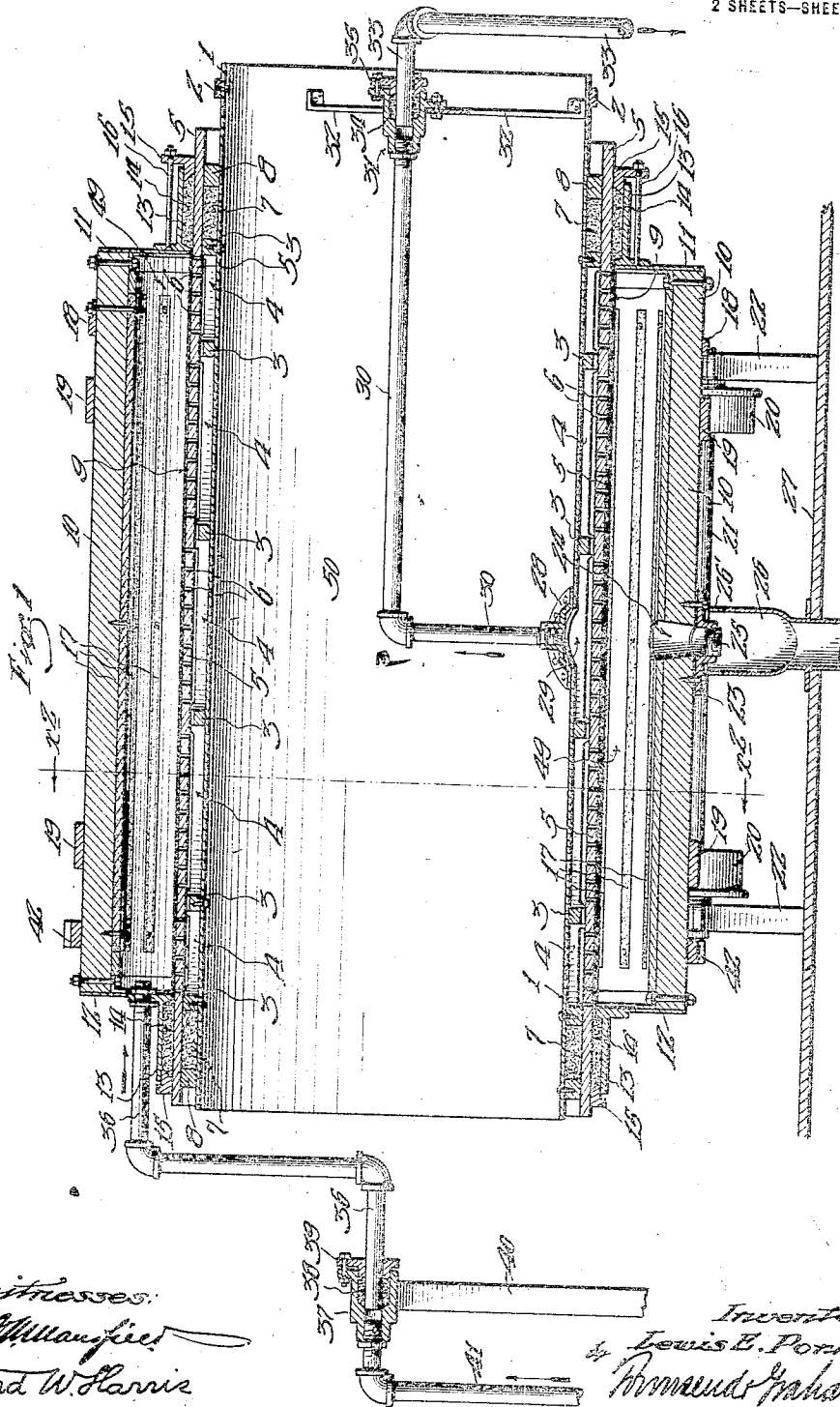


L. E. PORTER.
ELECTROLYTIC CELL.
APPLICATION FILED MAY 11, 1914.

1,167,594.

Patented Jan. 11, 1916.
2 SHEETS—SHEET 1.



