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CASE HARDENING BY NITRIDING

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5 Claims. (Cl. 148—16)

My invention relates to the nitriding of ferrous metals and especially to the production of hard, wear-resistant nitrided layers on ferrous materials by heating the materials in nitrogen-containing agents, such as ammonia. The object of my invention is to provide means for accelerating and intensifying the action of nitriding gases on ferrous materials so as to reduce the time required to produce a case of given hardness or thickness.

I have found many metals which will accelerate the action of nitriding agents on nitridable ferrous articles when aggregates of the metals are closely associated with the surfaces of the articles to be nitrided. Copper has been found to be an excellent accelerator. The metal may be used in its pure form or as an alloy containing a substantial amount of copper, for example brass. Acceleration is produced by closely associating the nitriding agent, the accelerator and the surface to be nitrided. The influence of the acclerator diminishes as the distance between the accelerator and the surface to be hardened increases, the closest proximity of the metals which will permit access of nitriding agent to the metal to be nitrided being the most effective. Accordingly, accelerators which can be made to conform readily to the surfaces to be nitrided and which constitute a porous covering are preferred. A suitable accelerator may consist of a powder or a screen composed of the metal but the accelerator may be used in other forms. The invention is especially useful in connection with the production of hard nitrided cases on steel by heating the steel in ammonia at low temperatures, as for example temperatures of about 450° C. to 580° C., but acceleration is produced at other temperatures.

As illustrative of my invention, a ferrous alloy object which contained about 1% aluminum was wrapped in a copper gauze having eighteen 0.018 inch diameter wires to the linear inch. The wrapped object was placed in a container and the air in the container was displaced with ammonia. An atmosphere of ammonia was maintained in the container, and the container and its contents were heated to about 460° C. for 4 hours. The object was found to have a uniform, hard, wear-resistant nitrided coating on its surface. The coating had a hardness corresponding to about 1000 Brinell.

Another specimen of the same alloy without any wrapping was placed in the container and heated under the same conditions for 4 hours. A hard, nitrided coating was not produced in 4 hours without the wrapping, but by heating for a period of 12 to 16 hours, a hard coating was produced.

Another specimen of the same alloy was wrapped in copper gauze and heated to about 460° C. for 2 hours in an atmosphere composed of about 40% ammonia and 60% nitric oxide. The use of nitric oxide in conjunction with ammonia is described in my copending application entitled "Process of case hardening" Serial No. 431,643 filed Feb. 26, 1930. The specimen was found to have a uniform surface layer of hard, wear-resistant, nitrogen-containing material. While the use of 40% ammonia and 60% nitric oxide in conjunction with copper gives excellent results, any mixture of ammonia and nitric oxide, whether the mixture is composed of pure gases or whether it is diluted with non-deleterious gas, such as nitrogen, may be used and any of the oxides of nitrogen may be used as the additional accelerator. For the sake of economy ammonia and oxides of nitrogen may be advantageously used in about the proportions of their reacting weights.

Copper alloy accelerators composed of brass were found to be practically as effective as those composed of copper. Acceleration was produced by the use of accelerators composed of other non-ferrous metals, among which are substantially pure aluminum, cromium, molybdenum, titanium, manganese, silicon or vanadium. Accelerators composed of copper or alloys rich in copper generally give the best results at lower temperatures. Because of their high melting points, chromium, molybdenum, titanium, manganese, silicon or vanadium have special advantages for use at high temperatures.

I claim:

1. The method of nitriding ferrous metal objects which comprises disposing an alloy containing a substantial amount of copper in close proximity to the ferrous metal and associating a nitriding agent with said metals.

2. The method of nitriding ferrous metal objects which comprises disposing copper in close proximity to the ferrous metal and associating a nitriding agent with said metals.

3. The method of nitriding ferrous metal objects which comprises disposing brass in close proximity to the ferrous metal and associating a nitriding agent with said metals.

4. The method of nitriding ferrous metal objects which comprises closely associating ammonia and copper with the object.

5. The method of accelerating the production of nitrided layers on ferrous materials by heating the materials at nitriding temperatures in ammonia, which comprises bringing the ammonia into contact with the surface of the said ferrous material and disposing in close proximity to said surface but externally thereto an article composed of at least one of the following substances: copper, brass, aluminum, silicon, chromium, vanadium, molybdenum, titanium, manganese.

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