

UNITED STATES PATENT OFFICE.

SAMUEL S. WALES, OF MUNHALL, PENNSYLVANIA, ASSIGNOR TO CARNEGIE STEEL COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

METHOD OF TREATING ARMOR-PLATE.

1,064,034.

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No Drawing.

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To all whom it may concern:

Be it known that I, SAMUEL S. WALES, of Munhall, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Method of Treating Armor-Plate, of which the following is a full, clear, and exact description.

My invention relates to the manufacture of face-hardened armor plate, and particularly to the steps of heating and quenching for final water-hardening. Heretofore in this step of the process, the plate has been bedded in loam or similar material, which covers the back and all the edges of the plate, leaving the face to be hardened exposed. The face of the plate is exposed to the heat of the furnace, while the other parts of the plate are protected by the loam, and this face is raised to about 850 degrees to 950 degrees centigrade. During this heating, the body of the plate is heated by conduction from the face to successively lesser degrees from the face to the back, the back being usually about 550 degrees to 600 degrees centigrade. The plate is then removed from the furnace and water sprays directed against both faces. This gives the final hardness to the face of the plate, and at the same time, the body of the plate is softened or annealed by reason of its temperature being in the range in which water annealing takes place. The strength of the body of the plate is decreased by this treatment, and this can not be remedied, it being the final treatment.

My invention is designed to overcome this difficulty and to provide a method which will give the same strength and resistance in the hardened face, while at the same time, retaining the original strength and toughness of the body.

In carrying out my process, I may treat the plate in the ordinary manner up to the final water-hardening; that is, in the ordinary method, the ingot will be forged, carburized, reformed and then fibered in the usual way. Of course, the plate may be reformed or not as desired, as this is an optional step in the method. The plate is then placed in a furnace where the plate to be hardened is exposed to the heat and the edges are preferably protected by loam in the usual manner. The lower face of the plate, however, is left exposed, and is positively cooled in any desired way. For this

purpose, I preferably apply sprays of water, steam, air or other cooling fluid to the back face of the plate. This positive cooling is preferably continued through the heating of the face, and the face will thus become heated to, say, 850 degrees to 950 degrees centigrade, while the back of the plate will be kept at any desired low temperature, preferably below 400 degrees and at most below 500 degrees centigrade. In practice, I have been able to keep the back of the plate as low as 300 degrees centigrade, while attaining a temperature of 950 degrees centigrade on the face. The plate is then removed from the furnace and water-quenched in the usual manner, as, for example, by spraying both faces of the plate with the water. In this water-quenching the heated face of the plate receives its final hardness, while the body of the plate is not materially changed in its characteristics, on account of having been maintained at a much lower temperature than that of its final toughening treatment.

When the plate which has been heated according to my method is withdrawn from the furnace, it shows two zones, namely, the zone which shows heat color extending from the heated face through about one-third of the depth of the plate; and the second zone which extends through two-thirds of the face through the cooled back, and which shows substantially no color. There is, of course, no sharp line of demarcation between the two zones, one zone merging into the other.

The results of my invention are that the body of the plate for one-half or more of its thickness retains the tough characteristics imparted by the previous toughening treatment, and these characteristics are not changed by the final water-hardening of the face, whereas in former practice, this portion of the plate was materially softened. In the former method of heating, the difference of temperature between the front and back of the plate depended wholly upon the time of heating and the character of the insulating medium, the loam acting merely as a passive insulation to prevent heating from the bottom and edges and compelling the heat to soak through from the face. There was no positive cooling. In my improved process, by positively cooling the back of the plate, I can control the tempera-

ture of the major portion of the body independent of and regardless of the amount of time used in heating.

Changes may be made in the steps of treatment of the armor plate prior to the final heating for water-hardening without departing from my invention.

In a modification of my method, the back of the plate being heated may be cooled by applying a thinner plate to it, and then positively cooling the back of this thinner plate by a water spray or other similar means. In this case, the cooling action will be transmitted to the plate proper by conduction rather than by direct action upon it, as in my preferred form. The second plate may be either in direct contact with the main plate, or material may be placed between them to modify or vary the influence of the cooling.

I claim:

1. In the manufacture of face-hardened armor plate, the step consisting of heating to a hardening temperature that face of the plate which is to be hardened and simultaneously maintaining the back face of the plate below 400 degrees centigrade by artificially cooling the same; substantially as described.

2. In the manufacture of face-hardened armor plate, the steps consisting of heating to a hardening temperature that face of the plate which is to be hardened while maintaining the opposite face below a water annealing temperature by applying a cooling fluid thereto and then quenching the plate to harden its face; substantially as described.

3. In the manufacture of armor plate, the steps consisting in heating one face of the plate to between 850 degrees to 950 degrees centigrade, simultaneously maintaining an-

other face of the plate below 400 degrees centigrade and then quenching the plate; substantially as described.

4. In the manufacture of armor plate, the steps consisting in covering and thereby protecting the edges of a plate, applying heat to one face thereof and simultaneously and positively cooling the opposite face thereof by forcing a cooling liquid against it and then quenching the plate; substantially as described.

5. In the manufacture of armor plate the steps consisting in covering and thereby protecting the edges of the plate, applying heat to one face thereof, simultaneously and positively cooling the opposite face thereof by forcing a cooling liquid against it and then quenching the plate; substantially as described.

6. In the manufacture of armor plate, the steps consisting of forging the plate, carburizing one face thereof and then heating one face thereof to between 850 to 950 degrees centigrade, simultaneously cooling the other face of the plate to maintain its temperature below 400 degrees centigrade and then quenching the plate; substantially as described.

7. In the manufacture of face-hardened armor plate, the step consisting in heating to a hardening temperature that face of the plate which is to be hardened while simultaneously cooling and keeping the back of the plate below the temperature at which red color is visible; substantially as described.

In testimony whereof, I have hereunto set my hand.

S. S. WALES.

Witnesses:

GEO. B. BLEMING,
R. D. LITTLE.