

# UNITED STATES PATENT OFFICE.

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## METHOD OF TOUGHENING MANGANESE-STEEL CASTINGS.

SPECIFICATION forming part of Letters Patent No. 572,891, dated December 8, 1896.

Application filed June 13, 1896. Serial No. 595,481. (No specimens.)

*To all whom it may concern:*

Be it known that I, ROBERT A. HADFIELD, a subject of the Queen of Great Britain, and a resident of Sheffield, county of York, England, have invented a Method of Toughening Manganese-Steel Castings, of which the following is a specification.

My invention has reference to the manufacture of manganese-steel castings, that is, castings made from manganese steel, such as described, for instance, in Letters Patent Nos. 303,150 and 303,151, dated August 5, 1884. Such castings are, when untreated, comparatively brittle, and to put them in the best condition to serve the purposes for which they are intended it is necessary to subject them to a process which will toughen them. In Patent No. 333,748, dated January 5, 1886, allusion is made to the softening of manganese steel by heating it to a dull red and then plunging it into cold water. This process of toughening or softening by heating the manganese steel and plunging it in cold water carries with it the disadvantage, however, that internal fractures are liable to be produced in the heating process, and, moreover, these are such as cannot be detected on the surface of the castings.

It is the object of my present invention to so carry out this process of toughening manganese-steel castings that such fractures will be avoided or prevented. I have discovered that these fractures are primarily due to the fact that manganese steel has an exceedingly low heat-conducting power, and that because of this characteristic strains will be set up in the casting in ordinary methods of heating, and internal fractures will result from the more rapid expansion of the portions of the castings which are near the surface as compared with the interior parts of the castings. I overcome these difficulties or prevent these troubles by beginning the heating in a cold furnace and by bringing the castings up to the desired heat very gradually until they are ready to be plunged into the cold water.

In actual practice after the manganese-steel

castings have been cleaned of any excess of sand from the molds they are put into the heating-furnace in which they are to be heated before the fire is started and while the furnace is still cold. A small fire is then started in the furnace and heat is thereby applied to the castings very gradually. The first heating must be conducted at a very slow rate. This rate depends upon the thickness of the castings, that is to say, the thicker the casting the slower must be the rate of heating. By way of illustration I may say that the rate of heating should be such for thick castings, say those from two to four inches thick in their thickest parts, that one hour would be consumed in raising the casting to heat of about 400° Fahrenheit. In two hours the casting may reach, say, 800° Fahrenheit, and in three hours 1,200° Fahrenheit. After the casting, heated at this slow rate, has become visibly red I believe there is no further danger of internal rupture, and the heating may then be carried on at a more rapid or moderately rapid rate until the desired temperature is reached, say about 1,700° Fahrenheit, or, in other words, orange heat. The castings are then taken from the furnace as quickly as possible and plunged into a tank of cold water, by which the toughening process is completed.

I claim as my invention—

The process herein described of toughening manganese-steel castings, consisting in heating them, beginning with the furnace in a cold state, applying the heat very gradually until the casting is visibly red, then continuing the heat to an orange heat and finally plunging in cold water, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT A. HADFIELD.

Witnesses:

WILLIAM CROSS,  
F. J. BROUGHAM.