Feb. 21, 1933. O. K. ENZOR 1,898,352

MEANS FOR ELECTROLYTIC PRODUCTION OF GASES

Filed May 31, 1932 2 Sheets-Sheet 1

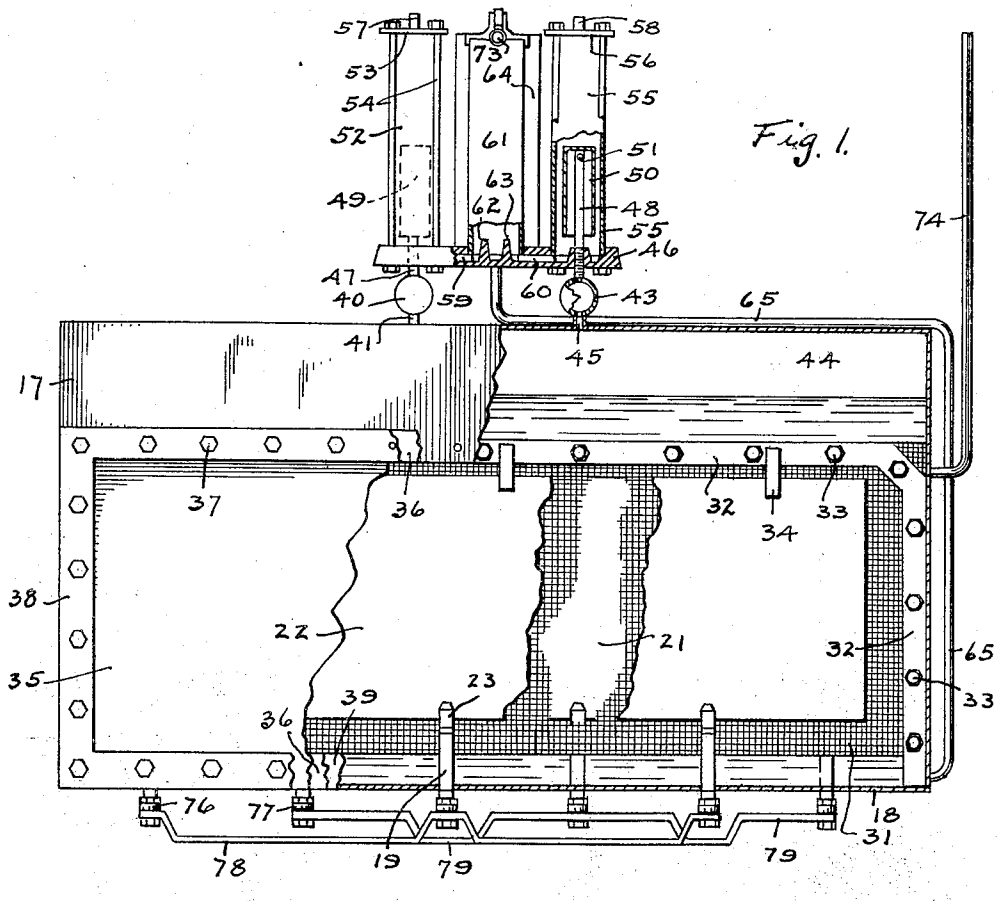


Fig. 1.

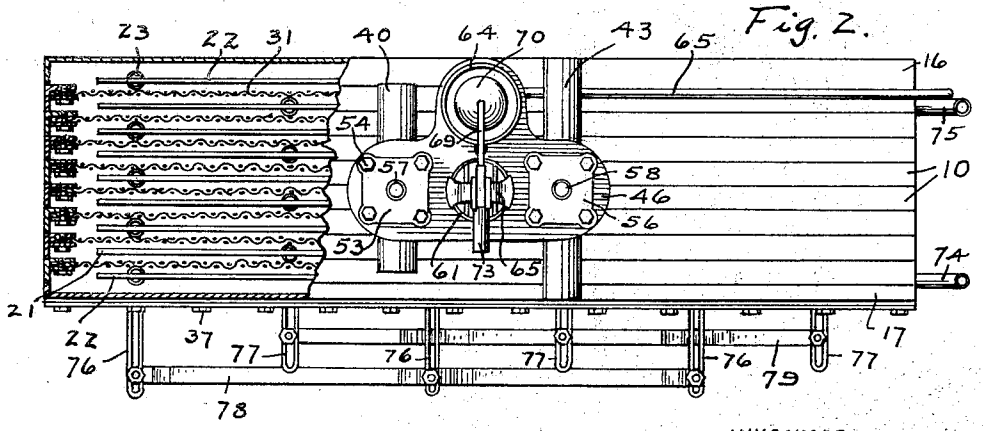


Fig. 2.

