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REINFORCED CONCRETE CELL FOR THE ELECTROLYSIS OF SALT, &c.

APPLICATION FILED NOV. 1, 1913.

1,125,201.

Patented Jan. 19, 1915.

2 SHEETS—SHEET 1.

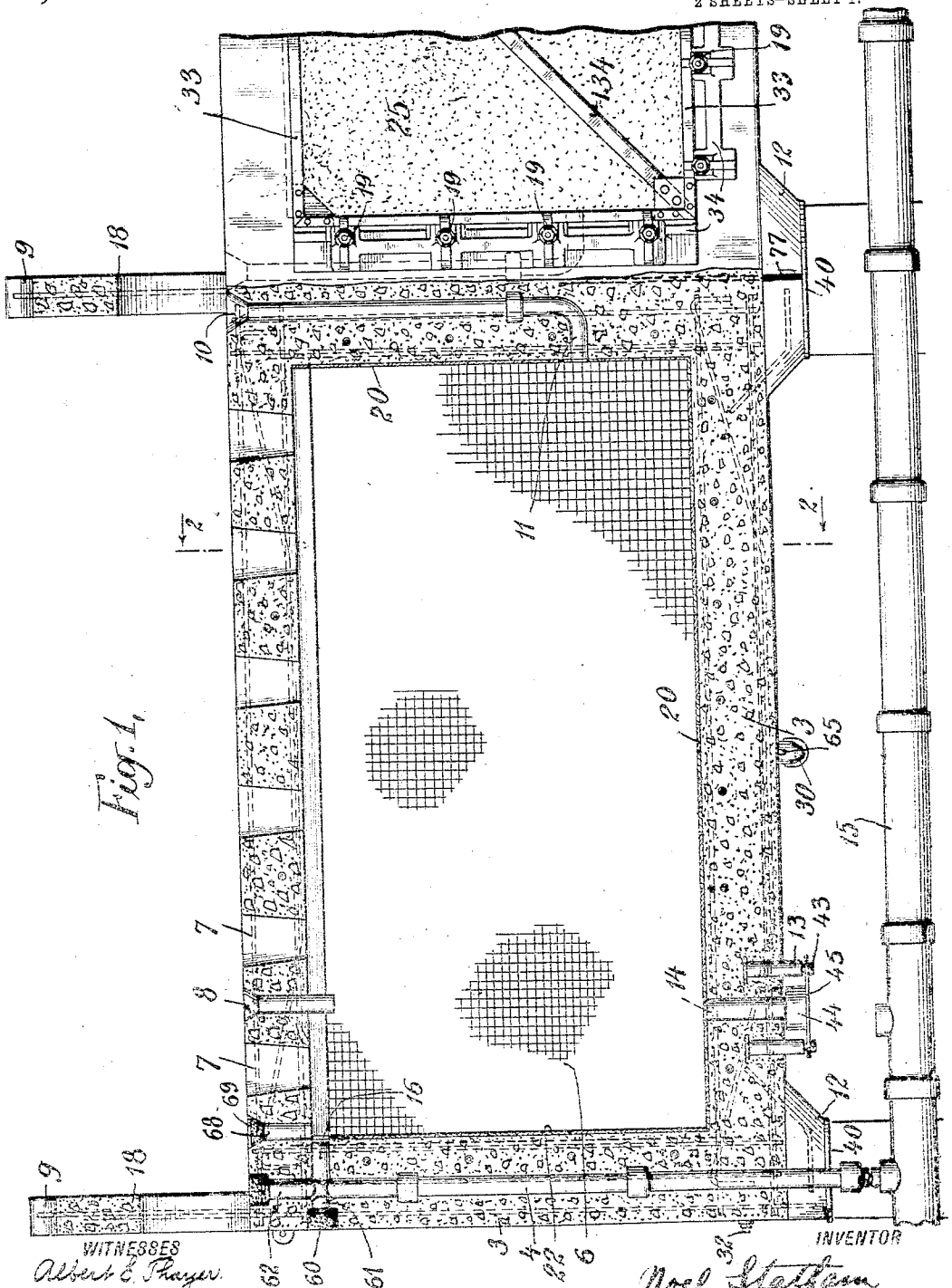


Fig. 1.

WITNESSES

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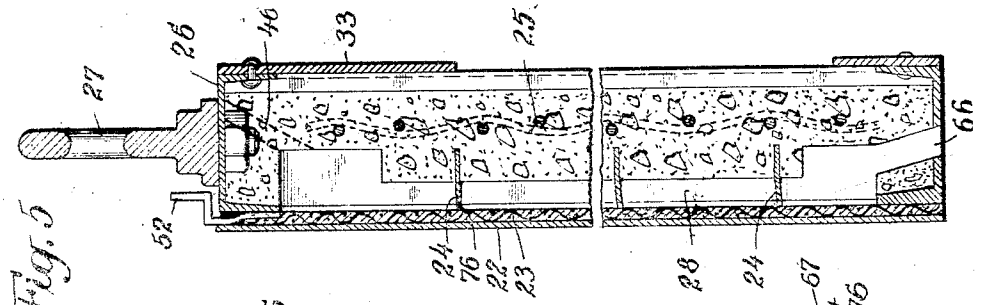


