H. H. BATES & F. ADAM.

ELECTROLYTIC APPARATUS.

APPLICATION FILED JUNE 7, 1909.

944,650. Patented Dec. 28, 1909

Fig. 1

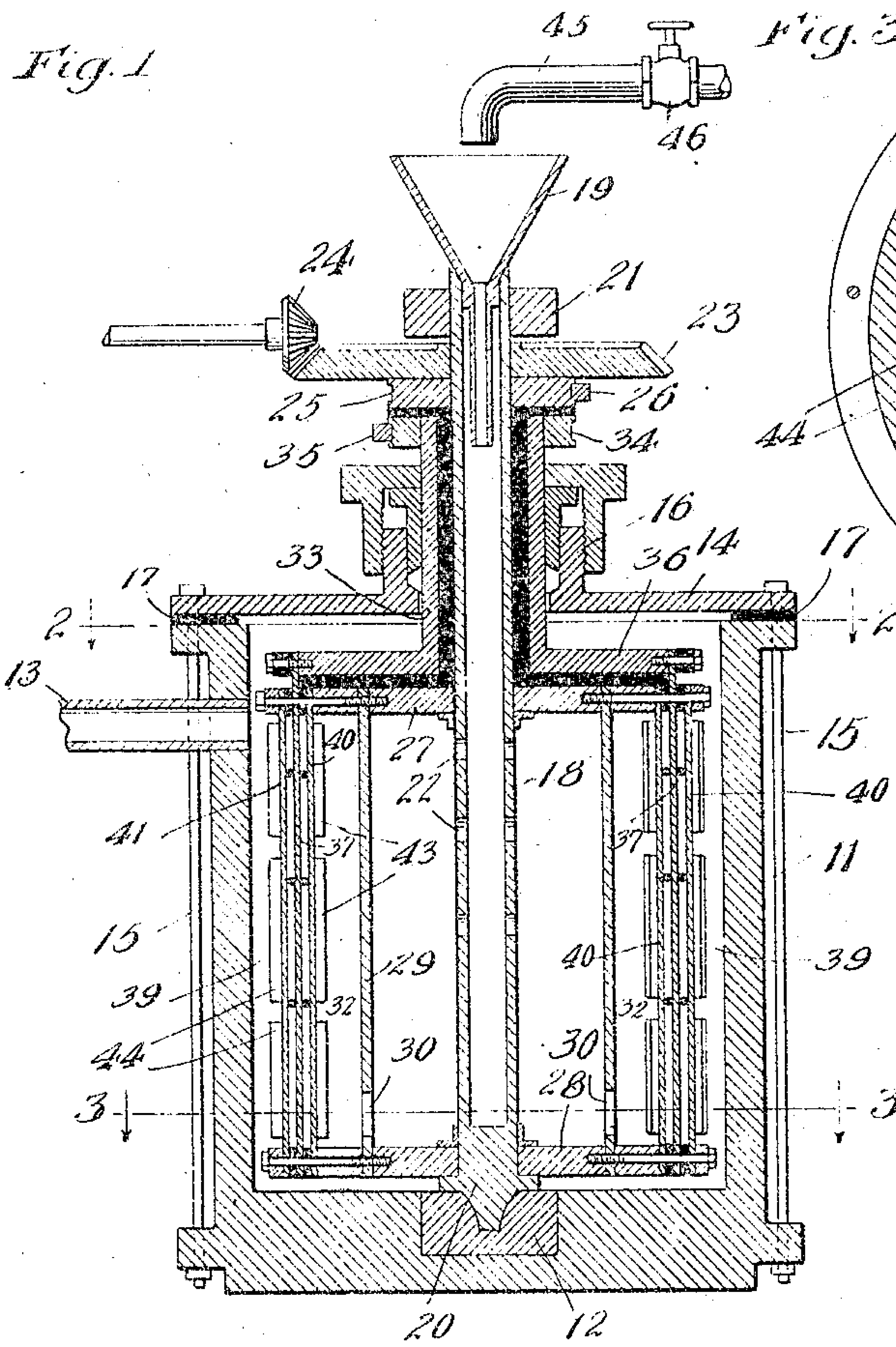


Fig. 3

