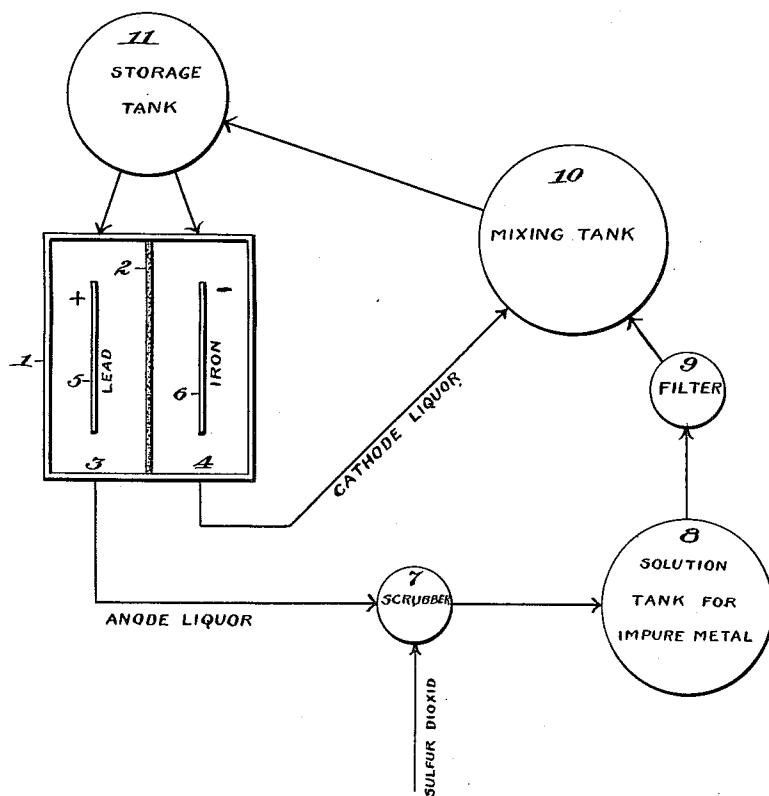


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ELECTROLYTIC METHOD OF REFINING IRON.
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1,007,388.

Patented Oct. 31, 1911.



Witnesses:

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UNITED STATES PATENT OFFICE.

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ELECTROLYTIC METHOD OF REFINING IRON.

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Specification of Letters Patent. Patented Oct. 31, 1911.

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To all whom it may concern:

Be it known that I, ALEXANDER S. RAMAGE, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Electrolytic Methods of Refining Iron, of which the following is a specification.

This invention relates to the electrolytic refining of impure iron, the object of the invention being the provision of a method whereby iron of high purity and substantially free from carbon may be prepared from impure forms of the metal, such for example as cast or wrought iron scrap, cast-iron turnings or borings, impure sponge, or the like.

In the practice of processes for the electrolytic refining of iron wherein the impure iron is employed as the soluble anode, it has proven impossible to avoid the contamination of the cathodic deposit by certain impurities derived from the iron, notably carbon and certain metals, such as arsenic and antimony, whose sulfids are insoluble in dilute acid solutions. According to the present process this difficulty is obviated by preparing the solutions for electrolysis by dissolving the impure iron outside of the electrolytic cell, and under conditions avoiding the solution of such metals as are liable to contaminate the electrodeposited iron.

In order that the invention may be fully understood, I will describe the same by reference to the accompanying drawings, wherein the figure is a merely diagrammatic representation of steps.

In the preferred embodiment of the invention, I provide an electrolytic cell 1, divided by a diaphragm 2 of asbestos cloth or other suitable material into anode and cathode compartments 3 and 4. The anodes 5 may be of sheet-lead and the cathodes 6 of iron. If a solution of ferrous sulfate be electrolyzed in both compartments of a cell of this character, iron will be deposited at the cathodes, while ferric sulfate and sulfuric acid will be formed in the region of the anode.

The electrolytic cell may be of any preferred type, its specific construction forming no part of the present invention; and the number of anode and cathode compartments may be multiplied as desired. The cathodes may be either stationary or revolving, the revolving cathodes permitting

the employment of much higher current densities, as is well understood in the art.