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Fig. 3.

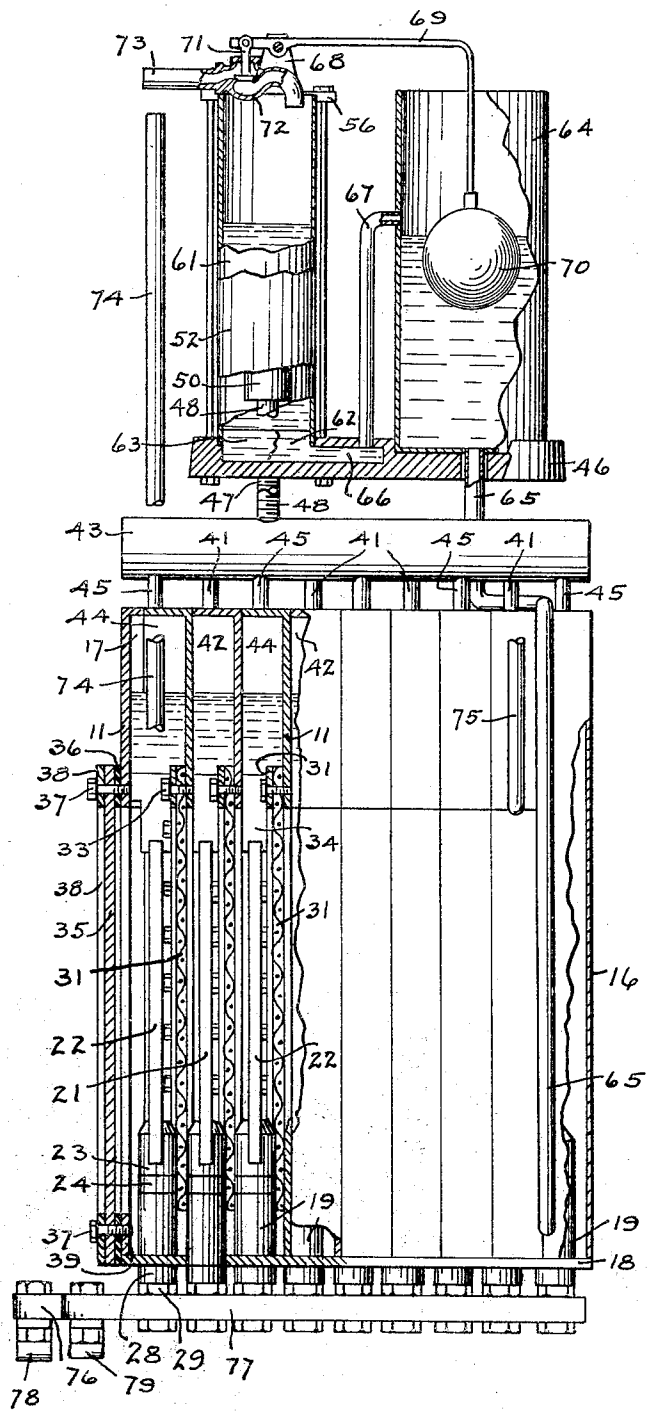
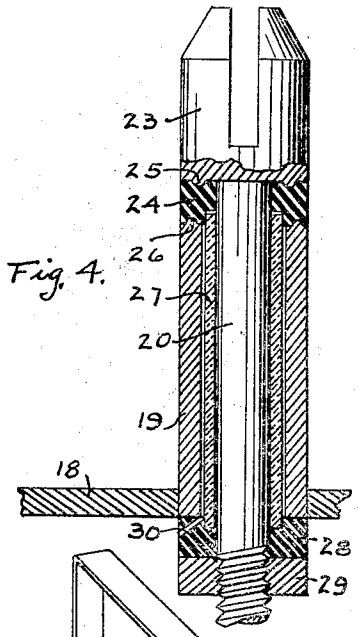


Fig. 4.



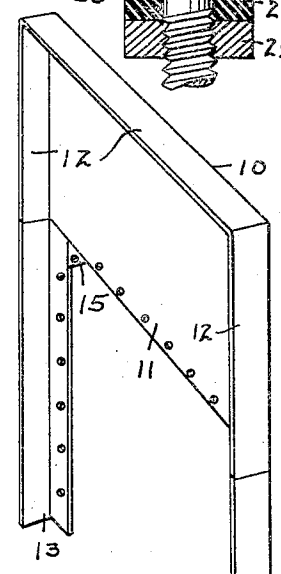


Fig. 5.

