Jan. 16, 1940. F. V. LENEL 2,187,589

POROUS IRON ARTICLE AND METHOD OF MAKIMG SAME

Filed Nov. 3, 1938 2 Sheets-Sheet 1

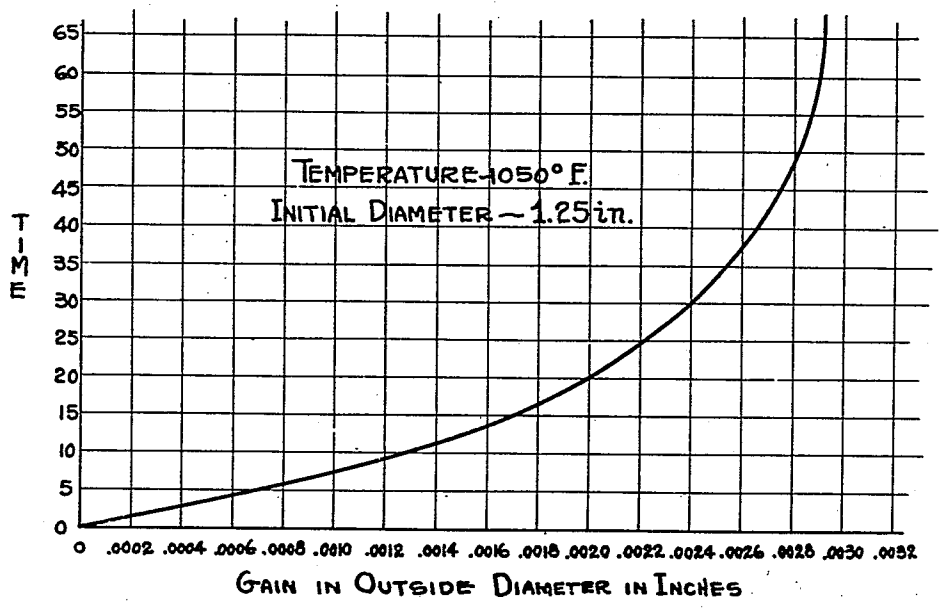


Fig. 1

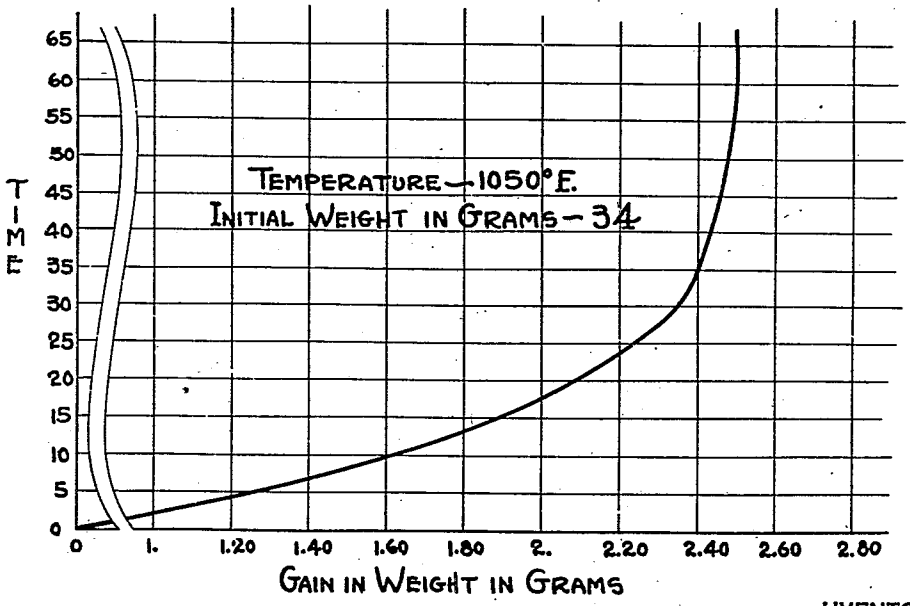


Fig. 2

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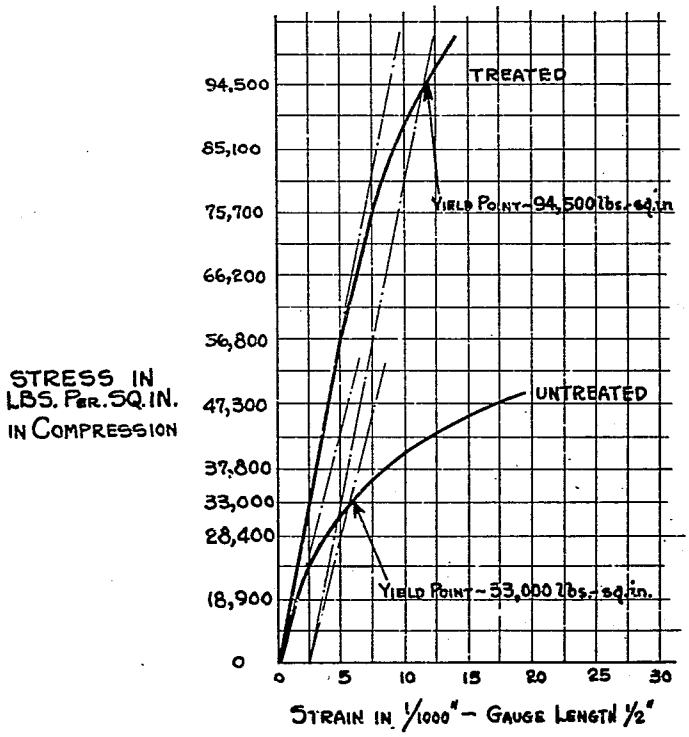


Fig. 3

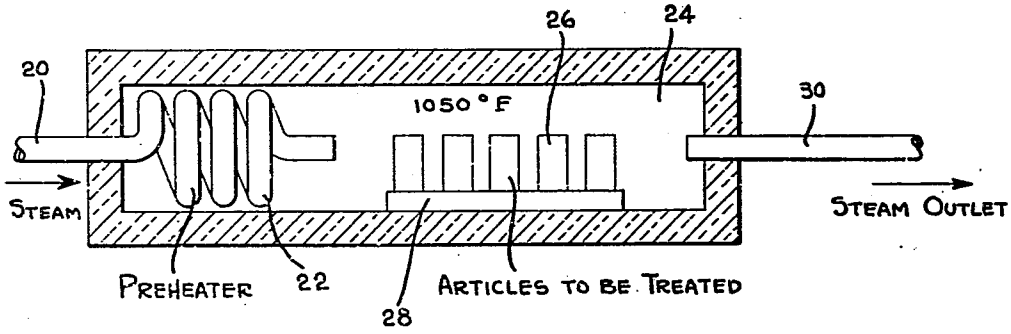


Fig. 4

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UNITED STATES PATENT OFFICE

2,187,589

POROUS IRON ARTICLE AND METHOD OF MAKING SAME

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Application November 3, 1938, Serial No. 238,527

12 Claims. (Cl. 75—22)

This invention relates to porous sintered iron articles and more particularly to a method of treating such articles to make the same resistant toward atmospheric corrosion.

An object of the invention is to provide a method for treating articles fabricated from powdered iron whereby the entire porous structure of the article is coated over the entire surface thereof with a corrosion resistant film or layer.

In carrying out the above object it is a further object of the invention to subject the porous iron article to treatment in an atmosphere of a chemical compound or element which reacts chemically with the surface of the article to form a corrosion resistant film or coating thereover.

It is still a further object in some instances to treat the porous iron article with steam, at a temperature above 1000° F., for accomplishing oxidation of the metal surface thereof.

A further object is to provide a new article of manufacture which consists of an object formed of porous sintered iron in which the entire porous surface thereof is coated with a corrosion resistant film resulting from a chemical reaction with the iron.

Another object of the invention is to provide a method whereby a porous iron article may be made corrosion resistant and simultaneously increased in hardness as well as bettering other physical properties thereof.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a graph showing the change in diameter of a porous iron briquette due to steam treatment thereof.

Fig. 2 is a graph showing the change in weight of a porous iron briquette due to steam treatment thereof.

Fig. 3 is a graph showing stress strain diagrams for treated and untreated iron, and

Fig. 4 is a schematic layout of the apparatus used for steam treating porous iron.

Porous iron articles formed by briquetting and sintering powdered iron, such as sponge iron, comminuted iron, electrolytic iron, etc., have many uses in industry. These porous sintered articles may be utilized as substitutes for articles formed by conventional methods from cast iron or steels, etc., and in each instance can be fabricated in substantially the exact shape and size desired without subsequent machining. The porous iron articles have the further advantage of being capable of absorbing a lubricant and thereby providing a self lubricating surface when the same is required.