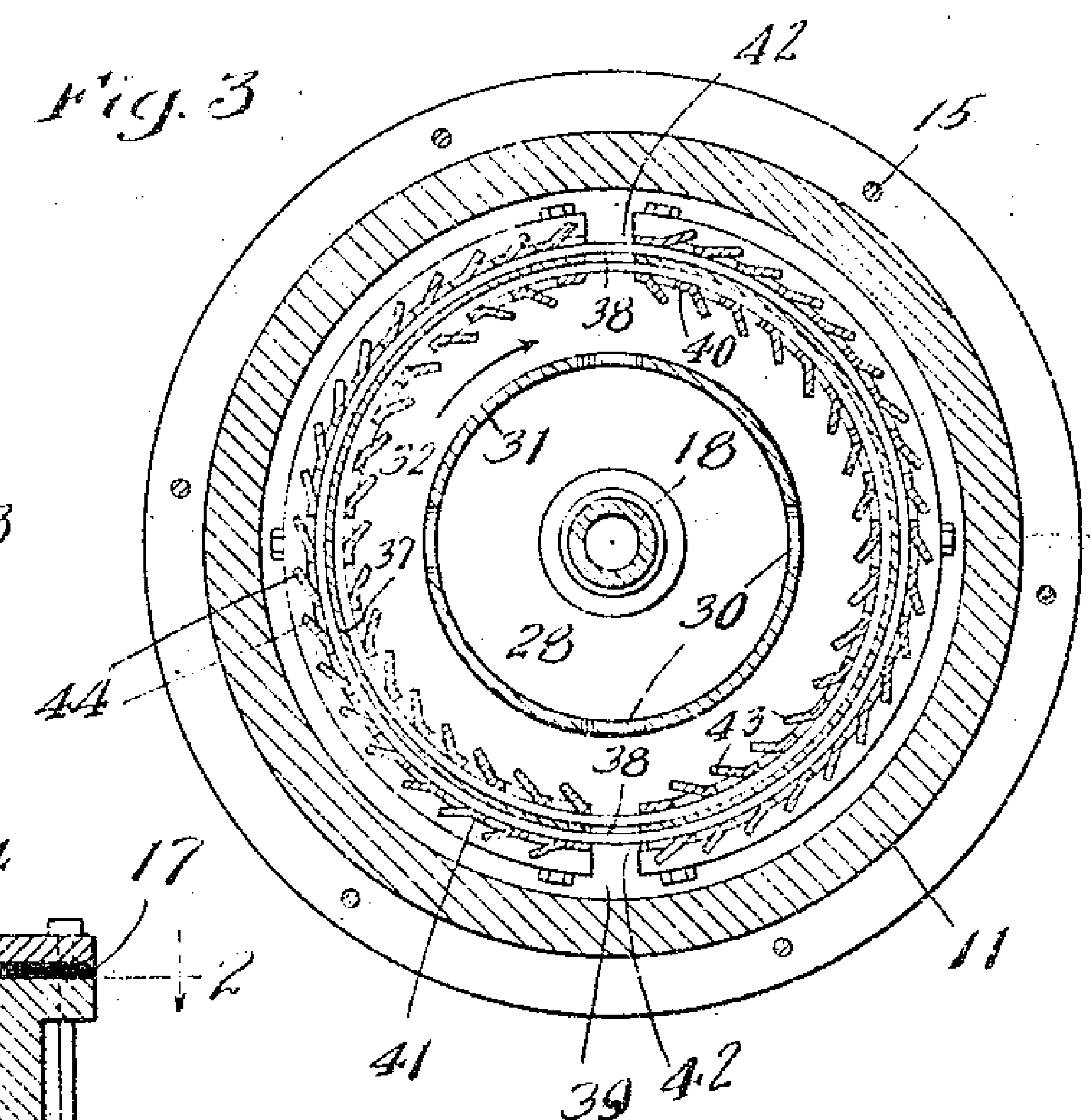
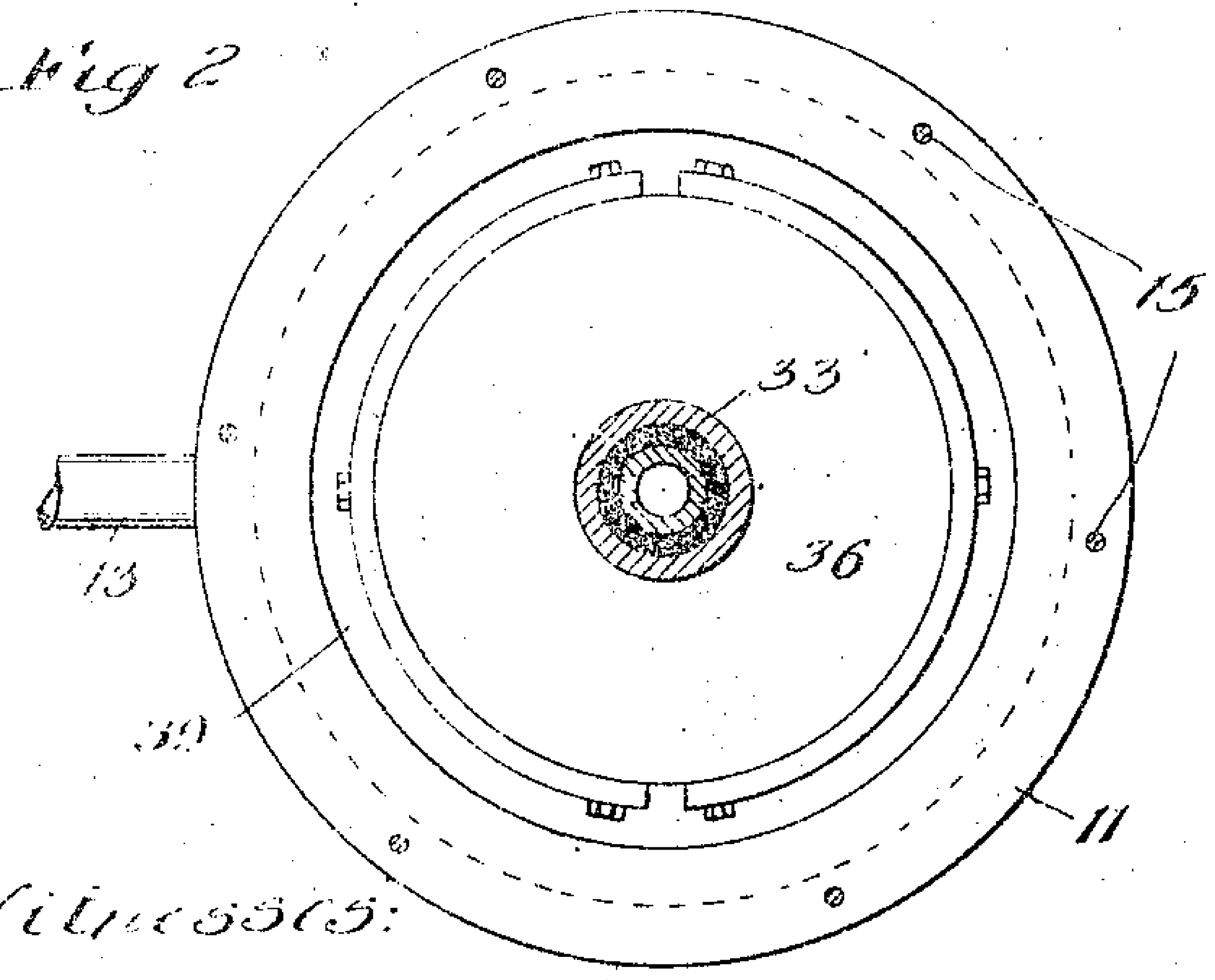