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UNITED STATES PATENT OFFICE

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MEANS FOR ELECTROLYTIC PRODUCTION OF GASES

Application filed May 31, 1932. Serial No. 614,379.

This invention relates to means for producing the gases hydrogen and oxygen by an electrolytic cell and has for one of its primary objects the formation of a multiple cell unit without packing between the various cells and in which the separators and electrodes may be installed and removed. Another primary object of the invention is to provide a permanent outside shell and permanent gas partitions within the shell within and between which the electrodes and separators may be removably placed.

A still further important object of the invention is to provide means for supporting electrodes within the individual cells of the unit which supports may be carried through the bottom of the unit without danger of leakage of the electrolyte and at the same time be of such nature that the electrodes may be installed and removed without difficulty. A still further important object of the invention is to provide means for automatically maintaining a predetermined level of electrolyte within the unit dependent upon the pressure maintained in the take-off lines.

An advantage of the invention to be noted is that of the construction whereby a plurality of like members may be assembled one against the other to form the desired number of cells in any one unit with a common floor across the bottom of these members, which floor may be preformed to carry sleeves to receive the electrodes with definite spacing.

These and many other objects and advantages will become apparent to those versed in the art from the following description of the invention which is more or less diagrammatically illustrated by the accompanying drawings, in which

Fig. 1 is a fragmentary front elevation of a unit embodying the invention;

Fig. 2, a fragmentary top plan view of the unit;

Fig. 3, a fragmentary end elevation of the unit on an enlarged scale;

Fig. 4, a detail in vertical section on an enlarged scale of an electrode support, and

Fig. 5, a front view in perspective of an individual cell forming member.

Like characters of reference indicate like parts throughout the several views in the drawings.

The present form of the invention involves the use of an eighteen percent solution of sodium hydroxide within which are immersed a number of plate-like electrodes of substantially pure iron and of nickel or of nickel plated iron. In the present form as herein shown and described, a unit is built up to include a number of individual cells nine in number although this number may be varied as desired and any number of the units may be hooked together to form a battery.

A number of cell defining members 10, Fig. 5, are formed to have a vertically disposed back wall 11 from the side and top edges of which extends the flange 12 a distance equal to the desired thickness of the individual cell. Angle bars 13 and 14 are brought up by their ends against the under edge of the wall 11 to have the legs of the bars turned respectively to have one leg serve as a continuation of the flange 12 and the other leg to be in the plane of the wall 11. The bars 13 and 14 are butt welded in this position to form an integral structure wherein an opening is provided between the bars 13 and 14 below the wall 11. A gusset 15 is welded in place in the corner between the under side of the wall 11 and the inturned leg of each bar to serve in part as a reenforcing member. The width of the forwardly turned leg of each bar 13 and 14 is the same as that of the flange 12. In the present form, eight of these members 10 are brought together to have the forward edges of the flange 12 and bars 13 and 14 abut the back of the next adjacent member and the members are welded one to the other about their lines of contact to form a rectangular box-like structure as viewed from the outside but divided internally into a number of upper chambers between the various walls 11 closed around the sides and top but open from the under side, and having an open space entirely therethrough below the under edges of the walls 11.

A back member 16 is formed to have the same dimensions as that of the member 10 but in this member 16 there is no opening left through the wall between the side flanges but

instead this back wall extends integrally from top to bottom and from side to side between side and top flanges. This member 16 is brought up to have its forwardly projecting flange abut the back of the last member 10 and is welded thereto entirely around the contacting flange edge. A front member 17 is formed to be substantially identical to the member 10 with a transverse upper wall 11 and this member 17 is reversed in position as compared to that of each member 10 so as to have the edge of its then rearwardly turned surrounding flange abut the forwardly projecting flange about the front member 10 and is welded thereto about the line of contact.

A bottom enclosing floor 18 is formed, preferably out of heavier metal than that of the other members 10, 16 or 17, and is perforated with a plurality of staggered holes within each of which holes is inserted the lower end of a thimble 19 to have the lower end thereof come flush with the under side of the floor. Each thimble is welded to the floor to form a gas and water tight joint therewith. The floor 18 is so perforated as to carry the thimbles 19 in fore and aft rows to have the thimbles alternately disposed to have transverse rows of thimbles come a slight distance in front of the forward sides of planes extended downwardly from the walls 11 when the plate 18 is brought up against the under sides of the bars 13 and 14. This floor 18 is rectangular in shape and is of sufficient area to have its edges come out flush with the outer sides of the side walls as defined between forwardly turned legs of the bars 13 and 14 and also to come flush with the outside of the back wall of the member 16 and across between the forward sides of the lower end of the member 17. The floor 18 is welded entirely around its outer edge to the members thereabove to form a gas tight joint therebetween.