Fig. 5

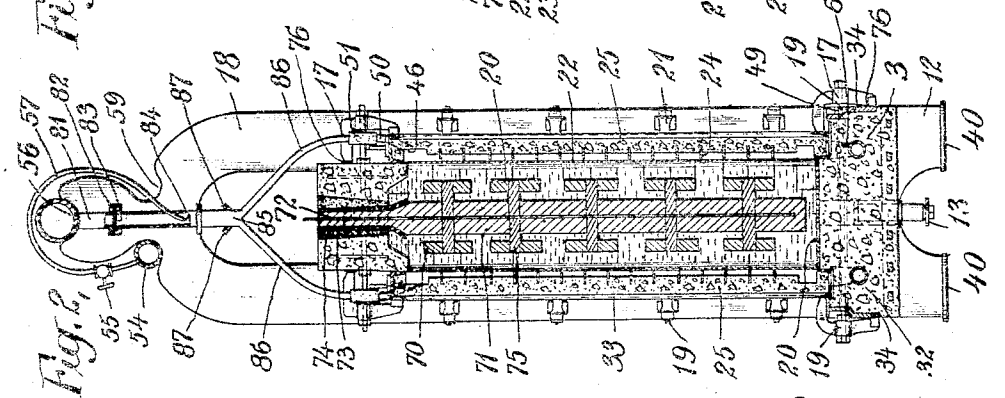


Fig. 2

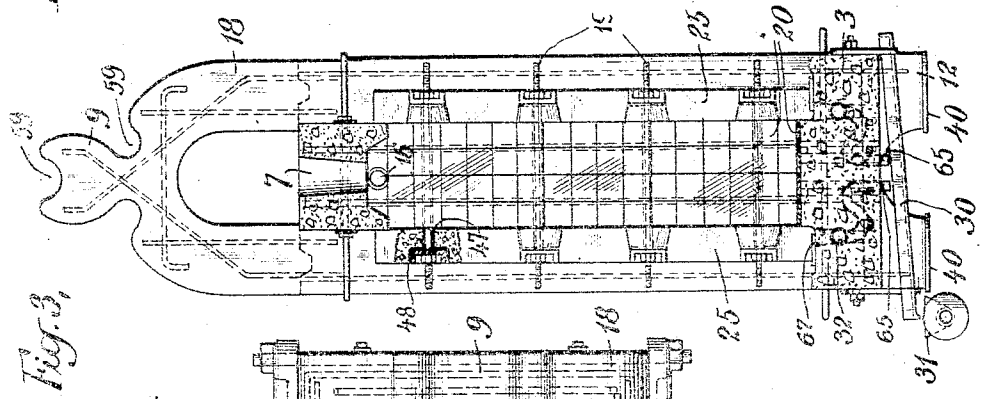


Fig. 3

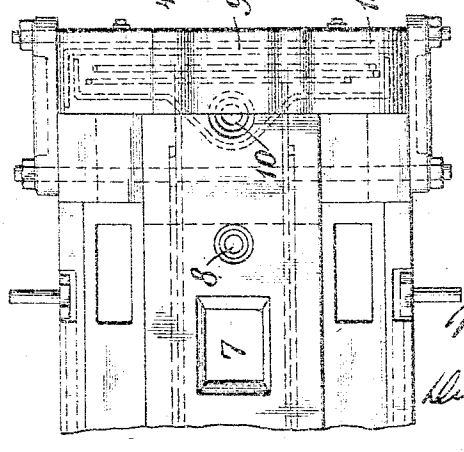


Fig. 4

WITNESSES

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NOEL STATHAM, OF YONKERS, NEW YORK, ASSIGNOR TO INDUSTRIAL CHEMICAL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

REINFORCED-CONCRETE CELL FOR THE ELECTROLYSIS OF SALT, &c.

1,125,201. Specification of Letters Patent. Patented Jan. 19, 1915.

Application filed November 1, 1913. Serial No. 798,619.

To all whom it may concern:

Be it known that I, NOEL STATHAM, a subject of the King of Great Britain, and resident of Yonkers, Westchester county, New York, have made a certain new and useful Invention Relating to Reinforced-Concrete Cells for the Electrolysis of Salt, &c., of which the following is a specification, taken in connection with the accompanying drawing, which forms parts of the same.

This invention relates especially to large electrolytic cells having their bodies or containing cases formed substantially or principally of reinforced concrete which can thus be cheaply and effectively made of such large size as to adapt them to the effective electrolysis of salt for the production of caustic soda and chlorin or for many other electrolytic processes. Cells of the general Hargreaves type can be conveniently made of such construction so as to secure high efficiency because of the comparative freedom from leakage of electricity and be also desirable because of the durability of the parts and the relative freedom from leakage of gas and so forth from the cells.

In the accompanying drawings showing in a somewhat diagrammatic way illustrative forms of this invention, Figure 1 is an elevation partly in section through a form of cell. Fig. 2 is a transverse section thereof taken substantially along the line 2—2 of Fig. 1. Fig. 3 is a similar section of the cell body with the cathode chambers removed. Fig. 4 is a partial top view on a larger scale: and Fig. 5 is an enlarged partial section through one of the cathode elements.

