April 9, 1935. A. W. MORRIS 1,997,006

METHOD OF PREPARING AND NITRIDING A FERROUS ARTICLE

Original Filed Dec. 17, 1931

Fig. 1.

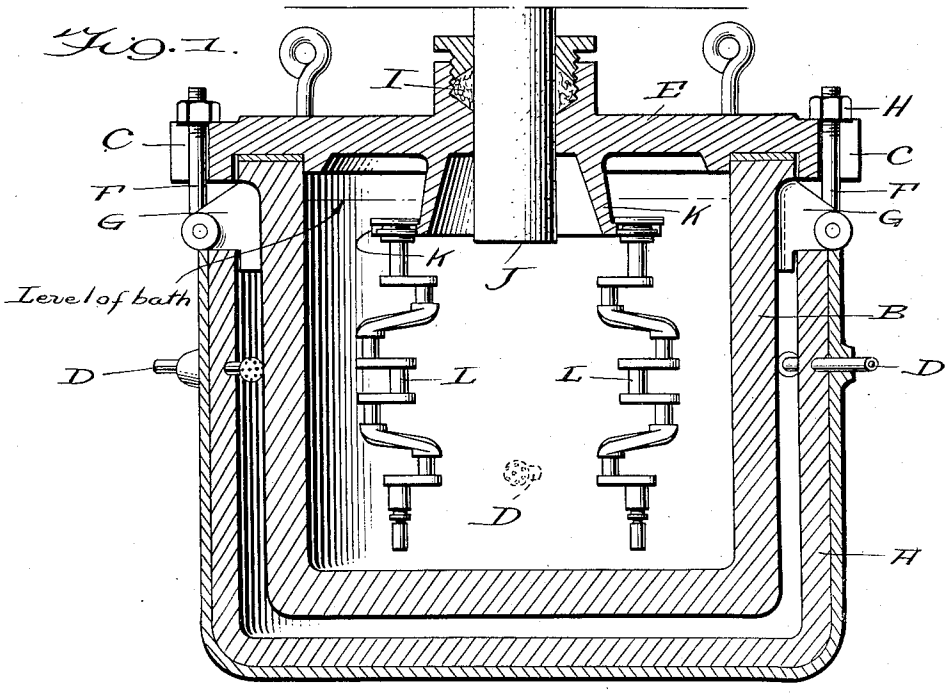
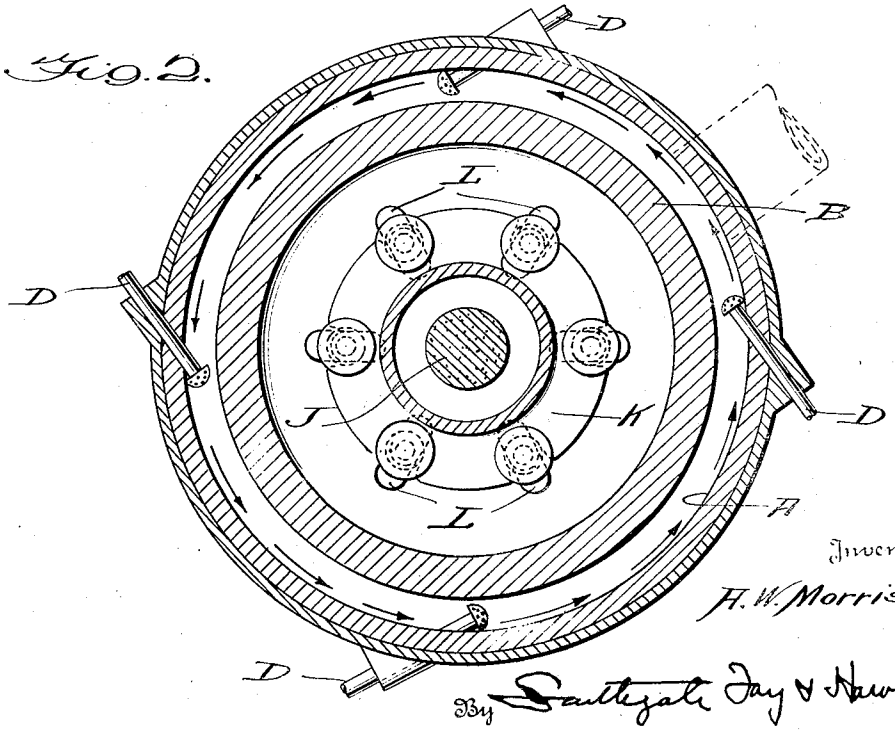



Fig. 2.

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Patented Apr. 9, 1935 1,997,006

# UNITED STATES PATENT OFFICE

1,997,006

## METHOD OF PREPARING AND NITRIDING A FERROUS ARTICLE

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Original application December 17, 1931, Serial No. 581,701. Divided and this application August 25, 1934, Serial No. 741,513

1 Claim. (Cl. 148—16)

This invention relates to a new method of preparing and nitriding a ferrous article, the present case being a divisional application of my co-pending application Serial No. 581,701, filed December 17, 1931.

Heretofore, so far as I am informed, in preparing a ferrous article for surface nitrogenization, all the metal in the article has been made of the same mixture or alloy. In other words, to get a surface suitable for nitridation, the entire piece has been made of a nitridable alloy or of the same composition throughout its mass.

This generally is a disadvantage, first because of the cost, and second because the elements included in the article to make it nitridable are usually detrimental to the texture of the article and often interfere with or prevent heat treatment.

