

# UNITED STATES PATENT OFFICE.

ROBERT A. HADFIELD, OF SHEFFIELD, ENGLAND.

## MANUFACTURE OF ARMOR-PLATES.

No. 831,858.

Specification of Letters Patent.

Patented Sept. 25, 1906.

Application filed October 18, 1905. Serial No. 283,235.

*To all whom it may concern:*

Be it known that I, ROBERT A. HADFIELD, a subject of the King of Great Britain, and a resident of Sheffield, county of York, England, have invented an Improvement in the Manufacture of Armor-Plates, of which the following description is a specification.

Armor-plates are now commonly made of steel by rolling with plain flat surfaces and subsequently hardening the face by cementation, and, as is well known, such plates are not only costly to produce, but they can be readily perforated with capped projectiles.

In the course of my experiments to decrease the cost of production of armor-plate and to increase the resistance thereof to penetration I have discovered that the desired results can be obtained by casting suitable steel in a suitable mold and subsequently hardening the face by appropriate treatment. Armor-plate so produced offers such great resistance to penetration as to largely, if not entirely, neutralize the protective action of the cap on a projectile of the type commonly used for perforating ordinary Krupp cemented armor.

The novel features of my invention will accordingly be fully described in the subjoined specification and particularly pointed out in the following claims.

In practicing my invention I prepare a mold from a pattern of appropriate dimensions and having a face formed of the desired, configuration for the plate to be produced.

The mold is conveniently made of fire-resisting sand dried in the usual manner. Upon one of its edges (the plate being preferably cast vertically) the head or feeding portion is located. The metal used may advantageously be steel prepared similarly to the manner set forth in my British Patent No. 16,132 of 1901. After pouring and while the casting is hot it is removed to a furnace to cool down slowly, and thereby prevent it being strained internally, after which the sand is removed and the casting carefully cleaned. The casting is now placed in a furnace, and upon the face of the casting is placed charcoal, forming a layer several inches thick, and the temperature of the furnace is raised to, say, between 900° and 1,100° centigrade and so maintained for several days, after which it is allowed to gradually cool down. The head or riser is then removed in suitable manner, and the plate is heated to from 700° to 800° centigrade, preferably about 730° centigrade,

and cooled slowly in the furnace, this heating being then repeated, with subsequent cooling to about 640° centigrade, and quenching. The quenched plate is now again heated to 620° centigrade, or thereabout, and quenched, after which the plate is then uniformly or "taper" heated. In the latter case the plate is so heated that its face assumes a temperature of from 700° to 750° centigrade, tapering or decreasing to about 400° or 500° at the back. I then heat the plate in a similar manner to that described in my British Patent No. 15,220 of 1904 to a sufficiently high temperature so that being somewhat hotter when dipped or sprayed with oil or water, according to the hardness required, the face of the plate becomes hard and the back remains soft and tough.

Preferably the plate is subjected to the entire process or treatment described in said patent.

I may more or less modify the details of treatment hereinbefore set forth without departing from my invention. In some cases, for instance, if a very soft steel is used—i. e., low in carbon—a uniform heating may be adopted instead of a taper heating.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The process of making steel armor-plate, comprising the steps of casting the plate, subjecting the plate to a temperature up to 1,100° centigrade while the face thereof is in contact with carbonaceous material, gradually cooling down the plate, and then reheating the plate to a lower temperature; subsequently quenching at about 640° centigrade; and finally heating to a hardening temperature and applying a cooling medium.

2. The process of making steel armor-plate, comprising the steps of casting the plate; covering the face of the plate with charcoal and subjecting the plate to a temperature up to 1,100° centigrade for several days; gradually cooling the plate; reheating to a lower temperature and slowly cooling; reheating the plate and then quenching it at about 640° centigrade; and finally heating to a hardening temperature and applying oil or water thereto.

3. The process of making steel armor-plate, which consists in casting the plate; slowly cooling and cleaning the casting; covering its face with charcoal and subjecting the plate for several days to a temperature of

from 900° centigrade to 1,100° centigrade and  
allowing it to gradually cool down; heating  
to from 700° to 800° centigrade and cooling  
it slowly in a furnace; repeating the last  
5 heating, cooling to about 640° centigrade and  
quenching; reheating to about 620° centigrade  
and again quenching; finally heating  
the casting to a temperature of from 700° to  
750° centigrade at its face and tapering to  
10 from 400° to 500° centigrade at its back, and

finally treating the plate so that when dipped  
or sprayed with oil or water the face becomes  
hard and the back remains soft and tough.

In testimony whereof I have signed my  
name to this specification in the presence of 15  
two subscribing witnesses.

R. A. HADFIELD.

Witnesses:

G. H. HEMSOLL,  
J. W. CRAWLEY.