The cell body or casing may with advantage be in the form of a one-piece narrow open sided casing as shown in Fig. 1 which is preferably given a substantially rectangular section. By making the casing in this shape of suitable Portland or other cement concrete in which reinforcing rods or metallic members are embedded during the process of casting or molding the concrete, additional strength is given to the horizontal members where beam action is most marked and the other portions of the cell are also strengthened in a well known manner. It is possible in this way to form the cell body with one or more integral lifting brackets adjacent the ends of each cell, such as 18, which may as indicated in Fig. 3 be provided with an upper portion or head 9 and with any desired number of supporting recesses, such as 59, which may be of any suitable size and shape to accommodate and support the pipes, mains or other connections used in relation to the cell. The cell body may be formed with integral supporting feet such as 12 adjacent each end and also, if desired, at other points as well so that they may support the cell preferably on suitable insulating plates, such as 40, of glass or other material. It is usually desirable to provide the inside of the cell body or casing with a suitable impervious or acid-proof lining which may with advantage be formed of acid-proof tile, such as obsidianite or the like which may be secured in place around the inside of the cell body when it is originally cast or secured thereto subsequently with any suitable cement or binder so as to effectively protect the inside of the casing or at least such part thereof as comes in contact with the electrolyte. It is possible by forming such large sized electrolytic cells of reinforced concrete to form integral therewith the desired conduits and to provide the cell with apertures and other fittings when originally casting or molding it.

As shown in Figs. 1 and 4 the cell body is preferably provided with embedded brine inlet and outlet pipes of acid-proof earthenware such as chemical stoneware or other suitable material, and it is quite desirable to form these pipes with straight runs and connections and with suitable cleanout apertures in line with the operating portions of these pipes adjacent any bend so as to facilitate cleaning and make it easy to maintain the cell in effective condition. The brine outlet pipe 4, for example, is formed with the lateral intake portion 16 adjacent the top of the cell preferably partly above and partly below the normal level of the electrolyte therein so as to continuously effect the withdrawal of the weak brine through this pipe and discharge the same into the weak brine main 15 which may extend longitudinally below the series of cells, and at the same time the chlorin gas may freely pass through this same brine outlet and brine main which may be connected with a gas reservoir and suction device so as to effectively prevent

leakage of chlorin into the cell room. By forming the cleanout extensions 61, 62 in line with the two portions 4 and 16 of this brine outlet pipe the cleaning of the entire outlet pipe may be readily effected by withdrawing the luted plugs 60 and pushing a suitable cleaning instrument through these cleanout extensions and the portions of the brine outlet in line therewith. A suitable brine inlet pipe 10 of earthenware, etc., may be embedded in either one of the end walls of the cell casing and when its discharge end 11 is located below the normal level of the electrolyte in the cell it is sealed in this way so that it is unnecessary to provide any other seal for this inlet. One or more cleanout or sampling tubes such as 8 may be formed or cast in the top of the cell body which may have their tops left open where these tubes extend below the normal liquor level in the cell so as to make a liquid seal in this way. One or more additional cleanout or inspection openings such as 68 may also be formed in various parts of the cell which are of course normally closed by suitable plugs, such as 69, where these tubes do not extend below the liquor level. A series of anode apertures of suitable size and shape, such, for example, as the rectangular sectioned tapering apertures 7 shown in Figs. 1, 3 and 4, may be formed in the top of the cell body or casing and suitable draw-off outlet openings or tubes, such as 14, may be formed in the cell body and provided with any suitable form of plug or closure, such for example as the plug 44 which may be readily held in the closed position over the outlet opening 14 as by the bar 45 which may screw the plug tightly home through the screws or bolts 43 threaded into suitable clamps or sockets 13 embedded in or otherwise secured to the cell body.

The cathode elements used with a Hargreaves general type of cell of this description may be advantageously formed by casting or molding similar Portland cement or other concrete 25 within a metallic or steel angle iron cathode frame 26 which may have the lifting ring 27 secured thereto in any desired way and be provided with the edge plates 35 and one or more diagonal braces 134, if desired. The bearing bars 24 may be secured to the metallic cathode frame as by riveting or bolting them thereto or in most cases they may be supported sufficiently by embedding them within the concrete when originally casting it so as to support the projecting edges of these bearing bars substantially in line with the inner edge of the cathode frame and form a suitable cathode chamber, such as 28, within these bearing bars which may have their outer ends substantially horizontal or preferably slightly downwardly inclined and also provided with corrugations such as 76 if desired, as indicated in Fig. 5. The upper and lower ends of this cathode chamber 28 are preferably somewhat enlarged so as to supply more uniformly and readily throughout the surface of the cathode diaphragm 22, 23 the treating gases or vapors which may be injected through suitable gas inlets 46 arranged at the desired intervals along the upper part of the cathode element. The cathode diaphragm may be formed of any suitable material, such for example, as one or more sheets of superimposed steel or copper gauze 23 shown of somewhat exaggerated thickness in Fig. 5 which rest upon the bearing bars and edges of the cathode frame and soldered or otherwise secured to the heavy copper bar or collector strip 52 which may be used to carry the current. The porous diaphragm sheet 22 which may be made of treated asbestos paper, cloth or other suitable material is under operating conditions held closely in contact with the porous cathode gauze or member 23 so as to effectively coöperate therewith for the separation of the caustic soda or other material from the electrolyte. A similar enlargement of the lower part of the cathode chamber 28 may communicate through one or more discharge or drip openings 66 with suitable drip pipes to carry off the sodium carbonate solution and also the carbon-dioxid and the hydrogen or other waste gases from the cathode chamber. For this purpose suitable drip openings 67 may be formed within the cell body as shown in Figs. 2 and 3 so as to coöperate with the discharge or drip openings 66 in the cathode chambers and lead this material down the drip pipes 65 which as indicated in Fig. 3 may be curved or trapped to prevent undesirable gas discharge may discharge into an inclined transverse drip chute collecting trough 30 so as to conduct this soda liquor into the collectiong main 31 running along the row of cells. It is also desirable to have one or more suitable exhaust gas mains such as the mains 32 embedded in the cell body in connection with the cathode chambers so as to prevent escape of the cathode chamber gases into the cell room and by connecting these mains with an exhaust fan or other device these exhaust gases may be continuously withdrawn.

