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PROCESS FOR HARDENING ALLOY STEELS

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This invention comprises improvements in or relating to processes for hardening alloy steels.

The invention is concerned with the application of the so-called "nitriding" process of surface hardening as applied to alloy steel. The nitriding process consists in subjecting the steel to the action of gasses containing nitrogen in combined form (preferably ammonia) at a temperature in the region of or somewhat above 500° C.

Difficulty has been experienced in the application of the nitriding process to certain alloy steels including some of austenitic structure, and in particular to rustless or stainless steels of the high chromium and austenitic high chrome-nickel types.

It is now widely accepted that the corrosion-resisting properties of alloy steels of the above type are due to the presence of an oxide film, commonly referred to as the passive film. We are led to the belief that the difficulty hitherto experienced of applying the nitriding process to alloy steels of the above class is due to the action of the passive film in preventing or substantially restricting the penetration of the nitrogen and its absorption by the surface layers of the alloy.

The above difficulties are overcome, according to the present invention, by first treating the surfaces of the alloy steel with a reducing agent (e. g. nascent hydrogen) and thereafter, before the surfaces so treated can come under any oxidizing influence, subjecting them directly to the action of the nitriding gas or gasses.

Preferably the treatment of the alloy with a reducing agent is effected by etching the surfaces with a hydrogen-liberating acid such as hydrochloric acid. Other methods of treatment, which are functionally equivalent, are however within the invention.

In carrying out the invention it is important to ensure that at the commencement of the nitriding process the surfaces of the alloy with which the nitriding gas is brought into contact shall be in that "exposed" condition brought about by the action of the etching acid or other reducing agent. This result can readily be obtained by commencing the nitriding process immediately after the surfaces of the alloy have been etched or similarly treated and while they are still under the influence of the reducing agent.

In one example the invention was applied to a stainless steel (sold under the registered trademark "Staybrite") containing 18% chromium

and 8% nickel. The alloy was first subjected to the action of a pickling bath comprising 50% HCl. The specimens were then washed in water, dried and placed in the nitriding furnace and the normal conditions under which the nitriding process is carried out were observed, the temperature being 500° C. At the conclusion of the process the specimens were compared with others which had been subjected to the same nitriding process but had not been etched, and it was found that a substantial increase in the surface hardening was obtained by carrying out the complete process according to the invention. Other examples giving similar improved results on test by the use of this process were (a) a stainless steel containing 14% chromium, 0.2% nickel, 0.3% carbon; (b) a steel of 22% chromium, 12% nickel, 3% tungsten, 0.3% carbon; (c) a steel of 12% nickel, 4% chromium, 5% manganese, 0.5% carbon.

The application of the process is not confined to steels of the particular compositions referred to above but is of general applicability to rustless or stainless steels which either contain a high proportion of chromium or are of austenitic structure and contain a relatively high total content of nickel and chromium. In addition to the process of surface hardening, the invention includes alloy steels when treated by the nitriding process as described herein.

I claim:—

1. A nitriding process of surface hardening applied to stainless steels of the high chromium class, which consists in first treating the surfaces of the steel with a reducing agent comprising hydrogen liberating acid and thereafter while the surfaces of the steel are still under the influence of the reducing agent, subjecting them directly to the action of the nitriding agent.

2. A nitriding process of surface hardening applied to stainless steels which are of austenitic structure and contain a relatively high total content of nickel and chromium, which process consists in first treating the surfaces of the steel with a hydrogen liberating acid and thereafter while the surfaces aforesaid are in the reduced condition brought about by the action of the acid, subjecting them directly to the nitriding agent.

3. A nitriding process of surface hardening alloy steels containing chromium which consists in etching the surface of the steel with hydrochloric acid and immediately thereafter while the surfaces of the steel are still in the reduced

condition brought about by the acid, subjecting them directly to the action of the nitriding agent.

4. A nitriding process of surface-hardening alloy steels containing chromium, which consists in removing the oxide film from the surfaces of the alloy steel without substantially af-

fecting the composition and properties of the alloy by exposing said surfaces to the reducing action of nascent hydrogen, and thereafter before the surfaces so treated can come under any oxidizing influence, subjecting them directly to the action of the nitriding agent.

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