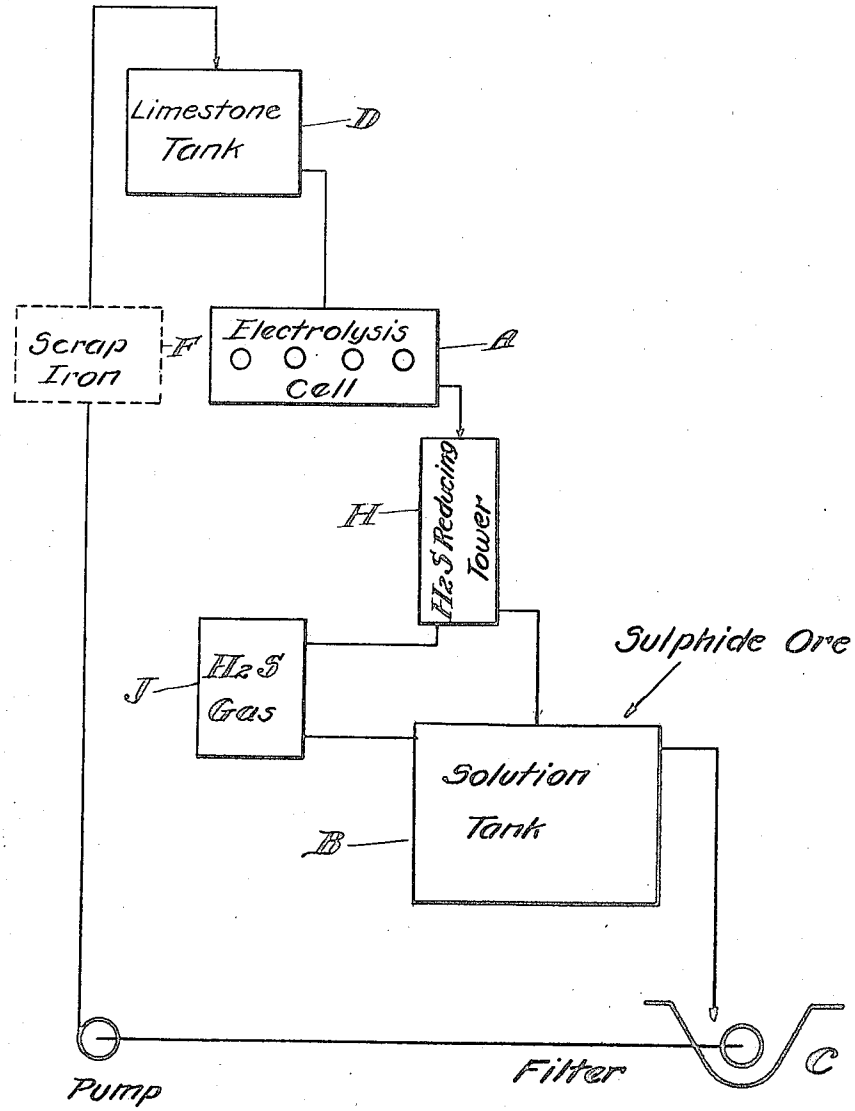
F. A. EUSTIS, C. R. HAYWARD, H. M. SCHLEICHER, AND D. BELCHER.

ART OF MAKING ELECTROLYTIC IRON.

APPLICATION FILED JULY 7, 1921.

1,432,543. Patented Oct. 17, 1922.



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UNITED STATES PATENT OFFICE.

FREDERIC A. EUSTIS, OF MILTON, CARLE R. HAYWARD, OF QUINCY, AND HENRY M. SCHLEICHER AND DONALD BELCHER, OF BOSTON, MASSACHUSETTS, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, OF ONE-HALF TO SAID EUSTIS AND ONE-HALF TO CHARLES PAGE PERIN, OF NEW YORK, N. Y.

ART OF MAKING ELECTROLYTIC IRON.

Original application filed December 1, 1920, Serial No. 427,541. Divided and this application filed July 7, 1921. Serial No. 482,929.

To all whom it may concern:

Be it known that we, FREDERIC A. EUSTIS, of Milton, in the county of Norfolk, CARLE R. HAYWARD, of Quincy, in said county of Norfolk, HENRY M. SCHLEICHER and DONALD BELCHER, both of Boston, in the county of Suffolk, all in the Commonwealth of Massachusetts, citizens of the United States of America, have invented new and useful Improvements in the Art of Making Electrolytic Iron, of which the following is a specification.

This invention relates to the manufacture of electrolytic iron from solutions, and the preparation of the ferrous solutions suitable for the electrolytic deposit of iron.

The present application is a division of an application filed by us December 1, 1920, Serial No. 427,541, now Letters Patent of the United States 1,412,174, issued April 11, 1922, and is addressed particularly to that modification of the invention described in our said former application employing hydrogen sulphide for reducing the ferric solution in the liquor discharged from the anode compartment of the electrolytic cell in which the iron is deposited.

The ferrous solution from which iron is deposited by electrolysis may be a solution of ferrous chloride in water, a ferrous sulphate solution, or indeed a solution containing any salts of iron that will in solution dissociate to deposit iron under the action of electrolysis, that will form the two series of salts, ferric and ferrous, and that will attack the ore or other raw material constituting the source of iron. By way of illustration therefore, and not of limitation, we will describe the processes using a ferrous chloride solution.

