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METHOD FOR HARDENING STEELS

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1 Claim. (Cl. 219-13)

This invention relates to methods for hardening alloy steels, and is particularly adapted among other uses, for hardening articles such as of high speed tool steel where it is desired to heat the steel to hardening temperature by electromagnetic induction and in the presence of the air of the atmosphere.

The use of induction heating in the hardening of high speed tool steels has heretofore involved difficulty due to the oxidation of the alloying metals of the steel within the surface thereof during the heating step. While this difficulty may be avoided by surrounding the steel with a protective gas such as hydrogen, nitrogen or carbon monoxide, such gases as used for the purpose are difficult to control and sometimes introduce factors of danger as in the case of hydrogen which may explode, and the use of which is often prohibitive because of fire regulations. Induction heating processes are also most economical when performed with a large number of articles treated in rapid succession, and the use of such protective gases would ordinarily involve rather cumbersome hood structures, or the like, which tend to interfere with the safe, rapid operation of the induction heating machine.

It has also been heretofore suggested in lieu of such protective gases, that the steel be coated with sodium silicate, borax glass, or other salts which are intended to fuse on the surface, and in that manner protect the tool edges from atmospheric degeneration. However, such coatings have the difficulty that they tend upon heating to flow away from the sharper edges of the tool steel and gather at the heavier portions which need little or no protection.

For these reasons the use of induction heating equipment for the hardening of high speed tool steels has heretofore been relatively limited.

The present invention provides a method for satisfactorily eliminating the above difficulties.

I have found that a mixture of oil such as ordinary mineral oil and finely divided graphite, provides a material which may be used as a coating on the steel pieces during the heat treatment and is highly successful in protecting the alloying metals in the surface of the steel against oxidation.

The following is a specific example illustrating the invention in one of its forms, although it will be understood that the invention is not limited thereto except to the extent indicated in the appended claim.

A steel such as known in the trade as 18-4-1 (comprising 18% tungsten, 4% molybdenum and

1% chromium) is coated as by brushing with a mixture comprising, for example, in the neighborhood of 50% ordinary mineral oil and 50% of finely divided graphite ground to 100 mesh or finer. If desired, the steel article may be coated all over, or if preferred, as in the case of some pieces having sharpened edges, the coating may be confined to the areas comprising or adjacent to such edges. The coated article is then placed in inductive relation with the work coil of a suitable electromagnetic induction heating machine. Suitable machines for this purpose are shown, for example, in the patent to Paul E. Dravneek, No. 2,321,189, granted June 8, 1943. Sufficient current is applied to the work coil of the machine to quickly heat the steel piece to the desired hardening temperature, for example 1800-2300° F. This may be accomplished, for example, during a period of 6 or 7 seconds, or usually within a period of much less than one minute for effective surface hardening. This rapid heating causes most of the oil to be at once burned off, yet the finely divided graphite is left adhering to the surface and acts to fully protect the alloy metals at the surfaces, even on the sharp cutting edges, against oxidation. After the surface has become cooled by air quenching or otherwise, the coating may be readily removed as by buffing or by the use of a wire scratch brush. If the product is one initially having a bright and polished surface, such surface may be retained substantially unimpaired after removal of the coating. Sand blasting or other harsh means which might cause a matted surface, are not required for removal of the coating.

Photomicrographs of tool steel articles hardened as above described, except without the coating, show a substantial loss of alloy at the cutting edge through oxidation. Photomicrographs of samples treated in the same way with the coating, however, show a very marked decrease in such loss, or a practically unobservable alloy loss. A "use test" of such samples is most reliable, since the usual tests with Rockwell or Brinnell machines may give a false reading because of penetration of any thin film of oxide which may occur at the cutting edge. Under such use tests, with the uncoated samples there was invariably a loss of cutting action due apparently to the turning over of the edges. On the other hand, use tests of the hardened samples which were coated during heating, with the oil and graphite mixture, give results fully as satisfactory as could be obtained by heat treating in the presence of a protective atmosphere of non-oxidizing gas.

Equally satisfactory results with the invention have been obtained with a wide variety of steels, for example those running as high as 9.8% molybdenum. In no case has there been found any loss of cutting action due to oxidation when the steel has been heat-treated with the above described protective coating.

Such a coating is particularly advantageous for use with induction heating, since due to the great rapidity with which the heating may be accomplished, there is insufficient time for the graphite particles to combine with the oxygen of the atmosphere at temperatures such as above mentioned. Also the heating may be readily accomplished by induction without any danger of scarring, disturbing or brushing off the adhering graphite particles of the coating as would be likely to occur in the case of heating with furnaces by the use of fuel.

The percentages of oil and graphite used for the coating mixtures are not particularly critical, but it has been found that the above mentioned 50% mixture satisfactorily adheres to the steel parts without forming a paste, which would be more difficult to apply uniformly. While various oils such as vegetable oil, for example as derived from corn, may be used, mineral oil appears to be preferable.

The invention is applicable for the "through

hardening" of steels as well as surface hardening.

The term "alloy steels" as used in the appended claim, is intended to include those containing one or more of the following metals: molybdenum, tungsten, vanadium, chromium, manganese and other hardening materials.

While the invention has been described in detail with respect to certain preferred examples, it will be understood by those skilled in the art after understanding the invention that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore in the appended claim to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

In the hardening of alloy steels, the method steps which comprise coating the surface of the steel with an adhering mixture comprising substantial amounts of oil and finely divided graphitic material, then rapidly heating to hardening temperature by electromagnetic induction in the presence of air, whereby a resulting coating of the graphitic particles formed on the steel protects the alloying metals in the surface thereof against oxidation during such heating.

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