R. J. McNITT.

ELECTROLYTIC PROCESS.

APPLICATION FILED SEPT. 30, 1909.

995,476. Patented June 20, 1911.

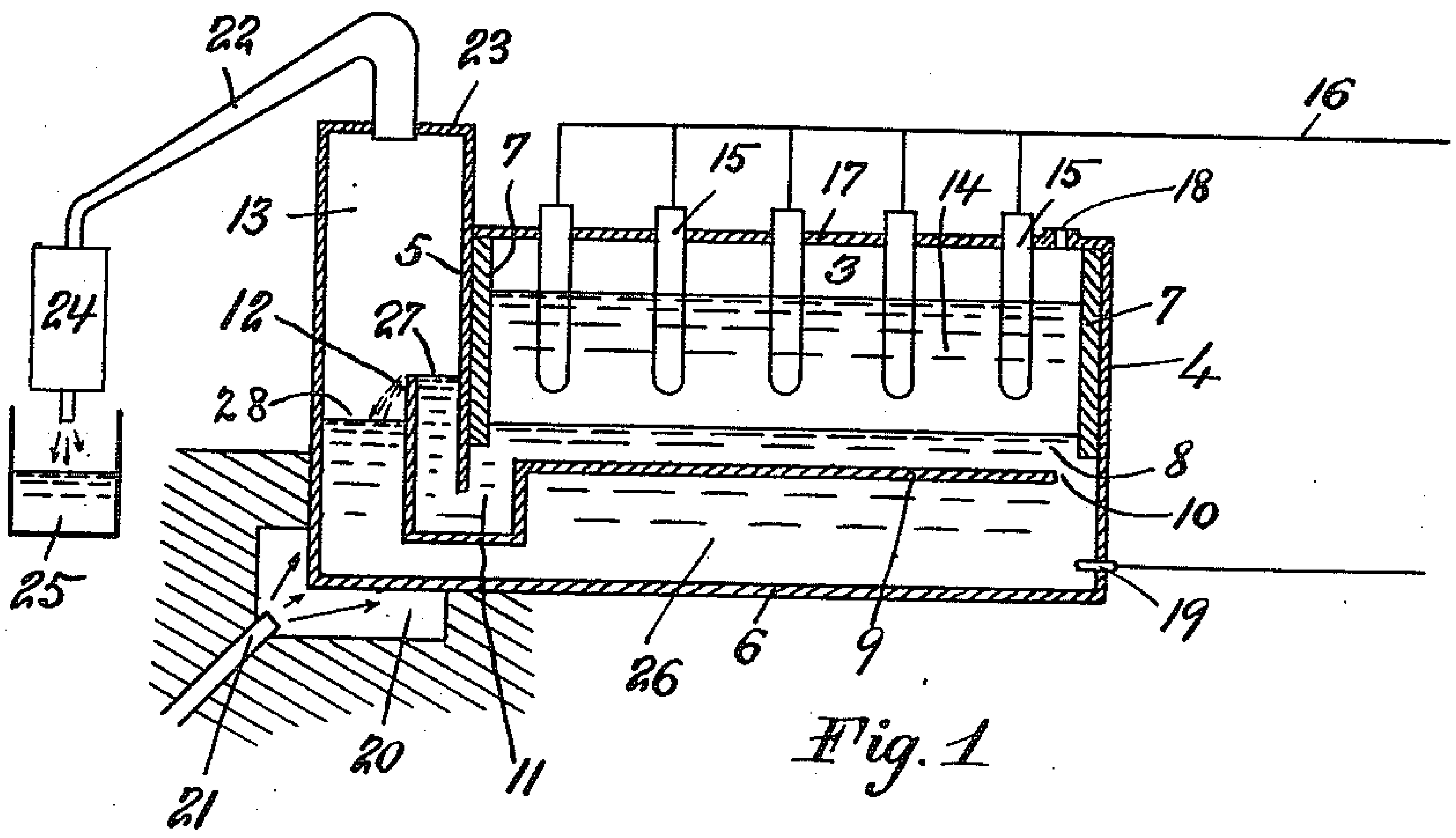

Fig. 1

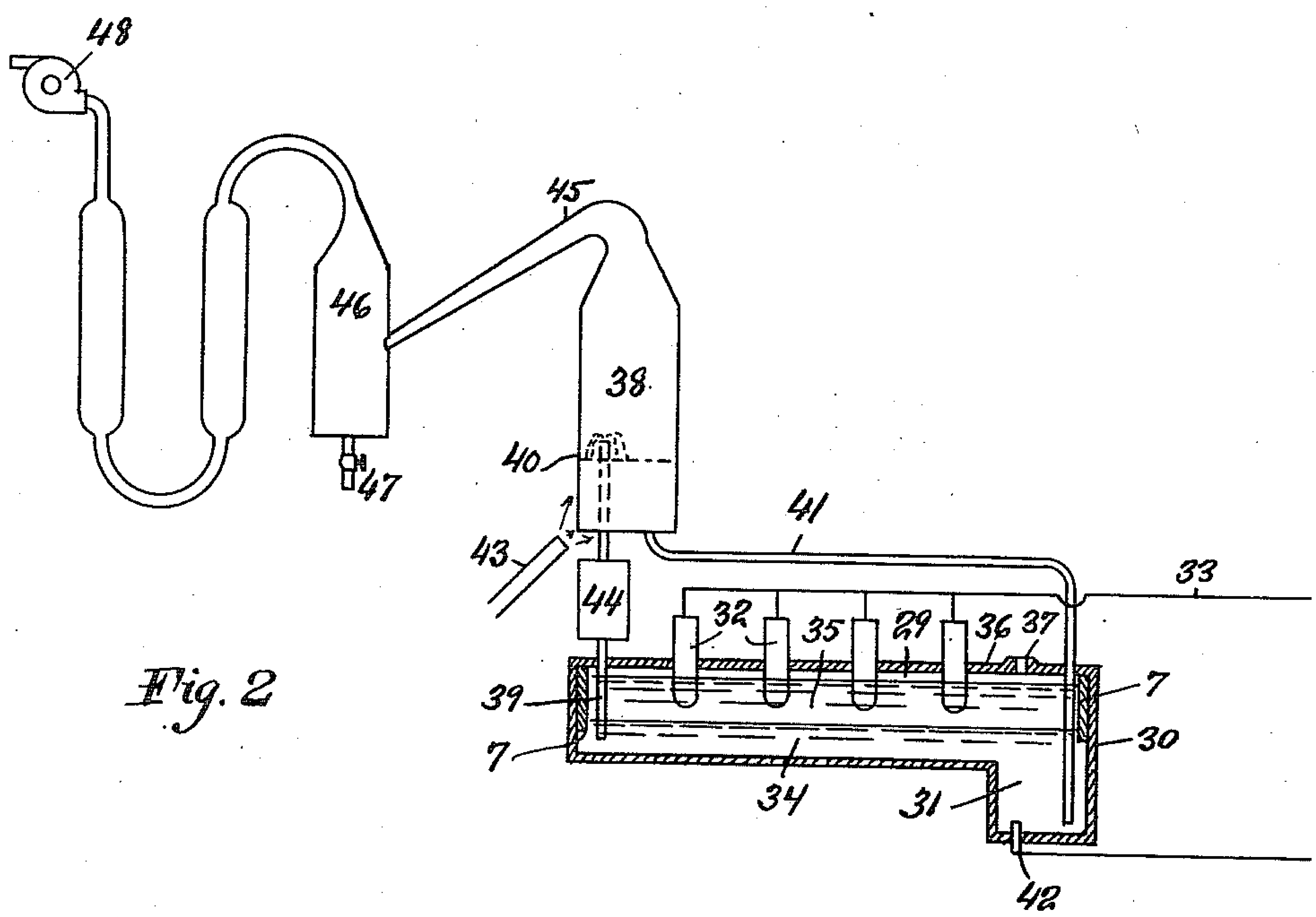

Fig. 2

Witnesses
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UNITED STATES PATENT OFFICE.

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ELECTROLYTIC PROCESS.

995,476. Specification of Letters Patent. Patented June 20, 1911.

Application filed September 30, 1909. Serial No. 520,366.

To all whom it may concern:

Be it known that I, ROBERT J. McNITT, a citizen of the United States of America, residing at Niagara Falls, in the county of Niagara and State of New York, have invented a certain new and useful Improvement in Electrolytic Processes, of which the following is a specification.

My invention relates to electrolytic processes in which one or more of the products of electrolytic decomposition may be dissolved, alloyed or chemically combined with a fluid electrode, the resulting electrode material removed from the electrolytic chamber and the desired products of electrolysis extracted by any suitable means, as by electrolysis, distillation or chemical reaction, and the object of my invention is an improved means of effecting the circulation of the electrode material in such process.