The anode elements may be of any suitable construction, such for example, as the built-up carbon anodes shown in Fig. 2 as comprising the anode blocks or pieces 70 of gas carbon or other suitable material supported on the rods 75 of graphite or other conducting substance which are connected with the copper or other metallic lead wires 72 and embedded in the anode support 71 of cement or other supporting material to give the desired mechanical strength and rigidity anode element. The upper end or neck of

this anode which extends into the anode aperture 7 may be covered with a layer of insulating tape or other material 73 so as to secure effective insulation at this point and then embedded in a layer of concrete calking 74 which may be wedged into the lower part of the anode opening tight enough to support the anode in proper position within the cell casing and also prevent escape of gas from the cell at this point. When the anodes have been assembled and supported in position in the cell the cathode frames and cathodes and coöperating cathode diaphragms may be secured on one or preferably both sides of the cell body in any desired way so as to clamp the cathode diaphragms securely to the metallic cathode frames to make electrical contact therewith and also to prevent escape of the electrolyte around this joint which may be promoted by previously applying to the cell casing where it is engaged by the edge of the cathode diaphragm any suitable calking or luting preferably of insulating mastic which can also serve to substantially electrically insulate the cathode diaphragm from the cell casing at this point. Any suitable clamping means may be used for this purpose and a desirable form of clamping means may comprise suitable clamping dogs such as 17 and 21 held in position by suitable bolts so as to clamp the cathode casing in the desired position. In this connection it is desirable to provide suitable clamping plates with which these clamping dogs may engage and by which their bolts are also supported and the clamping plates 34 have proved highly desirable for this purpose. These clamping plates are preferably embedded in the integral concrete cell body so as to be substantially flush with the outer edge thereof and are held in place in this way and also preferably by the action of suitable lock nuts 49 on the bolts 19 as shown in Figs. 2 and 3 which may coöperate with suitable recesses in these clamping plates. These clamping bolts 19 preferably extend through the cell body as by fitting loosely within an insulating tube or bushing 47 extending therethrough and projecting inside the clamping plate and formed of rubber or other suitable insulating material so as to have an electrically insulating and chemically protecting action on the bolt for which reason similar insulating and protecting washers 47 are arranged beneath the lock nuts 49 so as to electrically insulate them and the bolts from the clamping plate. The insulating tubes are preferably made large enough so that the bolts fit quite loosely therein, thus facilitating removal of one of these bolts in case of breakage or other undesirable action. The clamping dogs may also be insulated from the clamping plates by interposing insulating washers such as 76 between these dogs and the clamping plates or the cell body. By these clamping means all parts of the cathode frame and interposed diaphragm may be firmly clamped against the cell body or casing, while at the same time the cathode frame is effectively insulated for the working voltages used. When the cathode frames and diaphragms are assembled as indicated in Fig. 2 the gas supply pipes 50 may be inserted and luted within the gas inlets 46 so as to supply the desired mixture of carbon-dioxid and steam or other treating gas to the cathode chambers so that it can percolate down through them in substantial contact with the cathode diaphragm to take up and remove therefrom the electrolyzed caustic soda or other material. These gas supply pipes 50 are preferably formed with interposed insulating sections 51 of rubber tubing or the like which may connect with both branches 86 of the Y pipe 85. If desired suitable clean-out openings may be made in this pipe 85 substantially in line with the branches 86 and removable plugs 87 may be inserted in these openings so as to permit the use of cleaning devices when necessary. The desired amount of carbon-dioxid for the mixture fed to the cathode chambers may be supplied from the carbon-dioxid main 56 which may be arranged in one of the recesses 59 in the support and have suitable branches or gas pipes such as 81 at intervals along it, the gas flow being regulated in any desired way as by interposing an interchangeable nozzle plate such as 82 so that the size of hole 83 in this plate regulates the amount of carbon-dioxid passing through the corresponding gas pipe. The desired amount of steam may be mixed with the carbon-dioxid by injector action for example, the steam being shown as led in so as to be discharged through the injector nozzle 84 arranged within the injector section of this gas pipe so as to promote the mixture and progress of the gaseous material through the gas pipe and into the cathode chambers. The connected steam pipe 57 may with advantage be curved around to allow for expansion and be provided with a suitable regulating valve 55 and connected with the steam main 54 arranged in one of the lateral supporting recesses 59.

