the infolded edge of the diaphragm into the flange g^2 . The clips H and H' (Figs. 7 and 8) are made of sheet metal folded with one leg or side being of sufficient width to depend some distance below the bottom of the hanger G. The object of these clips is to prevent the oxygen which rises from the anodes C from getting between the hanger and diaphragm at the joint, thereby causing bellying of the diaphragm and tending to spread it out against the cathode plates, besides tending to produce leakage of oxygen through the diaphragm or the joint. The clip H' is made three-sided, as shown in Fig. 8, so as to extend around the corners of the flange g^2 at the ends of the hanger.

In the present case, the diaphragms D are provided at the bottom with troughs I

for stretching and holding them in place. One of these troughs is shown with the central portion broken away, in Fig. 10. The troughs I may be made of any suitable heavy material, but preferably of insulating material such as porcelain. Each trough is provided with a series of holes i' along its length, and the diaphragm D, which is otherwise closed at the bottom and forms a pocket, has a set of corresponding holes therein. These troughs, besides serving as weights to hold the diaphragms against flapping or bellying, serve as catching receptacles for the rust and scale which fall from the anodes, the object being to prevent this material from falling and accumulating on the bottom of the cell where it might form a pile which would electrically connect the walls of the cell with the anodes and thereby produce a short circuit. A little of the material will normally fall through the holes i' , but not enough to produce a short circuit. In cleaning the cell, this material is removed from the troughs by first removing the cover and anodes from the tank and then flushing the troughs I with a hose, thereby washing the accumulated material therefrom through the holes i' into the bottom of the cell, from which it is washed through the holes in the end covers.

The form of the bottom of the cell has been improved by offsetting the walls so as to enlarge it on both sides and ends, as shown, and by setting therein a tray or trough J, which is intended to hug the sides and bottom as closely as possible, and has open ends. This tray is made of insulating material and its purpose is to prevent electrolytic action between the anodes and that part of the walls of the cell which lies below them, as such action would tend to permit hydrogen to enter the tubular diaphragms D. The tray is preferably made of asbestos, and as this material becomes softened in the alkaline solution used for the electrolyte, flanges k' may be formed on the inside of the covers K, to support the sides of the tray. On the bottom of the tray J is laid a glass plate L which further prevents any electrolytic action of the bottom of the cell and enables the material accumulating thereon to be easily and cleanly removed.

The ends of the enlarged bottom portion a'' of the tank A are made open and provided with flanges a'' to receive the cover plates K, which are secured thereto by bolts k'' and provided with sealing gaskets k'' . Each cover plate is formed with two externally threaded tubular bosses k'' upon which are screwed caps k'' . These bosses enable the bottom of the cell to be flushed without removing the cover plates K, and furthermore, by making the caps k'' open in the center and confining glass plates k'' with sealing washers k'' between them and the bosses, it is

possible to inspect the interior of the cell during operation by holding a lamp adjacent to the glazed openings at one end and looking through one of the glazed openings at the opposite end of the cell.

One of the plates K is also formed, as shown in Fig. 1, with a threaded hole k'' for a pipe M leading from a water supply tank which is not shown, this pipe being shown at the opposite end of the cell in Fig. 5.

Means for indicating the liquid level within the cell comprise a gage N with glass sight tube n' and metallic coupling members n'' , which connect it with the tank A and neutral section B and must therefore be insulated from each other. To this end insulating collars n'' are provided for the fender rods n'' where they pass through the perforated lugs n'' in the lower coupling member n'' .

To produce and maintain perfectly tight joints or seals between the members A and B and between the members B and E, we have found that entire dependence cannot be placed upon paraffin or other liquefiable sealing material, nor upon the rubber gaskets, since the edges of a casting like the member B cannot in practice always be made perfectly smooth or without flaws. Should, moreover, the cell or particularly the upper section B, receive a jar, as may happen in setting the anodes and cover in place or in removing them, this may be sufficient to break the seal in the trough a' , b' or b'' and cause trouble if the rubber gaskets and paraffin or liquefiable sealing material are alone depended on. The sides of the members A and B respectively are therefore formed with forked lugs a'' and b'' to receive bolts O which are provided with insulating collars o' and nuts o'' ; said bolts being used particularly to draw the parts tightly together while the liquid sealing material is being poured.