Witnesses:
William F. Harris
Ford W. Harris

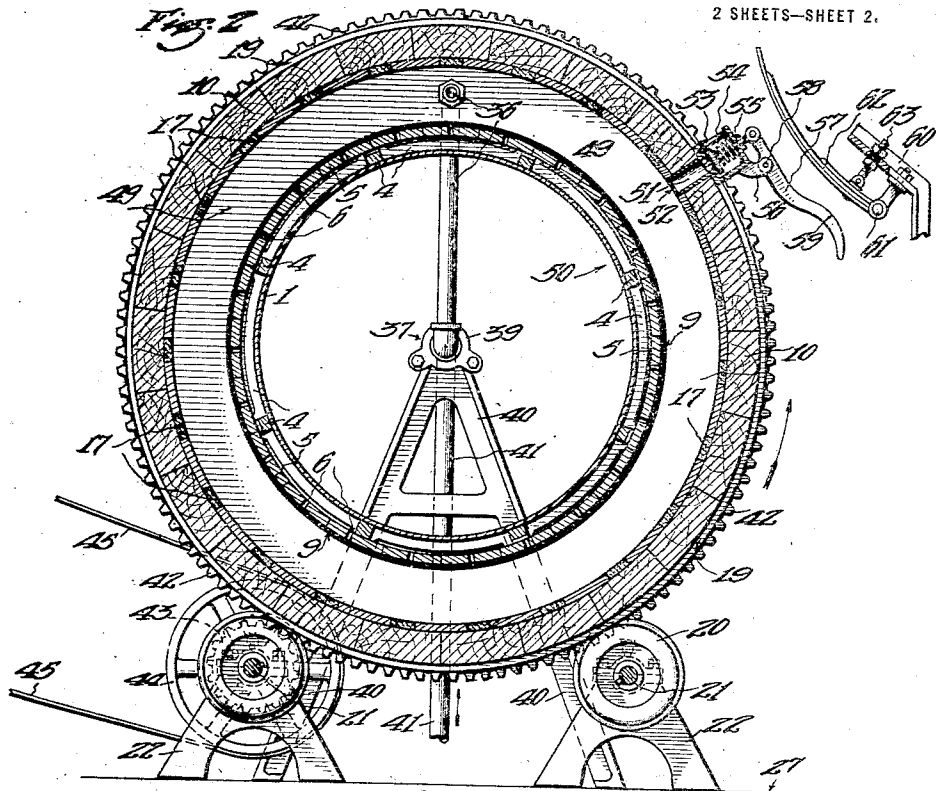
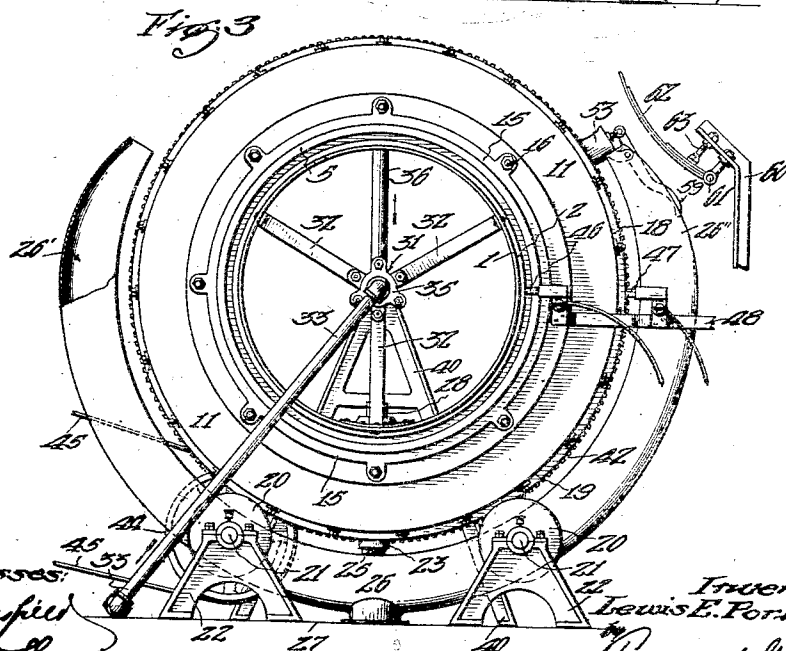
Inventor,
Lewis E. Porter,
Armand Graham

Per. Design.