With the unit thus assembled as above described, there is an opening left through the front side or section 17. The various electrodes and separators are carried into the unit through this opening. All of the electrodes are of the same area and each comprises a relatively thick flat iron plate rectangular in shape and having supporting studs 20 fixed along the lower edge. The positive electrodes 21 are nickel plated whereas the negative electrodes 22 are left unplated with the iron surfaces exposed. The area of each of these various electrodes is somewhat less than that of the opening through the front section 17 so that the electrodes may be easily carried through this opening and back through the unit. The supporting studs 20 each have a head 23 which is slotted to receive the lower edge of the electrode therethrough and the head is welded to the electrode. One of the negative electrodes 22 is first inserted through the opening in the section 17 and the upper edge of the electrode is inserted to between the back wall 16 and the short wall 11 immediately there in front so that the electrode may be lifted vertically to have the studs 20 raised up and allowed to drop down through the thimbles 19 which are disposed in a transverse line thereunder. An insulating collar 24, Fig. 4, is first placed over each of the thimbles 19 to have the studs 20 passed therethrough so that the under side of each head 23 may rest on the collar 24, the under side of the collar being supported by the top edge of the thimble. The under side of the head 23 is provided with an annular rib 25 and the top edge of the thimble 19 is provided with a similar annular rib 26. An insulating sleeve 27 is slipped up over each stud 20 from the under side of the floor 18, an insulating collar 28 brought up around the stud and a retaining nut 29 screw-threadedly engaged on the lower end of the stud whereby the tightening of the nut against the collar 28 will pull the stud 20 downwardly to cause the ribs 25 and 26 to become embedded in the collar 24 so that a water tight joint is formed between the head of the stud and the thimble. The length of the sleeve 27 is such that its respective ends may come within cup-like depressions in the collars 24 and 28 but will not compressively be engaged by its ends therebetween so that the collar 24 may be brought down against the upper end of the thimble 19 without being held thereaway by the sleeve. Preferably a drain passage 30 is provided through the lower collar 28 as an indicating means to determine from the outside if any leakage is occurring about the collar 24 to within the thimble 19. Since the electrode carried by the studs is fixed across the head thereof, the electrode will be securely held in a vertical position when the nuts 29 are drawn up on the studs 20. Upon the placing of the back electrode 22 as above indicated, an electrolytic mat or separator 31 made out of the usual and well known woven asbestos material is carried through the opening through the section 17 to have its upper edge brought against the front side of the wall 11 which is the first wall in front of the electrode just placed. A clamping band 32, essentially U-shaped is brought against the front of the mat and cap screws 33 are inserted through the band 32 and the mat 31 to screw-threadedly engage with the wall 11 horizontally thereacross and also vertically down along each of the inturned flanges of the bars 13 and 14 which are in the same plane as that of the wall 11 above. The mat 31 while being of a greater area than that of the electrodes is cut off across its bottom edge to leave a clearance or opening thereunder. After the mat 31 has been placed and secured as above described, the next electrode, being a positive and nickel plated electrode 21 is

then carried through the opening in the section 17 to have its upper edge carried first upwardly to between the next adjacent pairs of walls 11 to allow the studs extending from its lower edge to be entered into and dropped down through the thimbles 19 extending in the row thereunder. The insulating end joint forming collar 24 is employed as above indicated together with the sleeve 27, the lower collar 28 and the nut 29. The collar 24 is preferably made out of some compressible material such as rubber whereby the ribs 25 and 26 may be embedded therein upon application of pressure. The insulating sleeve 27 may be made of any insulating material even including porcelain since there is no strain upon it and it merely serves to space the stud laterally of the wall of the thimble 19. The lower collar 28 is here shown as being made of rubber although it may be made of any other insulating material even that which is not compressible. Since the electrolyte is a solution of sodium hydroxide the upper collar 24 must be made out of material that is not affected by the caustic.

In the same manner additional electrodes 21 and 22 with the intervening mats are placed within the unit and secured in place whereby there are in the form illustrated five negative electrodes 22 and four positive electrodes 21 with a mat 31 between each of the adjacent electrodes. Preferably the upper edges of each of the electrodes is supported against fore and aft displacement by insulating blocks 34 which are slipped loosely over the top edges of electrodes and are inserted upwardly between the back of the respective wall 11 and in front of the mat retaining band 32.

