R. T. SILL.

MACHINE FOR ELECTROCYANID CHLORINATION PROCESS.

APPLICATION FILED APR. 16, 1919.

1,368,362. Patented Feb. 15, 1921.

Fig. 1.

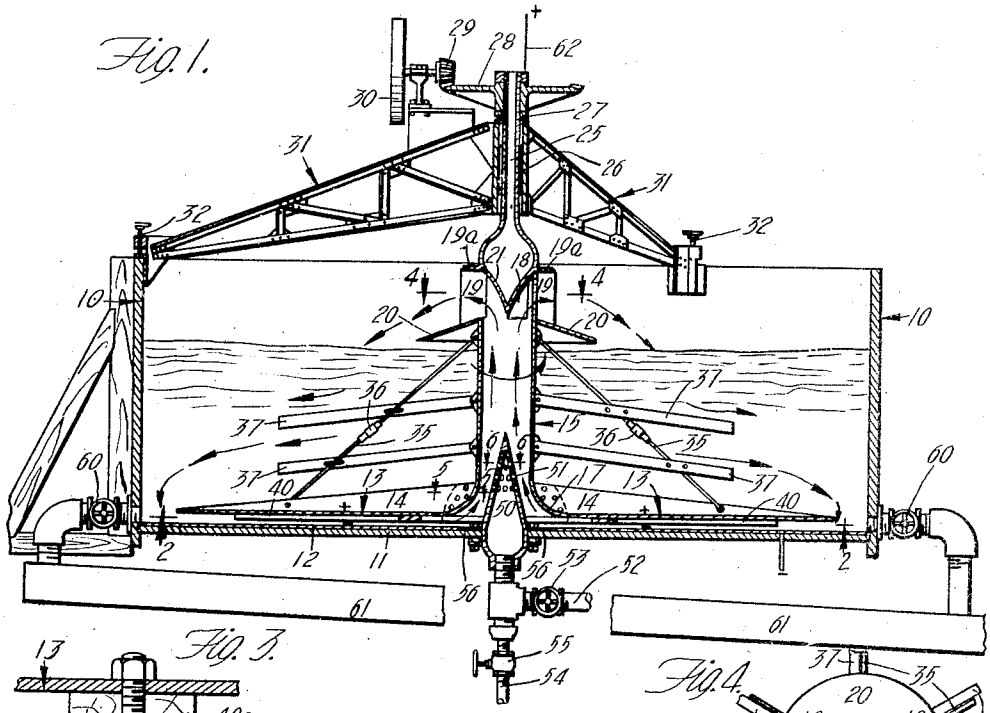


Fig. 3.

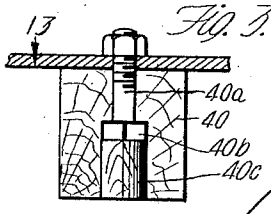


Fig. 4.

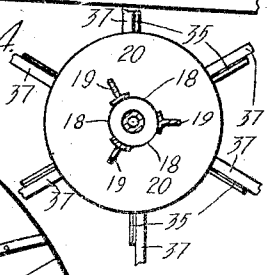


Fig. 2.

