

Title (en)  
Thermoformed steel product and method for producing same

Title (de)  
Warmumgeformtes Stahlprodukt und Verfahren zu dessen Herstellung

Title (fr)  
Produit d'acier déformé à chaud et son procédé de fabrication

Publication  
**EP 2453026 A1 20120516 (DE)**

Application  
**EP 10190719 A 20101110**

Priority  
**EP 10190719 A 20101110**

Abstract (en)  
Producing steel product comprises: subjecting steel comprising carbon, manganese, chromium, nickel, phosphorus, and iron and steel impurities to hot forming at 900-1300[deg] C; and cooling it in air. The average austenite grain size of the steel after the final hot forming step is less than 50 mu m. The cooling of the forming heat in static or moving air is carried out such that the cooling is carried out at a temperature of 800-500[deg] C with a cooling rate of 0.1-8 K/s. The steel product comprises lower bainite, granular or upper bainite, martensite, austenite, and ferrite. Producing steel product comprises: subjecting steel comprising (in wt.%) carbon (0.03-12.2), manganese (2-4), chromium (0.05-2), nickel (0.05-1), phosphorus (upto 0.035), and iron and steel impurities (remaining amount) to hot forming at 900-1300[deg] C; and cooling it in air. The average austenite grain size of the steel after the final hot forming step is less than 50 mu m. The cooling of the forming heat in static or moving air is carried out such that the cooling is carried out at a temperature of 800-500[deg] C with a cooling rate of 0.1-8 K/s. The weight proportion (x) of the above components satisfies the condition Bs (greater than 700) is equal to  $1.103-270x(x)\text{carbon} - 90x(x)\text{manganese} - 70x(x)\text{chromium} - 37x(x)\text{nickel} - 83x(x)\text{molybdenum}$  (less than 800). The steel product comprises (in %) lower bainite (60-95), granular or upper bainite (upto 10), martensite (upto 40), austenite (upto 20), and ferrite (upto 2). An independent claim is also included for a hot formed steel product, producible by the above method, comprising (in wt.%) carbon (0.03-0.20), manganese (2-4), chromium (0.05-2), nickel (0.05-1), phosphorus (upto 0.035), and iron and steel impurities (remaining amount).

Abstract (de)  
Zur Herstellung eines verbesserten Stahlprodukts wird ein Stahl mit einem Gewichtsanteil von: 0.03 bis 0.20 % Kohlenstoff (C), 2.00 % bis 4.00 % Mangan (Mn), 0.05 bis 2.00 % Chrom (Cr), 0.05 bis 1.00% Nickel (Ni), bis zu 0.035% Phosphor (P), der Rest Eisen sowie stahlübliche Beimengungen, einer Warmumformung bei 900 bis 1300°C unterzogen und danach an Luft abkühlt, wobei die mittlere Austenitkorngrosse nach dem letzten Warmumformungsschritt kleiner ist als 50 µm und wobei die Abkühlung aus der Umformhitze an ruhender oder bewegter Luft so geschieht, dass der Temperaturbereich zwischen 800 und 500°C mit einer Kühlrate von 0.1 bis 8.0 K/s durchlaufen wird. Die prozentualen Gewichtsanteile x(i) von Kohlenstoff, Mangan, Chrom, Nickel und Molybdän erfüllen dabei die folgende Bedingung:  $700 < B_s = 1 \cdot x_C - 90 \cdot x_{Mn} - 70 \cdot x_{Cr} - 37 \cdot x_{Ni} - 83 \cdot x_{Mo}$  < 800

IPC 8 full level  
**C21D 6/00** (2006.01); **C22C 38/04** (2006.01); **C22C 38/08** (2006.01); **C22C 38/18** (2006.01)

CPC (source: EP)  
**C21D 6/00** (2013.01); **C21D 6/004** (2013.01); **C21D 6/005** (2013.01); **C22C 38/02** (2013.01); **C22C 38/04** (2013.01); **C22C 38/08** (2013.01); **C22C 38/18** (2013.01); **C22C 38/44** (2013.01); **C22C 38/58** (2013.01); **C21D 2211/001** (2013.01); **C21D 2211/002** (2013.01); **C21D 2211/008** (2013.01)

Citation (applicant)  
• WO 2007017161 A1 20070215 - TENARIS CONNECTIONS AG [LI], et al  
• EP 0845544 A1 19980603 - ASCOMETAL SA [FR]  
• EP 0775756 A1 19970528 - ASCOMETAL SA [FR]  
• GB 2297094 A 19960724 - BRITISH STEEL PLC [GB], et al  
• CN 1477226 A 20040225 - UNIV TSINGHUA [CN]  
• W. STEVEN; A.J. HAYNES, JISI, vol. 183, 1956, pages 349 - 359

Citation (search report)  
• [XY] JP 2007284774 A 20071101 - JFE BARS & SHAPES CORP  
• [Y] EP 2103704 A1 20090923 - SWISS STEEL AG [CH]

Cited by  
DE102022110466A1

Designated contracting state (EPC)  
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Designated extension state (EPC)  
BA ME

DOCDB simple family (publication)  
**EP 2453026 A1 20120516**; EP 2453027 A1 20120516; EP 2453027 B1 20181024; PL 2453027 T3 20190531

DOCDB simple family (application)  
**EP 10190719 A 20101110**; EP 11188717 A 20111110; PL 11188717 T 20111110