UNITED STATES PATENT OFFICE.

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ELECTRODEPOSITION OF IRON.

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To all whom it may concern:

Be it known that I, SHERARD OSBORN COWPER-COLES, a subject of the King of Great Britain, residing at Grosvenor Mansions, 82 Victoria street, Westminster, London, England, have invented new and useful Improvements in the Electrodeposition of Iron; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the electro-deposition of iron and has for its object to provide a process which renders it possible to produce iron or steel articles such as tubes, cylinders, sheets and the like in one operation direct from crude iron or from iron ore.

It has hitherto been found impossible in practice to obtain by electro-deposition iron articles such as tubes, or sheets of a quality to render them of commercial value and at a cost which compares favorably with ordinary methods at present in use. The chief difficulties encountered have been the slowness of the process due to the necessity of employing a very low current density and in obtaining iron of a quality suitable for commercial purposes. Iron electro-deposited under ordinary conditions is porous and spongy, is difficult to anneal and has a tendency to flake off the cathode during deposition unless deposited at a very low current density, which makes the process and the plant too costly for commercial purposes. Now, I have discovered that iron can be deposited in a form suitable for the production of tubes, sheets and wire with a bright smooth surface resembling that of very highly polished iron by maintaining the solution from which the iron is deposited charged with iron oxid.

In a suitable way of carrying out the invention the iron oxid is kept in suspension in the electrolyte by means of stirrers or by moving one or both of the electrodes or by any other suitable means, the effect of which is to reduce the acidity and effect a burnishing action on the iron deposited. I have obtained excellent results from a solution containing 20 per cent. of sulfo-cresylic acid saturated with iron, the current density being 100 amperes per square foot of cathode surface, the voltage 3.25 at the terminals of the iron electrodes, these being ½ inch apart and the temperature of the electrolyte 70 C. I find the temperature of the electrolyte considerably affects the quality of the iron. If it is much below 70° C. the iron becomes laminated and flakes off; if it is much above 70° C. the surface becomes covered with ridges or stream lines and cannot be used for commercial purposes without further treatment.

The sulfo-cresylic acid above mentioned is a cresol-sulfonic acid containing approximately 108 parts cresol and 98 parts sulfuric acid. The cresol contains ortho 35%, meta 40% and para 25%. This cresol is heated with sulfuric acid, yielding isomeric cresol-sulfonic acids.

It is important that none of the oxid in suspension shall be deposited on the iron otherwise it will be worthless for commercial purposes. It is therefore advantageous in producing sheets or tubes, to slowly revolve the cathode which may be arranged longitudinally or vertically. This also insures an equal thickness of deposit by changing the relative position of the anode and cathode. I find that the iron produced from the sulfo-cresylic solution is exceedingly hard and when it is desired to produce soft tough iron, ferrous sulfate solution should be employed, I also find that it may be advantageous to add small quantities of carbon bisulfid from time to time to the electrolyte.

Iron articles produced as described above do not pit or corrode like iron which has been cast or wrought into the desired form, and this is probably due to the purity and uniformity of the metal.

When requiring to produce steel articles carbon is deposited with the iron and after removal from the mandrel they are heated to a high temperature to convert the iron into steel.

In a modified process according to the invention I make use of insoluble anodes such as lead or graphite and I leach the iron out of the ore by means of a suitable solvent. For example, a carbonate or sulfid ore is roasted and mixed with crushed coke so as to form a filter bed and a solution of sulfuric acid or other suitable solvent of iron oxid is caused to pass through the filter bed which is of a constitution to permit the solution percolating freely through it. The coke and iron oxid form an electric couple in the presence of the acid, thus facilitating the dissolution of the iron oxid. In some cases I find it is advantageous to arrange a cathode in a

porous cell above the filter bed which constitutes the anode and pass an electric current through the ore to assist its dissolution After its passage through the filter bed the solution is pumped or allowed to circulate through an electro-depositing tank containing insoluble anodes arranged around a revolving mandrel forming the cathode upon which the iron is deposited in the form of a sheet, tube or the like.

It is possible, when using a carbon or graphite anode, to electro-deposit carbon with the iron which, when heated, forms a steel.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. The process of obtaining the electro deposition of iron, which consists in forming an electrolyte from a substance containing iron and in maintaining the electrolyte charged with iron, substantially as described.

2. The process of obtaining the electro deposition of iron, which consists in forming an electrolyte from a substance containing iron, in charging the electrolyte with iron oxid and maintaining the same in suspension by agitation of the electrolyte, substantially as described.

3. The process of obtaining the electro deposition of iron, which consists in forming an electrolyte from iron ore, in circulating such solution through a tank containing insoluble anodes arranged around a mandrel forming the cathode, substantially as described.

4. In the electro-deposition of iron from the ore, the process consisting in mixing the roasted ore with coke so as to form a filter-bed through which an iron oxid solvent is caused to pass, the solution, after its passage through the filter bed, being caused to circulate through a tank containing insoluble anodes arranged around a revolving cathode, substantially as described.

5. The process of electro deposition of iron, which consists in forming an electrolyte from sulfo-cresylic acid, and substances containing iron and depositing the iron upon a cathode in the usual manner, substantially as described.

6. The process of electro deposition of iron, which consists in forming an electrolyte from sulfo-cresylic acid and substances containing iron and depositing the iron upon a cathode by an electric current of a density of 100 amperes per square foot of cathode surface, and maintaining the electrolyte at a temperature approximating 70° C., substantially as described.

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Witnesses:
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