

UNITED STATES PATENT OFFICE.

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METHOD OF MAKING ARMOR-PLATES.

996,544.

Specification of Letters Patent. Patented June 27, 1911.

No Drawing.

Application filed May 29, 1908. Serial No. 435,709.

To all whom it may concern:

Be it known that I, SAMUEL S. WALES, of Munhall, Allegheny county, Pennsylvania, have invented a new and useful Improvement in the Method of Making Armor-Plates, 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 process set forth in the application of Lee H. Bowman, Serial No. 433,499, filed May 18th, 1908.

The object of the present invention is to improve the Bowman process, and increase the strength of the back.

In carrying out the invention I preferably follow standard practice in casting and forging, after which the plate may be carburized and reformed or not as desired. I then fiber or anneal the plate in the ordinary manner by heat treatments such as are well known. The plate may then be shaped and machined if desired. In accordance with the Bowman treatment, I then heat the back of the plate up to a temperature of about 950 degrees C., while the sides and other face are protected. This protection may be by bedding in loam, or by protecting the sides and leaving the face-portion open to the air. In this step the plate is heated through preferably 60 or 75 per cent. of its depth from the back and up to a temperature above the recalescence point. Owing to the increased depth to which this heat is carried over that of ordinary face-hardening, I preferably give the plate a longer heat treatment than that now ordinarily employed. In this step the back and about three-fourths of the depth of the plate may be brought to a high temperature, above that at which steel hardens, after which the plate is taken out of the furnace and quenched, preferably in water. The back of the plate is thus given a crystalline or chilled structure, which preferably extends more than half way of the depth and usually to about three-fourths of the depth toward the face. After this step, I introduce my new step, which consists in annealing the back portion of the plate. If the entire plate is to be annealed, it is put in the furnace with the back exposed to the heat and without protecting the sides and face, and the plate is then raised to an annealing temperature which runs from about 450 to about 750 degrees C. In order to

minimize the difference in temperature between the back and front of the plate, this heating operation is preferably a long one. The plate is then allowed to cool, and if it is desired to hasten the operation it may be quenched. The annealing may be either carried out in the manner just stated, or the difference in temperature between the back and front may be accentuated by protecting the face and side edges of the plate while heating the back to the annealing temperature. This would be a somewhat shorter heating operation, and in it the back or chilled portion only of the plate need be raised to the annealing temperature of 450 to 750 degrees C. In this case also the plate may be cooled down gradually or quenched in water as desired. The plate may then be face-hardened in the ordinary manner by heating its face up to about 950 degrees C. while the back is bedded in loam, and then quenched in water. I prefer, however, to face-harden the plate in accordance with the process of my application Serial No. 401,702, filed November 11th, 1907. I therefore heat the face of the plate to about 950 degrees C., while the character of the back portion is preserved by applying a water spray to the back of the plate during the heating of its face, this water-spray holding the back so that no color appears thereon. This water spray in this case prevents the heat treatment of the face from changing the back which has now been put into its final desired condition. The plate is then taken out of the furnace and quenched to harden the face. In the chilling of the back, there is a certain gradation of temperature from the back to the front, which causes a proportional gradation in the hardness when quenched. For this reason, I prefer in the annealing step to anneal this back portion only while protecting the sides and face, because in this way I can give a gradation in the annealing temperature from the back toward the front which may roughly correspond to the gradation in the degree of hardness. The annealing temperature in this way may be roughly proportioned to this degree of hardness acquired from the original chill.

The advantages of my invention result from the special annealing step, after chilling the back and before face-hardening, (this either being an entire annealing of the plate or annealing of the chilled portion

only). This allows me to chill the back more severely and to a much greater depth than in the Bowman process, as I have complete control of the subsequent annealing temperatures, since I do not depend solely on sufficient heat soaking through from the face of the plate during heating for final water-hardening, to anneal the back. By this special step I insure the obtaining of the desired physical condition of the back.

The process may be applied to either face-carburized armor-plate, or ordinary face-hardened plates.

I claim:—

1. In the manufacture of armor plate, the steps consisting in taking a steel plate having a chilled back portion with the chill extending partly through the plate, annealing the plate from the chilled back inwardly partly through the thickness of the plate and then face-hardening the plate.

2. In the manufacture of armor plate, the steps consisting in chilling the back portion of the plate, the chill extending inward partly through the plate, annealing the plate from the chilled back portion inwardly partly through the plate and then heating the face portion to above the recalescence point while maintaining the back portion below a hardening temperature and then quenching the plate.

3. The method of making face hardened armor plate, consisting in chilling the plate from the back inwardly through the major portion of its thickness, then annealing the chilled thickness only of the plate and then face-hardening the plate.

4. In the manufacture of armor plate, the steps consisting in heating a steel plate from the back to a hardening temperature, said temperature gradually decreasing from the back toward the face, quenching the plate, then annealing the hardened back portion by applying heat to the back face of the plate, this temperature gradually decreasing toward the face of the plate while protecting the sides and face, cooling the plate, and then face-hardening the plate.

5. The method of making armor plate consisting in taking a fibered steel plate, heating the back portion of the plate to convert it into a crystalline structure while retaining the face portion in its annealed or fibered condition, quenching the plate, annealing the plate at a temperature from about 450° to 750° C., and then face hardening the plate.

6. The method of making armor plate consisting in forming a fibered steel plate, heating the back portion up to above the recalescence point while retaining the face portion in an annealed or fibered condition, quenching the plate, annealing the back portion of the plate and then heating the face portion to above the recalescence point while the back portion is of a temperature below that of hardening and then quenching the plate.

In testimony whereof, I have hereunto set my hand.

SAMUEL S. WALES.

Witnesses:

M. V. KIEHL,
H. M. CORWIN.