

IV.—REMARKS UPON THE COATING OF IRON WITH MAGNETIC OXIDE, AND A SUGGESTION OF A PROBABLY NEW METHOD OF PRODUCING IT—BY JOHN FORBES.

(Read February 9th, 1891.)

In the production of articles of metal, it is frequently desirable that the condition or color of the surface be changed, sometimes as a matter of taste, the natural color of the metal not comporting with its associations, or with its purposed use; sometimes as a protection of the article from deterioration by natural oxidation, and, in some cases, with both of these aims in view.

Often the surfaces of such articles are intentionally oxidized, and a more uniform and more durable, as well as a more beautiful, oxidation, produced by the artificial means, than that which would result if Nature were left to do the work herself in the ordinary course of wear or of exposure.

Silver articles are frequently artificially coated with a film of sulphuret of silver, which, while being of a more even character both in constitution and color, is also more tasteful and probably more durable than a natural result would produce.

Tin and zinc articles frequently have their surfaces treated in such a manner as to produce a crystalline effect, which is preserved by a thin covering of lacquer, giving a better and more durable effect than if left to the natural action of the atmosphere or other causes.

Copper, after being polished, is made darker, and the natural metallic lustre and redness changed to a dark chocolate color, the surface being thus improved and made more durable.

Iron is frequently covered with tin or zinc, by being dipped (after proper preparation of its surface) into a melted bath of one of those metals.

Steel and iron articles are also frequently treated in such a manner as to produce upon them a thin scale or film of magnetic oxide, Fe_3O_4 , which, being a different degree of oxidation than

would naturally occur, and not much (if at all) acted upon by a damp atmosphere, makes a fairly durable finish for such articles, and resists natural changes in a generally satisfactory manner.

Sometimes the artizan, wishing to produce this kind of surface in an expeditious manner, upon an article of steel or iron, will heat the article to a proper degree, and then smear upon it some heavy oil or fat, after which he will continue the heating for a while longer, and thus in a sort of impromptu manner obtain a surface which will resist natural oxidation from exposure to the weather, for a moderate length of time, fairly well. The exact effect of this rough-and-ready process is, probably, that a very thin film of superoxidation by heat is obtained, and, in addition to that, a slight carbonization of the surface, by the burning thereon of the greasy matter with which it had been smeared, and also a filling up of the minute surface-cells of the metal, by the same agent, which becomes hardened by the heat into a more or less durable varnish.

Contrasts in color between different parts of instruments or machines, of iron and steel, and giving very tasteful effects, are produced by simply carrying the oxidation and resulting discoloration to different degrees in the several parts treated. The ranges of color obtainable by proper manipulation and treatment being all the way between that of the brilliancy of the natural and polished surface, through the several tints of pale straw, light, dark, and reddish brown, and purple, to blue, of a very beautiful and agreeable tint, and this without sacrificing much of the brilliancy of the originally finished or polished surface.

The extremely thin films of oxidation thus produced do not, however, possess much durability, and a moderate amount of rubbing, or wear, suffices to remove it, and exposes anew the natural color and surface of the metal.

But if, instead of stopping the operation at this stage just named, we continue the treatment, increasing the heat, with a free access of a suitable oxidizing agent, a considerable coating of the superoxidation may be obtained, and the utility of the treatment as a means of protecting the article from natural deterioration greatly improved.

The treatment thus extended results in a much darker color, approaching very nearly to a black, and where it is intended to produce this kind of a finish, the surface need not be carefully polished beforehand, a smooth and even surface, (with, however, a full exposure of the clear metal), being all that is needed, as the surface after treatment presents a fine granular character, quite pleasing to the eye, but without polish, even though it may have been polished previous to treatment.

It is, however, necessary in order to obtain good results, that the surface be made clean, so that free action of the oxidizing agent may not be interfered with.

The extent of the treatment, and consequent depth of the scale formed, must of course be modified to suit the purposes for which the articles treated are intended to be used.

This kind of coating, as a preventive from further oxidation, has engaged the attention of scientific men, and several methods have been proposed for producing it.

About fourteen years ago, Prof. Barff, of some part of England, devised a method of submitting the articles to be treated to the action of steam, the articles having been raised to a suitable degree of heat in a muffle, the steam was then admitted, and becoming decomposed, the oxygen combined with the iron, and the hydrogen was enabled to escape by a suitable exit pipe.

At first this method was not quite successful, because although the desired oxidation was obtained, yet it was not satisfactory because it did not stick to the iron, but was formed in minute scales that were easily detached. This was afterwards remedied by using superheated steam and quite satisfactory results were then obtained, and the articles so treated present a very nice appearance. The method, however, requires a properly erected apparatus, at a considerable outlay, for its accomplishment. A short time after Prof. Barff's method was introduced, another method of accomplishing the result was invented by a Mr. Bower, of England. Mr. Bower's method consisted in subjecting the suitably heated articles, they being also enclosed, to the action of hot air—the supply of air being renewed from time to time as it became deoxidized, and fresh supplies introduced into the cham-

ber until the desired depth of coating was obtained. This method also requires considerable preparation in the way of suitably arranged facilities for its execution.

I now beg to explain a method which I have had occasion to use, which I have not found suggested by any authority with which I am acquainted, and which may have a field of adaptability in cases where an expeditious or rough and ready way of producing such a coating upon iron and steel articles is desirable. The method consists in enclosing the articles in a sheet iron box, imbedding them in some suitable supporting material which will not absorb oxygen, say blacksmith's scale, or gravel, or sand, and mixing with the contents of the box some substance which will give off oxygen when heated.

After some consideration I conjectured that Black Oxide of Manganese, MnO_2 would be a suitable agent, and upon experimenting was pleased to find my anticipation correct, and after a few trials succeeded in obtaining results which for the desired purpose seemed fairly satisfactory. We found that the thickness of the coating may be increased to an appreciable degree; the colour is quite good and uniform, and the adherent qualities generally satisfactory.

We discovered that the quality of the peroxide of manganese was important, and suffered disappointment in endeavoring to use some that was not adapted to the purpose. It should be of a good, deep black color, and decidedly granular. That which disappointed us was of a somewhat brown tinge, and dusty.

It may be interesting to state, that after finding our plan to succeed, we thought we would try the mixing of some other agent with the MnO_2 , and so mixed a little chlorate of potash with the oxide of manganese. The result was quite unsatisfactory,—in some cases sticking to the surface, and in others causing the resulting oxidation to be non-adherent, and dropping off in large plates as soon as handled. It is probable that the process as we have hitherto practised it may be improved, as we have only made use of the same appliances, furnaces, etc., that we have used for other purposes in connection with our business. It is, however, in this ready-to-hand feature that the chief utility of the method probably consists.