From the anode compartments of the electrolytic cells the acid liquor is permitted to flow into a suitable tank or scrubber 7, wherein it is subjected to the action of a small proportion of sulfur dioxide. The purpose of this treatment is merely to form sufficient sulfuric acid to replace that lost through leakage or from other mechanical causes, and the amount of sulfur dioxide introduced should in no case be sufficient to effect the reduction of the ferric sulfate to ferrous sulfate. The acid liquor passes then to a solution tank 8, wherein it is brought into contact with impure iron, such as iron scrap, cast-iron turnings, detinned scrap, reduced iron sponge, or the like, together with some sulfid, usually ferrous sulfid, which under the action of the acid liquor will generate hydrogen sulfid. Under these conditions, and in the acid liquor, there occurs a complete precipitation of those metals whose sulfids are insoluble in dilute acids. The solution of the impure iron is preferably aided by heat, and preferably also the solution tank is fitted with an insoluble anode buried in the scrap and contacting therewith, and with an iron cathode in the liquor above the scrap, the effect of this arrangement being to aid in the solution of the scrap iron and to diffuse the hydrogen throughout the solution. The hydrogen, and the sulfureted hydrogen resulting from the solution of the added sulfid, effect the reduction of the ferric sulfate to ferrous sulfate.

In practice, two or more solution tanks of similar construction are provided, one of these receiving the flow of liquid while the other is reacting on the scrap and thereby becoming neutralized. When the liquor has become practically neutral it is forced through a filter-press 9, flowing thence to a mixing tank 10, wherein it is mixed with the effluent liquor from the cathode compartments. The mixed liquor flows to a storage tank 11, whence it is distributed to the several anode and cathode compartments of the electrolytic cells, thus completing the cycle of operations.

The sulfid of iron used in the solution tank should be sufficient in quantity for the complete precipitation of such metallic sulfids as are insoluble in the acid solution, the actual proportion of sulfid depending of

course upon the character of the impure metal. The temperature of the liquors is preferably maintained throughout the cycle above normal, the preferred temperature 5 during electrolysis being approximately 145° F.

When stationary cathodes are employed a current density approximating 10 amperes per square foot is found suitable, the voltage 10 under these conditions approximating 2.5 volts per cell. With the use of revolving cathodes, current densities approximating 100 amperes per square foot may be used, the voltage being accordingly increased.

15 I claim:

1. The method of refining iron by electrolysis, which consists in electrolytically dissolving impure iron in an acid ferric liquor, and thereafter electrolyzing the resulting ferrous liquor in a cell provided with a diaphragm and insoluble anodes, whereby a cathodic deposit of iron of high purity is obtained.

2. The method of refining iron by electrolysis, which consists in dissolving impure iron in an acid ferric liquor while avoiding solution of metals whose sulfids are insoluble in dilute mineral acids, and thereafter electrolyzing the resulting ferrous liquor, using 20 insoluble anodes, whereby a cathodic deposit of iron of high purity is obtained.

3. The method of refining iron by electrolysis, which consists in electrolytically dissolving impure iron in an acid ferric liquor 25 while avoiding solution of metals whose sulfids are insoluble in dilute mineral acids, and thereafter electrolyzing the resulting ferrous liquor, using insoluble anodes, whereby a cathodic deposit of iron of high purity is obtained.

4. The method of refining iron by electrolysis, which consists in electrolyzing a solution of a ferrous salt in a cell provided with a diaphragm and insoluble anodes, neutralizing the anode liquor and reducing the ferric salt therein by reaction 40

50 with impure iron, combining the resulting ferrous solution with the effluent cathode liquor, and returning the combined liquors to the electrolytic cell.

5. The cyclical method of refining iron by electrolysis, which consists in electrolyzing a solution of a ferrous salt in a cell provided with a diaphragm and insoluble anodes, reacting on the anode liquor with sulfur 55 dioxid without effecting complete reduction thereof, neutralizing said anode liquor and reducing the ferric salt therein by reaction with impure iron, combining the resulting ferrous solution with the effluent cathode 60 liquor, and returning the combined liquors to the electrolytic cell.

6. The cyclical method of refining iron by electrolysis, which consists in electrolyzing a solution of a ferrous salt in a cell provided 65 with a diaphragm and insoluble anodes, neutralizing the anode liquor and reducing the ferric salt therein by reaction with impure iron in presence of ferrous sulfid, combining the resulting ferrous solution with the effluent cathode liquor, and returning the combined liquors to the electrolytic cell.

7. The cyclical method of refining iron by electrolysis, which consists in electrolyzing a solution of a ferrous salt in a cell provided 75 with a diaphragm and insoluble anodes, reacting on the anode liquor with sulfur dioxid without effecting complete reduction thereof, neutralizing said anode liquor and reducing the ferric salt therein by reaction 80 with impure iron in presence of ferrous sulfid, combining the resulting ferrous solution with the effluent cathode liquor, and returning the combined liquors to the electrolytic cell.

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

ALEXANDER S. RAMAGE.

Witnesses:

CHARLES F. HOUCK,
FRED. C. HOUCK.