

## UNITED STATES PATENT OFFICE

2,317,211

METHOD OF HARDENING CYLINDERS, PUMP  
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a corporationNo Drawing. Application March 3, 1939,  
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2 Claims. (Cl. 148—21.5)

This invention relates to a method of hardening steel and testing the same for depth hardness.

The primary object of this invention is the provision of a method by means of which the depth of hardening of a piece of metal, such as steel, can be determined by tempering.

Other objects and advantages of this invention will be apparent during the course of the following detailed description.

In my U. S. Patent 2,218,958, I have illustrated a machine and described a method of hardening steel cylinders such as pump liners. The method therein described briefly consists of hardening the cylinder or pump liner uniformly to above its critical hardening temperature, and while so heated encasing the same in an insulation jacket. The jacket and cylinder are then rotated and a spray of water is played upon the exposed surface of the rotating cylinder with a controlled quenching operation in order to harden the inner wall surface of the cylinder to the point of maximum hardness which the steel is capable of assuming. The quenching action is continued upon the inner wall to the point that latent heat from the tube adjacent the insulating jacket cannot run back to destroy the initial hardness of the inner wall surface of the tube.

It is very essential to accurately gauge the depth of hardening of the wall of the cylinder which is to be hardened, and I have employed both the Rockwell and Brinell systems of determining the hardness. However, I have discovered that a very accurate destructive test of this cylinder, or any piece of steel which is hardened, may be carried out, as follows:—a piece of the cylinder, or any metal, the depth of hardness of which is to be determined, after a heat treatment either in the above described manner, or however treated in order to harden the same, is either fractured or a proper cross section of the wall thickness is provided. The cross section represents a complete cross section of the wall thickness. At this cross section the steel is then tempered for the purpose of coloring to any of the well known tempering colors. The result is

somewhat surprising, since instead of the metal thru the thickness thereof having a uniform color, such, for instance, as straw, brown, purple, or blue; the wall thickness will develop very definitely in two colors. One color definitely represents the depth of hardness at the wall where the hardening operation has been carried out, according to the above or any other method. The other color will represent the unhardened or softer portion. This method does not establish the degree of hardness, but it very definitely establishes in a visual manner the exact depth of hardness. This is quite important, since in combination with a hardness testing machine, it is possible to obtain the maximum hardness obtained on the face of the liner or piece of steel, and by the color tempering process it is possible to determine the exact depth of hardness.

Various changes in the steps of the method herein referred to may be made without departing from the spirit of the invention or scope of the claims.

I claim:

1. The method of hardening steel and testing the same for depth of hardness which consists in hardening the piece of steel at a surface thereof, providing a cross section of the piece of steel substantially normal to the hardened surface and tempering the steel at this cross section so that the same will develop at said cross section one color throughout the portion of greatest hardness and a contrasting color throughout the remaining portion at said cross section.

2. The method of hardening steel and testing the same for depth of hardness which consists in heating a piece of steel to a temperature above its critical hardening temperature, quenching the steel so as to harden the same at a desired area, fracturing the steel so as to obtain a cross section of the steel, and tempering this fractured section so that the steel will develop at the fracture one color throughout the portion of greatest hardness and a contrasting color throughout the remaining portion of the fractured section.

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