One of the past difficulties in the use of porous iron has been the rapid corrosion of the iron due to exposure to atmospheric air. The porous spongy structure of the iron, due to its large area, acts very similarly to an activated surface, and corrosion is a great deal more marked than in cases where solid bodies of iron are used. This rapid corrosion has presented difficulties which heretofore have not been overcome, and as a result have impeded the widespread use of porous iron. The present invention provides a method for making porous iron articles which are substantially unaffected by atmospheric gases and which, due to the treatment thereof, have more desirable physical properties than untreated porous iron articles.

I am aware of the Bower-Barff process in which iron articles are subjected to steam to form an outside coating thereover. I am also fully cognizant of many other processes for effecting corrosion resisting films on iron and steel. In each of these cases, however, the only part of the ferrous article to be coated is the surface thereof which due to its non-porous nature requires long periods of treatment. In my invention I propose to subject porous iron articles to a steam treatment for a relatively short period of time, and ranging in temperature from 1000° F. upwards to 1500° F. This treatment differs from the conventional treatments inasmuch as the entire surface of the porous iron article is coated or filmed with the oxide. Thus the wall of each interstitial pore is oxidized to prevent further atmospheric oxidation thereof. Preferably my process is carried out at a temperature of approximately 1050° F. for a period of twenty minutes, although these figures are not in any way limiting as it is apparent that the length of treatment and temperature thereof may be varied within wide limits and still obtain satisfactory results.

One method of steam treatment is shown in Fig. 4 wherein steam enters pipe 20 and passes through a preheating or superheating coil 22 disposed within a closed furnace 24 to bring the steam temperature up to the temperature of the furnace. The articles 26 to be treated are placed on a rack 28 and maintained at a preferred temperature of 1050° F. An outlet 30 is provided for the steam and sufficient pressure is used to

cause a slow circulation of the vapor through the furnace.

I have further found that such treatment has very beneficial effects on certain physical properties of the porous iron, for example the hardness of a porous iron article is markedly increased. For example, the Rockwell hardness of a piece of porous iron as sintered equals "B" 10–15, whereas the Rockwell hardness of the same piece after steam treating under the preferred conditions equals "B" 85–89. This is an entirely new result as it has been found that cold rolled steel is actually decreased in hardness by steam treatment.

It has further been found that the porosity of a porous iron piece is decreased by steam treatment. This may be explained by the fact that the oxide film decreases the size of the pores of the piece. Another physical property which is materially improved is the yield strength in compression of the piece. In Fig. 3, the stress strain diagrams of treated and untreated porous iron are shown together with the yield points as determined by the offset method (offset ½% of gauge length). It will be observed that the yield point is materially increased by steam treatment. In this instance the iron article was fabricated from a mixture of 98 parts sponge iron, 2 parts graphite and 1½ parts zinc stearate or stearic acid, the function of the fatty acid or salt thereof being to lubricate the briquetting die.

As a result of the oxidation there is a growth of the article during steam treatment which causes the article to change in size in every direction. This growth necessitates briquetting an article of the desired shape but less in size in all directions than the article ultimately desired, and then by selective steam treatment causing the article to grow to the size ultimately desired. This growth has been rather accurately determined, and a graph showing a representative curve is shown in Fig. 1.

In some instances where extreme accuracy is desired the iron article may be subjected to a machine operation, such as grinding or turning, etc., to bring the same to the exact size. In this case the steam treatment may be carried out in either one of two alternative methods. First the article may be briquetted and sintered to the desired size and then steam treated for a suitable period to cause an increase in size thereof. This increased size may then be ground off until the article is the exact size, after which a short steam treatment may be used to oxidize the external surface where the oxide has been ground off. In this treatment the steam oxidize the interstitial pores in the preliminary oxidation step, whereby the final oxidation step does not cause any substantial additional growth at the interior of the article. The second method of obtaining the exact size, when the piece is to be machined, is to perform the grinding operation prior to the steam treatment and grind the surface of the article sufficiently so that by selective steam treatment the growth thereof will bring the article back to the exact size desired.

The amount of oxidation, or stated differently, the extent of oxidation may be measured accurately by the change in weight of the article, such change in weight per unit time being shown on the chart in Fig. 2 for a given temperature. In figuring out the percentage of oxide present, magnetic iron oxide (Fe_3O_4) should be considered as a base. Magnetic iron oxide is much more adherent than the usual red iron oxide and forms a much improved corrosion resistant film.