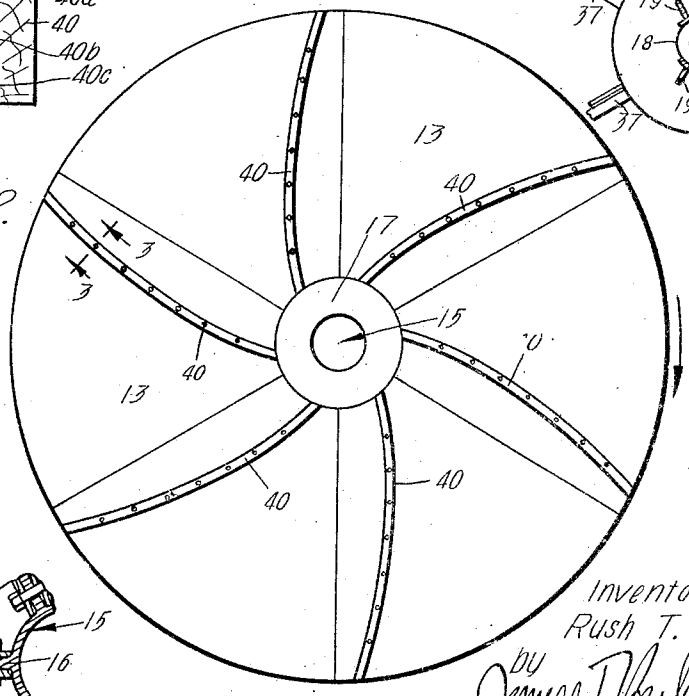
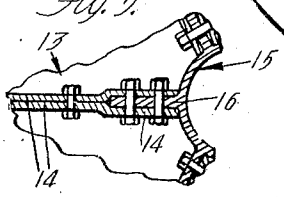


Fig. 6.



Fig. 5.



Inventor
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UNITED STATES PATENT OFFICE.

RUSH T. SILL, OF LOS ANGELES, CALIFORNIA.

MACHINE FOR ELECTROCYANID CHLORINATION PROCESS.

1,368,362. Specification of Letters Patent. Patented Feb. 15, 1921.

Application filed April 16, 1919. Serial No. 290,375.

To all whom it may concern:

Be it known that I, RUSH T. SILL, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented new and useful Improvements in Machines for Electrocyanid Chlorination Processes, of which the following is a specification.

This invention relates generally to that class of ore treating machinery in which a pulp or pulverized value carrying material is submitted to the action of a cyanid solution or other dissolving agent in the presence of an electrical current. Such processes may be carried out in a variety of manners; and I have developed a particular method or process for carrying out such an electrocyanid process in the presence of chlorin liberated by the electrical action from sodium chlorid put into the pulp. The present invention has for its general object the provision of mechanism for the efficient carrying on of such processes. This machine is particularly effective in carrying on my electrocyanid chlorination process, but it will be readily understood that the machine invention is not limited specifically to the chlorination process but may be applied to such a solvent process as is herein broadly referred to.

Due to several advantageous features and accomplishments of my improved machine, I obtain results which are far superior to those obtained by other machines of which I am aware. Among the advantageous features which I may preliminarily mention before going to a detailed description of my machine are the following:

(1) The constant and steady circulation of liquid pulp between spaced electrodes, in such a manner as to keep the positive electrode always clean and in such a manner as to expose every particle of the pulp to the inter-electrode action;

(2) Aeration of the pulp by means of an air-lift device which is a preferred method of causing pulp circulation. In connection with these major features of the machine, there are many other features, some of them more or less specific, which will be better understood from the following detailed description of a preferred form of machine embodying my invention; reference for this purpose being had to the accompanying drawings, in which—

Figure 1 is a vertical central section of my improved machine; Fig. 2 is a bottom plan of the rotating electrode, said view being taken as indicated by line 2—2 on Fig. 1; Fig. 3 is an enlarged detail section taken as indicated by line 3—3 on Fig. 2; Fig. 4 is a detail section taken as indicated by line 4—4 on Fig. 1; Fig. 5 is an enlarged detail section taken on line 5—5 of Fig. 1; and Fig. 6 is an enlarged detail section taken as indicated by line 6—6 on Fig. 1.

