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METHOD OF HEAT TREATING MALLEABLEIZED CAST IRON

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9 Claims. (Cl. 148—21.8)

This invention relates to a metal and to a method of heat treating for producing the metal.

One object of the invention is to provide a method or process of heat treatment for treating a ferrous metal to give it strength without unduly reducing its toughness or its ductility.

Another object of the invention is to provide a method of heat treatment of malleableized iron whereby it is strengthened without appreciably reducing its malleability.

Other objects will appear from time to time in the specification and claims.

While the method finds its most important application to the treatment of malleableized iron, it is not limited to the treatment of that material. One application of the method is, therefore, in connection with the treatment of malleableized iron and that treatment will now be described.

Where malleableized cast iron is to be treated by this method, the castings, whether of black heart malleable or white heart malleable, are treated in substantially the same fashion. The white heart iron, for the purposes of this method, differs mainly from black heart iron in that it is made from an iron having a higher sulphur content. This method makes usable iron castings formed of this higher sulphur iron for certain purposes in connection with which such iron has not heretofore been usable and thus the field of usefulness of this type of iron is expanded when the parts have been subjected to the treatment set out below.

The method may be used in the treatment of irons which contain certain alloying elements. Thus it might be used in the treatment of iron containing almost any suitable alloy. Among the most common may be mentioned nickel, molybdenum, copper, manganese and vanadium, although many other alloys or combinations of alloys may be used and it is within the contemplation of my invention to treat iron alloyed with any suitable alloy.

The iron that is to be treated, whether white heart or black heart iron, is malleableized in any suitable manner. When ready for treatment by the method of this invention, it is ordinarily in the form of malleableized iron castings. These castings are then placed in a suitable furnace and are initially raised to a temperature approximating, or slightly above, the effective critical temperature, that is to say, they are initially raised to a temperature at or slightly above that actually necessary in commercial practice, to initiate the combination of the carbon with the iron. In practice, this initial temperature is frequently higher than the theoretical critical or carbon combining temperature of the material, but in practice the initial heating is held at or slightly above, but close to, the temperature at which carbon combining commences. The temperature is thus held at a point where only very small quantities of carbon can recombine and at this temperature the actual effective practical recombination of the carbon does not occur, since the temperature is carefully kept below the temperature at which this general recombination can occur in practice. The temperature of this initial heating will vary somewhat, depending upon the analysis of the metal under treatment and depending also upon the quantity of metal under treatment at a given time, upon the size of the pieces and upon other factors. Thus the castings or other parts which are to be treated are raised slowly to this initial temperature, which, in one example, is approximately 1400° F. and held at this temperature, being allowed to "soak" until all of the material in the furnace has evenly reached this temperature. In one typical cycle, this may take from an hour to an hour and three-quarters. Whatever the quantity of material being treated and whatever the length of time during which it is subjected to this initial heating, care is taken that the initial heating is held at or very slightly above a temperature at which carbon combining commences, in practice. This initial temperature to which the material is first heated in the first step of this method, although definitely below that at which satisfactory general recombination or carbon can occur, is relatively close to the final temperature at which this recombination will occur, and, therefore, after the soaking, the material may be rapidly raised to a suitable temperature to cause effective general carbon recombination.

After the completion of the initial heating and the "soaking" the material is raised more rapidly to the next temperature; ordinarily this next temperature is approximately 1475° F. and the material may be raised to this temperature quite rapidly. It is then held at that temperature for a short period—in one cycle it is held at that temperature for five minutes, and it is raised from 1400° F. to 1475° F. in from twenty to twenty-five minutes.

After the material has been held at the second heating temperature, it is quenched, preferably in oil, and when cooled it is removed from the oil and reheated to approximately 1200° F. at which

temperature it is held for a while, usually for about fifteen minutes, and it is then quenched in water. This completes the treatment.

If the material is to be given a wear resisting surface, the first heating, that is, the heating to approximately 1475° F. and the oil quenching, are carried out in a carburizing atmosphere, but the last heating to 1200° F. and the water quenching are carried out as above.

The details of the above method may be varied considerably. The materials treated may be varied. The times of treatment will under certain circumstances be quite different from those given, which are taken from a typical cycle in the treatment of a charge of 500 pounds. For the treatment of a larger or a smaller charge, the times involved might be increased or reduced.