It is desirable in the practice of electrolytic processes of the kind referred to, to circulate the electrode in and out of the electrolytic chamber in order that the absorption by the electrode of the product desired and the extraction of said product therefrom may proceed efficiently and continuously. By making a suitable selection of the electrode material and by proper manipulation of the process, the richly laden electrode material leaving the electrolytic chamber may be caused to have a specific gravity different from that of the electrode material returning to said chamber.

My invention consists in utilizing this difference in specific gravity to effect the circulation of the electrode material.

In the following I have described, in connection with the accompanying drawings, two means of carrying out my invention, the features thereof being more particularly set forth hereinafter in the claims.

In the drawings, Figure 1 is a vertical sectional view of an electrolytic cell constructed to carry out the principles of my invention, showing the same in connection with a means for distilling off the product desired, the view being partly diagrammatic. Fig. 2 is a similar view showing a modification and illustrating an apparatus for carrying out my invention in connection with means for separating the product desired by distillation under reduced pressure, the view being partly diagrammatic.

In Fig. 1, 3 represents an electrolytic chamber having end walls 4 and 5 and a bottom 6, the chamber being preferably made of cast iron. The walls are lined with a suitable magnesia lining 7 to prevent corrosion, the magnesia lining extending down below the surface of the cathode metal 8. 9 is a transverse partition extending from side to side of the chamber and separated from the wall 4 by a space 10. The other end of partition 9 is turned downward to form a seal 11, the upturned portion 12 acting as one wall of the furnace chamber 13. The end wall 5 of electrolytic chamber 3 depends into seal 11. 14 is the electrolyte and 15 the anodes connected by wire 16 with a suitable source of electric current (not shown). 17 is an air-tight cover for chamber 3, preferably of asbestos, and 18 is an opening for the escape of gaseous products. 19 is an electrical connection to the cathode. 20 represents a suitable grate for heating furnace chamber 13, the means for heating shown being a gas burner 21. 22 is a gooseneck connection passing through cover 23 of furnace chamber 13 and connected to a condenser 24, which discharges into a suitable receptacle 25. 26 is a channel connecting furnace chamber 13 with electrolytic chamber 3 through opening 10.

I shall describe the operation of the apparatus shown in Fig. 1 in connection with the electrolysis of sodium chlorid in which molten lead is used as the cathode. In this case the electrolyte 14 is molten sodium chlorid which rests upon the molten lead cathode 8. To start the operation, it is advantageous to fill the channel 26 with molten pure lead or a molten weak alloy of lead and sodium and the lower part of the electrolytic chamber, that is the part above partition 9, including seal 11, with a molten richer alloy of lead and sodium in order to have a substance in the electrolytic chamber of lower density than the substance in channel 26, and hence a difference between the hydrostatic levels at the points 27 and 28. A current of electricity is then caused to pass between the anodes and the cathode, depositing sodium in the cathode and causing it to alloy with molten lead. Since the level 27 is, at the beginning of the process, made higher than the level 28 by filling the lower part of the electrolytic chamber above partition 9 with an alloy of lower density than the substance in channel 26 as described above, it is apparent that as the operation continues and more sodium chlorid is fed into the electrolytic chamber to replace that which is decomposed, a portion of the cathode metal is forced down through seal 11 under wall 5, over wall 12 into furnace chamber 13. In chamber 13 the temperature of the molten material is maintained at such a point that some or all of the sodium is driven off by distillation and passes through the connection 22 into condenser 24 and thence into container 25, leaving behind in the furnace chamber a weak alloy or molten lead which returns, as a denser substance than the richly laden alloy, through the channel 26 and opening 10 to the electrolytic chamber 3, where it absorbs more sodium and is again forced through the cell into the furnace chamber, the operation being repeated indefinitely.

