No. 700,941. Patented May 27, 1902.

N. S. KEITH.

PROCESS OF TREATING COPPER OR OTHER ORES FOR OBTAINING THEIR CONTENTS OF METALS.

(Application filed Dec. 7, 1901.)

(No Model.)

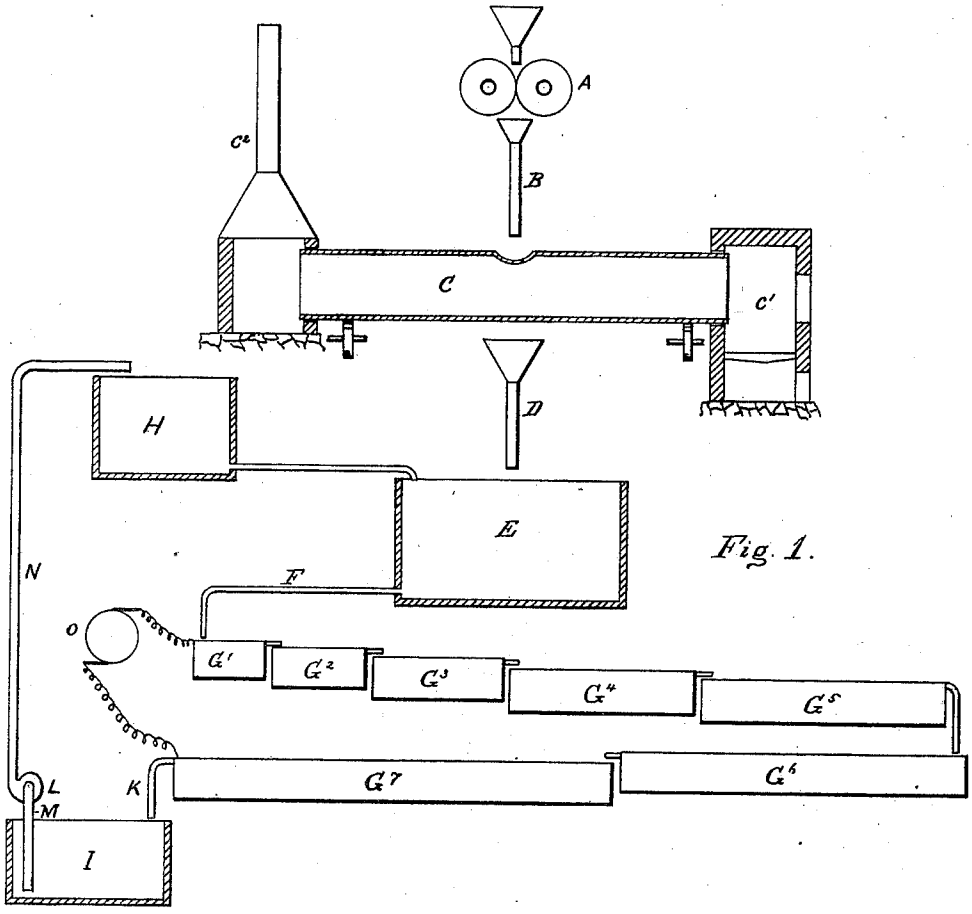


Fig. 1.

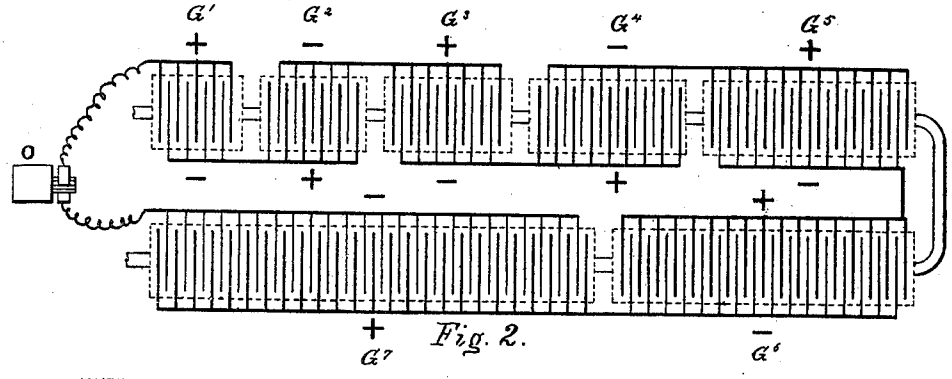


Fig. 2.

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PROCESS OF TREATING COPPER OR OTHER ORES FOR OBTAINING THEIR CONTENTS OF METALS.

SPECIFICATION forming part of Letters Patent No. 700,941, dated May 27, 1902.

Application filed December 7, 1901. Serial No. 85,095. (No specimens.)

To all whom it may concern:

Be it known that I, NATHANIEL SHEPARD KEITH, a citizen of the United States, and a resident of Arlington, in the county of Hudson and State of New Jersey, have invented new and useful Improvements in Processes of Treating Copper or other Ores for Obtaining their Contents of Metals, of which the following is a specification.

This invention relates to that class of processes of obtaining metals from their ores by means of solvents of the metals or of their salts and subsequent electrolysis of the solutions, and has for its objects to render the process more efficient, expeditious, and cheaper.

It more especially relates to methods of extracting metals by electricity from their solutions obtained by leaching or lixiviating the suitably-prepared ores with solvents of the metals.

This specification will cite copper ores and their treatment as illustrative of my improvements; but it is obvious to those skilled in the art that it is applicable to many other ores the metals of which can be dissolved therefrom.

