Title (en)

HIGH STRENGTH STEEL FLAT PRODUCT AND METHOD FOR ITS PRODUCTION

Title (de)

HOCHFESTES STAHLFLACHPRODUKT UND VERFAHREN ZU DESSEN HERSTELLUNG

Title (fr)

PRODUIT PLAT EN ACIER HAUTEMENT RÉSISTANT ET SON PROCÉDÉ DE FABRICATION

Publication

EP 2710158 B1 20170315 (DE)

Application

EP 12721842 A 20120516

Priority

- EP 11166622 A 20110518
- EP 2012059076 W 20120516
- EP 12721842 A 20120516

Abstract (en)

[origin: EP2524970A1] Flat steel product exhibiting a tensile strength of at least 1200 MPa, comprises steel comprising carbon, silicon, manganese, aluminum, phosphorus, sulfur, nitrogen, optionally chromium, molybdenum, vanadium, titanium, niobium, boron or calcium, iron and unavoidable impurities. The flat steel product exhibits a structure comprising (in surface %) ferrite (less than 5), bainite (less than 10), untempered martensite (5-70), residual austenite (5-30), and tempered martensite (25-80), where at least 99% of iron carbide present in the tempered martensite exhibits a size of less than 500 nm. Flat steel product exhibiting a tensile strength of at least 1200 MPa, comprises steel comprising (in wt.%) carbon (0.1-0.5), silicon (0.1-2.5), manganese (1-3.5), aluminum (up to 2.5), phosphorus (up to 0.020), sulfur (up to 0.003), nitrogen (up to 0.02), optionally chromium (0.1-0.5), molybdenum (0.1-0.3), vanadium (0.01-0.1), titanium (0.001-0.15), niobium (0.02-0.05), boron (0.0005-0.005) or calcium (up to 0.01), iron and unavoidable impurities. The sum of the contents of vanadium, titanium and niobium is = 0.2 wt.%. The flat steel product exhibits a structure comprising (in surface %) ferrite (less than 5), bainite (less than 10), untempered martensite (5-70), residual austenite (5-30), and tempered martensite (25-80), where at least 99% of iron carbide present in the tempered martensite exhibits a size of less than 500 nm. An independent claim is also included for producing the flat steel product exhibiting high tensile strength, comprising providing an uncoated flat steel product made of the above steel, heating the flat steel product to an austenitizing temperature (T(HZ)), which is greater than (A(c3)) temperature (temperature at which transformation of ferrite into austenite is completed upon heating a steel) of the steel of the flat steel product, preferably to not > 960[deg] C at a heating rate (theta (H1), theta (H2)) of at least 3[deg] C/second, holding the flat steel product at the austenitizing temperature for an austenitizing period (t(HZ)) of 20-180 seconds, cooling the flat steel product to a cooling stop temperature (T(Q)), which is greater than the martensite stop temperature (T(Mf)) and less than the martensite start temperature (T(Ms) at a cooling rate (theta Q), which is less than or equal to theta (Q)(min) (where theta (Q)(min) is equal to -314.35 [deg] C/s + (268.74%C (carbon content of the steel) + 56.27%Si (silicon content of the steel) + 58.50% Al (aluminum content of the steel) + 43.40% Mn (manganese content of the steel) + 195.02% Mo (molybdenum content of the steel) + 166.60% Ti (titanium content of the steel) + 199.19% Nb (niobium content of the steel)) [deg] C/(wt.%x s)), holding the flat steel product at the cooling stop temperature (T(Q)) for a holding period (t(Q)) of 10-60 seconds, heating the flat steel product after cooling to the cooling stop temperature (T(Q)), to a partitioning temperature (T(p)), preferably 400-500[deg] C at a heating rate (theta (P1) of 2-80[deg] C/second, optionally and isothermally holding the flat steel product at the partitioning temperature (T(P)) for a holding period (t(Pi)) of up to 500 seconds, and cooling the flat steel product after heating to the partitioning temperature (T(P)), at a cooling rate (theta (P2)) of -3 to -25[deg] C/second.

IPC 8 full level

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CPC (source: EP KR US)

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Citation (opposition)

Opponent : ArcelorMittal

- CA 2734976 A1 20100318 - JFE STEEL CORP [JP]
- EP 2258887 A1 20101208 - JFE STEEL CORP [JP]
- EP 2267176 A1 20101229 - JFE STEEL CORP [JP]
- JP 2009215571 A 20090924 - KOBE STEEL LTD
- EP 2524970 A1 20121121 - THYSSENKRUPP STEEL EUROPE AG [DE]
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