

# UNITED STATES PATENT OFFICE.

EUGÈNE SCHNEIDER, OF LE CREUSOT, FRANCE.

PROCESS FOR THE TREATMENT OF STEELS FOR INDUSTRIAL PURPOSES.

No. 931,489.

Specification of Letters Patent.

Patented Aug. 17, 1909.

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To all whom it may concern:

Be it known that I, EUGÈNE SCHNEIDER, of Le Creusot, Saône-et-Loire, France, have invented a new and useful Process for the Treatment of Steels for Industrial Purposes, which is fully set forth in the following specification.

In the manufacture of armor plates from special steels, the metal is allowed to cool after it has been rolled and forged and before it is subjected to the subsequent operations of cementation, tempering, etc. There are steels in which this cooling necessarily gives rise to the formation of blow holes, that is to say rents resulting from internal tensions.

The present invention has for its object a method of treatment which completely obviates this defect and likewise facilitates the machining of the metal. This process results from the observation that in the steels in question the formation of blow holes is inevitable unless care be had to insure the exhaustion of the exothermic phenomena due to the complex carbids which are produced on cooling.

The following are some explanations as regards these phenomena:—If a steel heated to a suitable temperature be allowed to cool, and if the curve of the cooling be plotted, an interruption in this cooling will be observed at a certain temperature. This interruption is explainable by a liberation of heat in the metal and corresponds to an exothermic phenomenon (literally a phenomenon which liberates heat). We call the temperature at which this phenomenon commences the critical point in the cooling.

When, on the other hand, the metal is heated, it is observed that at a certain temperature a phenomenon which is the inverse of the foregoing is produced, that is to say an absorption of heat, and the temperature at which this phenomenon begins is called the critical point in the heating of the metal. For the steels in question, the temperature of the critical point in the heating is always much higher than the temperature of the critical point in the cooling. The intensity of the exothermic phenomena and of the inverse phenomena, and the position of the critical points in the scale of temperatures vary largely with the circumstances and particularly with the nature of the steel.

A general description of the phenomena

indicated above is given in Chapter II of Baron von Jüptner's "*La Siderologie*".

Having given these explanations, we will proceed to indicate the treatment necessary for preventing the formation of blow-holes. The metal is seized at a temperature adjacent to that of the critical point in cooling, but slightly above it, and according to circumstances this cooling is stopped for an appropriate period, or else heating is effected to a temperature suitably lower than the critical point in heating, or these two treatments are adopted in succession. There are circumstances in which the stoppage of the cooling may be carried to such a point that during a given time the temperature of the metal does not fall at all. After this intermediate operation, total cooling is effected, and this operation can then be carried out without inconvenience or risk as the metal has assumed a final state of molecular equilibrium. This process can be adopted with a degree of utility which increases in proportion as the critical point in cooling the special metal is lower.

In practice the procedure may be as follows, for example:—After being subjected to the operations of rolling and forging the metal is heated to an appropriately high temperature such as 850° C. which may even should be higher than the critical point in heating. It is then allowed to cool to a temperature higher by about 250° than the critical point in cooling. At this moment the metal is seized, that is to say instead of leaving it alone its cooling is retarded as much as possible, either by the juxtaposition of heat-retaining materials or by furnishing a supplementary quantity of heat. In the case of thin plates the retardation of the cooling thus effected may be sufficient in certain cases. In the case of thick plates, it is advantageous either to replace the retardation of the cooling by an actual heating of the plates carried to a temperature lower than the critical temperature in heating, or to follow the retardation of the cooling by the re-heating already referred to. The highest temperature during this reheating is much lower than that of the first heating, and sufficiently low to avoid the destruction of the part of the molecular transformations obtained during the first half of the treatment. This second heating is followed by a cooling which may be rapid

or slow at will. After these several treatments have been effected, the exothermic phenomena are exhausted, the molecular arrangements are complete, the absence of tensions is perfect and the facility of machining in a cold state is as great as possible having regard to the nature of the metal, and owing to this the steels are rendered capable of industrial utility.

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

1. The process of treating steel for armor plates and other purposes, consisting in maintaining the temperature of said metal between the critical point in heating and the critical point in cooling for a suitable period to effect absence of blow holes in said metal.

2. The process for treatment of steels for armor plates and other purposes, consisting in heating said metal to a temperature above the critical point in heating, cooling the same to a point above the critical point in cooling, and then retarding the cooling of the same by maintaining for a period the temperature of the metal approximately at said last-named temperature for the purpose described.

3. The process for treatment of steels for armor plates and other purposes, consisting in heating said metal to a temperature above the critical point in heating, cooling the same to about 250° C. above the critical point in cooling and then retarding the cooling of the same by maintaining for a period the temperature of the metal approximately at said last-named critical point for the purpose described.

4. The process for treatment of steels for armor plates and other purposes, consisting in heating said metal to a temperature above the critical point in heating, cooling the same to above the critical point in cooling, then retarding the cooling of the same by maintaining for a period the temperature of the metal approximately at said last-named temperature and reheating to a temperature short of that of the first heating, and such that the transformations first obtained are preserved.

50 5. The process for treatment of steels for armor plates and other purposes, consisting in heating said metal to a temperature above the critical point in heating, cooling the same

to about 250° C. above the critical point in cooling, then retarding the cooling of the same by maintaining the temperature of the metal approximately at said last-named temperature and reheating to a temperature short of that of the first heating, and such that the transformations first obtained are preserved.

6. The process for the treatment of steels for armor plates and other purposes, consisting in heating said metal to a temperature above the critical point in heating, cooling to a point above the critical point in cooling and then retarding cooling of the metal by furnishing thereto a supplementary quantity of heat.

7. The process for the treatment of steels for armor plates and other purposes, consisting in heating said metal to a temperature above the critical point in heating, cooling to about 250° C. above the critical point in cooling and then retarding cooling of the metal by furnishing thereto a supplementary quantity of heat.

8. The process for the treatment of steels for armor plates and other purposes, consisting in heating said metal to a temperature above the critical point in heating, cooling to a point above the critical point in cooling and then retarding cooling of the metal by furnishing thereto a supplementary quantity of heat, and re-heating to a temperature short of that of the first heating and such that the transformations first obtained are preserved.

9. The process for the treatment of steels for armor plates and other purposes, consisting in heating said metal to a temperature above the critical point in heating, cooling to about 250° C. above the critical point in cooling and then retarding cooling of the metal by furnishing thereto a supplementary quantity of heat and reheating to a temperature short of that of the first heating and such that the transformations first obtained are preserved.

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

EUGÈNE SCHNEIDER.

Witnesses:

JEAN DES PORTES,  
H. C. COXE.