METHOD FOR REMOVAL of IRON NITRIDE
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The present invention relates particularly to removing of iron-nitride “white-layer” costing from case hardened alloy steel parts.

Nitriding is a process for the case hardening of alloy steel parts, usually of special composition, by heating the steel parts in an atmosphere of ammonia gas and dissociated ammonia mixed in suitable proportions, or by heating the steel parts in contact with a nitrogenous medium. The nitriding process has many desirable features; consequently, it has been widely used throughout the world in diverse engineering applications for over 30 years. The process is performed conventionally at a relatively low temperature of 75° F. to 1050° F., thus distorting more in steel parts kept to a depth. The case produced has extremely high hardness and wear resistance even at operating temperatures up to 1000° F., at which temperature carburized cases would long since have broken down. Case depths commonly used in industry are usually between 0.010” and 0.025” deep, and are produced in furnace runs of approximately 25 to 75 hours’ duration.

Conventional nitriding has one serious deficiency which is the simultaneous forming of a brittle iron-nitride skin on the outer surface of the nitrided case. This skin is commonly referred to as the “white-layer,” and due to its appearance under the microscope when nitrided. This “white-layer” is usually .001” to .002” thick and often chips and spalls in service, drastically shortening the life of the case hardened part. Extremely expensive finishing operations are usually therefore necessary for removal of the “white-layer” prior to use of the case hardened part.

Presently, “white-layer” is being variously reduced or removed by the Floe process wherein cracked ammonia gas and heat are employed to diffuse the layer, by the General Motors method wherein expensive proprietary etches and abrasives are employed and necessitate careful control of the time factor, by the Pratt and Whitney method wherein acid and alkaline cleansers are employed in series, together with an electrolytic cleaning bath and by the National Bronze and Machine method wherein the iron nitride coated article is replated with copper, bronze or tin and is re-heated treated for a prolonged period to further diffuse the iron nitride within the article to be case-hardened, then the replated is stripped, resulting in almost double the cost of the original nitriding.

Notwithstanding that the Floe process, being perhaps the most widely used of the above described processes, claims effective removal of “white-layer” to the extent that only a “white-layer” of .0002” to .0004” depth remains on the case hardened article, it is submitted that this process is not consistently effective to leave less than a .0007” depth “white-layer.” Today, especially in the automobile, aircraft, and missile industries, many design engineers are demanding .0005” or less as the maximum desirable depth of “white-layer” on critical components. Thus, expensive grinding and lapping operations are still requisite to conventional processes and for the Floe process.

According to the present invention the iron nitride coat is removed from case hardened alloy steel parts by immersing the part in a cyanide bath, preferably heated, then removing the article for finishing by light abrasive cleaning. The cyanide bath may be employed also to remove copper plate applied to portions of the part not requiring case-hardening. As a result, there is provided an economical and efficient method for removal of iron nitride coatings.

Accordingly, it is an object of the present invention to provide an economical method for the removal of “white-layer” from case-hardened alloy steel parts.

Another object of the invention is to provide a method for simultaneously stripping a copper-plating layer and iron nitride layer from case-hardened alloy steel parts.

Yet additional objects of the invention will become apparent from the ensuing specification and attached claims.

As is well known, many alloy steel parts are selectively nitrided by copper plating areas to be left soft and, thereby, preventing the nitriding action in these areas. The copper plate, as well as the “white-layer,” may be removed by immersing in heated cyanide solution. The nitrided surface often turns black in part after a thin white layer has peeled off and commenced to float in the solution. Metallurgical checks show that where the nitrided surface has turned black the “white-layer” has been decomposed or removed and where the nitrided surface remains white the “white-layer” has in part decomposed; a light abrasive cleaning will complete the “white-layer” removal in either instance.

According to the present method the nitrided part whether selectively copper plated or not, is immersed in a hot solution of potassium or sodium cyanide, the solution is heated to enhance reaction and according as the white-layer peels off the nitrided surface or sufficient immersion period has elapsed, the article may be removed from the solution and abrasive cleaned.

It is suggested that a water solution in the range of 1 to 36 ounces per gallon of 95 to 100 percent sodium or potassium cyanide be employed. Suggested heating is in the temperature ranges 140° to 220° F. It has been demonstrated that failure of the copper plating to strip as a result of immersing of the case-hardened part in cyanide solution indicates a weak solution and the necessity for the addition of cyanide. If the nitrided surfaces turn completely black considerable decomposition of the white-layer is indicated and abrasive cleaning may be unnecessary. If the nitrided layer remains white or partially black and white, then abrasive cleaning by 150° to 220° mesh aluminum-oxide discharged at 6–80 p.s.i., or like process, may be employed. Abrasive cleaning is recommended, however, regardless of the color of the parts after the cyanide solution immersion to insure that all decomposed white layer has been removed.

As will be seen from the foregoing, the present method does not require additional furnace capacity, special plating facilities, or special proprietary chemical compounds and may be accomplished with improvised equipment at any location, using unskilled labor. Furthermore, the copper plate as well as “white-layer” may be stripped simultaneously, the two operations being accomplished for the cost of one. Manifestly, variations in strength of the cyanide solution, temperature and treating times may be employed without departing from the spirit and scope of invention, as defined in the subjoined claims.

1 claim:

1. Method for removal of iron nitride comprising immersing an iron nitride coated article within a cyanide solution and withdrawing said article from said solution upon decomposition of said iron nitride.

2. Method for removal of iron nitride comprising immersing an iron nitride coated article within a cyanide solution, withdrawing said article from said solution upon decomposition of said iron nitride coat, and cleaning decomposed iron nitride from said article.
3. Method as in claim 2 wherein said cleaning of decomposed iron nitride is by abrasive means.

4. Method as in claim 2 wherein said cleaning of iron nitride is by means of aluminum oxide.

5. Method as in claim 1, including determining time for withdrawal of said article from said solution, according as blackness upon said article indicates decomposition of said nitride coating.

6. Method for removal of iron nitride comprising immersing an iron nitride-coated article within a water solution of cyanide, maintaining said solution in the temperature range 140-220°F., removing said article from said solution and lightly abrasively cleaning said article with aluminum oxide.

7. Method as in claim 6 wherein said article has been selectively copper plated prior to case hardening.

8. Method for removal of an iron nitride coating subsequent to case hardening of an alloy steel article comprising developing a cyanide solution having approximately 16 ounces of 95-100 percent cyanide per gallon of water, heating said solution in the temperature range 170° to 190°F., immersing for approximately 8 hours said article within said solution, withdrawing said article from said solution and lightly abrasively cleaning said article with 150 to 220 mesh aluminum oxide discharged at 60-80 p.s.i.

9. Method as in claim 8, wherein the cyanide is sodium cyanide.

10. Method as in claim 8, wherein the cyanide is potassium cyanide.

11. Method for removal of iron nitride and copper plate coatings subsequent to case hardening of an alloy steel article comprising developing a solution having approximately 16 ounces of 95-100 percent sodium cyanide per gallon of water, heating said solution in the temperature range 170-190°F., immersing for approximately 8 hours said article within said solution, removing said article from said solution, and lightly abrasively cleaning said article with 150 to 220 mesh aluminum oxide discharged at 60 to 80 p.s.i.

12. Method as in claim 11, including replenishing said solution according as said copper coating fails to strip during immersing.

13. Method as in claim 11, including determining time for withdrawal of said article from said solution according as blackness upon the article indicates decomposition of said iron nitride coating.

14. Method as in claim 11, wherein an iron nitride coated test piece is treated simultaneously, cut and examined to confirm white-layer removal.

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