

UNITED STATES PATENT OFFICE.

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TREATMENT OF IRON OR STEEL FOR THE PREVENTION OF OXIDATION OR RUSTING.

1,317,351.

Specification of Letters Patent.

Patented Sept. 30, 1919.

No Drawing.

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To all whom it may concern:

Be it known that we, (1) LEE S. CHADWICK and (2) MARC RESEK, citizens of the United States, residing at (1) East Cleveland and (2) Cleveland Heights, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in the Treatment of Iron or Steel for the Prevention of Oxidation or Rusting, of which the following is a full, clear, and exact description.

This invention relates to improvements in the art of treating iron or steel articles, or articles having a coating of iron or steel, for the purpose of preventing the oxidation or rusting thereof, and wherein such articles are provided with a protective covering adapted to render the surfaces thereof capable of resisting, or of being unaffected by the action of, moisture and other oxidizing influences.

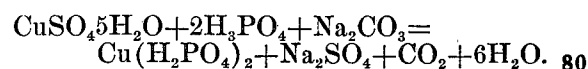
It has heretofore been proposed to treat iron or steel (or articles composed of or having a surface of iron or steel) with a dilute solution of ordinary phosphoric acid (H_3PO_4) and preferably in the presence of iron filings or other compound intended to control or regulate the rapidity or strength of the chemical action upon the metal or articles undergoing treatment. It has been found that, in the practice of such process, it is necessary to boil the articles for a considerable length of time. Furthermore, the coating which is obtained upon the surfaces of the iron or steel articles is composed only of a mixture of normal ferric and ferrous phosphate.

We have discovered that, by employing a bath made from a solution of phosphoric acid, an alkaline carbonate or hydroxid, and any metallic salt (except mercuric chlorid or salts of antimony) that will dissolve iron and deposit its metal, we are able to obtain a coating upon the surface of the iron or steel thus treated which consists of a mixture of phosphate of iron and phosphate of the metal constituent of such salt and that, among other advantages, we are able to produce an exceptionally satisfactory rust-resistant surface in a much shorter interval of time than is required in the practice of the process referred to hereinbefore. For instance, we have been able to produce an

entirely satisfactory rust-proofing by boiling the articles to be thus treated for forty minutes in the solution referred to.

In carrying out our invention, the articles to be treated and composed of or containing iron or steel are boiled for forty minutes or longer (according to circumstances) in a bath made from a solution of ordinary phosphoric acid and an alkaline carbonate or hydroxid and any metallic salt (except the chlorids of mercury and antimony) that will dissolve iron and deposit its metal. This includes any salt of a metal less basic than iron, provided only that the salt has an acid reaction and that the corresponding iron salt is soluble. Examples of such salts are the soluble sulfates, nitrates, and the chlorids of gold, platinum, silver, copper, tin, bismuth and lead.

With copper sulfate as the metallic salt employed and assuming that it is boiled together with ordinary phosphoric acid and sodium carbonate, the following reaction occurs:—



When a piece of iron or steel is placed in this bath, a coating is formed on the surface which consists of a mixture of copper and iron phosphates and, if a slight excess of copper sulfate be present, it will serve to clean the surface of the steel or iron and at the same time will deposit metallic copper upon, and which will become embedded with, the phosphate coating. This metallic copper not only will not rub off, but enhances the rust-resisting qualities of the steel or iron and also provides a surface which is capable of receiving special additional treatment as, for instance, plating with copper or other metals.

To operate a tank of five hundred gallons capacity, the tank is substantially filled with water heated to the boiling point by steam pipes, or in any other convenient manner. We then add to the tank one and one-third gallons of 50% phosphoric acid, fourteen pounds blue vitriol crystals, and six pounds of pure anhydrous sodium carbonate. The work to be treated is then placed in this boiling bath and, in ordinary cases, may be removed at the end of forty minutes. When

taken from the tank, the article or articles subjected to the bath will have each a permanent copper-tinted rust-resisting coating.

With each subsequent lot of work to be treated, and before placing the same in the tank, there is added to the bath remaining in the tank from the preceding operation two-thirds of a pint of the phosphoric acid, fourteen ounces of the blue vitriol crystals, and seven ounces of the sodium carbonate.

If a salt other than copper sulfate be employed, the chemically equivalent quantity of such salt must be taken, and the coating produced will be the phosphates of the metallic constituents of such salt and iron, combined with the metal of such salt, if a slight excess of the salt requisite to form such phosphate be employed.

