

# UNITED STATES PATENT OFFICE.

ABRAM A. BRENNEMAN, OF BROOKLYN, NEW YORK.

## PROCESS OF COATING IRON AND STEEL WITH RUSTLESS OXIDE.

SPECIFICATION forming part of Letters Patent No. 387,046, dated July 31, 1888.

Application filed January 10, 1888. Serial No. 260,363. (No specimens.)

*To all whom it may concern:*

Be it known that I, ABRAM A. BRENNEMAN, a citizen of the United States, residing at Brooklyn, Kings county, State of New York, have  
5 invented certain new and useful Improvements in the Process of Coating Iron with Rustless Oxide, of which the following is a full, clear, and exact specification.

My invention relates to the treatment of articles of iron for the purpose of rendering them  
10 non-corrodible or non-oxidizable and capable of resisting the deteriorating action of the elements and chemical agents to which they may be subjected in use; and my invention consists  
15 in an improved method, substantially as hereinafter more particularly set forth, of producing upon the articles a surface of the magnetic oxide of iron.

It is a well-known fact that the magnetic or  
20 black oxide of iron ( $\text{Fe}_3\text{O}_4$ ) is not oxidizable under ordinary conditions of exposure, and attempts have been made to make use of this fact in protecting articles of iron and rendering them non-corrodible under the various  
25 uses to which they are applied; and the object of my invention is to provide articles of iron with a substantial and uniform coating or surface of the magnetic oxide.

In carrying out my invention I have discovered that it is necessary to first reduce the surface of the articles to be treated to the state of metallic iron, and in doing this I may make use of various and different methods and means—  
30 as, for instance, it may be done mechanically by removing the oxidized or otherwise corroded surface of the iron by brushing or sand-blasts and the like, although I generally prefer to reduce the surface to the metallic state  
35 by subjecting the articles to the action of a reducing agent, and I preferably make use of a substance containing a hydrocarbon—as, for instance, any ordinary illuminating-gas. In using this reducing agent I find it preferable to inclose the articles to be treated in a retort  
40 or muffle and to bring the articles to a uniform heat, the degree of which will vary somewhat, according to the character of the articles to be treated; but I have generally found it best to heat the articles to about a cherry-red.

50 The next step in the method is to convert the metallic iron into the magnetic oxide, and

in carrying out this step I subject the articles to the action of an oxidizing agent, and I preferably make use of ordinary air, as this is the best and most available agent. It will be un-  
55 derstood, of course, that the articles should be uniformly heated when exposed to this oxidizing agent, and I preferably carry out my method by utilizing the same retort or muffle for both of the essential steps of the invention  
60 and providing the muffle with the necessary connections, whereby the reducing and oxidizing agents may be readily applied in succession.

When the reducing action has been properly carried out, I have found in some cases that a single subjection of the articles to the oxidizing agent will produce a uniform coating of the magnetic oxide sufficient to protect  
65 the articles; but when this is not the case I carry out the method by repeatedly submitting the articles to the alternate and successive action of the reducing agent and the oxidizing agent. Thus after the first coating of magnetic  
70 oxide has been formed I again submit the articles to the reducing action of the gas, which produces a coating of metallic iron, and then upon admitting the oxidizing agent it has the effect of penetrating below the surface of the material and removing a certain proportion of  
75 the carbon in the iron beneath the coating and to produce a greater thickness of the magnetic oxide than the first operation. This alternate and successive treatment may be followed until a coating of oxide of the required or desired  
80 thickness is produced, and it will be observed that at each action the surface is first uniformly reduced to the state of metallic iron, and finally converted into a continuous and uniform coating of magnetic oxide by the oxidizing agent.  
85 In this way the coating of magnetic oxide, instead of being in a series of layers corresponding to each successive operation, is produced as a single homogeneous layer covering every  
90 portion of the surface and interlocking with the particles of the metal upon which it rests.

While I have thus described what I consider the best method of carrying out my invention, it will be evident to those skilled in the art that the steps may be performed in various  
95 ways without departing from the principles thereof.

What I claim is—

1. The method, substantially as hereinbefore set forth, of producing a coating of magnetic oxide upon the surfaces of articles of iron  
5 for the purpose of rendering said articles non-corrodible, which consists in subjecting the uniformly-heated articles to the reducing action of a hydrocarbon and then to the oxidizing action of air.
- 10 2. The method, substantially as hereinbefore set forth, of producing a coating of magnetic oxide upon the surface of articles of iron for the purpose of rendering said articles non-

corrodible, which consists in repeatedly subjecting the uniformly-heated articles to the  
15 alternate and successive action of a reducing agent to bring the surface to the state of metallic iron, and of an oxidizing agent to produce the final coating of magnetic oxide.

In testimony whereof I have signed my name  
20 to this specification in the presence of two subscribing witnesses.

ABRAM A. BRENNEMAN.

Witnesses:

J. S. BARKER,  
F. L. FREEMAN.