In Fig. 2, 29 represents the electrolytic chamber having walls 30 of cast iron. One end of the chamber as 31 is deeper than the other. 32, 32 are the anodes connected by wire 33 with a suitable source of electric current (not shown). 34 is the cathode and 35 the electrolyte. 36 is an air-tight cover for chamber 29, preferably of asbestos and provided with an opening 37 for the escape of gaseous products of decomposition. 38 is a receiver connected by pipe 39 with cathode metal 34. The pipe 39 extends up into the receiver 38 a suitable distance, as shown at 40, so that the said pipe will overflow into the receiver. 41 is a pipe connecting the bottom of receiver 38 with the deeper portion 31 of electrolytic chamber 29, as shown. 42 is an electrical connection to the cathode. Receiver 38 is adapted to be heated by a suitable burner 43 and pipe 39 may also be heated by means of a suitable electrical resistance or heater 44 wrapped around said pipe. Receiver 38 has a suitable connection 45 to a condenser 46, provided with an outlet cock 47. Condenser 46 is in communication with a vacuum pump 48 by means of which the air in receiver 38 may be exhausted. In electrolyzing sodium chlorid by the means described, the bottom of the cell is filled with molten lead and molten sodium chlorid is charged into the cell. Electric current is then passed between the anodes and the cathode, decomposing the salt, the chlorin passing off through opening 27 and the sodium being absorbed by the cathode metal. As the diffusion of the sodium into the lower part of the well 31 is very slow, the molten metal there will remain denser than the alloy formed under the anodes and at the bottom of pipe 39. Pump 48 is then operated exhausting the air in receiver 38 and raising the metal in pipe 39 to a greater height than in pipe 41, and when the density of the alloy becomes low enough, the metal in pipe 39 overflows into receiver 38, at the same time giving off its sodium which is carried into condenser 46 by suction, the residual metal returning by gravity through pipe 41 into well 31, thence again under the anodes where it absorbs sodium and is again forced up pipe 39. Since the metal in pipe 39 will always be less dense than that in pipe 41, there will be a continuous siphoning of the cathode metal away from and to the electrolytic chamber.

Since the rate of circulation depends upon the relative densities of metal in pipes 39 and 41 and since the rate of distillation depends upon the strength of the alloy, it is evident that the general operation of the process, once started and properly supplied, will be automatic. It is also evident that the same principle of circulation is utilized whether the metal is returned to the electrolytic chamber by an indirect or intermittent or by a direct and continuous means.

What I claim and desire to secure by Letters Patent is:

1. The method of circulating a fluid electrode from and to an electrolytic cell consisting in causing said circulation by maintaining a difference in the specific gravity between the outgoing and incoming electrode substance.

2. The method of positively circulating a fluid electrode from and to an electrolytic cell consisting in alternately decreasing and increasing the density of the electrode substance.

3. The method of positively circulating a fluid electrode from and to an electrolytic cell consisting in reducing the density of the electrode by charging it with the products of electrolysis and subsequently increasing the density of the charged electrode by removing some or all of said products of electrolysis from said electrode.

4. The method of circulating a fluid electrode from and to an electrolytic cell consisting in reducing the density of the electrode by charging it with the products of electrolysis, removing said charged electrode from the cell by the difference in specific gravity between said charged electrode and the incoming electrode substance, increasing the density of said charged electrode by removing some or all of said products of electrolysis therefrom and returning said electrode of increased density to the cell.

5. The method of circulating a fluid electrode from and to an electrolytic cell consisting in reducing the density of the electrode by charging it with the products of electrolysis, removing said charged electrode from the cell by the difference in specific gravity between said charged electrode and the incoming electrode substance, extracting some or all of said products of electrolysis

from the electrode and returning said denser electrode to said cell by the action of gravity.

6. The method of positively circulating a fluid electrode from and to an electrolytic cell consisting in reducing the density of the electrode by charging it with the products of electrolysis, removing said charged electrode from the cell, maintaining it at a temperature sufficient to drive off some or all of the products of electrolysis and returning said denser electrode to said cell by gravity.

7. The method of positively circulating a fluid electrode from and to an electrolytic cell consisting in reducing the density of the electrode by charging it with the products of electrolysis, removing said charged electrode from said cell, extracting the products of electrolysis therefrom by maintaining the same under reduced pressure and at a temperature sufficient to drive off some or all of said products and returning said denser electrode to the cell.

8. The method of positively circulating a fluid electrode from and to an electrolytic cell consisting in reducing the density of the electrode by charging it with the products of electrolysis, forcing said charged electrode from the cell by the pressure of the electrolyte, removing some or all of the products of electrolysis and returning the denser electrode to the cell by gravity.

9. The method of positively circulating a fluid electrode from and to an electrolytic cell consisting in reducing the density of the electrode by charging it with the products of electrolysis, forcing said charged electrode from the cell by the pressure of the electrolyte assisted by suction, removing some or all of the products of electrolysis and returning the denser electrode to the cell by gravity.

10. The method of circulating a fluid electrode from and to an electrolytic cell consisting in establishing a difference in hydrostatic level between the outgoing and incoming electrode substance by making the outgoing substance of a lower density than the density of the incoming substance, causing the outgoing substance to flow from a higher to a lower level by the addition of the products of electrolysis to the outgoing substance, increasing the density of said substance by extracting part of its constituents and returning the residual electrode substance by gravity to the electrolytic chamber.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ROBERT J. McNITT.

Witnesses:
HOWARD E. BATSFORD,
J. CLOYD DOWNS.