Fig 2



Witnesses:

Wm. Geiger

H. M. Munday

Inventors.
Harry H. Bates
Folger Adam

By Munday, Evarts, Adcock & Clarke
Attorneys

UNITED STATES PATENT OFFICE.

HARRY H. BATES AND FOLGER ADAM, OF JOLIET, ILLINOIS.

ELECTROLYTIC APPARATUS.

944,650. Specification of Letters Patent. Patented Dec. 28, 1909.

Application filed June 7, 1909. Serial No. 500,508.

To all whom it may concern:

Be it known that we, HARRY H. BATES and FOLGER ADAM, citizens of the United States, residing in Joliet, in the county of Will and State of Illinois, have invented a new and useful Improvement in Electrolytic Apparatus, of which the following is a specification.

This invention relates to a cell apparatus for obtaining chlorates from alkaline or alkaline earth metals by electrolysis. And the invention consists generally stated in employing mechanical means for agitating the electrolyte as it passes through the cell, and thus causing said solution to be brought more rapidly and thoroughly into the necessary contact with the electrodes, whereby the rapidity of the action is much increased and other valuable results achieved, and further in utilizing a large body of the solution to retain the heat imparted by the electric current and to thus save in the cost of the operation, as will more fully hereinafter appear.

In the accompanying drawing, which forms a part of this specification, Figure 1 represents a vertical section of the cell apparatus; Fig. 2 is a horizontal section on the line 2, 2, of Fig. 1; and Fig. 3 is a horizontal section on the line 3—3 of Fig. 1.

Like numerals of reference made use of in the several figures denote like parts wherever used.

Hitherto in electrolytic cells which were operated without a diaphragm, either the electrolytic process was carried on until the whole or nearly all of the solution in the cell had been acted upon by the electric current, or the solution was passed rapidly through the cell at such speed that only a small part of it was presented to the action of the electric current. With the former method, a high efficiency was obtained at the first part of the process but as the amount of the salt converted increased, the cell became clogged and the efficiency correspondingly decreased at the latter part of the process, due to this clogging and to the fact that the slat which hed been converted was acted upon a second time by the electric current before it was conducted away. With the latter method the clogging was prevented by passing a large amount of solution through a small cell, but owing to the speed at which it was necessary to pass the solution through the cell to prevent clogging, too much of the electric current was consumed in bringing up the temperature of the solution to the required point; in other words a great many amperes of current first went to heat the entire amount of liquid in the cell before any of the current was used to make the conversion of the salt and inasmuch as only a small amount of salt was allowed to become converted, while the entire amount of the solution had to become heated, the result was an extravagant expenditure of electric current to heat this liquid over and over again until all of the salt contained in it had been converted.

In the cell which we have discovered the electrolytic solution is led into a central compartment which is entirely separated from that part of the liquid undergoing the action of the electric current and at the same time is entirely jacketed by the hot solution in contact with the electrodes, so that the liquid in this central compartment becomes heated and being of a large volume as compared with that which is in contact with the electric current holds the heat. From this central compartment the solution liquid, which is hot, is led to that portion of the cell wherein the electrolytic action takes place and is there subjected to violent agitation, and to the action of a large electrode surface, which converts practically all the chlorid into chlorate before the solution leaves the cell. From this compartment the liquid is drawn off into the ordinary cooling or settling chambers. With this apparatus no unnecessary current is wasted in reheating the solution for the reason that when the liquid first comes in contact with the electrodes it is already at the proper temperature and all that is required of the electric current is to hold it at that temperature and convert the chlorid into chlorate. Almost the entire amount of salt in this compartment of the cell can be allowed to become converted for the reason that the action takes place so quickly,—due to the large proportion of the electrode surface to the amount of the solution and further to the mixing and stirring action of the agitation—that the solution passes out into the cooling and settling receptacle before it has a chance to deposit in the cell itself. Thus with this apparatus we are able to heat and convert almost the entire amount of chlorid in the solution at one operation without the danger of having the efficiency of the cell reduced by clogging due to reconverted chlorid and we thus also avoid the needless waste of electric current in heating and reheating the solution liquid before the entire amount of chlorid contained in it has been converted.

As an element entering into the reduction of the first cost of a cell necessary for this process we are able to use both sides of the platinum anode surface, where hitherto, when thin sheets of platinum were used, only one side was available. In former constructions either a thick sheet of platinum was necessary, which made such a cell very high at first cost, or a thin sheet of platinum supported on one side by a heavy piece of baser material, was used, in which case only one side of the platinum could be employed. By the use of a cell with moving or revolving electrodes we are able not only to agitate the solution while it is being acted upon by the electric current and thus materially to assist in the forming of the secondary reactions, which hitherto were assisted only by the action of diffusion, but we are also able to prevent retention on the cathode surfaces of the gas bubbles of hydrogen which form there, and tend to retard the action by polarization.

In the said drawings 11 is a cell which may preferably be of metal cast in cylindrical form, provided at the bottom with a step bearing piece 12, at one side and in the upper part with an outflow pipe 13.