The ferrous solution when made by the method hereinafter described will contain at least some acid or ferric salts, such as ferric chloride, although it may be only traces, and must be thoroughly neutralized before it is suitable for the production of electrolytic iron, because the presence of acid or ferric salts causes poor iron deposit and results in low current efficiency. To this end the solution is mixed with pulverized limestone in a suitable tank. Limestone furnishes calcium carbonate ($CaCO_3$), which is the most suitable agent for neutralization, as it has the capacity of readily precipitating first ferric salts before precipitating the ferrous salts. We have found that for the best results it is advisable to use enough neutralizing agent to precipitate a small amount of ferrous iron. This insures complete neutralizatiton of the liquor, the neutrality of the solution in the cathode compartment of the electrolytic cell being an indispensable condition for the most efficient electrolysis of iron.

The solution is then filtered if necessary, heated nearly to the boiling point, and passed hot into the cathode compartment of a diaphragm electrolytic cell. Under proper conditions metallic iron is deposited on the cathode. The liquor passes through the diaphragm into the anode compartment and is thence returned to the process to be used in making more ferrous solution as hereinafter described.

A special electrolysis cell is used for depositing the iron, of the kind fully described in our said former application to which reference is made for a more detailed description of its construction and mode of operation.

The present process also has to do particularly with the use of sulphide ores such as pyrite, pyrrhotite or marcasite, as the source of iron, especially sulphide ores of such character that the anode liquor, which is a ferric solution, will not act readily on the ore to dissolve the iron without first being reduced. With certain sulphide ores the anode liquor may be used as it is discharged from the electrolysis cell to dissolve iron from the ore and in so doing the ferric solution will be reduced to a ferrous state, but when the sulphide ore is of a kind which will not yield readily to this reaction, the anode liquor should be reduced in a separate step after it is discharged from the electrolysis cell and before it is put on the ore to dissolve the iron.

The accompanying drawing illustrates diagrammatically apparatus for performing the process.

The anode liquor discharged from the elec-

trolysis cell A is put into the top of a reducing tower H, into the bottom of which hydrogen sulphide (H_2S) gas is introduced. Under these conditions the solution will be reduced to the ferrous state, acid will be formed, and sulphur precipitated. The latter may be recovered as a by-product. The acid liquor emerging from the tower H is then put on the sulphide ore in solution tank B and dissolves iron from the ore. At the same time the solution acting on the sulphide ore generates the hydrogen sulphide gas which is needed in the reducing tower H. This hydrogen sulphide gas may be led from tank B into a storage chamber J and thence delivered to the bottom of tower H.

The solution from the ore solution tank B is then filtered at C and pumped to the limestone tank D in which it is neutralized and ferric iron precipitated out. The solution is then heated to approximately the boiling point and delivered hot into the electrolysis cell A where the iron is deposited on the cathode as described in our said former application and a ferric solution is formed in the anode compartment, thus completing the cycle. If desired the liquor may be passed through scrap iron in a tank F before it is put into the limestone tank, to enrich the solution in iron and use up some of the acid which the sulphide ore has been unable to neutralize. Such acid may be made in the cycle by unavoidable oxidation of some portion of the sulphur. Agitation of some sort should be provided in the solution tank B.

For a further division of the aforesaid application Serial No. 427,541, reference is made to an application Serial No. 482,928, filed by us July 7, 1921.

We claim:—

1. The art of making electrolytic iron which comprises reducing a ferric solution with hydrogen sulphide, leaching sulphide ore with the reduced solution, thereby dissolving iron from the ore and producing hydrogen sulphide gas, returning the latter to the ferric solution at the reducing step, and depositing iron from the leach liquor by electrolysis.

2. The art of making electrolytic iron which comprises reducing the ferric solution with hydrogen sulphide, leaching sulphide ore with the reduced solution, and depositing iron from the leach liquor by electrolysis.

3. The art of making electrolytic iron which comprises treating a ferric solution with hydrogen suphide, thereby reducing the ferric solution to ferrous state and forming acid, neutralizing the solution, and depositing iron from the solution by electrolysis.

4. The art of making electrolytic iron which comprises treating a ferric solution with hydrogen sulphide, thereby reducing the ferric solution to ferrous state and forming acid, dissolving iron from a sulphide ore of iron with said solution, neutralizing the solution, and depositing iron from the solution, by electrolysis.

5. The art of making electrolytic iron which comprises treating a ferric solution with hydrogen sulphide to reduce the solution to ferrous state and to precipitate sulphur as a by-product, and thereafter depositing iron from the reduced solution by electrolysis.

6. The art of making electrolytic iron which comprises treating a ferric solution with hydrogen sulphide to reduce the solution to ferrous state, to form acid, and to precipitate sulphur as a by-product, then leaching sulphide of iron ore with the solution, and then depositing iron from the leach solution by electrolysis.

7. The art of making electrolytic iron which comprises treating a ferric solution resulting from the electrolysis hereinafter mentioned with hydrogen sulphide, thereby reducing the ferric solution to ferrous state and forming acid, leaching sulphide ore of iron with the reduced solution, thereby dissolving iron from the ore and producing hydrogen sulphide gas, returning the latter to the ferric solution at the reducing step and depositing iron from the leach liquor by electrolysis.

Signed by us this fifth day of July, 1921.

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