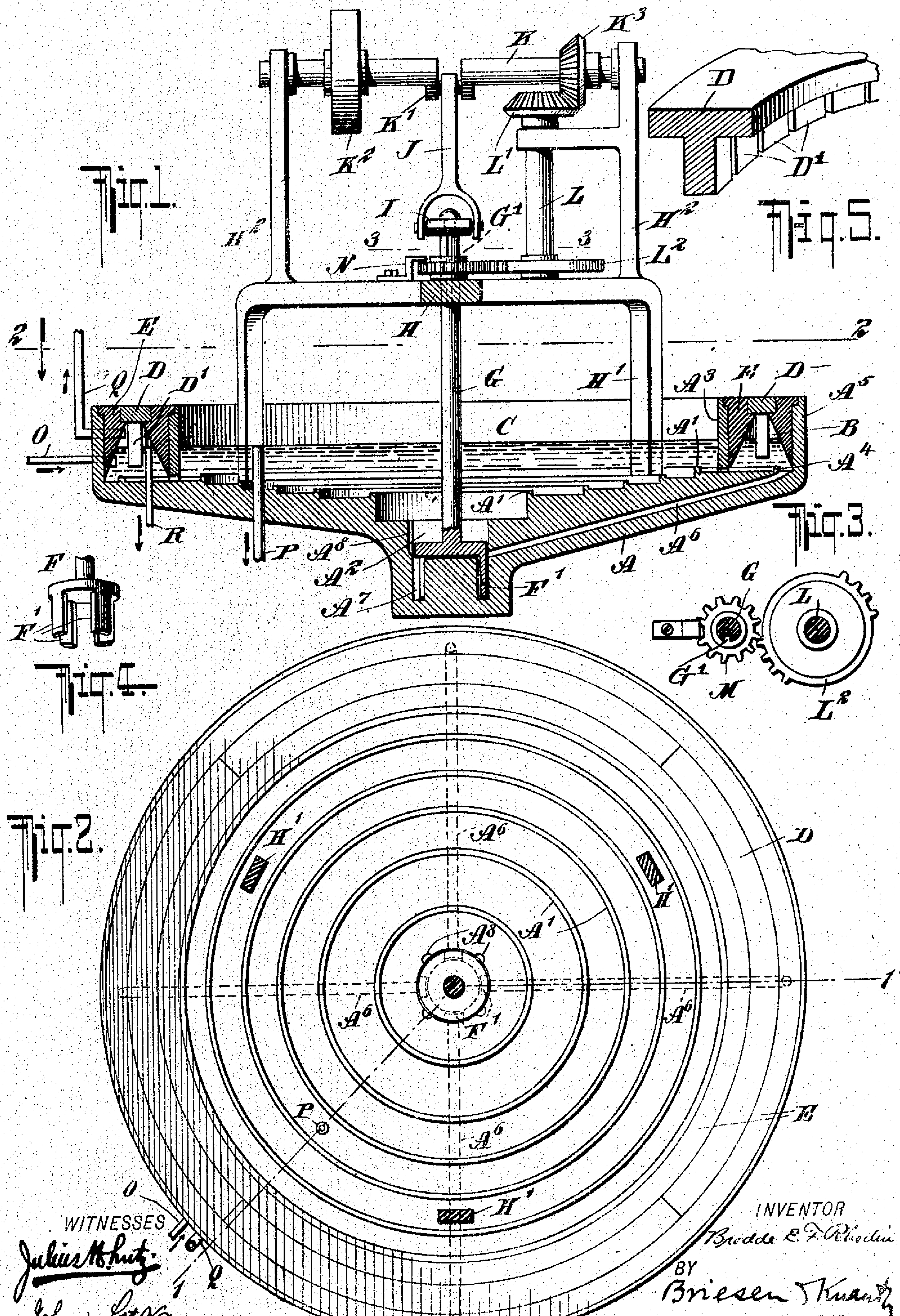
No. 885,083. PATENTED APR. 21, 1908.

B. E. F. RHODIN.

ELECTROLYTIC APPARATUS.

APPLICATION FILED OCT. 30, 1906.



WITNESSES

Julius M. Lutz

John Lotka

INVENTOR

Brodde E. F. Rhodin

BY

Briesen & Knauth

ATTORNEYS

UNITED STATES PATENT OFFICE.