It is desirable to assemble these cells in alined rows to minimize floor space and to facilitate their connections and these cells may be conveniently placed end to end as shown in Fig. 1, a layer of suitable insulation 77 of tar paper for example being interposed between them so as to prevent substantial leakage of electricity and also to allow for such expansion as occurs under service conditions. By minimizing the transmission of heavy electric currents

through the concrete casing or body of the cell undesirable or destructive electrolytic action is greatly minimized as compared with cells having cast iron casings through which the current is transmitted which are also very much more costly to install. In this way the cells can be conveniently assembled in long rows and be connected with common supply and discharge mains and may be conveniently cast or molded in place in the cell room to minimize transportation, although this is not of course necessary in all cases.

This invention has been described in connection with a number of illustrative embodiments, forms, proportions, shapes, parts, materials and arrangements, to the details of which disclosure the invention is not of course to be limited, since what is claimed as new and what is desired to be secured by Letters Patent is set forth in the appended claims.

I claim—

1. In electrolytic cells for the electrolysis of salt or other material, an open sided rectangular sectioned cell casing formed of reinforced concrete, a brine inlet embedded in said cell casing, cathode drip pipes and connected embedded cathode exhaust mains, said cell casing being provided with anodes, cathode elements coöperating with the open sides of said cell casing and each comprising a cathode diaphragm and a coöperating concrete body formed with a cathode chamber, said cathode elements being provided with drip openings coöperating with said drip pipes and provided with gas inlets communicating with the upper ends of their cathode chambers and gas and steam mains supplying treating gases to said gas inlets.

2. In electrolytic cells for the electrolysis of salt or other material, an open sided cell casing formed of concrete, a brine inlet embedded in said cell casing, cathode drip pipes and connected embedded cathode exhaust mains, said cell casing being provided with anodes, cathode elements coöperating with the open sides of said cell casing and each comprising a cathode diaphragm and a coöperating concrete body formed with a cathode chamber, said cathode elements being provided with drip openings coöperating with said drip pipes and steam pipes supplying treating gases to said gas inlets.

3. In electrolytic cells for the electrolysis of salt or other material, a one-piece open sided rectangular sectioned cell casing formed of reinforced concrete, a brine inlet embedded in said cell casing, cathode drip pipes embedded in said cell casing, said cell casing being provided with anode apertures, anodes coöperating with said anode apertures, cathode elements adapted to cooperate with the sides of said cell casing, a cathode diaphragm coöperating with each of said cathode elements, and clamping members to clamp said cathode elements and cathode diaphragms in position against the open sides of said cell casing, said cathode elements being provided with drip openings coöperating with said drip pipes.

4. In electrolytic cells for the electrolysis of salt or other material, a cell casing formed of reinforced concrete and provided with integral supporting feet and with integral brackets adjacent its ends, a brine inlet embedded in said cell casing, cathode drip pipes embedded in said cell casing, said cell casing being provided with an acid proof tile lining throughout the portion normally in contact with the electrolyte and provided with anode apertures, anodes coöperating with said anode apertures and coöperating cathode and cathode diaphragms removably clamped to said cell casing.

5. In electrolytic cells for the electrolysis of salt or other material, a cell casing formed of reinforced concrete, a brine inlet embedded in said cell casing, cathode drip pipes embedded in said cell casing, said cell casing being provided with anode apertures, anodes coöperating with said anode apertures and coöperating cathodes and cathode diaphragms removably clamped to said cell casings.

6. In electrolytic cells for the electrolysis of salt or other material, a one-piece narrow open sided rectangular sectioned cell casing formed of reinforced concrete and provided with integral brackets adjacent its ends, an electrolyte pipe of earthenware embedded in the concrete forming the end of the cell casing and comprising a lateral intake portion adjacent to the top of the cell and cleanout extensions provided with removable plugs substantially in line with the operating portions of said pipe, anodes mounted in said cell casing, clamping plates embedded in said cell casing, insulating tubes embedded in said cell casing and coöperating with said clamping plates and clamping bolts extending loosely through said insulating tubes, clamping nuts and insulating members on said clamping bolts and located in recesses in said clamping plates to hold said plates in position while insulated therefrom, reinforced concrete cathode elements adapted to coöperate with the sides of said cell casing and comprising embedded bearing members and coöperating cathode diaphragms and clamping members coöperating with said clamping bolts to clamp said cathode elements and cathode diaphragms in position.

7. In electrolytic cells for the electrolysis of salt or other material, a one-piece narrow open sided cell casing formed of reinforced concrete, an electrolyte pipe of earthenware embedded in the concrete forming the cell casing and comprising a lateral intake por-

tion adjacent to the top of the cell and cleanout extensions provided with removable plugs substantially in line with the operating portions of said pipe, anodes mounted in said cell casing, clamping plates embedded in said cell casing, insulating tubes embedded in said cell casing and coöperating with said clamping plates and clamping bolts extending loosely through said insulating tubes, clamping nuts and insulating members on said clamping bolts to hold said plates in position while insulated therefrom, reinforced concrete cathode elements adapted to coöperate with the sides of said cell casing and comprising embedded bearing members and coöperating cathode diaphragms and clamping members coöperating with said clamping bolts to clamp said cathode elements and cathode diaphragms in position.

