

UNITED STATES PATENT OFFICE.

PHILIP ELMER KERN, OF CHICAGO, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

PROTECTION OF IRON AND STEEL.

No Drawing. Application filed April 1, 1921. Serial No. 457,647.

To all whom it may concern:

Be it known that I, PHILIP ELMER KERN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in the Protection of Iron and Steel, of which the following is a full, clear, concise, and exact description.

This invention relates to the treatment of iron and steel to produce a protective coating thereon, and more particularly to improvements in the treatment of such materials by the methods known as Bower-Barffing.

The object of the invention in general is to produce in a short time a heavy scale or protective coating of uniform appearance which will render iron or steel articles upon which it is applied rust-proof or non-corrosive.

In accordance with the general features of this invention, the parts to be coated with a protective coating are first given a treatment under conditions which will produce a heavy crystalline oxide coating, and are subsequently given a treatment which will produce a smooth deposit upon the outside of the crystalline coating.

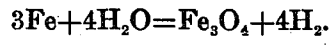
The process in effect is a two-part process in which the parts are first placed in a closed muffle at a temperature and under conditions which will produce rapid oxidation, resulting in the formation of a heavy crystalline coating upon the articles. After this rapid oxidation the articles are treated in a muffle from which the hydrogen has previously been driven and at a lower temperature than the first treatment, which will result in the formation of a smooth, even scale on the outside of the heavy crystalline scale.

More in detail, the steps of the process followed in this invention are as follows:

A rack of iron or steel parts together with approximately one-quarter pint of a fairly heavy hydro-carbon oil in small containers is introduced into the furnace muffle at a temperature of from 1320° Fahrenheit to 1400° Fahrenheit. The muffle is then closed tightly and the rack of parts is allowed to come to the temperature of the muffle. Super-heated steam is then introduced and a heavy crystalline coating of oxide of iron is produced on the parts. When this coating has reached the desired thickness the

rack is withdrawn and the hydrogen in the muffle is allowed to burn. After the rack has cooled slightly it is put back into the muffle together with the same quantity of oil as used on the first part of the run. It is allowed to come to the temperature of the muffle which should now be about 1330° Fahrenheit. Super-heated steam is then introduced and the parts oxidized a second time until the outside of the heavy crystalline deposit has become smooth and of uniform appearance. The rack is then withdrawn from the furnace and allowed to cool.

In the steps of this process the steam reacts with the iron to form a black magnetic oxide scale in accordance with the following reaction:



The composition formed in this process is shown by analysis to be approximately Fe_3O_4 .

An excess of steam is introduced into the muffle in order to produce an atmosphere which is chiefly a mixture of steam and hydrogen. The percentage of hydrogen in the muffle gases depends, of course, upon the area of the iron surface, the thickness of the scale already formed, the rate at which the steam is introduced into the muffle, and the temperature of the furnace. The higher the temperature of the furnace, other factors being the same, the faster the oxidation of the iron surface will progress and the faster hydrogen will be liberated.

A high temperature of the furnace and a large percentage of hydrogen in the atmosphere of the muffle causes the formation of a scale having a crystalline appearance. A lower temperature and small percentage of hydrogen in the muffle gases causes the scale of a smooth appearance to form.

It has been discovered that the ideal deposit for this protective coating should be of a crystalline nature with a smooth appearance on the outside. The crystalline deposit is an iron oxide of a lower oxygen content than the smooth deposit and consequently the conditions under which the two deposits are formed are somewhat different. While the crystalline deposit is not as uniform in appearance and generally has a larger number of defects than the smooth deposit, it has the advantage that it can be

formed much more rapidly than a smooth deposit of the same thickness and forms an ideal body for deposits of the smooth oxide surface, the two together providing an ideal protective coating which meets all requirements of protection and appearance.

It will be understood that the same results may be produced by variations of the above method without departing from the spirit of this invention. For example, it may not be absolutely essential to remove the parts from the furnace to cool them. Instead, if the door is opened or loosened and compressed air is blown through the muffle, the hydrogen will be burned and the temperature reduced. Also, it would be possible to use two furnaces, one for the preliminary treatment for producing the heavy crystalline deposit and the second for producing a smooth oxide coating.

What is claimed is:

1. The treatment of iron or steel to protect it from rust or corrosion, which consists in producing an oxide coating thereon comprising a heavy crystalline body portion covered by a smooth, even coating.

2. A two-step process of treating iron or steel to render it rust-proof or non-corrosive, which consists in first subjecting the material to a treatment at relatively high temperature in the presence of steam to form a crystalline oxide scale thereon, subsequently cooling the metal, and again subjecting it to a similar treatment at a lower temperature than the first treatment to produce a smooth, even coating.

3. A two-step process of treating iron or steel to render it rust-proof or non-cor-

rosive, which consists in first subjecting it to a relatively high temperature in the presence of steam with high hydrogen concentration, cooling the material, and subsequently subjecting it to a lower temperature in an atmosphere of steam with low hydrogen concentration.

4. A two-step process of treating iron or steel to render it rust-proof or non-corrosive, which consists in subjecting the material to a temperature of 1300° Fahrenheit to 1400° Fahrenheit in a closed muffle in the presence of oil and superheated steam, cooling the parts, and subjecting them to a temperature of about 1330° Fahrenheit in similar atmosphere low in hydrogen.

5. The process of treating iron or steel to render it rust-proof or non-corrosive, which consists in first subjecting the material to a treatment at relatively high temperatures in the presence of steam to form a crystalline oxide scale thereon, and then subjecting the metal to a similar treatment at a lower temperature than the first treatment to produce a smooth even coating.

6. The process of treating iron or steel to render it rust-proof or non-corrosive, which consists in subjecting it to a relatively high temperature in the presence of steam with high hydrogen concentration, and then subjecting it to a lower temperature in an atmosphere of steam with low hydrogen concentration.

In witness whereof, I hereunto subscribe my name this 25th day of March A. D., 1921.

PHILIP ELMER KERN.