L. E. PORTER.
ELECTROLYTIC CELL.
APPLICATION FILED MAY 11, 1914.

1,167,594.

Patented Jan. 11, 1916.
2 SHEETS—SHEET 2.



Witnesses:
M. W. Harnett
Ford W. Harnett

Inventor:
Lewis E. Porter
Forrest H. Harnett
Attys.

UNITED STATES PATENT OFFICE.

LEWIS E. PORTER, OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-HALF TO HUGH E. STOCK, OF CASPER, WYOMING.

ELECTROLYTIC CELL.

1,167,594.

Specification of Letters Patent.

Patented Jan. 11, 1916.

Application filed May 11, 1914. Serial No. 827,839.

To all whom it may concern:

Be it known that I, Lewis E. Porter, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented a new and useful Electrolytic Cell, of which the following is a specification.

This invention relates to electrolytic cells, and the principal object thereof is to provide means for extracting metal directly from metallic ores. While other uses will be evident to one skilled in the art after having the invention explained to him, such other uses will be only briefly touched on herein.

The invention consists of an electrolytic cell in which metallic ore is placed in an anode chamber and electrically connected to form the real anode. A porous diaphragm is provided dividing the anode chamber from the cathode chamber. In the cathode chamber is a metallic cathode upon which the metal is electrically deposited from an electrolyte which is continually forced from the anode chamber into the cathode chamber through the porous diaphragm, the partially impoverished solution being returned from the cathode chamber, by means external to the cell, to the anode chamber where it is again enriched from the metallic ore contained therein.

The invention further consists of such a cell having the cathode and anode chambers formed of concentric cylindrical walls with an intermediate cylindrical porous diaphragm separating them, the whole forming a pressure tight cell in which the electrolyte and the resulting gases are maintained under considerable pressure and actuated by rotating the cell.

The invention further provides means for taking off the gas, generally hydrogen, that forms in the cathode chamber, and taking off any excess of gas, such as oxygen, formed in the anode chamber.

Other objects and advantages will be evident hereinafter.

In the drawings, which are for illustrative purposes only: Figure 1 is a vertical cross section through the center of the cell. Fig. 2 is a section on the plane x^2-x^2 of Fig. 1. Fig. 3 is an end elevation of same.

In the drawings, 1 is a metallic cylinder, preferably of iron, to which is secured a

metallic slip ring 2 and a series of wood bands 3, these bands surrounding the cylinder. Intermediate strips 4 parallel to the axis of the cylinder serve to divide the spaces between the bands 3 into a series of segmental openings having straight sides. A porous diaphragm 5, preferably of wood, is supplied resting upon the strips 3 and 4 and is perforated with a multiplicity of holes 6. Packing 7 retained in place by plugs 8 is placed between the diaphragm 5 and the cylinder 1 for the purpose of making a tight closure therebetween. A filter cloth 9 is wrapped around the diaphragm 5 being secured thereto by any convenient means.

An outer shell 10, preferably formed of wood, surrounds the diaphragm 5, and is provided with metal ends 11 and 12 which extend downwardly and have secured to them stuffing box casing 13. Packing material 14 is placed inside the stuffing box casing 13 surrounding the diaphragm 5 and is compressed by followers 15 which are drawn into place by studs 16 secured in the stuffing box casing 13. A series of anode conductors 17 are secured to the inner side of the shell 10 being all connected to a second slip ring 18 which is external to the shell 10. Bearing rings 19 are also secured on the outer surface of the shell 10 and rest upon wheels 20 which turn on shafts 21 carried in brackets 22. A flange 23 is secured on the outer surface of the shell 10 registering with an opening 24 extending into the interior of the shell 10, the opening in the flange 23 being closed by means of a pipe plug 25. A hopper 26 is provided extending through the floor 27 to any convenient point, this hopper extending up on either side of the shell 10 as shown at 26' and 26''. A flange 28 is secured over an opening 29 in the cylinder 1 and a pipe 30 is tapped therein extending over and being secured in a stuffing box member 31 which is carried on supports 32 from the cylinder 1. A stationary pipe 33 extends into the stuffing box member 31, packing 34, held in place by means of a follower 35, being provided to make a tight closure with the pipe 33. This pipe extends downwardly and may connect with various apparatus as will hereinafter be described.