The cover for the cell is shown at 14, and is shown as being secured to the cell by through bolts 15, 15. In the center of the cover is shown an opening for the passage of a hollow double shaft, presently to be described, and this opening is shown as being provided with a stuffing box 16. Between the cover and the cylindrical cell is a layer 17 of electrical insulating material, which may if desired be so constituted as also to serve as a packing. The hollow double shaft, above mentioned, comprises the central tube 18; open at the top to receive the funnel 19; supported at the bottom by the pivotal bearing 20, setting on the step 12; supported at the upper part in the bearing block 21 and perforated within the cell as at 22, 22, for the outflow of the solution received through the funnel. Secured to this hollow shaft, and to revolve therewith, is the bevel gear wheel 23 (driven by the gear 24). There is also secured to and moving with the said hollow shaft just below the gear a contact ring 25, in electrical connection with the said shaft and with the stationary block or piece 26 constituting the terminal for the cathodes of the cell. Within the cell the said shaft carries near its upper part the disk or horizontal head 27 secured to and in electrical contact with said shaft; and also near the bottom of the cell the second disk or head 28. These two heads support both the cathodes and the anode, the former being in electrical contact with said heads and the latter insulated therefrom. And said heads also support a vertical cylindrical partition 29 secured firmly to both, and provided with perforations 30, 30, for the outflow of the solution from the inner part or chamber 31, to the middle part or chamber 32 of the cell. To the upper portion of the said shaft or tube 18 is attached the outer tube 33, the same being insulated from the said inner tube 18, and from the contact ring 25. This outer tube carries the contact ring 34 in electrical contact therewith and in contact with the stationary terminal 35, the same being the anode terminal. It also carries within the cell the head or disk 36 insulated electrically from the inner tube and its disks or heads. The anode is carried by and is in electrical contact with this head or disk 36.

The anode is shown at 37, carried by the head 36 and the head 28, and passing through the head 27 being insulated from the heads 27 and 28. As shown this anode is formed in cylindrical shape of a thin sheet of some suitable metal, say platinum, and having two vertical passages 38, 38 through it so that the solution occupying the middle chamber 32 may flow outward to the outer or peripheral chamber 39. The cathodes 40, 41, each consists of a cylindrical sheet of some suitable metal, say copper and having also the two vertical passages 42, 42, correspondingly to the passages 38, 38, to permit the circulation of the solution. One of the cathodes is placed on each side of the anode. Each of the cathode sheets is cut with rectangular cuts to form wings 43, 44, out of the material of the cathode by bending these cuts away from the sheet. The cuts of the inner cathode sheet are bent inwardly toward the axis of the cell to form the wings 43, and the cuts in the outer cathode sheet are bent outwardly toward the periphery of the cell to form the wings 44. The edges of the wings in both cathode sheets point in the general direction the shaft turns, that is in the general direction of the arrow on Fig. 3 of the drawing, so that as the cathodes are moved through the solution these wings gather the solution and cause it to flow from within and from without toward and against both sides of the anode, and at the same time agitating the said solution. Above the funnel is the inlet pipe 45, provided with a suitable regulating valve 46 for regulating the flow of the solution to the cell and thereby also regulating and determining how long the solution shall remain in the cell, since if the flow be slow the liquid solution will remain longer in the cell than if the flow be faster as the solution can only flow out as fast as it flows into the cell.

