UNITED STATES PATENT OFFICE.

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PICKLING IRON AND STEEL.

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To all whom it may concern:

Be it known that I, JAMES H. GRAVELL, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Pickling Iron and Steel, of which the following is a specification.

The object of this invention is to provide for pickling steel in such a way that it will not rust thereafter.

It is well known that ordinary baths of sulfuric, hydrofluoric or hydrochloric acids, used for pickling, cause the steel to subsequently rust and in order to prevent this rusting, a second operation known as liming must be restorted to. Although liming the work, after treating with acid, has proved fairly satisfactory, yet it is well known that work so treated is unsuitable for painting owing to its liability to rust under the paint.

The object of my invention is to provide a pickle bath for steel which will not cause the metal to rust, and in so doing entirely eliminate the use of a subsequent neutralizing operation.

My invention is based on my discovery that the addition of phosphoric acid to an acid pickle bath prevents iron or steel from subsequently rusting.

In carrying out my method commercially I treat the steel with a bath consisting of an admixture of one part phosphoric acid by volume; one part sulfuric acid by volume and twelve parts water by volume. The exact proportion of the materials used may be varied to a great extent while still accomplishing the object of the invention. The bath is allowed to act on the steel for sufficient time to clean it. The actual time, of course, depends on the condition of the work and temperature of the bath and in the ordinary run of commercial work, will vary from 2 to 30 minutes.

My pickle can be used hot or cold, and by suitably altering the proportions above given it can be applied by a brush or sponge, as a wash, in cases where the work is of such a character or size that it is not feasible to immerse it in a bath. As a wash I use, commercially, one part of phosphoric acid; one part of sulfuric acid and six parts of water and allow the admixture to remain on the steel from two or three minutes to several hours.

In case the work is to be painted, I wash the pickle work with water and allow it to dry prior to the application of the paint, irrespective of the method I use for cleaning, *i. e.* either bath or wash. In case the water used has a tendency to cause rust I find it can be corrected by the addition of a dichromate in the proportion of one ounce of potassium dichromate to one gallon of water.

It is evident from the foregoing description that I have simplified the art of pickling, in as much as I have eliminated the neutralizing bath, and I have also provided a non-rusting pickle. Sometimes the work to be pickled is greasy or oily, and in that case and in order to permit the described pickle to reach and act upon the surface there should be added to the pickle alcohol, acetone or equivalent substance adapted to replace the grease or oil and so permit the pickle to reach and act on the surface.

In the claims, I use the term "sulfuric acid" to include the various acid and acid salts used for pickling iron and steel such as hydrochloric acid, hydrofluoric acid, and niter cake and I use the term phosphoric acid to include the various forms of phosphoric acid and also those salts of phosphoric acid which react with the acids to form phosphoric acid.

My pickle may be used to advantage as simply a chemical bath which I have described, or it may be used as the electrolyte in electrolytic pickling.

I claim:

1. The method of pickling iron and steel which consists in subjecting the metal to the action of an admixture of phosphoric acid and sulfuric acid.

2. The method of pickling iron and steel which consists in subjecting the metal to the action of an admixture of phosphoric acid and sulfuric acid and then washing the metal with water.

3. The method of pickling iron and steel

which consists in subjecting the metal to the action of an admixture of phosphoric acid and sulfuric acid and then subjecting it to the action of an aqueous solution of a soluble dichromate.

4. The method of pickling iron and steel which consists in subjecting the metal to the action of an admixture of phosphoric acid and sulfuric acid and alcohol.

5. In the art of pickling iron and steel that improvement which consists in adding phosphoric acid to the pickling bath.

JAMES H. GRAVELL.