A pipe 36 is secured in the end 12 and extends down and communicates with the in-

terior of a stuffing box 37 which is supported by a pedestal 40 which extends down and is secured to the floor 27. A gland 39 is secured to the box 37 and compresses packing 38 about the shaft 36. A pipe 41 is tapped into the stuffing box member 37 and extends down and connects to other apparatus as will hereinafter be described.

A spur gear 42 is mounted on the exterior of the shell 10 and meshes with and is driven by a pinion 43 mounted on one of the shafts 21 which is driven by means of a pulley 44 by a belt 45 from a source not shown. A brush 46 makes contact with slip ring 2 and a brush 47 makes contact with the slip ring 18, these brushes being supported on an insulating standard 48 which may be supported from the floor by any convenient means not shown.

A relief valve is provided for the anode chamber consisting of a casting 51 having a hole 52 in open communication with the interior of the anode chamber and a valve 53 seating upon and closing this hole. A spring 54 surrounds the stem 55 of the valve 53 and exerts pressure between a yoke 56 formed on the casting 51 and the valve 53. This spring has sufficient strength to hold the valve closed against four times a predetermined pressure, called the relieving pressure. A handle 57 is pivoted at 58 on the yoke 56 and extends out and forms a cam surface at 59.

A bracket 60 is supported from the floor 27 or some other stationary structure. Pivoted at 61 thereon is a spring 62 which may be adjusted as to position by the bolt 63. The spring 62 is so located that it is struck by the cam surface 59 as the shell 10 revolves. The exact amount of pressure put on the cam 59 may be adjusted by the bolt 63. In practice it is adjusted to put a tension on the stem 55 equal to three times the relieving pressure, this tension acting against the spring 54 which it will be remembered exerts a pressure against the valve of four times the relieving pressure. There is therefore a normal unbalanced pressure on the valve 53 of four times the relieving pressure but when the spring 62 is fully in contact with the cam surface 59 the pressure of the spring 62 is subtracted from the pressure of the spring 54 leaving an unbalanced pressure equal to the relieving pressure on the valve 53. If the pressure in the anode chamber exceeds the relieving pressure the valve 53 will lift and discharge gas from the anode chamber. The bracket 60 is so located that this discharge takes place at or near the top of the movement of the shell 10 so that gas will be discharged from above the solids and liquids contained therein.

It will be noted that the diaphragm 5 divides the cell into two parts, the outer of

which may be called the anode chamber and designated by the figure 49 and the inner of which may be called the cathode chamber and designated by the figure 50, these chambers being in communication with each other through the perforations in the diaphragm 5 and the filter cloth which is secured thereover. In the anode chamber are located the anode conductors 17 which are connected to the slip ring 18, and in the cathode chamber is located the cathode which is the cylinder 1.

The method of operation of the invention is as follows: The parts being assembled as shown in the drawings, the cell is rotated until the pipe plug 25 is at the top thereof. The pipe plug is then removed and the anode chamber 49 is filled with metallic ore through the opening 24. The plug 25 is then replaced and the cell is rotated by means of the belt 45, the pulley 44, the shaft 21, the pinion 43, and the gear 42. An electrolyte nearly saturated with metallic salts is then admitted to the pipe 41 and is forced under pressure into the anode chamber 49, completely filling any spaces therein not already taken up by the metallic ore. The anode chamber being pressure tight, due to the packing 14, and the pressure being maintained this electrolyte is forced into the cathode chamber 50 through the filter cloth 9 and through the openings in the diaphragm 5. The metallic ore being in contact with the plates 17 this metallic ore becomes the true anode and the usual electrolytic chemical oxidation takes place therein, releasing metallic salts into the electrolyte. The electrolyte is already nearly saturated and the addition of more metallic salts fully saturates it. None of the metallic ore can pass into the cathode chamber due to the filter cloth but the electrolyte passes into the cathode chamber and a continuous deposition of metal takes place therefrom, this metal having been extracted from the ore by the electrolyte. The solution is removed, slightly impoverished, from the cathode chamber 50 by means of the pipe 30, being carried through the stuffing box 31 of the pipe 33. This solution may be treated externally to the cell if desired, or it may be pumped back through the pipe 41 into the anode chamber where it is again enriched by the ore contained therein. Any excess gases which may be generated in the anode chamber are relieved by the valve 53. Hydrogen or other gases evolved in the cathode chamber are drawn off through the pipes 30 and 33 with the electrolyte. These gases are not returned to the anode chamber but are trapped out before the solution is returned to the pipe 41. The cell being continuously rotated during the operation thereof the ore in the anode chamber is continuously agitated and the gases which form