Special clamping means are provided to hold down the cover E upon the sealing gasket F during the pouring of the melted sealing material into the trough b'' , and such means may comprise a series of screw clamps P which engage under the bottom of the trough b'' and upon lugs e'' formed on the cover as resting points for the clamping screws p' . These clamps may be either left on or removed after the sealing material has cooled and hardened or set.

In the case of the joint at the sealing gasket F, the length of the seal is considerable, as it embraces not merely the encircling portion, but also the medial portions of the troughs b' . It is necessary with this gasket to form a perfect hermetic separation between the hydrogen and oxygen chambers respectively, outside and inside the diaphragm hangers G. The troughs are first filled with liquefiable sealing material and the gasket then laid upon them, the gasket

corresponding in form with the troughs. On the cover E are formed encircling and medial flanges e^6 of the same contour as the gasket, and these are depressed upon the gasket by the weight of the cover and anodes and also by the clamps P. To further insure a perfect seal, the flanges e^6 are formed on their lower surfaces with longitudinal ribs e^7 (see Fig. 12) which are so placed as to depress the rubber of the gasket F into the middle portions of the troughs b' between the two flanges g' of the adjacent hangers, or between one of said flanges and the opposite wall of the trough.

The cover E is preferably provided in the top with two openings e^8 , which are adapted to receive safety covers Q. Each cover Q is made of sheet metal with a depending marginal flange q' which fits into a trough e^9 in the cover E, and when the trough is filled with paraffin or other liquefiable sealing material q^2 , forms therewith a gas tight joint which will yield only to excessive pressure within the cell. Each cover Q is also formed with a circular crease or rib q^3 , which rests upon an asbestos gasket q^4 and presses the latter into an annular groove e^{10} around the edge of the opening e^8 . The cover Q may be held down upon the gasket q^4 by extraneous means while the sealing material q^2 is being poured. To facilitate removal of the sealing material, the trough e^9 is formed in one side with a drain hole e^{11} , which can be stopped with a plug while the melted sealing material is being poured into the trough.

Two pipes R, which are screwed into threaded holes e^{12} in the cover E, are for conducting off the oxygen collected in the chamber under the cover, and the pipe S which is screwed into the hollow lug b^5 on one end of the member B, is for conducting off the hydrogen collected in the chamber in said member outside of the diaphragm hangers G.

Electrical terminals are formed by means of copper or brass studs T and U threaded into lugs b^6 and e^{13} on the tank A and cover E respectively, and provided with nuts t' and u' for the attachment of straps t^2 and u^2 , by which the cell is supplied with current.

Various modifications in the construction and arrangement of parts of the apparatus may be made without departure from the principle and scope of the invention as defined in the following claims.

We claim:

1. In a water electrolyzing cell the combination of a tank member which constitutes one electrode of the cell, a neutral member mounted on and insulated from the tank member, a cover member mounted on and insulated from the neutral member, an electrode plate suspended from and electrically

connected with the cover member and depending through an opening in the neutral member into the tank member, and a diaphragm suspended from said neutral member around said electrode plate and extending below the same.

2. In a water electrolyzing cell, the combination of a tank member which acts as one electrode, a neutral member which forms an extension on the upper part of the tank member and is insulated therefrom, and a cover member mounted on said neutral member and closing the top of the cell and insulated from said neutral member, said cover member forming the other electrode of the cell.

3. In a water electrolyzing cell, the combination of a tank member which acts as one electrode, a neutral member which forms an extension on the upper part of the tank member and is insulated therefrom, a cover member mounted on said neutral member and closing the top of the cell and insulated from said neutral member, said cover member forming the other electrode of the cell, and an electrode plate suspended from and electrically connected with said cover member and in position to act conjointly with the walls of said tank member as electrolytic surfaces.

4. In a water electrolyzing cell, the combination of a tank member which acts as one electrode, a neutral member which forms an extension on the upper part of the tank member and is insulated therefrom, a cover member mounted on said neutral member and closing the top of the cell and insulated from said neutral member, said cover member forming the other electrode of the cell, an electrode plate suspended from and electrically connected with said cover member and in position to act conjointly with the walls of said tank member as electrolytic surfaces, and a diaphragm suspended from said neutral member and disposed between said electrolytic surfaces of said plate and tank member.

5. In a water electrolyzing cell, the combination of a tank member which acts as one electrode, a neutral member which forms an extension on the upper part of the tank member and is insulated therefrom, a cover member mounted on said neutral member and closing the top of the cell and insulated from said neutral member, said cover member forming the other electrode of the cell, an electrode plate suspended from and electrically connected with said cover member and in position to act conjointly with the walls of said tank member as electrolytic surfaces, and a diaphragm suspended from said neutral member and surrounding said electrode plate.

