

UNITED STATES PATENT OFFICE

WILLIAM A. PAINTER, OF ALLEGHENY, PENNSYLVANIA.

METHOD OF HARDENING STEEL.

No. 882,162.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WILLIAM A. PAINTER, of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Methods of Hardening Steel, of which the following is a specification.

My invention relates to a new and improved method of hardening steel and more particularly to a new method of hardening cast or tool steel, whereby a piece of such steel of any size and configuration may be hardened at one or more points or portions and the balance left soft or unhardened.

15 In carrying out my method of hardening the piece of steel to be treated is first partially inclosed or shielded by a flexible covering of any suitable material that will stand a hardening temperature. I prefer to employ thin sheet iron or thin pieces or sheets of steel for the protecting material. In practice the thickness of this flexible covering material varies from .004 to $\frac{1}{16}$ of an inch. In no case should the thickness of the material be such as to prevent a practically uniform heating of the article while in its cover and a quick cooling of the protected portion or portions. In other words the thickness of the covering employed should be such as not to prevent a graduated heating and a graduated cooling of the piece being treated, whereby a wide variance in temperature producing a strain between the exposed and covered parts is avoided. A covering formed of thick or rigid plates or plates so thick as to be rigid or vice versa would produce such a variance in temperature between the protected and unprotected parts that a proper graduated tempering or hardening of the parts could not be effected. The employment of thick plates would cause a contraction of the metal and consequently a strain or crack at the line of juncture of the hardened and unhardened portions.

45 The cooling of the protected portion or portions should be quick as stated, but the said portions will cool somewhat more slowly than the exposed portion or portions. This will prevent any undue strains in the metal.

50 This shield or covering covers only that portion or portions of the article that are to remain soft, while the portion or portions to be hardened are left exposed. The covering being preferably thin flexible metal may be readily applied to an article of any size or shape, and cut or bent in such a manner as

to expose the portion or portions of the article to be hardened. The sheet or sheets constituting the covering should be fitted close to the surface of the article, following the contour of the article, and are suitably fastened by rivets, wires, or other suitable means.

The next step in the process is to subject the partially covered or protected article to the action of a proper hardening heat. This is done in the manner usually followed in hardening steel. The thin covering does not interfere in any way in the operation of heating the article to the desired hardening temperature, the operator having perfect control and being able to accurately determine the proper heat. After the piece being treated has reached the proper temperature for hardening, the piece together with its covering is immediately quenched in any suitable cooling-bath, preferably clear water. Upon the removal of the covering after the quenching step just described, it will be found that the exposed portion or portions of the steel will be hardened and the protected portion or portions soft.

By the employment of my method of hardening, I practically eliminate all risk of breakage, cracking and warping in the operation of hardening and in addition thereto, prolong the life of the treated article by having in a finished piece only those portions hardened that are desirable to be hardened, that is to say, the working or wearing surfaces, and leaving the other portion or portions soft. The hardened portions being backed up by the soft steel will produce in almost every hardened steel article much better results than if the article were hardened throughout as is the prevailing practice.

While my method is particularly applicable for hardening pieces or articles of steel of large size, such, for example, as large dies employed in the making of silverware, brassware and large sectional dies for electrical work, it may be advantageously employed for hardening any size or shape.

By my method of hardening, the operator can define with great accuracy the surface to be hardened, even to a $\frac{1}{32}$ of an inch. For example, a circular area may be hardened around a square opening or a square area hardened around a circular opening or any irregular shape. Under my method, after the quenching and the removal of the cover-

ing as above described, the steel is tempered or drawn to suitable hardness in the usual manner. With steel treated under my method the color will first appear on the hardened portions defining with accuracy the hardened and soft portions.

What I claim is:

10 The herein-described method of hardening a piece of steel to impart hardness to a portion of the steel, which consists in protecting that portion of the piece not to be hardened by a thin covering of a thickness that will not prevent a graduated heating and a grad-

uated cooling of the piece and leaving exposed that portion to be hardened, heating the piece while in its thin covering to a temperature necessary to produce hardening, then suddenly cooling the piece and its covering.

In testimony whereof I affix my signature 20 in presence of two witnesses.

WILLIAM A. PAINTER.

Witnesses:

MARGARET HUGHES,
W. G. DOOLITTLE.