therein have every opportunity to combine with the ore to form metallic salts. A continuous deposit of metal takes place on the surface of the cylinder 1, but this deposit only takes place in the spaces between the wooden members 3 and 4. When the cell has been operated for a sufficient length of time to produce a considerable coating of metal on the cylinder 1 the solution is shut off in the pipe 41 and the cell is emptied of solution through the pipes 30 and 33. The treated ore is then discharged through the hole 24 into the hopper 26. The diaphragm 5, and the cathode 1 are then removed by releasing the bolts 18 which have previously caused the packing 14 to press upon the diaphragm 5 and cause it to grip the rings 8 and the diaphragm and cathode are removed from the shell 10. The metal deposited in a cylindrical form on the cathode is thus accessible. The cylinder is divided up into a series of rectangular portions by the wooden strips 3 and 4 and the metal is deposited therebetween. The metal may ordinarily be readily removed from the cylinder 1 coming off as metallic plates approximately rectangular in outline.

It is evident that an electrolytic cell of this type may be applied to many uses. I have not attempted to describe the chemical theory or to give the equations explaining its use.

The process is ordinarily carried on by providing an anode composed of sulfid ore or the like. The electrolyte is pumped into the anode chamber loaded nearly to the saturation point with metallic salts. The action in the anode chamber is to increase these salts and the saturated solution is forced through the diaphragm 5 into the anode chamber. Here a small portion of the salts are decomposed, metal being extracted therefrom and the electrolyte is pumped back into the anode chamber to be resaturated.

One particular use to which the invention can be applied is the recovery of metallic zinc from zinc ores. Such ores ordinarily carry a large proportion of iron which greatly complicates any attempts to recover the zinc by ordinary methods. In the present invention the free oxygen released from the electrolyte in the anode chamber and maintained in that chamber under pressure acts on this iron to produce an insoluble iron oxid which is retained in the pulp, thus giving an electrolyte free from iron and

from which metallic zinc commercially free from iron may be deposited.

I claim as my invention:

1. An electrolytic cell comprising a cylindrical metal cathode, a series of insulating strips on the outer surface of said cathode dividing it into a series of rectangular areas, an insulating shell surrounding said cathode, ends making a tight closure and forming a pressure tight compartment between said shell and said cathode, a series of anode conductors inside said shell, a porous diaphragm dividing said compartment into two chambers, and means for connecting an electrical source to said cathode and to said anode conductors.

2. An electrolytic cell comprising a cylindrical cathode, a porous diaphragm surrounding said cathode, an outer shell surrounding said diaphragm, anode conductors inside said shell, ends forming a tight joint with said shell and forming a stuffing box casing about said diaphragm, means for forming a tight joint between the ends of said cathode and said diaphragm, and means for forming a tight joint between said stuffing box casing and said diaphragm.

3. An electrolytic cell comprising a cylindrical cathode, a porous diaphragm surrounding said cathode, an outer shell surrounding said diaphragm, anode conductors inside said shell, ends forming a tight joint with said shell and forming a stuffing box casing about said diaphragm, means for forming a tight joint between the end of said cathode and said diaphragm, packing placed inside said stuffing box casing about said diaphragm, and means for compressing said packing.

4. An electrolytic cell comprising an outer cylindrical shell having a horizontal axis, means for rotating said cell, a porous diaphragm inside said shell, a cathode inside said porous diaphragm, ends making a tight closure between said shell and said cathode, a swiveled pipe for conducting liquid into said shell through one of said ends, and a swiveled pipe for conducting liquid from the interior of said shell through the wall of said cathode.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 5th day of May, 1914.

LEWIS E. PORTER.

In presence of—

FRED A. MANSFIELD,
FORD W. HARRIS.