After all of the electrodes and mats have been positioned and secured in place within the unit, a cover 35 is brought up over the opening through the front section 17 and a gasket 36, preferably made of rubber is placed around the opening on the forward side of the wall so that the cover 35 may be compressively drawn against the gasket and the front face of the wall on the section 17 by means of cap screws 37 passed through a retaining band 38 which passes entirely around the outer edge of the cover 35 on its forward face, through the cover 35 and gasket 36 and screw-threadedly engaged through the wall of the section 17, Fig. 3. Thus it is to be seen that the only opening which had been left in the unit and appearing through the front wall of the section 17 is effectively closed and sealed over by the cover 35 forming a water tight joint against the wall of the section through the rubber gasket 36. The lower end of the cover 35 is brought up against a bar 39 which is turned upwardly from the floor 18 to form a face thereacross against which the gasket 36 may be compressed.

A manifold 40 is horizontally disposed across the upper side of the unit and is there supported by relatively short nipples 41, four in number, Fig. 3, each of which nipples forms a passageway from the compartments 42 which compartments are found between the transverse adjacent walls 11 immediately above and to either side of the positive electrodes 21, or in other words each nipple leads from the second, fourth, sixth and eighth compartments. A second manifold 43 is likewise horizontally disposed across the top of the unit in parallel alignment with but spaced apart from the other manifold 40. This manifold 43 is supported above the unit by nipples 45, here shown as five in number, which nipples provide passages from the first, third, fifth, seventh and ninth compartment 44, the compartments 44 being above the negative electrodes 22.

Above and across between the two members 40 and 43 is located a plate 46, from the under side of which toward one end leads a pipe 47 to connect with the manifold 40, and from the other side of which leads a pipe 48 to connect with the manifold 43. Both of these pipes 47 and 48 extend upwardly beyond the top side of the plate 46 for substantial distances and cups 49 and 50 respectively are inverted to hang down over the upper ends of the pipes to be held in fixed relation with the pipes. Both pipes are formed with outlets 51 whereby gases accumulating in either or both of the manifolds 40 and 43 may escape upwardly through the pipes, out of the openings 51 to within the inverted cups. Surrounding the cup 49 is a cylinder 52 having its lower end fitted to within the plate 46 and a cap 53 fitted over its upper end. Bolts 54 passing down through the cap 53 and through the plate 46 compressively draw the cap 53 against the top of the cylinder and hold the cylinder against the plate 46 against displacement. This cylinder 52 may be made out of any suitable material and if desirable for the purposes of observation may be made out of glass although metal may be employed. The internal diameter of the cylinder 52 is sufficiently great to permit it to surround the cup 49 with an annular space therebetween so that gases and liquids may flow freely upwardly and downwardly therebetween.

In the same manner a cylinder 55 is placed over and surrounding the cup 50 to be held in place on the plate 46 by bolts through the cap 56. Both of the caps 53 and 56 are provided with outlet nipples 57 and 58 respectively. The plate 46 is provided with internal passageways 59 and 60 leading respectively from under the lower ends of the cylinders 52 and 55 to under a centrally disposed cylinder 61 which is mounted on the plate 46 between the other two cylinders and is open at both the top and bottom ends. Up-

wardly extending baffles 62 and 63 are disposed across the respective passageways 59 and 60 below the cylinder 61 so that any flow through these two passageways is deflected upwardly rather than allowing the flow from each of the passageways to collide.

A tank 64 open at the top is carried by the plate 46 back of the central cylinder 61 and a pipe 65 leads from the bottom of this tank around and down the side of the battery unit to connect therewith to provide a passageway from the tank to within the unit to discharge therewithin at a point just above the floor 18. This pipe may have its discharge connection through the wall of the unit or the floor thereof at other positions, the essential location being below the tops of the electrodes 21 and 22. The plate 46 has an internal passageway 66, Fig. 3, leading rearwardly from under the cylinder 61 and a pipe 67 is carried by the plate to extend upwardly therefrom with its lower end intercepting the passageway 66 and its upper end connected to and discharging to within the tank 64 at a distance considerably above the base of the tank.

Mounted on the upper end of the cylinder 61 is a bracket 68 which rockably supports a lever 69, one end of which extends over and is bent downwardly to within the tank 64 to have a float 70 fixed to its lower end. The other end of the lever 69, comprising a relatively short arm is pivotally engaged with the stem 71 connected to a valve within the valve body 72 whereby lowering of the float 70 will cause the lever 69 to rock and lift the valve member and upward travel of the float will tend to seat the valve member. The valve body 72 has a discharge end directed downwardly to within the cylinder 61 and also has an inlet pipe 73 leading from some supply of distilled water (not shown). A pair of relief pipes 74 and 75 is provided, one pipe preferably leading from a space between two mats 31 between which is located a negative electrode 22 and the other pipe from between two mats between which is located a positive electrode 21. The pipes 74 and 75 both lead out through the side wall of the unit at points substantially on the line of the under edges of the walls 11. The pipes are turned upwardly to extend well above the top of the unit.

