UNITED STATES PATENT OFFICE.

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PROCESS FOR THE REDUCTION OF ORES.

No. 815,881. Specification of Letters Patent. Patented March 20, 1906.

Application filed April 12, 1902. Serial No. 102,583.

To all whom it may concern:

Be it known that I, CLINTON P. TOWNSEND, a citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Processes for the Reduction of Ores, of which the following is a specification.

This invention relates to the reduction of ores, and particularly to the reduction of sulfid of lead or galena. Heretofore this sulfid has been electrolytically reduced by constituting it the cathode or by placing it in contact with the cathode in an aqueous electrolyte, generally sulfuric acid, and passing an electric current through the bath for long periods, amounting usually to several days for a single charge. In this manner a sponge of lead is produced. This method has several defects. It is very slow, and it is difficult to make the reduction complete. The lead sponge recovered is not in available form for many purposes, and the presence of impurities in the ore is very troublesome. Such impurities, of which zinc-blende may be taken as a type, are not reduced by the hydrogen set free by the current, and therefore remain to contaminate the sponge, from which it is impracticable to separate them. I have discovered that such ores may be reduced with great facility in a fused bath, preferably a bath consisting of the haloid salts of the alkali or alkaline-earth metals, and that by effecting the reduction under these conditions all of the objections above referred to are obviated. The lead is recovered not as a sponge, but as molten metal, which may be tapped continuously from the fusion vessel, the ore being fed continuously or at intervals thereto. By reason of the great difference in the specific gravities of the molten lead, the ore, and the electrolyte the ore floats upon the surface of the lead beneath the electrolyte and remains, therefore, in the field of most active reduction until it is itself reduced, and any irreducible impurities which may be present in the ore collect above the lead and are removed in any suitable manner. A high-current density may be used, and the reduction proceeds, therefore, with great rapidity.

In operation the electrolyte is fused in a suitable vessel and the charge of galena added, a cathode connection being made to the charge, preferably by means of a pool of lead upon which it rests. Current of suitable character is passed from anodes, which may be of carbon or of metal, located in the molten bath in proximity to the charge.

If it is desired to make the operation continuous, the lead is drawn off through a siphon or other tap and fresh ore added continuously or from time to time.

As an alternative construction the lead ore may be placed in a basket or perforated holder, which may be constructed of metal, the cathode connection being made, preferably, to the central portion of the body of the ore. Upon the passage of the current the ore is reduced, and the molten lead escapes through the perforations to the bottom of the fusion vessel, from which it may be removed in any suitable manner.

It will be understood that the method is applicable to the reduction of all classes of ores and that the reduction of lead sulfid is taken as an illustration merely. For the reduction of galena and other sulfid ores, however, the process possesses several important advantages, as follows: First, no oxygen being present in the bath or ore, anodes of conductive carbon, as retort carbon or graphite, may be used without undue consumption of material or the formation of carbon dioxid. Second, the electropositive metal, as sodium, liberated from the molten bath combines at once with the sulfur of the ore, with the result that the electromotive force required for the decomposition of the electrolyte is correspondingly reduced. Third, a certain amount of sodium sulfid is thus formed which accumulates in the bath until it is sufficient in quantity to carry the current. Thereafter sodium sulfid alone is decomposed, sulfur distilling or burning around the anode, according as access of air is prevented or permitted. Fourth, this sodium sulfid is decomposed at a lower electromotive force than the haloid salts, exerting a favorable influence on the process. Thereafter the electromotive force required is merely that necessary to overcome the ohmic resistance of the bath. Fifth, the electrolyte is inert toward galena in all stages of the process. Hence no metal exists in solution. This is important, since otherwise unavoidable losses of electrolyte would entail loss of metal.

In all cases the electrolyte should preferably be so chosen as to be incapable of acting chemically upon the ore or of dissolving it to an appreciable extent.

While the invention contemplates, primarily, the reduction of ores which are conductive and themselves constitute the cathode, it is nevertheless applicable under proper conditions to non-conducting ores, and certain claims which specifiy that the ore is floated upon a body of molten metal are intended to cover the reduction of both conductive and non-conductive ores.

The term "ore" is herein employed in its technical sense to cover concentrates, mattes, and other sources of metal which are applicable to the purposes of this invention.

I claim—

1. The herein-described method of reducing sulfid ores, which consists in supporting the ore in a body of fused electrolyte which is substantially inert toward the ore, and passing an electric current to said ore as cathode.

2. The herein-described method of reducing galena, which consists in supporting the galena in a body of fused electrolyte which is substantially inert toward the galena, and passing an electric current to said galena as cathode.

3. The herein-described method of reducing sulfid ores, which consists in supporting the ore in a body of fused haloid salt, and passing an electric current to said ore as cathode.

4. The herein-described method of reducing galena, which consists in supporting the galena in a body of fused haloid salt, and passing an electric current to said galena as cathode.

5. The herein-described method for the reduction of ores, which consists in floating the ore upon a body of molten metal under a fused electrolyte and reducing the ore by the passage of a current.

6. The herein-described method for the reduction of ores, which consists in floating the ore upon a body of molten metal, under a fused electrolyte, connecting such ore as the cathode, and reducing the ore by the passage of a current.

7. The herein-described method for the reduction of ores, which consists in floating the ore upon a body of the metal which forms the base of the ore, under a fused electrolyte, and reducing it by the passage of a current.

8. The herein-described method for the reduction of ores, which consists in floating the ore upon a body of the metal which forms the base of the ore, under a fused electrolyte, connecting such ore as the cathode, and reducing it by the passage of a current.

9. The herein-described process of reducing lead ores, which consists in floating the ore upon a body of molten metal, under a fused electrolyte, connecting such ore as the cathode, and passing an electric current through the bath.

10. The herein-described method of reducing ores, which consists in floating the ore upon a body of molten lead under a fused electrolyte, and reducing such ore by the passage of an electric current.

11. The herein-described method of reducing ore, which consists in floating the ore upon a body of molten lead, under a fused electrolyte, connecting such ore as the cathode, and passing an electric current through the bath.

12. The herein-described method of reducing lead sulfid, which consists in floating the sulfid upon a body of molten lead under a fused electrolyte, connecting such sulfid as the cathode, and passing an electric current through the bath.

13. The herein-described method of reducing ores, which consists in floating the ore upon a body of molten metal, under a fused electrolyte, and reducing the ore by passing a current through the bath from superposed anodes.

14. The process of decomposing lead sulfid which consists in electrolytically separating lead therefrom by bringing said sulfid into contact with a cathode, in a fused electrolyte in which lead sulfid is substantially insoluble.

15. The process of decomposing lead sulfid which consists in electrolytically separating lead therefrom by bringing said sulfid into contact with a cathode, in a fused electrolyte, mainly of sodium chlorid.

In testimony whereof I affix my signature in presence of two witnesses.

CLINTON P. TOWNSEND.

Witnesses:

EUGENE A. BYRNES,

CLAUDE I. PARKER.