In the drawings I show a circular tank preferably of wood with sides 10 and bottom 11. On the bottom 11 I place a metallic cathode plate 12 and immediately above this cathode plate there is an anode plate 13 preferably made of plate iron or other suitable metal and constructed in several sector-sections with flanges 14 turned up at their edges. These sector-sections are secured together by bolting their flanges together; and the whole anode plate is secured to the lower end of a hollow column 15 by the expedient of bolting the flanges 14 on opposite sides of flanges 16 which project from the lower end of the hollow column. This hollow column 15 forms the upward central passage for the liquid pulps from the inter-electrode space; and it also conveniently forms the driving means whereby the upper electrode is rotated. It will be understood however, that, so far as the function of the column as a vertical passage is concerned, it is not necessary for it to rotate. This hollow column may be formed in any desired manner, as by casting it as an integral piece; and its lower end may be flared as indicated at 17 for the easy and smooth passage of the liquid pulp upwardly into it. Near its upper end this hollow column has a plurality of discharge openings 18, shown here as three in number. To strengthen the column at the openings, I provide flanges 19 between the openings, which extend downwardly from a circular flange 19^a above the openings and connect below with a circular sloping apron 20 which directs the discharge outwardly instead of allowing it to fall directly downwardly. At the discharge openings 18 there is an inverted conical deflector 21 adapted to deflect the upwardly flowing stream of pulp outwardly to the outlets; and the flange 19^a may assist in or continue such deflecting action.

Column 15 is suspended on a shaft 25 which may also be hollow, this shaft running in bearing 26 and being suspended by

an end thrust bearing 27. The shaft is driven by a gear 28 driven in turn by gear 29 from a pulley 30, or any other suitable driving means. Bearings 26 and 27 are suspended on a suitable frame work 31 in a central position over the top of the tank. The frame work rests upon the edges of the tank, and there it has adjusting screws 32 by means of which the frame may be adjusted vertically in position, thereby adjusting the vertical position of the electrode 13 with reference to the lower stationary electrode 12. By this means the space between the electrodes may be accurately adjusted to suit any particular circumstances and the rotating plate may thus be also accurately leveled with reference to the stationary plate.

In order to properly suspend the rotating plate on the hollow column and to keep it in true alinement, I provide brace rods 35 which extend out to the flange of the plate. These brace rods may have turn-buckles 36 so that they may be accurately adjusted to accurately aline the plate so that it will truly rotate in the proper plane. I may provide a suitable number of paddles 37 mounted at their inner ends on the column 15 and supported at their outer ends on the brace rods 35, these paddles serving to keep the liquid pulp in constant circulation above the rotating plate so as to cause an outward movement of the liquid pulp toward the outer edge of the rotating plate. The outer edge of the rotating plate is fairly close to the tank wall, allowing sufficient space around its entire periphery for the passage of the liquid pulp around and under the edge of the plate to enter the inter-electrode space.

On the bottom of electrode 13 I provide a suitable number of members 40 in the form of pump runners which are designed for the purpose of causing inward movement of the pulp toward the central column. These members 40 are made of insulating material (I make them of wood) and are secured to plate 13 by bolts 40^a whose heads 40^b are sunk into the wood and are covered by a tightly fitted wooden plug 40^c. In a machine of substantial size the rotating electrode rotates fairly slowly so as to not agitate the pulp. It is an object to keep the pulp flowing evenly and constantly without over agitating it, or without any substantial agitation at all. Pump runners 40 are designed to suit the speed of rotation and to give a smooth even inward flow of the pulp in the inter-electrode space. These pump runners of course aid in lifting the liquid through the central column; and they may be so designed as to do all of the lifting work. If the speed of rotation be somewhat increased, the runners can be designed to do more or all of the lifting work. Thus, in a machine of 20 foot diameter, or so, at 3—5 revolutions per minute, the runners do a substantial part of the lifting. If the speed be increased to, say, 15 revolutions per minute, the runners can be so designed as to do all the lifting work, at the same time handling the pulp smoothly and without agitation. However, I prefer to design these pump runners so that they will only assist in the lifting work and will, by the nature of their action, keep the pulp flowing smoothly and evenly in all parts of the inter-electrode space, while the major part of the lifting work is done by the airlift which also aerates the pulp. It will be readily seen that the pump runners not only positively help the lift but also perform a function of regulation to regulate and make smooth and even the flow of pulp through the inter-electrode space; keeping the pulp flowing equally in all parts of the inter-electrode spaces, so as to subject equally all parts of the thin flowing stream to the electric action.

