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METHOD OF ANNEALING NITRIDED STEEL

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My invention relates to a process of annealing or softening the metal constituting the surface portion of nitrided ferrous material.

An object of my invention is to provide a process of removing nitrogen from the surface portion of nitrided ferrous products so that they may be machined with regular carbon-steel tools.

Another object of my invention is to provide a process which comprises treating nitrided ferrous products with a chemical reagent that is capable of reacting with the nitrogen without attacking the physical characteristics of the base metal which, as a rule, contains alloys that are capable of being readily nitrided.

Another and more specific object of my invention is to provide a process of treating nitrided ferrous products which comprises subjecting them to the action of a fused alkaline salt, the metal constituent of which is capable of reacting with the nitrogen present in the surface portion of the ferrous material.

It has heretofore been the practice to subject ordinary carbon-steel alloys, or those containing special alloying ingredients, such as molybdenum, aluminum, chromium or vanadium or a combination of two or more of such elements, to the action of compounds containing nitrogen at an elevated temperature for the purpose of hardening the surface and preventing corrosion. In such processes, the compounds containing nitrogen are decomposed, and nitrogen is liberated in the nascent state.

Steel or other special alloys which have been subjected to such process, however, are difficult to machine, when employing the usual carbon-steel tools, because of the extreme hardness of the nitrided surface material. Attempts have heretofore been made to anneal or soften the nitrided products by subjecting them to a high temperature or by heating them in one of the usual liquid metal baths but the results have not been satisfactory. For example, subjecting them to temperatures as high as 2000° Fahrenheit or heating them in the usual lead baths have not been effective.

I have made the discovery, however, that ferrous products having an outer surface portion containing nitrogen may be annealed or softened to such an extent that they may be machined by the ordinary carbon-steel tools by a simple process which involves treating the material with a fused salt bath.

In practicing my invention, the nitrided ferrous product is immersed in a bath comprising an alkaline metal chloride, such as potassium or sodium chloride or a mixture of such salts, which is maintained in a fused state by the application of heat. I have found that, when the bath is maintained at a temperature of 1000° to 1400° Fahr., satisfactory results may be obtained, although it is understood that higher temperatures may be utilized. The reaction between the alkali metal and the nitrogen in the surface material of the ferrous product will take place if the salt or mixture of salts are maintained in a fused state. Approximately fifteen minutes to one hour is required to effect complete reaction, depending upon the temperature. After the nitrogen has been removed from the surface material of the ferrous product, it is withdrawn from the bath, and the salt remaining upon its surface may be removed by washing or in any other desired manner.

In my process, the alkali or alkaline-earth metal reacts chemically with the nitrogen and removes it from the surface portion of the ferrous material, liberating chlorine. After the nitrogen has been removed and the necessary marching operations performed, the ferrous product may be again subjected to one of the usual nitriding processes, and, since the physical properties of the base alloy are not affected by the process, a nitrided product may be again produced having properties similar to the original nitrided material.

My process has the distinct advantage that the nitrogen is chemically removed from the surface material. When attempts have heretofore been made to anneal or soften the nitrided surface material of a ferrous product, the nitrogen was not removed, and any softening that occurred was caused by a dilution of the nitrogen throughout the surface

material. Such processes are not commercially feasible because they have the tendency to destroy the characteristics of the base metal. Since it is possible, by my improved process, however, to remove the nitrogen without impairing the physical properties of the base metal, it may be again nitrided with the usual good results.

While I have described my invention in considerable detail, it will be understood that it is not limited to the specific details set forth in the foregoing examples, which should be construed as illustrative and not by way of limitation. For example, the chlorides of one or more of the alkaline-earth metals, such as calcium, barium or strontium, or a mixture of one or more of such salts, with one or more of alkali-metal salts may be employed. It is, therefore, desired that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. In the process of removing nitrogen from alloys which have been subjected to a nitriding process, the steps which comprise heating the alloy in a bath comprising one or more chlorides of the alkali or alkaline-earth metals for a sufficient length of time to cause a reaction between the metal constituent of the salt and the nitrogen in the surface material of the alloy.

2. The process of treating alloys having a nitrided surface which comprises placing the alloy in a bath containing one or more of the alkali-metal chlorides and maintaining the bath in a fused state by the application of heat for a sufficient length of time to cause a reaction between the alkali metal and the nitrogen in the surface material.

3. The process of treating alloys having a nitrided surface which comprises subjecting the alloy to the action of a bath containing a mixture of sodium and potassium chlorides while the chlorides are maintained in a fused state.

In testimony whereof, I have hereunto subscribed my name this 21st day of January, 1930.

WILLIAM J. MERTEN.