

Title (en)  
METHOD FOR PRESS HARDENING OF STEEL

Title (de)  
VERFAHREN ZUM PRESSHÄRTEN VON STAHL

Title (fr)  
PROCÉDÉ DE DURCISSEMENT D'ACIER À LA PRESSE

Publication  
**EP 2864505 B1 20200506 (DE)**

Application  
**EP 13732131 A 20130625**

Priority  
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• EP 2013063282 W 20130625

Abstract (en)  
[origin: DE102012105580B3] Press hardening of steel, comprises cold pre-forming a steel sheet made of a hardenable steel alloy, transforming in a mold, which has the contour of the preformed component, heating to perform a complete austenitization, and cooling at a speed higher than the critical hardening speed, such that a quenching of the preformed element takes place. A press hardness number is determined e.g. for adjusting the suitable steel alloy to known plant geometry, where the press hardness number is equal to the cooling rate in the mold/theoretical press cooling rate. Press hardening of steel, comprises either: cold pre-forming a steel sheet made of a hardenable steel alloy, transforming in a mold, which has the contour of the preformed component, heating to perform a complete austenitization, and cooling at a speed higher than the critical hardening speed, such that a quenching of the preformed element takes place; or heating a sheet of a steel with a composition, which allows a press hardening, to a temperature above the austenitizing temperature, hot molding in a mold, cooling at a speed which is higher than the critical hardening speed, such that hardening takes place, where the austenitic structure is transformed into a martensitic structure optionally with residual austenite. A press hardness number is determined for: adjusting the suitable steel alloy to known plant geometry, and the cooling rate achieved during operation in the mold; or adjusting a required mold to a given grade of steel, where the press hardness number is equal to the cooling rate in the mold/theoretical press cooling rate. The cooling rate in the mold is predetermined for a required thickness. The determination of the theoretical press cooling rate for steel material, which contain greater than 5 ppm boron dissolved in the starting material is represented by: theoretical press cooling rate is equal to  $1750 / (28.5\% \text{ carbon} + 3.5\% \text{ silicon} + 2.3\% \text{ manganese} - 2\% \text{ aluminum} + 4\% \text{ chromium} + 3\% \text{ nickel} + 25\% \text{ molybdenum} - 20\% \text{ niobium} - 6.3) \geq 7$ . The determination of the theoretical press cooling rate for steel material, which contain less than 5 ppm boron dissolved in the starting material is represented by:  $2750 / (28.5\% \text{ carbon} + 3.5\% \text{ silicon} + 2.3\% \text{ manganese} - 2\% \text{ aluminum} + 4\% \text{ chromium} + 3\% \text{ nickel} + 25\% \text{ molybdenum} - 20\% \text{ niobium} - 7) \geq 8$ , where: when press hardness number is less than 1 the complete hardening by martensite formation does not takes place; when press hardness number is equal to 1 an undeformed or preformed sheet is cured via an indirect process; and when press hardness number is less than 1, in addition to the indirect process, the sheet is thermoformed or increased security against plastic deformation during hardening takes place.

IPC 8 full level  
**C21D 1/18** (2006.01); **C21D 1/673** (2006.01); **C21D 6/00** (2006.01); **C21D 8/00** (2006.01); **C21D 11/00** (2006.01); **C22C 38/02** (2006.01); **C22C 38/04** (2006.01); **C22C 38/06** (2006.01); **C22C 38/44** (2006.01); **C22C 38/46** (2006.01); **C22C 38/48** (2006.01); **C22C 38/50** (2006.01); **C22C 38/54** (2006.01); **C22C 38/58** (2006.01)

CPC (source: EP US)  
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Citation (examination)  
MERKLEIN ET AL: "Determination of Material and Process Characteristics for Hot Stamping Processes of Quenchenable Ultra High Strength Steels with Respect to a FE-based Process Design", vol. 1, no. 1, 15 April 2009 (2009-04-15), pages 411 - 426, XP009505257, ISSN: 0096-736X, Retrieved from the Internet <URL:http://www.jstor.org/stable/26282671> DOI: 10.4271/2008-01-0853

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