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(54) A method of hardening steel.

(57) A method for hardening steel in which the steel is from an austenitic state cooled through, or held at, that temperature range in which the transformation of the steel to ferrite, pearlite or bainite occurs the most rapidly, and in which after the transformation has taken place to a sufficient degree, rapid heating to hardening temperature is performed with a brief holding time at that temperature before the steel is hardened in the conventional manner in a suitable hardening medium.

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A method of hardening steel

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DESCRIPTION

The invention is for a method of hardening steel. Hardening is generally employed to enhance the strength of the steel, by which is understood also tensile strength and yield strength, and its hardness.

A general problem in connection with employment of hardened steel components is that the steel's toughness generally decreases when the strength and hardness are increased by various hardening methods.

The problem is particularly prominent when hardened steel components are employed directly in a hardened condition without the hardening being followed by a tempering process. Tempering will generally enhance the toughness of the steel at the expense of its strength and hardness.

For many applications of hardened and hardened/ tempered steel respectively it is, however, necessary that the steel has maximum strength and hardness combined with maximum toughness. Examples of such applications are the wear components of agricultural implements and digging and loading machines.

It is known in the art to increase steel toughness by making the granular structure as fine-grained as possible. This principle is employed in various methods of producing and treating steel, for example in controlled rolling. The same beneficial effect of reduced grain size also applies to hardened and hardened/tempered grain structures in steel.

The grain size of the steel <u>after</u> hardening is chiefly determined by the grain size in a heated condition at the hardening temperature <u>before</u> hardening. In this condition the grain structure of the steel is known to practitioners of the art as austenite.

Hardening creates a new structure, transformed from austenite, called martensite. The martensite structure is a series of fine needles or plates formed within the individual austenite grain, in such a manner that the martensite grain size is determined by the austenite grain size <u>before</u> hardening.

The austenite grain size varies greatly according to the steel type and the holding temperature/ holding times at which the steel is at high temperature and has an austenitic structure. A particularly coarse austenitic structure is obtained if the steel is heated above the temperature that produces granulation. This generally happens in various forms of heat treatment, for example forging, and it often directly limits the ability to harden steel direct from the forging temperature, in that the steel becomes too brittle after hardening, and there is also a greater risk of the steel cracking during the hardening itself. In order to avoid this the steel has in the prior art been allowed to cool to room temperature followed by a new heating and hardening, that is, heating to hardening temperature and sudden cooling. This, however, involves heavy energy expenditure in that the steel must be reheated. The grain structure of the steel, moreover, does not become particularly fine as a result of the afore-mentioned procedure, as the austenite grain structure is formed by the transformation of a relatively coarse structure formed by the slow cooling to room temperature.

The purpose of the invention is to supply a method for hardening of steel in which the grain size of the steel is reduced and which, when the method is employed together with the heat treatment of steel, will enable energy savings to be made.

The purpose is achieved according to the invention by causing a transformation of the steel in a temperature range between the hardening temperature and the critical temperature for formation of martensite.

The transformation is achieved by cooling the steel from an austenitic state through or holding it at that temperature at which its transformation to ferrite, pearlite or bainite occurs most rapidly. After the transformation has taken place to a sufficient degree, a rapid heating to hardening temperature is performed, with a brief holding at that temperature before the steel is hardened in the conventional manner in a suitable hardening medium. Heating and hardening times are made short to avoid new unwanted grain growth.

A method for hardening steel, characterised in that steel is from an austenitic state cooled through, or held at, that temperature range in which the transformation of the steel to ferrite, pearlite or bainite occurs the most rapidly, and that after the transformation has taken place to a sufficient degree, rapid heating to hardening temperature is performed with a brief holding time at that temperature before the steel is hardened in the conventional manner in a suitable hardening medium.