My improved method consists in impregnating the surface of the ferrous article to be treated to a suitable depth with a metal or alloy having affinity for nitrogen. The article thus treated is then subjected to the action of nitrogen so that a hard nitrided surface will be obtained on the article and whereby the core or center of the article will be practically untreated and will retain the characterictics due to its original composition or alloy.

By my method almost any ferrous alloy having good properties of strength and that will be insensible to tempering brittleness can be used, thus insuring better castings, forgings and permitting heat treatment of ferrous articles having nitrided surfaces.

My method may be carried out as follows:—

After making the ferrous article in the form desired, either by casting or forging I immerse or dip it, while hot, and preferably heated to a temperature above 1200° Fahrenheit, in a bath of molten metal having affinity for nitrogen. This bath is preferably molten aluminum either pure or alloyed with zirconium, titanium, chromium, vanadium, magnesium, beryllium, silicon, nickel, molybdenum, manganese, or any desired combination of these, known in the art for alloying with iron to make up a nitridable alloy.

I have found by thus treating a ferrous article that there will be a surface impregnation thereof to a considerable depth by the metal or alloy having affinity for nitrogen.

I have also found that I can increase both the depth and amount of the impregnation of the ferrous article by subjecting the bath of molten metal having affinity for nitrogen to a hydrostatic pressure.

The improved method may be carried out by many forms of apparatus, a preferred form being illustrated in the accompanying sheet of drawing forming part of this application for patent.

Referring to the drawing:

Fig. 1 is a sectional elevation, and

Fig. 2 is a cross sectional view of the apparatus shown in Fig. 1.

Referring more specifically to the drawing, in which like reference numerals designate like parts, A designates a heating chamber, and B a suitable crucible which can be placed in the chamber A, the crucible having lugs G which position the same in the heating chamber. Gas pipes D—D extend through the walls of the chamber A and a mixture of air and gas may be led through these pipes, tangentially into the annular space between the heating chamber and crucible so that the metal in the crucible can be kept in molten condition and at a suitable temperature.

E designates a cover plate which is adapted to rest upon the top rim of the crucible B. This cover plate may be tightly clamped to the top of the crucible by screws F, which are pivoted in the lugs G on the crucible and which screws fit between ears C formed on the rim of the cover plate E, nuts H being threaded on the screws F.

A packing or bearing washer may be placed on top of the crucible. The cover plate E may be provided with a stuffing box I through which a plunger J can be reciprocated for purposes hereinafter described. This plunger may be made of graphite or may have its surface coated with graphite. Extending from the cover plate is a notched flange K for holding the ferrous articles to be treated.

Practically any ferrous article can be treated in the apparatus above described. As shown a number of automobile shafts L are being treated. With the above described apparatus, the shafts L after being shaped whether by forging or casting are placed in the notches in the flange K.

Care should be taken to keep the articles from touching each other, while in the bath, as such touching would hinder impregnation of the articles at the points of contact and would result in thin spots in the coating.

These shafts or ferrous articles to be treated when placed in position should be very hot, preferably heated to a temperature above 1200° Fahrenheit. This temperature can be obtained by taking the articles while they are hot from forging or casting or they can be heated to the desired temperature before being placed in the notches.

The crucible is filled with a bath of molten metal or alloy having affinity for nitrogen. The metal or alloy thus employed is preferably aluminum or any alloy that is known in the art as useful for affecting nitrogenization.

This bath is kept at the proper temperature by the gas jets D—D previously described.

The cover plate is then placed in position on the crucible and tightly clamped thereto so that the hot ferrous articles will be immersed or dipped in the bath of molten metal. The articles are kept in the bath a suitable length of time.

During the treatment in the bath, care should be used to see that the surface of the ferrous articles to be impregnated are clean and free from scale.

I found that under these conditions, the metal or alloy having affinity for nitrogen will penetrate to a sufficient depth into the surface of the ferrous articles being treated to permit them to be nitrided after being machined to size.

This impregnation is accelerated by depressing the plunger J to create a hydrostatic pressure between the bath and the articles.

After the above treatment the cover plate is removed and the ferrous articles are allowed to cool. They then may be subjected to a finishing process such as grinding or machining to get the same to exact size.

Then the articles are subjected to the action of free or nascent nitrogen as in any ordinary nitrogenization or nitridation process.

Impregnation of surfaces not to be nitrided later may be prevented by protecting said surfaces by a suitable plating or paint. This also can be done after impregnation and before the time for nitridation.

For example, all of the surfaces of the crank shafts under treatment in the apparatus, except the bearing surfaces may be protected so that the only surfaces which will be hardened or nitrided will be the bearings and the crank pins or journals.

The nitrogen will unite with the metal having affinity for nitrogen which has impregnated into the surface of the ferrous article.

Thus a ferrous article will be produced having any desired ferrous composition in its core and having a hard nitrided surface or surfaces. This article will thus have the advantages previously described, and is particularly adapted for heat treatment.

While I have shown a preferred form of apparatus for practicing my improved method, other forms of apparatus may be devised whereby the surface impregnation, which is the principal feature of my invention, can be practiced, and I do not intend to be limited other than in the appended claim.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:—

The method of treating a ferrous article which consists in immersing the article while heated in a bath of molten metal having affinity for nitrogen and composed at least in part of aluminum, placing the bath under a hydrostatic pressure to obtain a surface impregnation of the ferrous article with said metal, removing the article from the bath and thereafter hardening the surface thereof by nitridation.

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