6. In a water electrolyzing cell, the combination of a tank member which acts as one

electrode, a neutral member which forms an extension on the upper part of the tank member and is insulated therefrom, a cover member mounted on said neutral member and closing the top of the cell and insulated from said neutral member, said cover member forming the other electrode of the cell, an electrode plate suspended from and electrically connected with said cover member and in position to act conjointly with the walls of said tank member as electrolytic surfaces, and a diaphragm suspended from said neutral member and surrounding said electrode plate, the upper portion of said diaphragm being of impermeate metal and the lower portion of material pervious to liquid and impervious to gas when immersed in the electrolyte.

7. In a water electrolyzing cell, the combination of a metal tank member forming the lower portion and one electrode of the cell, a neutral member also of metal forming an extension of the tank walls mounted on and insulated from said tank member, said neutral member forming also a gas chamber for one of the two gases evolved and having a delivery duct leading therefrom, a tubular diaphragm suspended from said neutral member, a metal cover member mounted on and insulated from said neutral member and forming the other electrode of the cell, and an electrode plate suspended from and electrically connected with said cover member, said electrode plate being disposed within said tubular diaphragm.

8. In a water electrolyzing cell, the combination of a tank member forming one electrode of the cell and having a trough encompassing its upper edge, a neutral member forming an upward extension of the walls of said tank member and mounted thereon and having its lower edge in said trough but out of contact with said tank member, insulating material filling said trough and electrically separating said neutral member from said tank member and forming a hermetic seal between the two members, said neutral member having a trough completely encircling its upper edge, a cover member mounted on said neutral member and forming the other electrode of the cell and having a marginal portion depending into said last named trough; and insulating material lying between and electrically separating said cover member and neutral member, a part of said insulating material filling said trough and forming a hermetic seal between said cover and neutral member.

9. In a water electrolyzing cell, the combination of a tank member forming one electrode of the cell and having a trough encompassing its upper edge, a neutral member forming an upward extension of the walls of said tank member and mounted

thereon and having its lower edge in said trough but out of contact with said tank member, insulating material filling said trough and electrically separating said neutral member from said tank member and forming a hermetic seal between the two members, said neutral member having a trough completely encircling its upper edge, a cover member mounted on said neutral member and forming the other electrode of the cell and having a marginal portion depending into said last named trough; insulating material lying between and electrically separating said cover member and neutral member, a part of said insulating material filling said trough and forming a hermetic seal between said cover and neutral member, a diaphragm suspended from said neutral member, the upper part of said diaphragm which lies in the gas space being of impervious material and the lower part of porous material and the two being united by a hermetic joint approximately at the liquid level, and an electrode plate suspended from and electrically connected with said cover member.

10. In a water electrolyzing cell, the combination of a tank member forming one electrode of the cell and having a trough encompassing its upper edge, a neutral member forming an upward extension of the walls of said tank member and mounted thereon and having its lower edge in said trough but out of contact with said tank member, insulating material filling said trough and electrically separating said neutral member from said tank member and forming a hermetic seal between the two members, said neutral member having a trough completely encircling its upper edge, a cover member mounted on said neutral member and forming the other electrode of the cell and having a marginal portion depending into said last named trough; insulating material lying between and electrically separating said cover member and neutral member, a part of said insulating material filling said trough and forming a hermetic seal between said cover and neutral member, said neutral member having also an encircling trough surrounding its inner margin, a tubular diaphragm the upper edge of which has a recurved flange extending down into said trough, liquefiable sealing material in said trough which forms a hermetic seal between said neutral member and said diaphragm, and an electrode plate suspended from and electrically connected with said cover and disposed within said tubular diaphragm.

11. In a water electrolyzing cell, the combination with an upper supporting member having a trough, liquefiable sealing material in said trough, and a diaphragm in two parts, the upper one of which is of sheet metal provided with a recurved flange on

its upper margin which extends into said trough and the lower part of which diaphragm is of flexible fabric; the two being united by a hermetic joint at about the level of the electrolyte, said joint comprising re-
 5 curved interlocking flanges.