Now, although I may use any desired form of lifting means for the liquid pulp in the column, I prefer to use an airlift means because that means aerates the pulp at the same time that it lifts it. For this purpose I provide a conical air nozzle 50 having in its upper part air openings 51 adapted to deliver air in fine streams into the liquid pulp. These openings are so directed that their jets of air tend to overcome or neutralize the rotary motion of the pulp in the column, thus overcoming any tendency of the solid particles to be thrown to the outside of the column and more or less cling to its wall. The conical shape of the nozzle allows room for the expansion of the mixed fluids as the air is fed into the pulp. The nature of an airlift being well understood, it is not necessary here to explain it in detail. I utilize air pressure of five pounds per square inch or so, delivered through the air pipe 52 under control of valve 53. Pipe 54, which is controlled by valve 55, is a pipe for draining or for introducing cleaning water or other fluid to the nozzle to clean the apparatus. The air nozzle is insulated, as at 56, from the surrounding cathode plate, and is also insulated from the anode plate by being spaced therefrom, so that there is no tendency for the current to short-circuit through the air nozzle.

The tank may have one or more valve controlled outlets at 60 which may discharge into a suitable trough as illustrated at 61. The process may be carried on continuously by continuous operation of the machine and continuous introduction and withdrawal of pulp; or it may be operated on the batch principle by introducing a batch of pulp and treating it to deposit the valves on the deposit plate 12 and then withdrawing the spent pulp and introducing a new charge.

Such methods of operation are readily understood in the art and need no specific description.

The cathode deposit plate 12 is preferably an amalgamated copper plate. Electrical connections are made to this cathode plate by any suitable electrical connector and to the anode plate by an electrical connection which may be made, as diagrammatically illustrated at 62, to the upper end of the hollow column or shaft 25. A direct current of comparatively low voltage and of low amperage per square foot of surface, is used. In a machine of say 20 ft. diameter, the circulation of liquid pulp may be at any efficient rate; and without limiting ourselves to any particular rate of flow, we may state that, about 1500 gals. per minute more, or less, has given effective results. This circulation is fast enough to keep the solid particles in suspension; and furthermore any tendency of the solid particles to settle is caused by the action of deflector 20 and paddles 37 to be at the outer edge of the rotating plate rather than at its inner part; and the settlement, if any, being at the outer edge, these particles are of course drawn directly into the stream which is constantly passing around and under the edge of the anode plate. This whole circulation of liquid passes through the relatively thin space between the two plates, in a smooth evenly flowing stream. Thus there is a relatively thin sheet of liquid pulp being constantly subjected to the electrical action, and to the chemical reactions induced by the electrical action on the solvent and on the other substances which may be introduced. The action of the pump runners in keeping the liquid moving at all times, also of course keeps the solid matter moving and keeps it in suspension and therefore keeps the deposit plate 12 clean at all times. The valves deposited on the cathode deposit plate may be periodically cleaned off; the upper structure 31 and the rotating parts being lifted out of the tank for this purpose.

This apparatus has proved to be exceptionally efficient in electro-cyanid work and particularly in carrying on the process of electro-cyanid chlorination; being highly effective both on clean ore and on ores containing organic impurities. The cyanid or other dissolving agent may be added to the pulp liquid either before or after placement in the tank; as may also the salt which is introduced for conductivity and to give the chlorination action. The dissolution and deposit of precious metals takes place in this machine in a time period of one-eighth to one-twentieth of that required for the ordinary cyanid process; with complete or very nearly complete precipitation of precious metals from the solution, which may then be regenerated to be used again. Furthermore, a smaller quantity of cyanid is used in this machine than in other machines or processes.