8. In electrolytic cells for the electrolysis of salt or other material, a one-piece open sided cell casing formed of reinforced concrete, an electrolyte pipe of earthenware embedded in the concrete forming the cell casing, anodes mounted in said cell casing, clamping plates embedded in said cell casing, insulating tubes embedded in said cell casing and coöperating with said clamping plates and clamping bolts extending loosely through said insulating tubes, clamping nuts and insulating members on said clamping bolts to hold said plates in position while insulated therefrom, cathode elements adapted to coöperate with the sides of said cell casing and comprising embedded bearing members and coöperating cathode diaphragms and clamping members coöperating with said clamping bolts to clamp said cathode elements and cathode diaphragms in position.

9. In electrolytic cells for the electrolysis of salt or other material, a one-piece open sided cell casing formed of reinforced concrete, an electrolyte pipe of earthenware embedded in the concrete forming the cell casing, anodes mounted in said cell casing, clamping plates embedded in said cell casing, insulating tubes embedded in said cell casing and coöperating with said clamping plates and clamping bolts extending loosely through said insulating tubes, clamping nuts and insulating members on said clamping bolts to hold said plates in position while insulated therefrom, cathode elements adapted to coöperate with the sides of said cell casing and comprising bearing members and coöperating cathode diaphragms and clamping members coöperating with said clamping bolts to clamp said cathode elements and cathode diaphragms in position.

10. In electrolytic cells for the electrolysis of salt or other material, an open sided narrow rectangular sectioned cell casing formed of reinforced concrete, an electrolyte pipe of earthenware embedded in the concrete forming the cell casing and comprising a lateral intake portion adjacent to the top of the cell and a cleanout extension provided with a removable plug substantially in line with an operating portion of said pipe, anodes mounted in said cell casing, insulating tubes embedded in said cell casing and clamping bolts extending through said insulating tubes, clamping nuts and insulating members on said clamping bolts to hold said bolts in position while insulated from said casing, concrete cathode elements adapted to coöperate with the sides of said cell casing and comprising embedded bearing members and coöperating cathode diaphragms and clamping members coöperating with said clamping bolts to clamp said cathode elements and cathode diaphragms in position.

11. In electrolytic cells for the electrolysis of salt or other material, an open sided cell casing formed of reinforced concrete, an electrolyte pipe of earthenware embedded in the concrete forming the cell casing and comprising a lateral intake portion adjacent to the top of the cell and a cleanout extension provided with a removable plug substantially in line with an operating portion of said pipe, anodes mounted in said cell casing, insulating tubes embedded in said cell casing and clamping bolts extending through said insulating tubes, clamping nuts and insulating members on said clamping bolts to hold said bolts in position while insulated from said casing, concrete cathode elements adapted to coöperate with the sides of said cell casing and coöperating cathode diaphragms and clamping members coöperating with said clamping bolts to clamp said cathode elements and cathode diaphragms in position.

12. In electrolytic cells for the electrolysis of salt or other material, a one-piece open sided rectangular sectioned cell casing formed of reinforced concrete, electrodes coöperating with said cell casing, clamping plates embedded in said cell casing, insulating tubes embedded in said cell casing and coöperating with said clamping plates and clamping bolts extending loosely through said insulating tubes, clamping nuts and insulating members on said clamping bolts and located in recesses in said clamping plates to hold said plates in position while insulated therefrom, concrete cathode elements adapted to coöperate with the sides of said cell casing and comprising embedded bearing members and coöperating cathode diaphragms and clamping members coöperating with said clamping bolts to clamp said cathode elements and cathode diaphragms in position.

13. In electrolytic cells for the electroly-

sis of salt or other material, a one-piece open sided rectangular sectioned cell casing formed of reinforced concrete, electrodes coöperating with said cell casing, clamping plates, insulating tubes embedded in said cell casing and coöperating with said clamping plates and clamping bolts extending through said insulating tubes, clamping nuts and insulating members on said clamping bolts to hold said plates in position while insulated therefrom, concrete cathode elements adapted to coöperate with the sides of said cell casing and comprising coöperating cathode diaphragms and clamping members coöperating with said clamping bolts to clamp said cathode elements and cathode diaphragms in position.

14. In electrolytic cells for the electrolysis of salt or other material, a one-piece open sided rectangular sectioned cell casing formed of reinforced concrete, electrodes coöperating with said cell casing, insulating tubes embedded in said cell casing and coöperating with said clamping plates and clamping bolts extending through said insulating tubes, clamping nuts and insulating members on said clamping bolts to hold said plates in position while insulated therefrom, concrete elements adapted to coöperate with the sides of said cell casing and clamping members coöperating with said clamping bolts to clamp said elements in position.

