J. R. CROCKER.

ELECTROLYTIC CELL.

APPLICATION FILED SEPT. 30, 1909.

**982,037.** Patented Jan. 17, 1911.

Fig. 2,

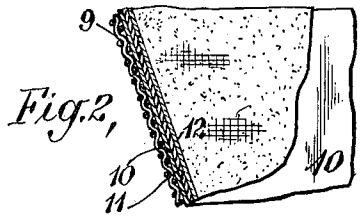


Fig. 1,




WITNESSES

Joseph J. Collins

Albert E. Thayer

INVENTOR

James R. Crocker

BY

Duncan & Duncan ATTORNEYS

# UNITED STATES PATENT OFFICE.

JAMES R. CROCKER, OF NEW YORK, N. Y., ASSIGNOR TO McDONALD ELECTROLYTIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## ELECTROLYTIC CELL.

982,037. Specification of Letters Patent. **Patented Jan. 17, 1911.**

Application filed September 30, 1909. Serial No. 520,284.

*To all whom it may concern:*

Be it known that I, JAMES R. CROCKER, a citizen of the United States, and resident of the city, county, and State of New York, have made certain new and useful Inventions Relating to Electrolytic Cells, of which the following is a specification taken in connection with the accompanying drawing.

This invention relates to electrolytic cells and relates especially to cells for the electrolysis of sodium chlorid and the recovery of the caustic soda by its constant elimination from the cathode diaphragm.

In the accompanying drawings showing in a somewhat diagrammatic way an illustrative embodiment of this invention, Figure 1 is a transverse vertical section through a cell; and Fig. 2 is an enlarged detail sectional view showing a construction of the cathode diaphragm.

In the illustrative embodiment of this invention shown in the drawings, the cell body 2 may be conveniently formed of cast iron or other material and provided with suitable conductor lugs 3 with which the cathode leads 34 may be connected in any desired way. A series of ribs 29 may be formed integral with the cell body or otherwise and arranged at intervals between the end walls 42 of the cell so as to preferably have their inner faces inclined and located in the same plane for engagement with the support or cathode diaphragm 36 at the proper intervals. These ribs may as indicated be formed with suitable recesses 38 so as to provide communicating openings forming a longitudinal channel through the cell adjacent the liquor pockets 4 which may as indicated be cast integral with the cell body and formed with suitable liquor taps 35 if desired. The cathode diaphragm 36 may be placed in suitably inclined position against the ribs 29 with which its metallic support forms sufficiently good electrical contact, the upper, lower and lateral edges of these diaphragms being embedded if desired within a suitable concrete filling such as the bottom 1, the end members or lining 31 and the upper concrete lining members 18 upon which a suitable cover 22 of slate or other material may rest.

The anode may be conveniently formed with anode facings 14 of graphitic carbon or other suitable material secured to and electrically connected with the anode spider 21 of suitable metal, such as brass or the like, which may be provided with suitable arms 16, 26 as indicated. The studs 15 of carbon or other material may as indicated have a threaded engagement with the spider arms and have their outer ends located in suitable apertures in the facing plates, the outer portions of these apertures being closed with plugs 33 of carbon or similar composition. When the anode members are assembled to this extent a suitable acid-resisting filling 17 of cement, concrete or the like may be cast between them so as to solidly back the anode facings and more rigidly support the other members. The anode may as indicated rest upon a suitable slate, porcelain or other insulating member 27 and be provided with the insulating and protecting bushing 20 around each anode spider and extending up through the cover 22 so as to protect this portion of the spider from the action of fumes when the lower portion of this bushing is sealed into the anode filling 17 by suitable impervious cement 30 or the like. The anode lead 32 indicated diagrammatically may be connected with the slot or other connecting means 24 in each of the spiders in any desired way. The cover 22 may as indicated be provided with suitable gas outlets 28 and with any desired feeding device for the electrolyte, such, for instance, as the feed funnel 23 preferably having its lower end 19 dipping into the electrolyte as indicated in dotted lines so as to supply at the proper time the salt brine or other electrolyte 13, which may as indicated rest in the somewhat tapering spaces between the inclined lower working faces of the anode and the coöperating faces of the cathode diaphragm 36.