Connecting bars 76 and 77 are passed under the unit to connect respectively fore and aft rows of the depending ends of studs 20 leading from negative and positive electrodes and bus bars 78 and 79 interconnect the respective members in such manner that the bus bar 78 is connected only to those connecting members attached to negative electrode studs and the bus bar 79 connected to those connecting members attached only to the connecting member 77 uniting the studs of the positive electrodes.

In operating the unit above described, an eighteen percent solution of sodium hydroxide in distilled water is poured into the unit through the tank 64 until the solution reaches some such level as indicated within the unit in Fig. 3 wherein the level is above the under edges of the walls 11 completely submerging the electrodes and mats and leaving a gas collecting space between each of the walls 11 thereabove. The bus bars 78 and 79 are connected in a circuit with some suitable supply of electrical energy whereupon hydrogen gas will become liberated along the negative electrodes 22 to pass up through the electrolyte and oxygen will be formed along the positive electrodes 21 to likewise pass up through the electrolyte, each gas being kept entirely separate and prevented from mixing with the other by reason of the intervening mats 31 between electrodes. Consequently the respective gases hydrogen and oxygen will pass up through the electrolyte to escape to within the spaces thereabove between the walls 11 and flow out into the manifolds 43 and 40 respectively, from which manifolds the gas flows upwardly through the pipes 48 and 47 to escape to within the inverted cups 50 and 49. However before the gases are started to be generated, the tank 64 being initially empty, distilled water is allowed to flow past the valve member in the body 72 to within the cylinder 61, and this cylinder being open from the top end as well as at the bottom end, the water will flow transversely from the bottom and through the passageways 59 and 60 to within both of the cylinders 52 and 55. Continued flow from the valve member 72 to within the tank 61 will raise the level of the water therewithin as well as the two adjacent cylinders to such a point that the water may travel upwardly through the pipe 67 to overflow into the tank 64. As the gases are generated and flow within the cups 49 and 50, these gases will tend to displace the water therewithin to bubble out around the lower edges of these cups to pass upwardly to within the cylinders 52 and 55 tending to displace the water therewithin and to escape through the nipples 57 and 58. As the gases are liberated sufficient pressure thereof upon the electrolyte may be developed to lower the electrolyte level somewhat so as to force some of the electrolyte around up through the pipe 65 to enter within the tank 64 and thus raise the float 70 to shut off the supply of distilled water. This pressure is determined by the location of the upper outlet end of the pipe 67 within the tank 64 since the difference in level of the fluid in the tank 64 and the level of electrolyte in the unit determines the pressure exerted on the gases within the chambers 42 and 44 and the level of the water within the cylinders 52 and 55 is maintained substantially at the level of this outlet and of the pipe 67 through the alternate lowering and raising of the float

70. Even after the valve member is seated in the body 72, the level of the water in the cylinders 52 and 55 will drop down to that of the outlet end of the pipe 67 and at all times be sufficient to submerge the lower open ends of the cups 49 and 50. It is thus to be seen that both the hydrogen and oxygen gases must pass out through distilled water from under the cups and thus be washed before the gases pass out to the nipples 57 and 58. Should the flow from the nipples 57 and 58 be restricted unduly, sufficient pressure may build up in the cylinders 52 and 55 to cause the gases to displace the water within these two cylinders and allow the gases to flow out through the passageways 59 and 60 and pass up through the cylinder 61 to escape into the atmosphere, the baffles 62 and 63 tending to prevent the intermixing of these gases as they pass up through the cylinder. Likewise should an excessive pressure be built up so as to depress the level of the electrolyte to below the under edges of the walls 11 whereby there would be a tendency to uncover the upper ends of the mats 31, gases above the electrolyte would then escape through the safety pipes 74 and 75, these pipes otherwise being filled with electrolyte and acting as stand pipes within which the level is ordinarily that within the tank 64. As the water of the solution may be used up, new distilled water is added through the action of the dropping of the float 70 and this water enters through the cylinder 61 so that any traces of caustic solution coming over with the gases and washed out in the cylinders 52 and 55 will be returned to within the unit eventually as the water flows up around the pipe 67 into the tank 64 and down through the return pipe 65.