12. In a water electrolyzing cell, a compound diaphragm comprising a sheet metal upper portion occupying the gas space and a flexible fabric lower portion occupying the
 10 electrolyte space, the two being united by a hermetic joint comprising a recurved flange on said sheet metal portion in which the upper edge of said lower portion is confined; and a metal clip of U-shaped section with
 15 the inner leg confined within said recurved flange and the outer leg being longer and subtending said flexible fabric to a distance below the bottom of said sheet metal portion whereby said flexible fabric is prevented
 20 from spreading outwardly.

13. In a water electrolyzing cell, a compound diaphragm pocket comprising a sheet metal upper portion occupying the gas space and a flexible fabric lower portion occupying
 25 the electrolyte space, the two being united by a hermetic joint comprising a recurved flange on said sheet metal portion in which the upper edge of said lower portion is confined; and a trough-shaped weight on the
 30 bottom of said pocket which prevents the fabric from bellying.

14. In a water electrolyzing cell, the combination of an electrode plate, an inclosing
 35 diaphragm pocket of flexible material and a trough-shaped weight on the bottom of said pocket which acts to hold said diaphragm pocket distended.

15. In a water electrolyzing apparatus, the combination of an electrode plate, a
 40 diaphragm pocket inclosing said plate and out of contact therewith, and a trough supported on the bottom of said pocket below said electrode plate and adapted to receive
 45 and hold scale and the like dropping from said plate.

16. In a water electrolyzing apparatus, the combination of an electrode plate, a
 50 diaphragm pocket inclosing said plate and out of contact therewith, and a trough supported on the bottom of said pocket below said electrode plate and adapted to receive and hold scale and the like dropping from
 55 said plate, said trough having holes in the bottom thereof through which any accumulated scale and the like may be flushed.

17. In a water electrolyzing cell, the combination of a suspended electrode plate and an independently suspended diaphragm
 60 pocket inclosing said plate and substantially closed at the bottom at some distance below the bottom of said plate whereby it is adapted to retain scale and dust falling from said
 65 plate.

18. In a water electrolyzing cell, the com-

bination of a suspended electrode plate and a suspended diaphragm pocket inclosing
 said plate and substantially closed at the bottom at some distance below the bottom of
 said plate whereby it is adapted to retain
 70 scale and dust falling from said plate and provided with one or more holes through which any scale and dust therein may be washed out.

19. In a water electrolyzing apparatus, an
 75 electrode plate comprising two parallel plates, spacers separating them and rivets uniting them together through said spacers, thus forming an interior hollow space
 80 adapted to permit the downward circulation of the electrolyte; and hanger rods riveted between said plates at the top and extending upwardly therefrom and provided with means on their upper ends for securing
 85 them to a support.

20. In a water electrolyzing cell, the combination of a tank member having the walls
 thereof at the bottom offset outwardly from the walls of the upper portion thereby forming
 90 an enlarged bottom chamber, one or both end walls of said bottom portion being removable; and a trough-shaped insulating member fitting in said bottom portion, the upper edges thereof extending approxi-
 95 mately to the top of said bottom portion whereby solid materials are prevented from getting between said insulating member and the tank walls.

21. In a water electrolyzing cell, the combination of a tank member having the walls
 100 thereof at the bottom offset outwardly from the walls of the upper portion thereby forming an enlarged bottom chamber, one or both end walls of said bottom portion being removable; and a trough-shaped insulating
 105 member fitting in said bottom portion and extending approximately to the top thereof, whereby solid material is prevented from getting between the insulating member and the walls of the tank; and inwardly extend-
 110 ing flanges on the end walls of said enlarged portion which are adapted to abut on the inner faces of said insulating member and thereby support the same.

22. In a water electrolyzing cell, a tank
 115 member having a hollow threaded boss on each end wall, plates of transparent material covering said bosses and annular threaded caps screwed on said bosses and holding
 120 said plates in place whereby the cell may be inspected interiorly while in operation.

23. In a water electrolyzing cell, the combination of a tank member adapted to act as
 an electrode and having its walls at the bottom offset outwardly from the walls of the
 125 upper portion and forming an enlarged bottom portion, a trough-shaped insulating lining member covering the bottom and sides of said enlarged bottom portion, two removable end covers for said enlarged bot-
 130

tom portion, each having one or more openings; and removable transparent closures for said openings whereby when in place the interior of the cell can be inspected while in
5 operation and when removed the bottom of the cell is accessible from end to end for cleaning.

In witness whereof we have hereunto set our hands in the presence of two witnesses.

RUDOLPH JACOB JOHANNES MUELLER.

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