

UNITED STATES PATENT OFFICE.

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MANUFACTURE OF ARMOR-PLATES.

1,051,380.

Specification of Letters Patent.

Patented Jan. 28, 1913.

No Drawing.

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To all whom it may concern:

Be it known that I, JOHN LAWRENCE BENTHALL, a subject of the King of Great Britain, residing at Highfield Hall, Chesterfield, in the county of Derby, England, have invented certain new and useful Improvements in the Manufacture of Armor-Plates, of which the following is a specification.

This invention relates to the manufacture of armor plates that are composed of nickel steel alloyed with one or more of the metals chromium, vanadium, tantalum, molybdenum, etc., and that are subjected during their manufacture to heat treatment, such as for example that disclosed in the specification of the prior British Patent No. 4,328 of the year 1893.

The chief object of the invention is to improve the structure of the back portion of the plate so that its resisting power in attack will be strengthened, thus rendering the plate particularly suitable for resisting penetration by capped projectiles.

According to this invention, the plate, after having been rolled and annealed in the usual manner, is subjected to cementation on both sides; then after treatment by known methods adopted in the manufacture of armor plates such for example as that hereinafter set forth, and after machining, the said plate is finally hardened on each side in succession, the final hardenings being effected at the appropriate final face hardening temperature; the side that is last hardened constituting the face proper of the plate when in its finished condition. An intermediate low heat (1100° F. to 1250° F.) may be given to plates of high carbon percentage, between the two final hardenings. The effect of heating for the second final hardening is to reduce the extreme hardness of the back portion of the plate produced by the first final hardening and to leave it considerably improved as regards tensile strength without materially affecting the tensile strength of the middle portion of the plate.

In order that the invention may be clearly understood and readily carried into effect, I will describe the same more fully with reference to a specific method of manufacturing an armor plate from nickel chrome steel of a particular and known composition, it

being understood that the invention is not restricted to steel of this particular composition or to the details of the method of manufacture set forth.

The steel referred to contains .3 to .4 per cent. of carbon, .3 to .4 per cent. of manganese, 3.7 to 3.9 per cent. of nickel, and 1.7 to 2 per cent. of chromium. A plate of this steel after being rolled and annealed is subjected to cementation in the ordinary manner, except that it is cemented on the face and the back simultaneously, instead of on the face only as is usual. After being subjected to cementation for the requisite time which varies with the thickness of the plate, amounting to from about fifteen days for a six inch plate to about eighteen days for a twelve inch plate, the cemented plate is heated to from 1450° F. to 1550° F. and bent to shape while hot. It is then heated to from 1560° F. to 1620° F. and oil hardened in the ordinary way. The plate is then heated to from 1200° F. to 1350° F. and cooled in air on supports. It is then heated to from 1100° F. to 1250° F. according to the amount of carbon in its composition and is then sprinkled with water and cooled down to the atmospheric temperature. The plate is then machined and drilled where necessary prior to the final hardenings.

To perform the final hardenings the plate is placed on a sand bed with the back upward and is differentially hardened to a depth of about two thirds the thickness of the plate. After being sprinkled in the regular way it will be found that the face proper is concave. The plate is then again bedded on sand with the face proper upward this time, and is finally differentially hardened in the known manner, thereby imparting to the face proper a hardened layer of about 1½ inches to 1¾ inches thickness for a six inch plate and about 2 to 3 inches for thicker plates. It will also be found that this second final hardening, namely that applied to the face proper, has resulted in the hardness of the back, which has been hardened to a depth of about two thirds the thickness of the plate, as above mentioned, being drawn out by the second differential hardening, but the structure of the back will be found to be in a fine fibrous condition and with a tensile strength very much greater than before. The two final hardenings,

namely those upon the back and face respectively, are of course effected by raising these parts to the high temperature necessary for final hardening, that is to say a temperature of from 1850° F. to 2000° F. according to the thickness of the plate.

What I claim and desire to secure by Letters Patent of the United States is:—

10 1. In the manufacture of armor plates, subjecting both sides of the plate to cementation, then subjecting the cemented plate to successive heatings and coolings, and subsequently subjecting the plate to final hardening on each side in succession.

15 2. In the manufacture of armor plates, subjecting both sides of the plate to cementation simultaneously, then subjecting the cemented plate to successive heatings and coolings, and then, after machining said

plate, subjecting it to final hardening on each side in succession. 20

3. In the manufacture of armor plates, rolling and annealing the plate, subjecting it to cementation on both sides, heating it to a temperature suitable for oil hardening, 25 cooling it with oil, heating it to a temperature suitable for air hardening, cooling it in air, heating it to a temperature suitable for water hardening, cooling it with water, and then, after machining said plate, sub- 30 jecting it to final hardening on each side in succession.

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

JOHN LAWRENCE BENTHALL.

Witnesses:

HENRY KING,
ALFRED PEAKS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."