Thus it is to be seen that I have produced a battery unit built up from a number of cells into an integral structure wherein electrodes and separators or mats may be installed and removed without having to break joints or make up joints between the individual cells; that the electrical connections are made with the various electrodes from without through connections insuring loss of electrolyte through leakage; that has an automatic control of the electrolyte level; and is fully provided with safety features preventing the accumulation of gases beyond a predetermined pressure and preventing the formation of explosive mixtures. Combined with these structures and safety features is the fact that the gases are simultaneously washed as they leave the battery unit so that they are immediately available for use in other operations wherein a high degree of purity of gases is necessary.

Attention is directed to the fact that I employ a unit with closed top cells and by reason of the welding together of the cell walls to form an integral structure, gases may be generated in the unit under pressure, and as above indicated, that pressure is controlled by the level of liquids in the tank 61 as affected by the level of the outlet of the overflow pipe 67. By varying the outlet level of the pipe 67, the pressure of the gases in the unit is accordingly varied. For example, gases may be generated in the unit at sufficient pressure to be conveyed directly to a welding or cutting torch without any intermediate compressor.

While I have herein described and shown my invention in the form as now best known to me, it is obvious that structural changes may be made without departing from the spirit of the invention and I therefore do not desire to be limited to that precise form except as may be necessary by the limitations imposed by the following claims.

I claim:

1. In a gas producing electrolytic device, a plurality of individual cell defining units, each of said units comprising a metallic wall with a forwardly turned flange around its top and vertical edges and having downwardly extending legs from the sides thereof with forwardly extending flanges, said units being assembled one against the other to have the flanges of one unit abut and be welded to the back of the next forward unit to define an externally appearing box-like structure with a plurality of chambers defined between said metallic walls, a back section forming a back wall and a front section, each of said sections being welded to said box-like structure, said front section having an opening therethrough, a floor extending entirely across under and welded to the lower ends of said sections and of the legs of said units, a plurality of thimbles carried by said floor in transverse rows, positive and negative electrodes, studs fixed to the lower edges of the electrodes fitting within said thimbles and extending externally to below said floor, said electrodes being alternatingly disposed and each having a shape and area permitting it to be inserted to through said front section opening and carried back into said box-like structure to enter the studs into the thimbles, means for making a water tight joint between the studs and the thimbles, mats hanging from said unit plates to between adjacent electrodes, a manifold interconnecting alternate chambers, a second manifold interconnecting the other chambers, and a cover over said front section opening secured to the section with a water-tight fit.

2. In a gas producing electrolytic device, a plurality of individual cell defining units, each of said units comprising a metallic wall with a forwardly turned flange around its top and vertical edges and having downwardly extending legs from the sides thereof with forwardly extending flanges, said

units being assembled one against the other to have the flanges of one unit abut and be welded to the back of the next forward unit to define an externally appearing box-like structure with a plurality of chambers defined between said metallic walls, a back section forming a back wall and a front section, each of said sections being welded to said boxlike structure, said front section having an opening therethrough, a floor extending entirely across under and welded to the lower ends of said sections and of the legs of said units, a plurality of thimbles carried by said floor in transverse rows, positive and negative electrodes, studs fixed to the lower edges of the electrodes fitting within said thimbles and extending externally to below said floor, said electrodes being alternatingly disposed and each having a shape and area permitting it to be inserted to through said front section opening and carried back into said box-like structure to enter the studs into the thimbles, means for making a water tight joint between the studs and the thimbles, mats hanging from said unit plates to between adjacent electrodes, a manifold interconnecting alternate chambers, a second manifold interconnecting the other chambers, and a cover over said front section opening secured to the section with a water-tight fit, water containing cylinders individually connected with said manifolds, water sealed gas escape means interconnecting said cylinders, an overflow tank interconnected with said means, and a drain from the tank connecting with said box-like structure below the said unit walls.

3. In a gas producing electrolytic device, a plurality of individual cell defining units, each of said units comprising a metallic wall with a forwardly turned flange around its top and vertical edges and having downwardly extending legs from the sides thereof with forwardly extending flanges, said units being assembled one against the other to have the flanges of one unit abut and be welded to the back of the next forward unit to define an externally appearing box-like structure with a plurality of chambers defined between said metallic walls, a back section forming a back wall and a front section, each of said sections being welded to said box-like structure, said front section having an opening therethrough, a floor extending entirely across under and welded to the lower ends of said sections and of the legs of said units, a plurality of thimbles carried by said floor in transverse rows, positive and negative electrodes, studs fixed to the lower edges of the electrodes fitting within said thimbles and extending externally to below said floor, said electrodes being alternatingly disposed and each having a shape and area permitting it to be inserted to through said front section opening and carried back into said box-like structure to enter the studs into the thimbles, means for making a water tight joint between the studs and the thimbles, mats hanging from said unit plates to between adjacent electrodes, a manifold interconnecting alternate chambers, a second manifold interconnecting the other chambers, and a cover over said front section opening secured to the section with a water-tight fit, water containing cylinders individually connected with said manifolds, water sealed gas escape means interconnecting said cylinders, an overflow tank interconnected with said means, and a drain from the tank connecting with said box-like structure below the said unit walls, valve means for admitting water to within said escape means, and a float in said overflow tank operating said valve means.