15. In electrolytic cells for the electrolysis of salt or other material, cathode elements comprising an angle iron frame and a reinforced concrete body molded therein, cathode bearing elements embedded in said body and having their corrugated edges substantially flush with the edge of said cathode frame to form a cathode chamber, a cathode diaphragm coöperating with said cathode element and comprising porous metallic material in contact with said bearing elements and said frame, said cathode element being provided with gas inlets communicating with the upper portion of said cathode chamber and with a drip opening communicating with the lower portion of said cathode chamber.

16. In electrolytic cells for the electrolysis of salt or other material, cathode elements comprising an iron frame and a reinforced concrete body molded therein, cathode bearing elements having their edges substantially flush with the edge of said cathode frame to form a cathode chamber, a cathode diaphragm coöperating with said cathode element and comprising porous metallic material in contact with said frame, said cathode element being provided with gas inlets communicating with the upper portion of said cathode chamber and with a drip opening communicating with the lower portion of said cathode chamber.

17. In electrolytic cells for the electrolysis of salt or other material, cathode elements comprising a frame and a concrete body molded therein, cathode bearing elements having their edges substantially flush with the edge of said cathode frame to form a cathode chamber, and a cathode diaphragm coöperating with said cathode element and comprising porous metallic material in contact with said frame.

18. In electrolytic cells for the electrolysis of salt or other material, a one piece open-sided rectangular sectional cell casing formed of reinforced concrete and provided with electrolyte passages embedded in the ends of said casing, removable cathode elements adapted to coöperate with the sides of said cell casing and formed with cathode chambers and with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains embedded in said cell casing and communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers, and means to supply gaseous material to said cathode chambers.

19. In electrolytic cells for the electrolysis of salt or other material, a cell casing formed of reinforced concrete and provided with electrolyte passages embedded in said casing, cathode elements adapted to coöperate with said cell casing and formed with cathode chambers and with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains embedded in said cell casing and communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers, and means to supply gaseous material to said cathode chambers.

20. In electrolytic cells for the electrolysis of salt or other material, a cell casing formed of reinforced concrete and provided with electrolyte passages embedded in said casing, cathode elements adapted to coöperate with said cell casing and formed with cathode chambers and with communicating drip openings, cathode drip passages embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains communicating with said cathode drip passages above their trapped portions to exhaust waste gases from said cathode chambers, and means to supply gaseous material to said cathode chambers.

21. In electrolytic cells for the electrolysis of salt or other material, an open-sided rectangular sectioned cell casing formed of

reinforced concrete and provided with supporting brackets and with electrolyte passages embedded in the ends of said casing, removable cathode elements adapted to cooperate with the sides of said cell casing and formed with cathode chambers and with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains embedded in said cell casing and communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers, gas pipes having branches communicating with said cathode chambers but insulated from said cathode elements, a gas main mounted on said brackets and extending longitudinally of said cell casing and connected with said gas pipes, a steam main mounted on said brackets and extending longitudinally of said cell casing and having a curved expansion connection with said gas pipe and provided with an injector nozzle within said gas pipe to mix and promote the feed of the mixed gases into said cathode chambers.

22. In electrolytic cells for the electrolysis of salt or other material, a cell casing formed of reinforced concrete and provided with supporting brackets and with electrolyte passages embedded in the ends of said casing, cathode elements adapted to coöperate with the sides of said cell casing and formed with cathode chambers, gas pipes having branches communicating with said cathode chambers, a gas main mounted on said brackets and extending longitudinally of said cell casing and connected with said gas pipes, a steam main mounted on said brackets and extending longitudinally of said cell casing and having a connection with said gas pipe.

23. In electrolytic cells for the electrolysis of salt or other material, a row of alined one piece open-sided rectangular sectioned cell casings formed of reinforced concrete and provided with upwardly extending supporting brackets and with electrolyte passages embedded in the ends of said casings, removable cathode elements adapted to cooperate with the sides of said cell casings and formed with cathode chambers and with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains embedded in said cell casing and communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers, gas pipes having branches communicating with said cathode chambers but insulated from said cathode elements, a gas main mounted on said brackets and extending longitudinally of said cell casings and connected with said gas pipes, a steam main mounted on said brackets and extending longitudinally of said cell casings and having curved expansion connections with said gas pipes and provided with injector nozzles within said gas pipes to mix and promote the feed of the mixed gases into said cathode chambers.

24. In electrolytic cells for the electrolysis of salt or other material, a row of alined open-sided cell casings formed of reinforced concrete and provided with upwardly extending supporting brackets and with electrolyte passages embedded in the ends of said casings, removable cathode elements adapted to coöperate with the sides of said cell casings and formed with cathode chambers and with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers, gas pipes having branches communicating with said cathode chambers, a gas main mounted on said brackets and extending longitudinally of said cell casings and connected with said gas pipes, a steam main mounted on said brackets and extending longitudinally of said cell casings and having connections with said gas pipes.

25. In electrolytic cells for the electrolysis of salt or other material, a row of alined cell casings formed of reinforced concrete and provided with upwardly extending supporting brackets and with electrolyte passages embedded in the ends of said casings, removable cathode elements adapted to cooperate with the sides of said cell casings and formed with cathode chambers, gas pipes having branches communicating with said cathode chambers, a gas main mounted on said brackets and extending longitudinally of said cell casings and connected with said gas pipes, a steam main mounted on said brackets and extending longitudinally of said cell casings and having connections with said gas pipes.