A very marked advantage in my machine is in this: that its capacity can be very easily increased by simply increasing the depth of pulp, increasing the depth of the tank if necessary. This can be done because the method of operation can be carried on efficiently regardless of the depth of pulp. My machine is not limited at all to a shallow body of pulp. Another distinctive feature, and one which is further emphasized by the possibility of operation of a great depth of pulp, is this: that I move the large mass of pulp—all that above the upper plate—with rather than against centrifugal action; only the smaller part in the thin space between the plates being moved inwardly.

While I have proceeded to a description which is full in particular and detail, I have done so for the purpose of rendering my invention clearly and fully intelligible to those skilled in the art and not for the purpose of limiting my invention to the particular and specific things herein set forth; believing my invention to be broad in its nature and scope and not limited except as is hereinafter specifically set forth in the following claims, which claims are to be read and interpreted broadly as applying to the invention herein typified, as well as specifically as applying to the particular things herein set forth.

Having described a preferred form of my invention, I claim:

1. In combination, a tank, an electrode plate in the tank, another electrode plate in the tank spaced above the first mentioned plate, a hollow column leading upwardly from the central part of the inter-electrode space and discharging above the upper electrode, and means for raising liquid pulp through the column.

2. In combination, a tank, an electrode plate in the tank, another electrode plate spaced a relatively small distance from the first mentioned plate; the capacity of the tank relatively to the capacity of the inter-electrode space being comparatively large; and means to cause rotation and outward centrifugally assisted flow of the liquid in the tank exterior of the inter-electrode space, and to cause inward flow of liquid in said inter-electrode space.

3. In combination, a tank, an electrode plate in the tank, another electrode plate spaced a relatively small distance from the first mentioned plate; the capacity of the tank relatively to the capacity of the inter-electrode space being comparatively large; and means to cause rotation and outward centrifugally assisted flow of the liquid in the tank exterior of the inter-electrode

space, and to cause inward flow of liquid in said inter-electrode space, and means to transfer liquid from the center of the inter-electrode space to the body of liquid in the tank.

4. In combination, a tank, an electrode plate in the tank, another electrode plate in the tank spaced above the first mentioned plate, a hollow column leading upwardly from the central part of the inter-electrode space and discharging above the upper electrode, and means for raising liquid pulp through the column, the upper plate extending out toward the wall of the tank and being imperforate so that the liquid pulp must travel outwardly over the upper plate and around its edge in order to reach the space between the plates.

5. In combination, a tank, an electrode plate in the tank, another electrode plate in the tank spaced above the first mentioned plate, a hollow column leading upwardly from the central part of the inter-electrode space and discharging centrally above the upper electrode, means for raising liquid pulp through the column to be discharged into the tank at its upper end, and means for directing the discharge from the column outwardly so as to cause an outward movement of liquid pulp over the upper plate toward its edge.

6. In combination, a tank, an electrode plate in the tank, another electrode plate in the tank spaced above the first mentioned plate, a hollow column leading upwardly from the central part of the inter-electrode space and discharging centrally above the upper electrode, means for raising liquid pulp through the column to be discharged into the tank at its upper end, and means for causing outward movement of the liquid pulp above the upper plate.

7. In combination, a tank, a lower electrode plate therein, an upper electrode plate spaced above the lower plate and rotatable about a substantially vertical axis, a hollow column leading upwardly from the inter-electrode space and discharging above the upper electrode, means for raising liquid pulp through the hollow column, and means on the under side of the rotating plate acting to move the liquid pulp inwardly toward the center in the inter-electrode space.

8. In combination, a tank, a lower electrode plate therein, an upper electrode plate spaced above the lower plate and rotatable about a substantially vertical axis, a hollow column leading upwardly from the inter-electrode space, and means to create an inward flow of liquid pulp in the inter-electrode space and to raise the liquid pulp through the hollow column.