Heretofore in electrolytically depositing metals from and depleting their solutions on a cathode or cathodes, using insoluble anodes, it has been the practice in order to obtain reguline metal to the last to continuously decrease the amperes of current operating on the solution in the depositing-cell in proportion as the metal in solution decreased in quantity. This practice, as is obvious, consumed much time, the efficiency is small, and the expense is much more considerable than is the case under my improvements.

On the accompanying drawings, Figure 1 illustrates in elevation an apparatus or association of known appliances by the use of which my invention may be operated. Fig. 2 is a plan showing the arrangement of electrodes in the depositing cells or vats G′ to G⁷ in Fig. 1.

The drawings are diagrammatic, illustrating well-known appliances used in the art, and the several parts may be varied as to details by those skilled in metallurgy without departing from my invention.

Taking ores containing copper, for example, I operate my invention as follows: I first crush and pulverize the ores by means of machines, such as rolls A, Fig. 1. The degree of comminution is to be determined in the case of any ore by experiment or experience, the requisite being that the ore be finely enough divided to become thoroughly oxidized or may be chlorinated by the subsequent roasting, so as to be amenable to the solvent action of the suitable solvent. As pulverized the ore is passed through a chute B into a roasting-furnace C, having its fireplace c' and its chimney, as at c^2. The drawings represent a cylindrical furnace well known in the art, in which the ore is roasted in charges. I prefer, however, to use one of that class of furnaces in which the ore is continuously treated. When roasted, the ore is passed, as through the hopper and conveyer D, into a leaching-tank E. I prefer to have two or more of these leaching-tanks, so that by drawing at different stages of the leaching operation from the two or more I obtain continuously a solution of the desired metal of as nearly constant strength as possible. Upon the ore in tank E, I draw from the tank H a sufficient quantity of the solvent—say a five or ten, or more, per cent. sulfuric-acid solution in the case of copper ores—and leach in well-known manner. The solution of copper thus obtained is run through the pipe or conductor F into and through the electrolytic depositing-cells G′ to G⁷ in series to the last. Any number above one of these cells may be used, the requisite being that enough be employed to insure the depletion of the solution of its contents of metal, as of copper, to that degree which may be desired. As the metal need not be completely exhausted from the solution, only enough cells need be used to insure the deposition of reguline metal in the last of the series.

The letter O designates the source of electricity.

The deposition or electrolytic cells or vats are arranged and associated after the manner shown in Figs. 1 and 2. Fig. 1 shows the vats arranged in step-down order, so that the solution or electrolyte may run from one to another. Fig. 2 shows the arrangement of the electrodes. The electrodes of each cell are in multiple in the cell, but in series in their relation to all of the other cells. The

strength of current is the same in each cell. It is evident that the strong solution running into cell G' will admit of the use of a greater density of current in producing reguline metal on the cathodes than will the weaker solutions or electrolytes entering the succeeding cells of the series. The deposition of metal in each cell of the series makes the electrolyte which enters the succeeding cell less strong in amount of metal than that from the preceding cell, and therefore the density of the current must be correspondingly less in order to insure the deposition of reguline metal therein. To effect this desirable condition, I under my invention increase the number of electrodes or the surface thereof in a progressive order in each succeeding cell from the first to the last of the series, so that the density of the current—that is, the amperes per square foot or other unit—may be approximately in proportion to the strength or density of the solution in the metal being deposited.

The number of cells in series is determined by the electromotive force of the source of electricity and the electromotive force necessary for each cell. For instance, if the source of electricity has an electromotive force of one hundred volts and the electromotive force necessary to effect the electrolysis in each cell be 1.65 volts, then the number of cells in series will be $\frac{100}{1.65}$, equal to sixty cells. Of course this number may be varied a little, with care that if the number be decreased the current does not become too great, thus producing a nonreguline or powdery or flocculent deposit, or if it be increased the deposition be too slow for economy. The anodes are of a conducting material insoluble in the electrolyte under current, such as lead or carbon in the case of sulfate solutions. The cathodes may be of the same kind of metal which is being deposited or other metal or material desirable. The amount of solution flowing through the series should be regulated to the depositing capacity of the cells. From the last of the depositing or electrolytic cells, as at G^7, the depleted solution or electrolyte flows through the pipe or conduit K into a tank I, from whence it is elevated by a pump L and pipes M and N or by other means to the tank H for subsequent use in leaching more material in another cycle of operation.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The process of obtaining a reguline metal from its ores; which consists in powdering the ore; roasting the powdered ore; leaching the roasted ore with a solvent of the metal; and electrolyzing the lixiviate to deposit the metal therefrom, by passing it as an electrolyte, through a succession of two, or more, electrolytic cells, arranged so that the cells are connected in electrical series with a source of electricity; the anodes insoluble; the electrodes of each cell in electrical multiple; and having gradually-increasing surfaces; whereby there is a gradual reduction of the current density as the metal of the electrolyte is deposited.

2. The process of electrolyzing a solution of a metal, to deposit the metal therefrom; which consists in passing it, as an electrolyte, through a succession of two, or more, electrolytic cells, arranged so that the cells are connected in electrical series with a source of electricity; the anodes insoluble; the electrodes of each cell in electrical multiple; and having gradually-increasing surfaces; whereby there is a gradual reduction of the current density as the metal of the electrolyte is deposited.

In witness whereof I have hereunto subscribed my name, in presence of two subscribing witnesses, this 25th day of November, 1901.

NATHANIEL SHEPARD KEITH.

Witnesses:
S. G. CRAWFORD,
T. S. NEWELL.