The cathode diaphragm may as indicated comprise a suitable metallic support in the form of a screen of heavy wire of iron or other suitable material, the straight filling members of this screen preferably running horizontally as indicated in the drawings. Upon this support and forced into firm electrical contact therewith is provided a suitable diaphragm which may be composed of diaphragm fabric, such as asbestos cloth or paper impregnated or treated with suitable compositions if desired. The diaphragm may comprise a layer of asbestos paper 10

and of asbestos cloth 12 which may be treated or impregnated with suitable metallic oxids or salts, including zinc oxid or the like, preferably promoting the conductive properties of the diaphragm and of a fairly permanent character in this connection. The treating composition may be prepared by mixing 180 to 240 grams or so of zinc oxid with 250 cubic centimeters of silicate of soda of 18 Baumé, the silicate of soda being preferably slowly added to the zinc oxid and thoroughly incorporated to form a creamy mixture to which 120 to 140 grams or so of litharge may be slowly added and incorporated. About 50 cubic centimeters of silicate of soda of about 18 Baumé may then be added and thoroughly mixed with the other ingredients and then 180 to 240 grams or so of ferric oxid ($Fe_2O_3$) thoroughly incorporated therewith, after which the treating composition may be diluted with 200 c. c. more silicate of soda of about the same strength to give the treating composition a thick creamy or rather pasty character suitable for treating the asbestos diaphragm material. This metallic oxid treating composition may be applied to the coarsely woven asbestos cloth an eighth of an inch or so thick and thoroughly rubbed into the same after which 100 c. c. of silicate of soda of 18 Baumé may be used to wet the treated side of the cloth, after which further rubbing may be employed to effect the more uniform impregnation of the diaphragm material. The quantities above indicated give good results when applied so as to cover about 15 square feet of the asbestos cloth, although of course asbestos paper, cloth or other diaphragm material may be impregnated in other ways with this or generally similar treating compositions. In forming the composite cathode diaphragm a layer of fairly pliable asbestos paper 10 a sixteenth of an inch or so thick may be placed next to the wire screen support 9 of eight or ten mesh or so in such a way as to become embedded more or less in the screen and form proper contact therewith. The asbestos cloth 12 may then be placed in contact with the diaphragm paper so as to bring the treating material 11 in contact with the paper against which the cloth is firmly pressed and held by the liquid pressure of the electrolyte during the operation of the cell.

The electrolyzed sodium is forced into the cathode diaphragm into the presence of the treating salts which apparently tend to prevent recombination of the caustic soda or its rediffusion into the body of the electrolyte adjacent the anode. The caustic soda passes outward through the cloth and paper layers of the cathode diaphragm, the outer portions of which are supplied with moisture from the electrolyte within by the static and osmotic pressure. Moisture may also be supplied to the outside of the cathode diaphragm by the water vapor evolved from the caustic liquor 5 in the liquor pockets under the influence of suitable heating devices such as the steam pipes 6, 7, which may be located therein to heat and somewhat vaporize the caustic liquor. The water vapors 8 which are thus driven off from the caustic liquor rise in the cathode chambers 39 and collect on the support and diaphragm to promote the diffusion of the caustic soda therethrough and to combine with the caustic soda and form in droplets which tend to run down the bent screen wires away from the asbestos diaphragm material so that the caustic liquor is finally collected in the liquor pockets from which it may be drawn in somewhat concentrated form from time to time through the liquor taps 35. Suitable vapor vents 25 may be formed in the upper part of the cathode chambers 39 to allow the escape of air or gas therefrom and to regulate the action of the vapor therein. The chlorin evolved at the anode rises in bubbles in contact with the lower inclined working faces thereof through the gradually expanding electrolyte passage 13 so as to be eliminated by discharge through the gas outlets 28 in the gas chamber above the anode. Undesirable recombinations of the electrolyzed materials are carried and kept away from the diaphragm and good efficiency and permanency are both secured, as has been proved by operation of many months under practical conditions.

Having described this invention in connection with illustrative ingredients, proportions, forms and devices, to the details of which disclosure the invention is not of course to be limited, what is claimed as new and desired to be secured by Letters Patent is set forth in the appended claims.

1. The electrolytic cell suitable for the electrolysis of sodium chlorid brine or similar salt comprising a cast metallic body having inclined ribs forming lateral cathode chambers, liquor pockets communicating therewith, cathode diaphragms engaging said ribs and consisting of supporting wire screens having the straight wires horizontal, asbestos paper and cloth diaphragm material in engagement therewith and oxids of zinc, lead and iron and sodium silicate treating material impregnating the coöperating faces of said paper and cloth, said cathode diaphragms having inclined upper working faces for engagement with the electrolyte, an anode comprising a protected metallic spider and anode facings of graphitic carbon connected with said spider and having inclined lower working faces coöperating with said cathode diaphragms to form an upwardly expanding electrolyte section communicating with the gas chamber above said anode and

heating steam pipes in said liquor pockets to vaporize and concentrate the caustic liquor therein and supply water vapor to said cathode diaphragm supports and eliminate the electrolyzed caustic therefrom.

2. The electrolytic cell suitable for the electrolysis of sodium chlorid brine or similar salt which comprises a metallic body having inclined ribs and liquor pockets adjacent thereto, combined cathode diaphragms engaging said ribs and consisting of metallic supports and asbestos material impregnated with substantially permanent metallic oxid and silicate treating material comprising zinc oxid, said cathode diaphragms having inclined upper working faces for engagement with the electrolyte, an anode comprising carbon inclined lower working faces coöperating with said cathode diaphragms and forming upwardly expanding electrolyte sections and heating means to vaporize the liquor in said liquor pockets and supply water vapor to said cathode diaphragms and eliminate the electrolyzed caustic therefrom.