9. In combination, a tank, a lower electrode plate therein, an upper electrode plate spaced above the lower plate and rotatable about a substantially vertical axis, a hollow column leading upwardly from the inter-electrode space, and means to create an inward flow of liquid pulp in the inter-electrode space and to raise the liquid pulp through the hollow column, said means including means to aerate the liquid pulp.

10. In combination, a tank, a cathode deposit plate in the tank, a rotating metallic anode supported at a suitable distance from the deposit plate, a hollow central column, and means for moving a liquid pulp through the hollow central column.

11. In combination, a tank, a cathode deposit plate at the bottom of the tank, a rotating metallic anode supported at a suitable distance above the deposit plate, a hollow central column, and means for moving a liquid pulp upwardly through the hollow central column.

12. In combination, a tank, a cathode deposit plate at the bottom of the tank, a rotating metallic anode supported at a suitable distance above the deposit plate, a hollow central column, means for moving a liquid pulp upwardly through the hollow central column, and a series of non-conducting fluid controlling means mounted on the under side of the rotating anode to regulate the movement of the liquid pulp inwardly under the anode to the hollow central column.

13. In combination, a tank, a cathode deposit plate at the bottom of the tank, a rotating metallic anode supported at a suitable distance above the deposit plate, a hollow central column, and means for moving a liquid pulp upwardly through the hollow central column, said last mentioned means comprising means for forcing a fluid under pressure into the hollow central column to produce an upward circulation of the fluid pulp, the hollow central column having an outlet at its top through which the fluid discharges into the tank, thus creating a circulation of the liquid pulp which moves outward and downward to the outer edge of the rotating anode, and then moves inwardly under the rotating anode and over the cathode deposit plate, and then moves upward through the hollow central column in a closed circuit of circulation.

14. In combination, a tank, a cathode deposit plate at the bottom of the tank, a rotating anode plate supported above the deposit plate and rotatable about a substantially vertical axis, a hollow central column communicating below with the inter-electrode space and discharging above the upper rotating electrode, air lift means for raising liquid pulp in the column, means for causing movement of liquid pulp above the upper electrode outwardly toward the periphery of the upper electrode, said electrode being imperforate so that the liquid

pulp must flow to its edge in order to enter the inter-electrode space, and means on the under side of the rotating electrode to move the liquid pulp inwardly toward the column.

15. In combination, a tank, a cathode deposit plate at the bottom of the tank, a rotating anode plate supported above the deposit plate and rotatable about a substantially vertical axis, a hollow central column communicating below with the inter-electrode space and discharging above the upper rotating electrode, air lift means for raising liquid pulp in the column, means above the rotating electrode and rotating therewith and adapted to throw the liquid pulp outwardly toward the periphery of the upper rotating electrode, said electrode being imperforate so that the liquid pulp must flow to its edge in order to enter the inter-electrode space, and pumping means on the under side of said electrode to cause inward movement of the liquid pulp toward the central column.

16. In combination, a tank, a cathode deposit plate at the bottom of the tank, a rotating anode plate supported above the deposit plate and rotatable about a substantially vertical axis, a hollow central column communicating below with the inter-electrode space and discharging above the upper rotating electrode, air lift means for raising liquid pulp in the column, means above the rotating electrode and rotating therewith and adapted to throw the liquid pulp outwardly toward the periphery of the upper rotating electrode, said electrode being imperforate so that the liquid pulp must flow to its edge in order to enter the inter-electrode space, and pump runners of a non-conducting material mounted on and projecting below the lower surface of the rotating electrode and adapted by rotation to move the liquid pulp inwardly toward the central column.

17. In combination, a tank, an electric deposit plate at the bottom of the tank, a rotating electrode plate supported at a suitable distance above the deposit plate, a hollow central column, and means for moving a liquid pulp upwardly through the hollow central column, the hollow column having discharge openings at its upper end, and a circular deflector around the hollow column immediately below the openings to direct the liquid outwardly.

