

# UNITED STATES PATENT OFFICE.

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## ART OF HARDENING AND TOUGHENING STEEL.

No. 832,770.

Specification of Letters Patent.

Patented Oct. 9, 1906.

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*To all whom it may concern:*

Be it known that I, JAMES CHURCHWARD, a subject of the King of Great Britain, residing in the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in the Art of Hardening and Toughening Steel, of which the following is a specification.

In carrying out the invention it will suffice to describe the actual process preferably employed in making a hardened-steel plate, although the procedure may be slightly varied, as well as the ingredients employed, when dealing with castings for different purposes. For making such a plate take the proper quantity of open-hearth steel and melt it in combination with about one per cent. of chromium, about one-half of one per cent. of tungsten, (wolfram,) about one and one-half per cent. of nickel, and about one per cent. of manganese. When the mixture of metals is melted, it is poured on a bed or in a mold composed of manganese in the form of the black oxide of manganese. It is only important that the manganese shall be on the surface of the bed or mold, where it will come in contact with the molten metal of the casting. When cooled to about a cherry-red heat, the casting is removed from the mold or bed and subjected to pressure to reduce it to the required thickness for the plate, the reduction being preferably from about ten to four in order to properly consolidate the mass. The plate may now be trimmed, sized, and bored when and where necessary, after which it is heated and immersed in a liquid bath composed of linseed-oil, creosote, and a small proportion of water and then left in said bath until it cools, when the face or part of the metal which was exposed to the manganese bed or mold will be found to be very hard, tough, and resistant.

The hardness of the face of the plate and the depth to which this hardening extends will depend on the length of time the hot metal casting remains in the bath—that is, if the metal be very hot when it is immersed in the bath it will remain longer in the bath to cool than it would if not so hot when immersed, and hence it will be the harder, or the metal may be subjected to a series of re-heatings and immersions in the bath. The treatment in the bath governs the degree of hardness, the strength, and the general durability of the metal.

Preferably the metal to be hardened will be mixed with small percentages of the four metals named—chromium, tungsten, nickel, and manganese; but the percentages of these may be varied, and for some uses the tungsten may be omitted, without departing from the present invention.

For linseed-oil any other oil or fatty substance may be employed as an equivalent, or glycerin (glycerol) may be used. The word "fatty" substances is intended herein to include glycerin. For creosote (which is a monohydric phenol) any phenol or suitable phenol derivative may be employed—as carbolic acid, for example. The word "phenol" as here used is intended to include any one or all of these substances.

By the word "manganese" as herein used is meant either the metal manganese or any of its compounds or mixture which will yield manganese by reduction in the process described.

Having thus described my invention, I claim—

1. The herein-described improvement in the art of hardening and toughening metals, which consists in mixing with the metal to be treated certain small percentages of the metals chromium, nickel, manganese and tungsten, then melting the metals, then casting the same in contact with a surface containing manganese, then pressing the hot casting, and finally immersing the hot and pressed casting in a bath composed essentially of a fatty substance and phenol and allowing it to remain therein until it cools.

2. The herein-described improvement in the art of hardening and toughening metals, which consists in mixing steel with small percentages of chromium, nickel, tungsten and manganese, then melting this mixture of metals, then casting the same in contact with a surface containing manganese, then pressing the casting produced, while hot, to the thickness required, and finally immersing the pressed casting in a liquid bath containing a fatty substance, a phenol, and water.

In witness whereof I have hereunto signed my name, this 12th day of July, 1905, in the presence of two subscribing witnesses.

JAMES CHURCHWARD.

Witnesses:

H. G. ROSE,  
WILLIAM J. FIRTH.