3. The electrolytic cell suitable for the electrolysis of sodium chlorid comprising a body having vapor chambers and communicating liquor pockets, cathode diaphragms mounted in said body and comprising metallic supports and asbestos diaphragm material impregnated with treating material comprising metallic oxids, said cathode diaphragms having inclined upper working faces for engagement with the electrolyte, an anode having inclined lower working faces coöperating with said cathode diaphragms and means to supply water vapor to said cathode diaphragms to eliminate the electrolyzed caustic therefrom.

4. The electrolytic cell suitable for the electrolysis of sodium chlorid comprising a body having a vapor chamber and coöperating liquor pocket, an inclined cathode diaphragm mounted in said vapor chamber and coöperating with said liquor pocket, said cathode diaphragm comprising a foraminous conducting support and diaphragm fabric material in engagement therewith, an anode coöperating with said cathode diaphragm and means to concentrate the caustic liquor in said liquor pocket and simultaneously supply vapor therefrom to said cathode diaphragm to eliminate the electrolyzed caustic therefrom.

5. The electrolytic cell suitable for the electrolysis of sodium chlorid comprising a body having a vapor chamber and coöperating liquor pocket, an inclined cathode diaphragm mounted on a series of supporting ribs in said vapor chamber, said cathode diaphragm comprising a foraminous conducting support and fabric diaphragm material in coöperation therewith, an anode coöperating with said cathode diaphragm, an anode having an inclined lower working face coöperating with said cathode diaphragm and means to concentrate the caustic liquor in said liquor pocket and simultaneously supply vapor therefrom to said cathode diaphragm to eliminate the electrolyzed caustic therefrom.

6. The electrolytic cell comprising a body having a vapor chamber, a coöperating liquor pocket, a cathode diaphragm mounted in said vapor chamber, an anode coöperating with said cathode diaphragm and means to concentrate the caustic liquor in said liquor pocket and simultaneously supply vapor therefrom to said cathode diaphragm to eliminate electrolyzed caustic therefrom.

7. The electrolytic cell suitable for the electrolysis of sodium chlorid comprising a body having a cathode chamber, an inclined cathode diaphragm mounted in said chamber and comprising a conducting support and diaphragm material provided with an inclined upper working face for engagement with the electrolyte, a resistant anode having an inclined lower working face coöperating with said cathode diaphragm and means to concentrate the caustic liquor and simultaneously supply water to said cathode diaphragm and eliminate the electrolyzed caustic therefrom.

8. The electrolytic cell suitable for the electrolysis of sodium chlorid comprising a body having a cathode chamber, a coöperating liquor pocket, a cathode diaphragm mounted in said chamber, an anode coöperating with said cathode diaphragm and heating pipes in said liquor pocket to vaporize and concentrate the caustic liquor therein and supply vapor to said cathode diaphragm to eliminate the electrolyzed caustic therefrom.

9. The electrode for an electrolytic cell comprising a metallic spider having transverse arms provided with threaded apertures, angularly arranged facing plates of graphitic carbon, conductive carbon studs having threaded connection with the arms of said spider and embedded in said facing plates and a resistant supporting filling embedding and protecting said spider and connections and supporting said facing plates.

10. The electrolytic cell comprising an anode and a cathode diaphragm comprising a supporting wire screen mounted in inclined position, asbestos paper and cloth material in engagement with said screen and substantially permanent metallic oxid and silicate treating material comprising zinc oxid impregnating said diaphragm material.

11. The combined electrode diaphragm for an electrolytic cell comprising an inclined foraminous metallic support, an asbestos fabric diaphragm material in engagement with said support, said diaphragm material being impregnated with substantially permanent conductive material com-

prising silicate and coöperating metallic oxid material.

12. The combined electrode diaphragm for an electrolytic cell comprising a foraminous metallic support, asbestos diaphragm material in engagement with said support, said diaphragm material being impregnated with substantially permanent metallic oxid material comprising lead oxid and silicate treating material.

13. The electrolytic cell suitable for the electrolysis of sodium chlorid brine or similar salt comprising inclined cathode diaphragms and an anode having inclined lower working faces coöperating with said cathode diaphragms to form upwardly expanding electrolyte sections between said cathode diaphragms and the adjacent faces of said anode and said cathode diaphragms.

14. The electrolytic cell suitable for the electrolysis of sodium chlorid or similar salt comprising an inclined cathode diaphragm and an anode having an inclined lower working face coöperating with said cathode diaphragm to form an upwardly expanding electrolyte section between the adjacent faces of said cathode diaphragm and said anode.

JAMES R. CROCKER.

Witnesses:
HARRY L. DUNCAN,
JESSIE B. KAY.