18. In combination, a tank, an electrode deposit plate at the bottom of the tank, a rotating electrode plate supported at a suitable distance above the deposit plate, a hollow central column, and means for moving a liquid pulp upwardly through the hollow central column, the hollow column having discharge openings at its upper end, and deflector means inside and outside the hollow column at the discharge openings to deflect the upward stream of liquid and direct it outwardly horizontally into the tank to cause outward movement of the liquid pulp above the upper rotating electrode.

19. In combination, a suitable tank, a cathode deposit plate on the bottom of the tank, a rotating element in the tank above the cathode deposit plate, said rotating element embodying a horizontal anode plate with its edges close to the side of the tank and allowing a passage-way around the edges of the anode plate and between the anode plate and the cathode plate, and a central hollow column carrying the anode plate and open at its lower end to the space under the anode plate and having discharge openings at its upper end; and means to cause upward movement of a liquid pulp in the hollow column.

20. In combination, a suitable tank, a cathode deposit plate on the bottom of the tank, a rotating element in the tank above the cathode deposit plate, said rotating element embodying a horizontal anode plate with its edges close to the sides of the tank and allowing a passage-way around the edges of the anode plate and between the anode plate and the cathode plate, a central hollow column carrying the anode plate and open at its lower end to the space under the anode plate and having discharge openings at its upper end; and means to cause upward movement of a liquid pulp in the hollow column; said rotating element being suspended from and rotatable in an overhead bearing adjustably supported on the tank.

21. In combination with a tank, an electrode on its bottom, a rotating electrode above, and means for adjustably and rotatably carrying said rotating electrode embodying a shaft member on which the electrode is suspended, an upper bearing for the shaft, and a frame carrying the bearing and spanning the top of the tank and adjustably mounted with reference to the tank so that the position of the suspended electrode may be adjusted.

22. In combination, a tank, an electrode deposit plate at the bottom of the tank, a rotating electrode plate supported at a suitable distance above the deposit plate, a hollow central column, and means for moving a liquid pulp upwardly through the hollow central column, said means embodying means for counteracting within the column the rotation and centrifugal action of the pulp due to rotation of the anode.

23. In combination, a tank, an electrode deposit plate at the bottom of the tank, a rotating electrode plate supported at a suitable distance above the deposit plate, a hollow central column, and means for moving a liquid pulp upwardly through the hollow

central column, said means embodying air jets directing air into the pulp in the column in directions opposite to the rotation of the anode.

24. In combination, a tank, an electrode deposit plate at the bottom of the tank, a rotating electrode plate supported at a suitable distance above the deposit plate, a hollow central column, and means for moving a liquid pulp upwardly through the hollow central column, said means embodying an upwardly tapering air nozzle in the column.

25. In combination, a tank, a plate in the tank spaced above the bottom of the tank, a hollow column leading upwardly from and communicating at its lower end with the space below the plate, and means to cause movement of liquid through said column.

26. In combination, a tank, a plate in the tank spaced above the bottom of the tank, a hollow column leading upwardly from and communicating at its lower end with the space below the plate, and means to cause movement of liquid through said column, said means including means to aerate the liquid.

27. In combination, a tank, a rotatable plate in the tank spaced above the bottom of the tank, there being an opening at the center of the plate forming communication between the space below the plate, and the space above the plate, and means on the plate and adapted by virtue of its rotation to cause inward movement of liquid beneath the plate toward its center.

28. In combination, a tank, a rotatable plate in the tank spaced above the bottom of the tank, there being an opening at the center of the plate forming communications between the space below the plate and the space above the plate, and means on the plate and adapted by virtue of its rotation to cause inward movement of liquid beneath the plate toward its center, said means embodying curved runners adapted to cause inward flow of the fluid.

In witness that I claim the foregoing I have hereunto subscribed my name this 8th day of April, 1919.

RUSH T. SILL.

Witness:
VIRGINIA BERINGER.