26. In electrolytic cells for the electrolysis of salt or other material, a row of alined one-piece open-sided rectangular sectioned cell casings formed of reinforced concrete and having their ends spaced closely together and separated by layers of interposed yielding insulating material, each casing being provided with upwardly extending supporting brackets and with electrolyte passages formed with earthenware lining pipes embedded in the ends of said casings, removable cathode elements adapted to cooperate with the sides of said cell casings and formed with cathode chambers and

with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains embedded in said cell casing and communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers, gas pipes having branches communicating with said cathode chambers but insulated from said cathode elements, a gas main mounted on said brackets and extending longitudinally of said cell casings and having an adjustable connection with said gas pipes, a steam main mounted on said brackets and extending longitudinally of said cell casings and having a curved expansion connection with said gas pipes and provided with an injector nozzle within said gas pipes to mix and promote the feed of the mixed gases into said cathode chambers.

27. In electrolytic cells for the electrolysis of salt or other material, a row of alined one-piece open-sided rectangular sectioned cell casings formed of reinforced concrete and having their ends spaced closely together and separated by layers of insulating material, each casing being provided with upwardly extending supporting brackets and with electrolyte passages formed with earthenware lining pipes embedded in the ends of said casings, removable cathode elements adapted to coöperate with the sides of said cell casings and formed with cathode chambers, gas pipes having branches communicating with said cathode chambers but insulated from said cathode elements, a gas main mounted on said brackets and extending longitudinally of said cell casings and having a connection with said gas pipes, a steam main mounted on said brackets and extending longitudinally of said cell casings and having a curved expansion connection with said gas pipes.

28. In electrolytic cells for the electrolysis of salt or other material, a row of alined one piece open-sided rectangular sectioned cell casings formed of reinforced concrete and having their ends spaced closely together and separated by layers of interposed yielding insulating material, each casing being provided with electrolyte passages formed with earthenware lining pipes embedded in the ends of said casings, removable cathode elements adapted to coöperate with the sides of said cell casings and formed with cathode chambers and with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains embedded in said cell casing and communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers, gas pipes having branches communicating with said cathode chambers but insulated from said cathode elements, a gas main extending longitudinally of said cell casings and having connection with said gas pipes, a steam main extending longitudinally of said cell casings and having a curved expansion connection with said gas pipes and provided with an injector nozzle within said gas pipes to mix and promote the feed of the mixed gases into said cathode chambers.

29. In electrolytic cells for the electrolysis of salt or other material, a row of alined one piece open-sided cell casings formed of concrete and having their ends spaced closely together and separated by layers of interposed yielding insulating material, each casing being provided with electrolyte passages formed with earthenware lining pipes embedded in the ends of said casings, removable cathode elements adapted to coöperate with the sides of said cell casings and formed with cathode chambers and with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains embedded in said cell casing and communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers, gas pipes having branches communicating with said cathode chambers but insulated from said cathode elements, a gas main extending longitudinally of said cell casings and having connection with said gas pipes, a steam main extending longitudinally of said cell casings and having a connection with said gas pipes.

30. In electrolytic cells for the electrolysis of salt or other material, a row of alined open-sided cell casings formed of concrete and having their ends spaced closely together and separated by insulating material, each casing being provided with electrolyte passages in the ends of said casings, removable cathode elements adapted to coöperate with the sides of said cell casings and formed with cathode chambers and with communicating drip openings, cathode drip pipes embedded in said cell casing and communicating with said drip openings and formed with trapped discharge portions, cathode exhaust mains embedded in said cell casing and communicating with said cathode drip pipes above their trapped portions to exhaust waste gases from said cathode chambers.

31. In electrolytic cells for the electrolysis of salt or other material, a row of alined one-piece open-sided rectangular sectioned cell casings formed of concrete and having their ends spaced closely together and separated by layers of interposed yielding insulating material, removable cathode ele-

ments having concrete bodies adapted to form a water tight closure of the open sides of said cell casings and formed with cathode chambers, gas pipes having branches communicating with said cathode chambers but insulated from said cathode elements, a gas main extending longitudinally of said cell casings and having connection with said gas pipes, and a steam main extending longitudinally of said cell casings and having connection with said gas pipes.

32. In electrolytic cells for the electrolysis of salt or other material, a row of alined open-sided rectangular sectioned cell casings formed of concrete and having their ends spaced closely together and separated by layers of interposed yielding insulating material, and removable cathode elements having concrete bodies adapted to coöperate with the sides of said cell casings and formed with cathode chambers.

33. In electrolytic cells for the electrolysis of salt or other material, a row of alined open-sided rectangular sectioned cell casings formed of concrete and having their ends spaced closely together while substantially insulated from each other and removable cathode elements having concrete bodies adapted to coöperate with the sides of said cell casings.

34. In electrolytic cells for the electrolysis of salt or other material, a row of alined open-sided cell casings formed of concrete and having their ends spaced closely together and separated by yielding insulating material, and removable cathode elements adapted to substantially close the open sides of said cell casings.

NOEL STATHAM.

Witnesses:
W. L. COVERT,
H. E. GOWARD.