Where in the specification and claims the expression "effective practical critical temperature" occurs, there is meant that temperature at which in practice effective carbon recombining takes place, in distinction to the theoretical critical temperature.

The temperatures at which the process may be carried out vary widely, depending among other things upon the nature of the metal, its analysis and also upon its previous heat treatment. Thus the "effective practical critical temperature" may in practice be found to vary widely and consequently the initial heating and the second heating will, in some cases, be carried out at temperatures quite different from those mentioned above. In one heat treated ferrous metal, for instance, the initial heating will be carried out at approximately 1350° F. and the second heating will be carried out at 1425° F. Thus the critical temperature may be higher or lower and when that critical temperature is determined for a given metal or a given condition, the temperatures for the first and second heatings are determined accordingly and the temperature of the first heating will be as close as it is possible to go to the approximate effective practical critical temperature without causing effective change of the metal so that when the heat has become uniform throughout the mass of metal, it may thereafter be quickly raised to the final heating temperature and when so raised will not lose uniformity of temperature throughout the mass, and thus all parts of the mass of metal can be raised rapidly in the second heating and will retain uniformity of heat and consequent uniformity of treatment throughout the mass.

I claim:

1. The method of treating malleableized cast iron, which includes the following steps: heating it initially to approximately, but slightly below the effective practical carbon combining temperature, holding it at that temperature a time sufficient to attain uniformity, subsequently raising it to a temperature definitely above the effective practical carbon combining temperature, thereafter quenching and reheating it to a temperature below the carbon combining temperature.

2. The method of treating malleableized cast iron which includes the following steps: heating it initially to approximately, but slightly below the effective practical carbon combining temperature retaining it at that temperature to raise all of the material being treated to that temperature uniformly, subsequently raising it to a temperature definitely above the effective practical carbon combining temperature, thereafter quenching it, reheating to a temperature below the carbon combining temperature, holding at that temperature to attain uniformity throughout the material being treated, and thereafter quenching.

3. The method of treating malleableized cast iron which includes the following steps: initially heating to a temperature approximately 1400° F., holding at that temperature a period sufficient to raise all of the material to a uniform temperature, thereafter raising the material to a temperature approximating 1475° F., quenching, after the quenching reheating the material to approximately 1200° F., and quenching.

4. The method of treating malleableized cast iron which includes the following steps: initially slowly heating to a temperature approximately 1400° F., holding at that temperature a period sufficient to raise all of the material to a uniform temperature, thereafter raising the material more rapidly to a temperature approximating 1475° F., quenching, after the quenching reheating the material to approximately 1200° F., and quenching.

5. The method of treating malleableized cast iron which includes the following steps: initially heating to a temperature approximately 1400° F., holding at that temperature a period sufficient to raise all of the material being treated to a uniform temperature, thereafter raising the material to a temperature approximating 1475° F., holding at that temperature to attain uniformity of temperature in all the material under treatment, quenching, after the quenching reheating the material to approximately 1200° F., and quenching.

6. The method of treating malleableized cast iron which includes the following steps: initially slowly heating to a temperature approximately 1400° F., holding at that temperature a period sufficient to raise all of the material to a uniform temperature, thereafter raising the material more rapidly to a temperature approximating 1475° F., holding at that temperature approximately five minutes, quenching in oil, after the quenching reheating the material to approximately 1200° F., holding at that temperature for approximately fifteen minutes, and quenching in water.

7. The method of treating malleableized cast iron which includes the following steps: heating the metal to a temperature approximately and slightly below its effective practical carbon combining temperature, maintaining that temperature until all of the metal is uniformly heated, thereafter rapidly increasing the heat to a temperature definitely above the practical effective carbon combining temperature, the initial heating being such that when the second heating is carried out rapidly, uniformity of temperature throughout the mass of metal is retained.

8. The method of treating malleableized cast iron, which includes the following steps: heating it initially to approximately, but slightly below the effective practical carbon combining temperature, holding it at that temperature a time sufficient to attain uniformity, subsequently raising it to a temperature definitely above the effective practical carbon combining temperature, thereafter quenching.

9. The method of treating malleableized cast iron, which includes the following steps: initially heating to a temperature approximately 1400° F., holding the material under treatment, at that temperature a period sufficient to raise all of it to a uniform temperature, thereafter raising the material to a temperature approximating 1475° F. and quenching it.

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