BRODDE E. F. RHODIN, OF SAULT STE. MARIE, ONTARIO, CANADA.

ELECTROLYTIC APPARATUS.

No. 885,083. Specification of Letters Patent. Patented April 21, 1908.

Application filed October 30, 1906. Serial No. 341,273.

To all whom it may concern:

Be it known that I, BRODDE E. F. RHODIN, a subject of the King of Great Britain, and a resident of Sault Ste. Marie, in the Province of Ontario and Dominion of Canada, have invented certain new and useful Improvements in Electrolytic Apparatus, of which the following is a specification.

My invention relates to an apparatus adapted for carrying out various electrolytic processes and particularly the formation of caustic soda and chlorin by the decomposition of brine, that is a solution of sodium chlorid.

The apparatus, in which I employ a mercury cathode, which is kept in motion by a circulation of the mercury, is designed more particularly to produce a very large surface of mercury amalgam in the combining chamber and to continuously renew said surface.

The features of my invention will be fully described hereinafter and its characteristic points of novelty defined in the appended claims.

Reference is to be had to the accompanying drawings in which

Figure 1 is a sectional elevation of an apparatus embodying my invention, taken on the line 1—1 of Fig. 2; Fig. 2 is a horizontal section on line 2—2 of Fig. 1; Fig. 3 is a detailed section on line 3—3 of Fig. 1, Fig. 4 is a detailed perspective view of the plunger member, which in the construction shown is the means employed for causing the mercury to circulate, and Fig. 5 is a detail view of a portion of the anode.

The apparatus illustrated in the drawings comprises a cell or tank A, preferably made of conducting material, and in this case connected with the negative pole of a source of electric current. The bottom of this tank is inclined and is formed with a series of annular ridges A′ located in tiers, the ridge nearest the center being lowest and the ridges near the periphery highest. At the center the tank is provided with a depression or collecting chamber A^2 in which the mercury collects after flowing over the lowest ridge A′. Along the periphery is located an annular chamber B, which is formed by an interior rim A^3 supported at suitable points from the bottom of the tank, so as to leave at the bottom of said rim spaces or passages through which the decomposition chamber B may communicate with the combining chamber C of the tank. Within the chamber B a ridge A^4 projects upwardly from the bottom of the tank, the level of said ridge being about the same as that of the lower edge of the rim A^3 while the outermost ridge A′ projects to a slightly higher level than the lower edge of said rim. Thus the rim A^3 forms a seal for the mercury passing from the decomposition chamber B to the combining chamber C. Within the decomposition chamber is located the positive electrode D which may consist of a carbon ring T-shaped in cross-section as shown in Fig. 1, and supported upon insulating linings E, which fit upon and are affixed to the outer rim A^5 and the inner rim A^3 respectively, said linings forming a slot for the passage of the anode and shoulders adjacent to the slot, to engage the horizontal member of the anode. Preferably these linings have their inner walls converging upwardly as shown toward the depending member of the anode, which member I prefer to make with a series of vertical slits or saw cuts D^1. The lower end of the anode should be some distance above the level of the outermost and highest ridge A′ so that the anode will not be in contact with the mercury. Exteriorly of the ridge A^4 are located the discharge ends of circulating channels A^6 which lead upwardly from the collecting chamber A^2 to the peripheral chamber B.

In order to bring about the circulation of the mercury I provide a plunger F mounted to reciprocate in the collecting chamber A^2 and provided with arms F^1 which extend into an annular chamber A^7 at the bottom of the collecting chamber A^2. In one position, the arms F^1, as shown in Fig. 1 close the lower ends of the channels A^6, but when the plunger is given a quarter turn the channels A^6 connect with the collecting chamber A^2. The plunger is connected with a shaft G mounted to rotate in a bearing H and in a pin I at the lower end of the connecting rod J. This rod is also connected with a crank K^1 upon the shaft K which receives power in any suitable manner, as for instance by means of a belt applied to the pulley K^2. The shaft G not only turns in the bearing H but is also capable of sliding therein lengthwise, the said bearing being supported by legs H^1 within the tank which legs also carry the standards H^2 in which the shaft K is journaled. Of course, the shafts G and K and the parts connected therein might be supported in any other suitable manner. On the shaft K is located a bevel pinion K^3 meshing with a similar pinion L^1 on a shaft L, the lower end of which carries the mutilated gear L^2. This gear meshes at times with a pinion M connected with the shaft G so as to always rotate therewith, for instance by means of a key G′, but a sliding movement of the shaft G within the pinion is allowed, the pinion being held against vertical movement, for instance by means of a stop N.