The operation of the apparatus is as follows: A suitable solution of the salts of alkaline or alkaline earth metals is made in water and this solution is regulably permitted to flow into the funnel and through the hollow shaft and its perforations into the inner chamber of the cell whence it passes through the perforated sides of said inner chamber into the middle chamber and thence to the outer or peripheral chamber filling the interior of the cell up to a level with the outflow pipe. In the meantime, power being applied by the gearing, the hollow shaft, carrying the anode and cathode, is caused to revolve in the direction of the arrow on Fig. 3, and the electric current is also turned on. The spreading wings of the cathode moving through the solution gather it in and produce a flow of the solution from both sides toward the anode thus impinging the solution upon both sides of the anode sheet. The solution after being acted upon finds its way to the outflow pipe, and escapes into a receiver. There it should be tested to determine its condition and to determine whether it has remained long enough in the cell. If this test indicates that the solution should have remained longer the supply of inflowing solution is lessened by means of the valve in the inlet pipe, or if it shows that the solution has remained too long the supply is increased as occasion requires. The solution in the cell is heated by the electric current up to the required temperature for the electrolysis within a reasonable time and the solution being in considerable body in the inner chamber this heat is held to meet the incoming flow so that less current is thereafter required because the already heated solution acts to warm the portion that is added by the inflow and there is therefore no waste of electric current in heating the solution, this is a material advantage and economy in the use of the apparatus. So too the most expensive part of an electrolytic cell for the production of chlorates is usually the anode, which is best made of platinum to withstand the disrupting action. In the present apparatus the anode is preferably made of a very thin sheet of platinum although it is understood we do not limit ourselves to platinum. It is possible to use the thinnest sheet of metal because it is supported at both top and bottom firmly and in such manner that there is no strain upon it and being smooth and moving smoothly through the solution no strain whatever is put upon it in the operation. Moreover this thin sheet of the metal is made to do double service by presenting both of its sides to the electrolytic action, one side to one cathode and the other side to another cathode, thus obtaining in the cell double the amount of anode surfaces with the same amount of material than was heretofore thought practicable with such thin sheets of metal. Inasmuch as the cost of the platinum is the main initial cost of the cell our construction enables us to greatly reduce the initial cost of an apparatus for the manufacture of chlorates. It will be seen that though one of the electrodes is made use of as the moving means to agitate and circulate the solution in the cell, the one selected for this purpose is the cathode element, which may be made of cheap metal and may without great expense be constructed as thick and heavy as required to do the work and to sustain the wear; and this utilization of one of the electrodes is a material advantage in the construction and operation of the apparatus. So too it should be noted that one of the great hindrances to active electrolysis of chlorids has always been the formation of hydrogen bubbles on the surface of the cathode and which by keeping the solution from the surface retards the action. But in the present apparatus both of the electrodes are in motion through the agitated solution and are consequently being washed by the solution so that as the inevitable bubbles form they are immediately washed away into the solution and escape without having time to do any damage in retarding the action.

We claim:—

1. An electrolytic cell for the production of chlorates from chlorids having moving anodes and cathodes mounted so as to move in the same direction upon a common axis.

2. An electrolytic cell for the production of chlorates from chlorids containing moving anodes and cathodes mounted so as to move in the same direction upon a common axis constructed to agitate the solution by their movement.

3. An electrolytic cell for the production of chlorates from chlorids in which the cathode is given a rotary movement in the solution and is constructed with vanes to agitate the solution by such movement.

4. An electrolytic cell for the production of chlorates from chlorids in which the anode is made without vanes and the cathode made with vanes, and the latter given a rotary movement through the solution to agitate the same and bring all parts thereof rapidly into contact with the electrodes.

5. An electrolytic cell for the production of chlorates from chlorids in which the anode is given a rotary movement and is formed of both sides of a thin sheet of metal and the cathode is made to face both sides of the anode sheet.

6. In an electrolytic cell the cylindrical anode formed of a thin sheet of metal and the cathode formed in two parts facing both sides of said anode and in proximity thereto,

said cathode and anode being mounted in bearings to revolve through the solution, the cathode being provided with means for directing the current of solution into contact with the anode at both of its sides, combined with mechanism for revolving the cathode.

7. In an electrolytic cell the cylindrical anode formed of a thin sheet of metal and the cathode formed in two parts facing both sides of said anode and in proximity thereto, said cathode and anode being mounted in bearings to revolve through the solution, the cathode being provided with means for directing the current of solution into contact with the anode at both of its sides, combined with mechanism for revolving the cathode, said means for directing the current of solution into contact with the anode consisting of vanes carried by the cathode.

8. An electrolytic cell made in two parts, an outer and an inner part, the inner part of which is not an electrode and does not contain electrodes, and is constructed to receive the solution to be treated, and another or outer part surrounding the inner one and containing the moving electrodes and treating and discharging the solution, the whole constituting a close vessel provided with a cover, whereby the heat and gases of the electrolytic action are conserved and used to heat the incoming solution before it reaches the electrodes, substantially as specified.

HARRY H. BATES.
FOLGER ADAM.

Witnesses:
JOHN W. MUNDAY,
H. M. MUNDAY.