METHOD OF CASE HARDENING ARTICLES

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This invention relates to iron, particularly to treatment thereof, and more especially to that kind of treatment which is generally called cementation or case-hardening treatment.

Those skilled in the art of treating bodies composed entirely, or largely, of elementary iron know that there are certain forms of iron, generally known as crucible or tool steel, which may be hardened and tempered by well known processes such as heating followed by sudden cooling and partial reheating. This process causes a change throughout the entire body treated, so it might be said, that the hardening and tempering extend throughout the entire body.

It is also known, by those skilled in the treatment of bodies composed entirely, or largely, of elementary iron, that forms of iron other than those known as tool or crucible steel, may be altered, more or less deeply, so as to present a comparatively hard surface or shell, or in the case of extremely thin bodies, throughout the entire substance, by proper treatment. This proper treatment is known as cementation or case-hardening.

It may be, that the word cementation applies strictly to a process in which the iron is treated by being surrounded by a powder in which fusion does not take place, but as the term is commonly applied to processes in which fusion of the substances, used to treat the iron, takes place, the term will be used hereinafter as synonymous with case-hardening, and each will be considered to identify a process in which bodies, composed largely of elementary iron which will not be hardened by the ordinary process by which tool steel is hardened and tempered, are hardened by a process in which the iron is subjected in a heated state to the action of various substances, compounds, and mixtures thereof to produce a more or less deep hardened surface, shell or casing thereon.

Heretofore, iron has been case-hardened by heating it while in contact with carbonaceous nitrogenous substances, such as, for instance, leather chips. It has also been accomplished by the use of potassium ferrocyanide. Probably, the most used cementation or case-hardening substances, at the present time, is alkali-er alkalime-earthly sodium cyanide. Alkali or alkaline-earth cyanides, such as sodium cyanide, may be used as a cementation or case-hardening substance in various ways, but the most generally used method, at the present time, is to dip or immerse the heated iron into a molten mass or bath of the cyanide.

It may be that the action of a cyanide bath on heated iron is not exactly understood, but it is believed that a decomposition of the cyanide takes place, and an absorption or combination of the iron with the carbon of the cyanide and perhaps with the nitrogen takes place with the result that a substance similar to tool steel is formed as a layer or casing on the surface of the body and extending to some distance therein, depending upon the concentration of the bath used, the heat employed, and the length of treatment, so that in some cases, especially in the case of very thin bodies, the action may extend completely through the body.

It is known that a case-hardening bath of the alkali or alkaline-earth cyanides ceases to case-harden with its original rapidity or even at all after a certain time, but before the bath is free of unaltered cyanide, that is, before all of the cyanide has been decomposed.

Careful investigation is believed to show that during the case-hardening process the cyanides give rise to decomposition products, which remain in the bath, and are believed to be the oxide and carbonate of the metal or base of the cyanide. It is believed, that careful investigation has shown that the decomposition products of the cyanide, such as, the oxide and carbonate act to prevent further decomposition of the unaltered, original cyanide remaining in the bath. It is believed that this action is due to the fact that the oxide and carbonate dissociate, and by causing a high concentration of the dissociated metal or base in the bath prevents the dissociation of the original cyanide, and so prevents the case-hardening action of the cyanide. In short, the decomposition products of the cyanide remaining in the bath act as stabilizers, or cyanide anti-dissociation substances. Investigation has further shown that the stabilizing or anti-dissociation action of the decomposition products of the cyanide toward the original unaltered cyanide increases with the alkalinity of the decomposition products and also as their extent of dissociation increases.

A principal object of this invention, taking advantage of the hereinafter mentioned discoveries and proceeding upon the basis thereof, is to regulate the rate of effective case-hardening decomposition of a cyanide bath, to the end that the activity may be decreased to the rate desired.

The stabilizing action of the decomposition products, if required, could be accomplished by adding a regulating substance to the bath originally, or at any time during its use, for instance,
If the cyanide is the sodium salt, an alkaline substance, then, such as barium oxide could be added to the bath as originally made up and the stabilization of the undecomposed cyanide would be accentuated or the bath would have a reduced activity.

Although a bath, as originally compounded may give the exact result desired, nevertheless in use the activity of the bath will change, due to the varying of the decomposition products and anti-stabilizers. In order to keep the bath at the desired point of activity, the desired decreaser may be added from time to time, and in proper proportion to the addition of such further cyanide as is required by the normal exhaustion of the bath both by reason of the cementation action and by reason of adhesion losses, that is, those losses due to the adhesion of the material of the bath to iron bodies removed therefrom.

By following the teachings of this specification, case-hardening of iron bodies may be made to take place at such a slow rate as to penetrate the desired distance. The case-hardening bath may be kept in operation for a long period of time, even to weeks, by addition thereto at suitable intervals, the necessary compound, or compounds, or mixtures necessary in accordance with the teachings of this invention in order to maintain a desired concentration of stabilizers in the bath.

By following the teachings of this specification iron bodies may be case-hardened, with a complete absence of over-carbonization, with a gradual and uniform transition from the glassy hard layer to the unaltered iron, and with almost complete certainty.

One specific mixture forming a proper bath comprises 70 parts barium chloride, 10 parts strontium chloride, 10 parts alkali chloride, as sodium chloride, and 10 parts sodium cyanide. A bath, of this composition, used at the temperature usually employed in cementation work, decomposes rather rapidly. In order to retard the decomposition, about 3 to 5 parts of barium oxide or from 5 to 10 parts of barium carbonate are incorporated therein.

The above mentioned bath would be revived daily or in accordance with the needs so that it may be brought up to the proper efficiency or activity, by incorporating therein daily, the necessary amounts of sodium cyanide. If the addition of sodium cyanide should activate the bath too greatly, then the necessary amount of barium oxide or barium carbonate should be incorporated therein to reduce the activity to the desired rate.

Although we have particularly described the principle of our process, and the preferred way of practicing the process, and the particular and specific mixture of substance preferred in practicing the process, nevertheless, we desire to have it understood that the example given is merely illustrative, but does not exhaust the possibilities of the process, or the possible substances useable in carrying out the process.

This application is a division of our copending application Serial No. 541,108, filed May 29, 1931, for a Method of case-hardening iron articles.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. The method of retarding the action of a molten bath containing cyanide of sodium for case hardening iron which consists in incorporating therein barium oxide.

2. The method of retarding the action of a molten bath containing cyanide of sodium for case hardening iron which consists in incorporating therein barium carbonate.

3. The method of retarding the action of a molten bath containing cyanide of sodium for case hardening iron which consists in incorporating therein barium carbonate.

4. A fused salt bath comprising a mixture of 70 parts barium chloride, 10 parts strontium chloride, 10 parts sodium chloride, and 10 parts sodium cyanide, in combination with a basic reacting compound of barium selected from the group comprising barium oxide and barium carbonate.

5. A fused salt bath comprising a mixture of 70 parts barium chloride, 10 parts strontium chloride, 10 parts sodium chloride, and 10 parts sodium cyanide, in combination with a basic reacting compound of barium selected from the group comprising 3 to 5 parts of barium oxide and 5 to 10 parts of barium carbonate.

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