Instead of utilizing steam, heated air, carbon dioxide, oxygen, etc., may be used with satisfactory results. In other words any oxidizing gas, or vapor, which will permeate the porous structure of iron article will cause oxidation of the surfaces of the same to form a protective film or coating thereover which prevents further oxidation at normal temperatures by the action of the atmosphere or water vapor. It is apparent that the time and temperature of the treatment must be varied in accordance with the results desired, also the time and temperature should be varied in accordance with the oxidizing quality of the gaseous medium. Thus when using air or oxygen the temperature is best maintained toward the lower limits of temperature range, namely, 1000 to 1500° F. When carbon dioxide is used, however, the temperature should approach the upper limits since carbon dioxide is a slower oxidizer than air or oxygen containing vapors or gases.

From the foregoing it is apparent that the treatment described herein for porous iron articles provides a protective coating thereover against corrosion and simultaneously improves certain physical characteristics of the porous iron. Similar treatment can be accorded various porous iron alloy articles which include graphite and metallic alloying ingredients, copper, nickel, manganese, etc., the description being limited to iron merely for illustrative purposes.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a method for preventing corrosion of porous sintered iron articles, that step comprising, treating a porous iron article with steam at a temperature of 1050° F. and for a period of approximately 20 minutes, whereby the surface only of the iron is oxidized for producing a corrosion resistant oxide film thereover.

2. In a method of fabricating articles from powdered iron, the steps comprising, briquetting powdered iron under high pressure to the shape desired but of a slightly smaller size in all directions than the size ultimately desired, sintering the briquette to form a strong porous article, and then subsequently treating the porous iron article with steam at a temperature between 1000° F. and 1500° F. and for a time sufficient to oxidize the surface only of the iron and to cause the article to increase in size to the size ultimately desired and simultaneously provide a corrosion resistant surface thereover.

3. In a method of fabricating articles from powdered iron, the steps comprising, briquetting powdered iron under high pressure, sintering the briquette to form a strong porous article, machining the article thus formed to a size less in all directions than the size ultimately desired, and then treating the machined article with steam at a temperature in excess of 1000° F. and for a time sufficient to oxidize the surface only of the iron and cause the article to increase in size to the size ultimately desired, and simultaneously provide a corrosion resistant surface thereover.

4. In a method of fabricating articles from powdered iron, the steps comprising, briquetting powdered iron under high pressure to the shape

desired, sintering the briquette formed into a strong porous article, treating the article with steam at a high temperature and for a sufficient time to oxidize the surface only of the iron thereby causing the article to increase in size, machining the article to the desired size, and then treating the article in high temperature steam for such a short time as to only oxidize the external surface thereof for providing a corrosion resistant film thereover.

5. As a new article of manufacture, an object of porous sintered iron having high strength and having substantially the entire porous surface only thereof coated with a corrosion resistant oxide film of superficial depth formed by the chemical reaction between iron and steam.

6. As a new article of manufacture, an object of porous sintered iron having high strength and having substantially the entire porous surface only thereof coated with Fe_3O_4 in a film of superficial depth.

7. In a method of preventing corrosion of porous sintered iron articles, that step comprising, treating a porous iron article in an atmosphere of an oxidizing gas at a temperature in a neighborhood of 1,050° F. and for a period of about 20 minutes to cause substantially the entire porous surface only of the iron to be oxidized to a superficial depth.

8. In a method of preventing corrosion of porous sintered iron articles, that step comprising, treating a porous iron article in an atmosphere of air at a temperature in the neighborhood of 1,050° F. and for a period of about 20 minutes for causing substantially the entire porous surface only of the iron to be oxidized to a superficial depth.

9. In a method for treating porous ferrous articles, that step comprising, subjecting a porous iron article to a steam treatment at a temperature of about 1,050° F. and for a period of about 20 minutes for oxidizing the entire porous surface only thereof to a superficial depth and simultaneously to improve certain physical characteristics thereof.

10. In a method of fabricating articles from powdered iron to substantially the exact size desired, comprising the steps of briquetting powdered iron under high pressure to the shape desired but of a slightly smaller size in all directions than the size ultimately desired, sintering the briquette under non-oxidizing conditions into a strong porous iron article, and then treating the article with an oxidizing gas at a high temperature and for such a time as to oxidize the external surface only thereof for causing the article to increase in size to the size ultimately desired and simultaneously provide a porous corrosion resistant surface thereover.

11. As a new article of manufacture, an object of porous sintered iron having high strength and having substantially the entire porous surface thereof coated with a corrosion resistant oxide film of superficial depth formed by the chemical reaction between iron and air.

12. As a new article of manufacture, an object of porous sintered iron having high strength and having substantially the entire porous surface only thereof coated with a black oxide of iron in a film of superficial depth.

FRITZ V. LENEL.