O indicates the pipe for supplying the tank with the brine or other liquid to be treated; P is the pipe for carrying off the caustic soda formed; Q is the pipe for the escape of the chlorin and R is the pipe for the removal of brine.

The anode D may be made in sections as indicated in Fig. 2.

In operation sufficient mercury is poured into the apparatus to fill the space between the ridges A′ and A^4 and some mercury is also poured into the central collecting chamber A^2. The decomposition chamber B is then also filled with brine on top of the mercury and the combining chamber C with water, for instance to the level indicated in Fig. 1. The tank itself is connected with the negative pole, the anode D with the positive pole of a dynamo or other source of electricity. I need not here give details of the chemical reaction as the same is well known and no novelty is claimed for it. During the operation the shaft K is rotated so that the plunger F will be reciprocated up and down and also given partial turns at the end of the upstroke and also at the end of the downstroke. Fig. 1 shows the position of the parts at the end of the downstroke, and the plunger F has just been turned in such a manner that the arms F^1 close the lower ends of the channels A^6. The plunger now moves upward and the mercury contained in the collecting chamber A^2 passes through channels A^8 at the side of said chamber, and while remaining in said chamber, is thereby placed beneath the plunger instead of above the same. The channels A^8 should reach down to about the lowest point which the lower surface of the plunger reaches. When the plunger F has attained its highest position, the mutilated gear L^2 will give the plunger a quarter turn thus bringing the arms F^1 out of registry with the channels A^6 but into registry with the channels A^8. The movement of the mercury from above the plunger to below it is thus arrested and the collecting chamber A^2 and the chamber A^7 are connected with the channels A^6. As the plunger F now moves downward, the mercury contained in the chambers beneath the plunger is forced through the channels A^6 into the decomposition chamber B of the apparatus. This mercury flows inwardly over the ridge A^4, passes through the seal formed by the lower edge of the rim A^3 and flows over the ridges A′ thus again reaching the collecting chamber A^2. In this manner the mercury is constantly circulated, passing inwardly over the tiers of ridges A′ and outwardly through the return channels A^6.

Of course, where I have spoken of mercury, this has been done for the sake of simplicity; as a matter of fact, of course, the liquid circulating at the bottom of the cell and returning through the channels A^6 is not pure mercury after the operation has been started, but a mixture of mercury and sodium amalgam. The term "mercury" as used in some of the claims, is therefore not to be given any restrictive or literal interpretation. I desire also to call particular attention to the provision of two entirely separate paths for the circulating cathode liquid, the return path formed by the channels A^6 being separate from the downward path of the cathode liquid; yet in the preferred form of my invention as shown, both paths are within the walls of the tank, so that there is no danger of leakage.

As a means for propelling the cathode liquid, I have here shown a reciprocating plunger which at the same time forms a valve arranged to turn periodically; I desire it to be understood, however, that other devices may be employed for effecting the circulation of the liquid.

I claim;

1. A cell for electrolytic processes, having a series of concentric retaining ridges arranged stepwise each of said ridges being separate from the others.

2. An electrolytic cell having a series of retaining ridges arranged one within the other and step-wise, each ridge being continuous and separate from the others.

3. An electrolytic cell having an imperforate bottom with entirely separate retaining ridges projecting therefrom stepwise.

4. An electrolytic cell having a series of endless retaining ridges arranged one within the other and step-wise, said cell being provided with a collecting chamber, a return channel leading from said chamber to another portion of the cell, and means for propelling mercury through said channel.

5. An electrolytic cell having a series of retaining ridges arranged one within the other and step-wise, the outer ridges being higher than the inner ones, said cell being provided with a central collecting chamber, a return channel leading from said chamber to the peripheral portion of the cell, and means for propelling mercury through said channel.

6. An electrolytic cell having a series of entirely separate retaining ridges arranged one within the other and step-wise.

