

Title (en)

Method for manufacturing grain oriented electrical sheets with improved core loss

Title (de)

Verfahren zur Herstellung von kornorientierten Elektroblechen mit verbesserten Ummagnetisierungsverlusten

Title (fr)

Procédé pour la fabrication de tôles électriques à grains orientés et à perte dans le fer améliorée

Publication

EP 0619376 B1 19980805 (DE)

Application

EP 94103908 A 19940314

Priority

DE 4311151 A 19930405

Abstract (en)

[origin: DE4311151C1] Grain-orientated electro-steel sheeting of finished thickness 0.1-0.5 mm is mfd. by a process in which iron slabs contg. more than 0.005%, pref. 0.02-0.10%, C, 2.5-5% Si and 0.04-0.15% Mn undergo pre-heating followed by hot-rolling to final dimensions, annealing, rapid cooling followed by cold-rolling, recrystallisation annealing in a damp atmos. contg. H₂ and N₂ plus simultaneous decarbonisation, application of a separatory cpd. contg. primarily MgO to both sides of the sheet, high-temp. annealing, and, finally, annealing with an insulating coating, the novelty of the process being that: (a) the slabs also contain 0.010-0.50% S, 0.010-0.035% Al, 0.0045-0.0120% N, 0.020-0.300% Cu, balance Fe plus impurities; (b) the slabs are preheated to a temp. less than solubility temp., T₁, for manganese sulphide derived from the respective Si content, but greater than the solubility temp., T₂, for copper sulphide derived from the respective Si content; (c) preheated slabs are rolled to an intermediate thickness, and then at min. 960 deg. C., then finally 880-1000 deg. C., to a final thickness of 1.5-7 mm, with simultaneous elimination of min. 60% of sheet N content as coarse A1N particles; and (d) hot-rolled sheets are annealed for 100-600 seconds at 880-1150 deg. C., then cooled at a rate of 15 K/second, with simultaneous elimination of the max. possible amt. of sheet N content as coarse and fine A1N particles and of fine copper sulphide particles. Slab compsn. os 3.0-3.3% Si, 0.040-0.070% C, 0.050-0.150% pref. 0.070-0.100% Mn, 0.020-0.035% pref. 0.020-0.025% S, 0.015-0.025% Al, 0.0070-0.0090% N, 0.020-0.200% Cu, balance Fe plus impurities, with (Mn content x Cu content)/S content = 0.1 to 0.4. Hot-rolling is performed at more than 1000 deg. C., final rolling temp. being 900-980 deg. C. Annealing occurs at 950-1100 deg. C., and annealed sheets are cooled at a rate of more than 25 K/second to less than 700 deg. C. Cold-rolling to an intermediate thickness is followed by a second cold-rolling which reduces sheet thickness by min. 65%, pref. 75%, or to the final thickness. The first cold-rolling is preceded by annealing at 800-1000 deg. C. The sheets are maintained at 100-300 deg. C. for at least one pass of the final cold-rolling.

IPC 1-7

C21D 8/12; C22C 38/02

IPC 8 full level

B21B 1/26 (2006.01); **C21D 1/78** (2006.01); **C21D 8/12** (2006.01); **C21D 9/46** (2006.01); **C22C 38/00** (2006.01); **C22C 38/02** (2006.01); **C22C 38/16** (2006.01); **H01F 1/16** (2006.01); **C21D 3/04** (2006.01)

CPC (source: EP US)

C21D 8/1205 (2013.01 - EP US); **C21D 8/1222** (2013.01 - EP US); **C21D 8/1261** (2013.01 - EP US); **C22C 38/02** (2013.01 - EP US); **C21D 3/04** (2013.01 - EP US); **C21D 8/1233** (2013.01 - EP US)

Cited by

DE102011054004A1; FR2761081A1; CN110218850A; CN102199696A; DE19745445C1; WO9842882A1; US6524400B1; WO2013045339A1; WO9919521A1; KR100566597B1

Designated contracting state (EPC)

AT DE ES FR GB IT SE

DOCDB simple family (publication)

DE 4311151 C1 19940728; AT E169346 T1 19980815; AU 5924394 A 19941027; AU 673720 B2 19961121; BR 9401398 A 19941018; CA 2120438 A1 19941006; CA 2120438 C 20060613; CN 1040998 C 19981202; CN 1098440 A 19950208; CZ 282649 B6 19970813; CZ 67194 A3 19941215; DE 59406591 D1 19980910; EP 0619376 A1 19941012; EP 0619376 B1 19980805; ES 2121590 T3 19981201; HU 216760 B 19990830; HU 9400843 D0 19940628; HU T70224 A 19950928; JP 2728112 B2 19980318; JP H06322443 A 19941122; KR 100247598 B1 20000401; PL 173284 B1 19980227; RO 114637 B1 19990630; RU 2126452 C1 19990220; RU 94009842 A 19960627; SK 281614 B6 20010510; SK 38894 A3 19941109; US 5711825 A 19980127; US 5759294 A 19980602

DOCDB simple family (application)

DE 4311151 A 19930405; AT 94103908 T 19940314; AU 5924394 A 19940331; BR 9401398 A 19940405; CA 2120438 A 19940331; CN 94105439 A 19940405; CZ 67194 A 19940323; DE 59406591 T 19940314; EP 94103908 A 19940314; ES 94103908 T 19940314; HU 9400843 A 19940323; JP 6747294 A 19940405; KR 19940007070 A 19940404; PL 30283294 A 19940329; RO 9400529 A 19940330; RU 94009842 A 19940321; SK 38894 A 19940331; US 22262794 A 19940404; US 73589696 A 19961023