4. In an electrolytic device for producing gases, an integrally formed metallic box-like unit having a plurality of transverse spaced apart walls defining chambers in the upper part thereof, said walls terminating to leave a clear opening from front to back in the unit having a cross-sectional area exceeding the area of one of said walls, an opening in the front of said unit, a floor in said unit, a plurality of thimbles fixed to the floor and disposed in transverse rows directly under said chambers, plates forming positive and negative electrodes alternatingly disposed fore and aft in parallel vertical alignment to have their upper ends directed toward said chambers, studs fixed to the plates and inserted through said thimbles to extend externally to below said floor, an insulating and sealing collar about each stud and the top end of the thimble, a mat secured to each of said transverse walls to hang between adjacent plates whereby each of said chambers is extended downwardly to receive a plate therein, said mats terminating a distance above the said floor and being secured by their vertical edges to flanges inturned from the side walls of said box-like structure, said plates and mats being each of a shape and area to permit them to be carried through said front opening and fixed in position within the unit, a cover for said opening, and gas collecting manifolds interconnecting alternate chambers.

5. In an electrolytic unit for producing gases in combination with a box-like structure carrying an electrolyte, a plurality of electrodes therein with individual chambers within which the gases are produced, and a pair of manifolds collecting separate gases from said chambers, a pair of cylinders, one cylinder being interconnected to one manifold and the other cylinder being connected to the other manifold, an inverted cup in each cylinder under which gases are discharged in flowing from the manifolds, each cylinder having an upper gas outlet, a third cylinder

interconnected at the bottom from the bottoms of the other two cylinders by passageways, an overflow tank, a drain pipe from the tank to said box-like structure, and an overflow pipe leading from a passage from the bottom of the third cylinder to discharge into the tank at a point spaced above the bottom thereof dependent upon the gas pressure to be maintained in said structure.

6. In an electrolytic unit for producing gases in combination with a box-like structure carrying an electrolyte, a plurality of electrodes therein with individual chambers within which the gases are produced, and a pair of manifolds collecting separate gases from said chambers, a pair of cylinders, one cylinder being interconnected to one manifold and the other cylinder being connected to the other manifold, an inverted cup in each cylinder under which gases are discharged in flowing from the manifolds, each cylinder having an upper gas outlet, a third cylinder interconnected at the bottom from the bottoms of the other two cylinders by passageways, an overflow tank, a drain pipe from the tank to said box-like structure, and an overflow pipe leading from a passage from the bottom of the third cylinder to discharge into the tank at a point spaced above the bottom thereof dependent upon the gas pressure to be maintained in said structure, a valve for admitting a fluid into said third cylinder, and float means in said tank for operating said valve.

7. In an electrolytic cell, in combination with an electrode and a metallic floor in the cell, a metallic thimble integrally joined with the floor, a head stud fixed to the electrode and extending through the thimble externally of the floor, a head on the stud, an insulating collar on the stud under the stud head and resting on the top of said thimble, said collar being slightly compressible, a rib around the under side of the stud head, a rib around the top edge of the thimble, said ribs becoming embedded in said collar upon drawing the stud down through the thimble, an insulating sleeve around the stud, a lower insulating collar around the stud under the floor, and a nut screw-threadedly engaging the lower end of the stud to compress the lower collar against the floor and pull down the stud.

8. In an electrolytic cell, in combination with an electrode and a metallic floor in the cell, a metallic thimble integrally joined with the floor, a head stud fixed to the electrode and extending through the thimble externally of the floor, a head on the stud, an insulating collar on the stud under the stud head and resting on the top of said thimble, said collar being slightly compressible, a rib around the under side of the stud head, a rib around the top edge of the thimble, said ribs becoming embedded in said collar upon drawing the stud down through the thimble, an insulating sleeve around the stud, a lower insulating collar around the stud under the floor, and a nut screw-threadedly engaging the lower end of the stud to compress the lower collar against the floor and pull down the stud, said lower collar having a drain passage therethrough whereby leakage past the upper collar may escape.

In testimony whereof I affix my signature.

ORA K. ENZOR.