7. An electrolytic cell having a partition extending to a point within a short distance from the bottom of the cell and dividing the

cell into communicating inner and outer compartments, a ridge located within the inner compartment and extending above the level of the lower edge of said partition to form a seal, and electrodes in said compartments.

8. An electrolytic cell having a central combining compartment and an annular decomposition compartment surrounding it, ridges arranged step-wise in the central compartment, a channel connecting the lower portion of said compartment with the decomposition compartment, and a retaining ridge arranged within the decomposition compartment adjacent to the orifice of said channel.

9. An electrolytic cell having a partition spaced from the bottom and dividing the cell into two compartments located at different levels, a return channel connecting the two compartments, and a retaining ridge located in the higher compartment adjacent to the orifice of said channel.

10. An electrolytic cell having a partition spaced from the bottom and dividing the cell into two compartments located at different levels, a return channel connecting the two compartments, a series of ridges arranged step-wise in the lower compartment, and a retaining ridge located in the higher compartment adjacent to the orifice of said channel.

11. An electrolytic cell having a partition spaced from the bottom and dividing the cell into two compartments located at different levels, a return channel connecting the two compartments, and a series of ridges arranged stepwise in the lower compartment.

12. An electrolytic cell having a partition spaced from the bottom and dividing the cell into two compartments located at different levels, a return channel connecting the two compartments, and a series of ridges arranged stepwise in the lower compartment, the uppermost of these ridges extending to a level above that of the lower edge of the partition.

13. An electrolytic cell having a partition spaced from the bottom and dividing the cell into two compartments located at different levels, a return channel connecting the two compartments, a series of ridges arranged stepwise in the lower compartment, the uppermost of these ridges extending to a level above that of the lower edge of the partition, and a retaining ridge located in the higher compartment adjacent to the orifice of said channel.

14. An electrolytic cell having an annular electrode compartment with insulating linings inclosing a space which widens towards the bottom, and an electrode dipping into said space.

15. An electrolytic cell having an electrode compartment with insulating linings inclosing a space which widens toward the bottom, and forming a slot with shoulders adjacent thereto, and an electrode T-shaped in cross-section, supported on said shoulders and dipping into said space through the slot of the filling.

16. An electrolytic cell having within its walls two separate yet connected paths for the circulation of a liquid cathode electrode which paths are entirely within the walls of the cell.

17. An electrolytic cell having a downward path for a liquid cathode electrode and a separate upward return path for said liquid electrode connected with said downward path both paths being located interiorly of the cell's outer surface.

18. An electrolytic cell having two separate yet connected paths for the circulation of a liquid cathode electrode, both paths being located interiorly of the cell's outer surface and a device for propelling the liquid cathode electrode.

19. An electrolytic cell having a downward passage for a liquid cathode electrode, a separate upward path for the return of the liquid electrode, both paths being located interiorly of the cell's outer surface and a device for propelling the liquid through said return path.

20. An electrolytic cell having a downward passage for a liquid cathode electrode, formed with a collecting chamber at the bottom of said passage and a supply channel leading to said chamber, a return channel leading from said chamber to the upper portion of the said passage, and a plunger mounted to reciprocate in said chamber and also mounted to turn, said plunger having a valve member or arm which in one position closes the connection from the supply channel to the collecting chamber and in the other position closes the connection of said chamber with the return channel, and means for reciprocating and turning said plunger.

21. An electrolytic cell having a downward path for a liquid cathode electrode, a return channel leading from the lower portion of said path to its upper portion, and a plunger mounted to reciprocate to propel the liquid electrode periodically through its return channel, said plunger being also mounted to turn at predetermined stages of its reciprocating movement and forming a valve to open or close the inlet to the return channel.

22. An electrolytic cell having a substantially conical bottom with entirely separate ridges arranged stepwise and an independent circulating passage connecting the central portion of said bottom with its peripheral portion.

23. An electrolytic cell having a substantially conical bottom with ridges projecting therefrom stepwise, and an independent circulating passage located entirely within the bottom wall of the cell and connecting the central portion of the bottom with the peripheral portion thereof.

24. An electrolytic cell having a substantially conical bottom and an independent circulating passage located entirely within the bottom wall of the cell and connecting the central portion of the bottom with the peripheral portion thereof.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

BRODDE E. F. RHODIN.

Witnesses:
JOHN G. REID,
ARTHUR E. BROWN.