As a substitute for the particular ingredients specified hereinbefore, we may employ a solution containing a phosphate, an acid, and a metallic salt which will dissolve iron and deposit its metal, preferably using a slight excess of the salt over that required to form a di-hydrogen phosphate of the metal.

It is often desirable in producing a rust-proof surface, to secure a nice finish for such surface. We have found that, by subjecting the rust-proof surfaces formed as described hereinbefore to the action of certain compounds of sulfur, (such as a solution of liver of sulfur, or a solution of ammonium sulfid), the rust-proof surface will have thereupon a coating of the sulfid of the metal constituent of the metallic salt. For instance, where copper sulfate is the metallic salt employed, this subsequent treatment will produce a coating of copper sulfid deposited upon the rust-proof surface. This coating of copper sulfid imparts a finish to the rust-proofed article or surface which is pleasing to the eye and which in no wise detracts from the rust resistant qualities of such articles or surface. We have found that a solution of one half ounce of liver of sulfur in a gallon of water produces a solution which has proven satisfactory in the production of the sulfid coating referred to above. After having received the sulfid treatment, the articles may be dipped in oil.

Having thus described our invention, what we claim is:—

1. The process of treating iron or steel, or articles composed of or having a surface of iron or steel, which consists in subjecting the same to the action of a bath made from a solution of ordinary phosphoric acid, an alkaline carbonate or hydroxid, and a salt that will dissolve iron and deposit its metal.

2. The process of treating iron or steel, or articles composed of or having a surface of iron or steel, which consists in subjecting the same to the action of a bath made from a solution of ordinary phosphoric acid, an

alkaline carbonate or hydroxid, and a salt of a metal less basic than iron, said salt being employed in a proportion greater than requisite to form a di-hydrogen phosphate of the metal.

3. The process of treating iron or steel, or articles composed of or having a surface of iron or steel, which process comprises subjecting such article or articles to a bath made from a solution of ordinary phosphoric acid, sodium carbonate, and copper sulfate.

4. The process of treating iron or steel, or articles composed of or having a surface of iron or steel, which process comprises subjecting such article or articles to a bath made from a solution of ordinary phosphoric acid, sodium carbonate, and copper sulfate, the copper sulfate being present in excess of the quantity required to form di-hydrogen phosphate of copper.

5. The treatment of iron or steel, or articles composed of or having a surface of iron or steel, which consists in subjecting the same to the action of a bath prepared from phosphoric acid, sodium carbonate, and copper sulfate.

6. The process of treating iron or steel, or articles composed of or having a surface of iron or steel, which process comprises subjecting such article or articles to a bath made from a solution of ordinary phosphoric acid, an alkaline carbonate or hydroxid, and a salt of a metal less basic than iron, and in subsequently subjecting such article or articles to the action of a compound of sulfur that will produce a metallic sulfid with the coating upon such article or articles.

7. The process of treating iron or steel, or articles composed of or having a surface of iron or steel, which consists in subjecting the same to the action of a bath made from a solution of phosphoric acid, an alkaline carbonate or hydroxid and copper sulfate, and to a solution of a sulfid.

8. The process of treating iron or steel, or articles composed of or having a surface of iron or steel, which consists in subjecting the same to copper di-hydrogen phosphate and a copper salt, and then subjecting the same to a solution of a compound of sulfur capable of producing a metallic sulfid with the coating thus formed.

9. The treatment of iron or steel which consists in subjecting same to copper di-hydrogen phosphate and a copper salt, immersing the article or articles in a bath containing a compound of sulfur capable of producing a metallic sulfid with the coating thus formed and then dipping such article or articles in oil.

10. A rust resisting coating for iron or steel, or articles composed of or having a surface of iron or steel, said coating con-

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taining phosphate of copper, metallic copper, and copper sulfid.

11. A rust resisting coating for iron or steel, or articles composed of or having a surface of iron or steel, said coating containing phosphate of copper, metallic copper, copper sulfid and an oil.

12. A rust-resisting coating for iron or steel, or articles composed of or having a surface of iron or steel, said coating containing a metal other than iron, a phosphate of

a metal other than iron, and a metallic sulfid.

In testimony whereof, we hereunto affix our signatures in the presence of two witnesses.

LEE S. CHADWICK.
MARC RESEK.

Witnesses:

W. E. SHEPPARD,
K. G. EAST.